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DOCTORAL THESIS

The Implementation and Achievement of Biofuel Sustainability Principles in Sub-Saharan Africa: recognising limitations and opportunities

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The Implementation and Achievement of Biofuel Sustainability Principles in Sub-Saharan Africa: recognising limitations and opportunities

This dissertation is presented for the degree of Doctor of Philosophy

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Abstract

Generating a global effort to source alternate energy sources in response to concerns for energy security and rising oil prices has sparked a growing demand for biofuels. This increasing interest has raised questions regarding their sustainable production, especially in sub-Saharan Africa.

Biofuels – potential carbon-neutral renewable hydro-carbon energy – are regarded as a likely mechanism for diversifying agriculture, alternate energy sources, security of energy supply, job creation and the reversal of land degradation. Possible adverse environmental and socio-economic implications, especially in relation to the “food and fuel” debate and land competition, feature in contemporary social discourse. Current concerns include how economic benefits are distributed, socio-economic impacts of large scale development, and improved land use planning directed towards biofuel integration.

This research began in pursuit of a comprehensive sustainability assessment framework for biofuel production in developing countries. Within the year (2010) a flood of initiatives arrived on the international stage, suggesting many international institutions with an interest in biofuels had investigated similar concerns. However, the implementation and achievement of these sustainability initiatives in developing countries remains problematic. Mechanisms ranging from voluntary standards to regulatory certifications have been implemented to address sustainability issues, including social, environment and economic measures. Often the design of an assessment framework does not consider the diverse stakeholder understandings or their capacity for the implementation of such initiatives. Tools such as environmental impact assessments, life-cycle assessment and social impact assessment may be useful, however, at a local level their implementation is rife with complexities. This is a concern considering that key to achieving the aims of assessment frameworks are the successful implementation of sustainability principles.

This research aims to recognise opportunities and limitations to the successful implementation and achievement of biofuel development sustainability principles in sub-Saharan Africa, and to help understand solutions to limitations. Through a systematic process of examining theory, case study research and an expert-oriented survey, the aim is to better understand solutions to limitations and uncover approaches towards successful implementation of sustainability principles in sub-Saharan Africa. The following five objectives are proposed to help achieve the overarching aim: identify theoretical discourse exhibiting an interest in both sustainability and development in sub-Saharan Africa; explore approaches towards the implementation of sustainable biofuel development in sub-Saharan Africa; examine the relationships of biofuel developments and their effects on socio-

economic and environmental sustainability; ascertain local and national implementation opportunities and constraints of sustainable biofuel cultivation; and discuss limitations and opportunities for biofuel development to achieve sustainability.

Drawing on the key interests of several supporting theories, a conceptual framework from which to develop an understanding of widespread biofuel sustainability quandaries in sub-Saharan Africa is presented. The results of a survey comprising thirty-eight international experts suggest that projects that display a high degree of transparency, dynamic stakeholder participation and include local villagers as partners are most likely to achieve sustainability principles. Assisted by an advisory/mediating body, a process that attempts to harmonise sustainability principles and integrate the different interests of diverse stakeholders is presented.

Building on the results of the survey, a cross-sectional study was designed by way of case study research on two projects in each of two countries in sub-Saharan Africa. The countries, Zambia and Zimbabwe, were chosen for their characterisation of many sub-Saharan developing countries – high rates of poverty, soil erosion, deforestation, unemployment, inequitable distribution of resources, reliable energy deficiency, poor governance and health issues. Semi-structured interviews conducted with stakeholders involving two biofuel case study projects in Zambia ascertained the likely barriers and opportunities for biofuel production linked to *Jatrophra curcas*.

The results suggest that imbalances in the allocation of political and social influence, knowledge and access to resources provide a likely rationale for the lack of sustainability in biofuel developments in emerging countries. Through semi-structured and open-ended interviews and physical observation in relation to a large-scale biofuel case study in Zimbabwe, it is argued that biofuel initiatives can uphold societal and environmental integrity if the capacity of locals is developed to understand equitable cost and benefit sharing within effective sustainability implementation guidelines. This research advances the implementation and achievement of biofuel sustainability principles and has application not only to Zambia and Zimbabwe, but to other developing countries in sub-Saharan Africa and beyond.

Declaration

This thesis is submitted to Bond University in fulfilment of the requirements of the degree of Doctor of Philosophy. This thesis represents my own original work towards this research degree and contains no material which has been previously submitted for a degree or diploma at this University or any other institution; except where due acknowledgement is made.

In addition I certify that all information sources and literature used are specified in the thesis.

Ian Duvenage

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Chapter 1

Introduction

1.1 Overview

Centred within the diverse viewpoints of international authors striving to reason from various positions of authority (e.g. economic, social, environmental, ethical or energy security) is the debate on the sustainability of biofuel development in sub-Saharan Africa. Agreed unanimously amongst commentators, is the need for sustainability in biofuel production. Subsequently many methods and approaches have been devised by various interested institutions with an aim of providing a framework from which to sustainably develop biofuels. What remains a concern is the lack of understanding of the limitations and opportunities for the implementation and achievement of such sustainability frameworks and processes.

This thesis, through addressing various objectives (Section 1.4), aims to understand the limitations and opportunities to successfully implement and achieve biofuel sustainability principles in sub-Saharan Africa. The intermediate chapters 2, 3, 4, 5 and 6 are a collection of peer reviewed published papers that respectively address objectives I, 2, 3, 4 and 5 (Table 1.1 and section 1.4). The thesis is designed to achieve the overarching aim by systematically and cumulatively addressing the objectives and related research questions (Section 1.4 RQ1 to RQ6).

Chapter 7 draws conclusions to the set objectives, the set of research questions drawn from the literature, and the overarching aim. Drawing on the intermediate chapters, (especially chapter 6, which combines the research reported in chapters 2, 3, 4, and 5 (section 1.7)), chapter 7 also discusses recommendations, implications for practice and future research. Commencing the following paragraph, section 1.1 provides a background on the international biofuel debate. The literature is further examined in the five intermediate chapters, relative to the topic of each specific chapter. Subsequent to section 1.1, chapter 1 provides a rationale for the thesis (1.2), the significance of research (1.3), aims and objectives (1.4), the research's scope (1.5), the limitations (1.6) and thesis structure (1.7).

Energy security is emerging as a major concern worldwide (McMichael 2009; Sinclair 2009), and more so for nations without access to domestic energy sources. Biofuels have been suggested as a solution to this problem, and sub-Saharan Africa is well-placed to produce them (von Maltitz and Stafford 2011). Investors detect an opportunity for energy development from what they recognise as a continent with ample unused (idle) land, abundant water supplies and for the most part suitable climatic conditions (Ogaboh et al. 2010). Concerns have nevertheless been raised by Achten et al. (2010) regarding the suitability of land designated for large-scale biofuel development, especially *Jatropha curcas L.* (Jatropha), in sub-Saharan Africa.

Increasing demands on land are thought likely to exacerbate disproportionate allocations of natural resources and environmental injustices (Amigun et al. 2011; Lozano 2009), with local populations pursuing natural resource-based livelihoods being particularly prone to adverse effects (Vermeulen and Cotula 2010). Even land acquired legally, with compensation, can lead to traditional farming methods being replaced by industry-owned mono-cropping which may lead to loss of cultural practices, agro-biodiversity and the disempowerment of small-scale farmers (Sagar and Kartha 2007). Unlike in the developed world, crop yields have potential to be increased many times in Africa before being impinged by physiological constraints (Ruttan 2008), but in reality the situation is beset with environmental and socio-economic complexities.

Biopact (2007) argues that biofuels can help rural populations by stabilising fuel supplies and food prices (especially in developing countries that suffer from the volatility of oil prices), and offering access to energy choices other than timber harvesting and charcoal. One area in need of further clarity is the issue of exploitation of local farmers (e.g. marginalisation through land and water appropriation), alongside weak governance in developing countries (Franco et al. 2010; Wilkinson and Herrera 2008). Such agendas may be enacted by encouraging locals into becoming biofuel producers, then excluding them from participation in decision-making and influencing outcomes, or by employing the poor as menial labourers who receive lower than minimum wages without lucid employment protectionism (Boyd and Watts 1997). The main achievement of sustainable development of promoting stakeholder participation can be strengthened through economic growth actively favouring the poor and removing fiscal policies that harm the environment (Diaz-Chavez 2011).

Managing the interaction between food and biofuels is as much an opportunity as it is a threat to bioenergy and food security as a whole (Woods et al. 2010). Based on the controversy of biofuel production (Borras et al. 2010; Cotula 2010; Wilkinson and Herrera 2010), it is obvious the use of land (and more particularly food crops) for biofuels in Africa is an expected cause for conflict (Woods et al. 2010). Likewise, unless systems are developed for sustainable biofuel cultivation, achieving the energy opportunities available to countries in sub-Saharan Africa is unlikely. According to Romanova (2010), the modern nation must strive to ensure food and energy security through domestication to retain its own potential and to minimise losses over the conflict of natural environments.

Fuel sources (oil, coal and gas) account for 80% of current global energy demand. In contrast only 17% is used for electricity (Hankamer 2012). Yet, almost all CO_2 free energy production systems under development are designed to drive electricity generation (e.g. clean-coal, nuclear, photovoltaic and wind technologies). Biofuels on the other hand, target the much larger fuel market and have clear potential to play an increasingly important role (Hankamer 2012).

The sustainability of introducing domestic fuel supplies through biofuel production in sub-Saharan Africa rests largely on implementation approaches that ensure environmental protection and socio-economic equality (Leduc 2007; Mandil and Shihab-Eldin 2010; Metzlaf and Hedin 2007). Developing countries need to embrace policies that emphasise environmental benefits, climate change mitigation and sustained social-economic growth (Schurr 2007; Hope 2009).

1.2 Rationale for the Thesis

Uncovering a number of potential gaps worthy of research following an examination of the literature of sustainable biofuel development in 2009 through early 2010, this research began as an investigation into the development of an inclusive biofuels sustainability assessment framework. In 2010 an article was submitted for review to *Energy Policy* recommending the need for an inclusive assessment framework. The paper was declined for a number reasons, nevertheless, of the many useful reviewer comments the following suggestion was particularly arresting: "*This is a worthy topic and necessary work… but the challenge is implementation and achievement of assessment frameworks. Why repeat what has already been said, why not address the challenge of implementation and achievement*?".

Further investigation uncovered two factors that changed the overarching aim of this thesis. Firstly, perhaps an awareness of the shortcomings of assessment frameworks compelled a number of institutions in 2010 to flood the international scene with biofuel assessment initiatives exhibiting more comprehensive sustainability principles and criteria (BEFSCI 2011). Examples of some of these initiatives are discussed in Chapters 2 and 6. Secondly, much of the literature cited the implementation and achievement of sustainability principles as a major constraint facing biofuel development, especially in emerging economies (e.g. Janssen et al. 2009; Scarlat and Dallemand 2011).

A significantly cautious approach to biofuel development must be taken until effective implementation controls are demonstrated to address marginalisation (Gallagher et al. 2008). Harrison et al. (2009) and von Braun and Meizen-Dick (2009) express that the poor design and implementation of agro-industry developments in developing nations has diminished the trust local citizens have in foreign investors. As large areas of uncertainty remain for overall impacts and benefits of cultivating biofuels, Mortimer (2011) recommends that international action by governing bodies, experts, local populations and policy makers is needed to improve data, models and controls to better understand and manage effects. Although biofuels may be an optional source of renewable energy (Fischer et al. 2009), unless flexible implementation approaches address socio-economic and environmental sustainability, an effective biofuel industry is unlikely to be developed in sub-Saharan Africa (Leduc 2007).

In an age of globalisation, exploration is needed to contribute to a theory that explains how values, perspectives, and outcomes can be conciliated across contrasting cultures and institutions on a global scale (Scoones 2009). Sustainable development needs research into new structural changes to work in all areas of social, economic and political life that actively favours the poor (Dalal-Clayton and Bass 2002). Research that finds solutions to improve the links between existing indigenous social structures and formal institutional set-ups such as governance structures would not only address a currently under-researched area, but also promise to yield highly relevant policy results (Jutting 2003). As it is clear that case-specific sustainability design and assessment must underpin any biofuel development, measures need to be put in place to provide informative sustainability data through empirical and field research (Elghali et al. 2007; Gallagher et al. 2008; Groom et al. 2008; Haywood et al. 2010).

Owing to the scarcity of research into proven sustainable biofuel production schemes, studies with empirical or field derived data are limited (Haywood et al. 2010). This is especially true for sub-Saharan Africa, of which most countries have only lately considered biofuels as a substitute energy source. A key reason for the failure for the implementation and achievement of sustainability principles is that solutions to complex issues are sought by decision-makers, experts and implementers through the same paradigm, using the same approaches and tools and adopting the same international views that have raised sustainability concerns in the first place (Du Plessis 2008; Fiksel 2003). The sustainability assessment paradigm needs to change, adopting a set of novel initiatives, away from a modernist or mechanistic view to that of a systemic view (Du Plessis 2008).

To support the achievement of biofuel sustainability, implementation designs need to consider the following matters: the complexity and quantity of data for decision-making within an environmental assessment framework can be too complicated for all except informed experts (Zah et al. 2009); long term goals are not clearly defined, which can breed scepticism amongst stakeholders (Buchholz et al. 2007); and perspectives and opinions of stakeholders are often neglected and only sought once the planning stage has been completed, often resulting in project failure (Stringer et al. 2006; Buchholz et al. 2009).

1.3 Significance of the Research

The significance of achieving the sustainability principles advocated in biofuels assessment frameworks is reiterated in the literature from the viewpoints of climate change (Houtart 2009), environmental integrity (Cotula et. al 2008) and socio-economic (food, marginalisation and poverty reduction) (Diaz-Chavez et al. 2010). To assist with the emerging challenges of climate change and development of response strategies in African developing countries, the Food and Agricultural Organisation is concerned with the lack of guidelines for best practice with regard to natural resource management and food security. Included in eight topics that require examination are bio-energy policy, food and water security, biodiversity and energy security (FAO 2010).

Changing rainfall patterns, increasing deforestation and land degradation are provoking conflict, causing the migration of rural populations to urban centres further swelling slums with the unemployed (Houtart 2009). By providing the opportunity for affordable energy sources, biofuels can lessen this if produced within the guidelines of best practice sustainability principles.

From a perspective of alleviating poverty, evidence produced suggests that countries that have rejected aid have prospered and those that have become dependent on aid are trapped in a vicious cycle of corruption, market distortion and increased poverty – hence "needing" more aid (Moyo 2009). Biofuels can provide the opportunity for emerging economies to become less aid-dependent, especially in relation to energy needs. In addition, biofuels offer sub-Saharan Africa diversification from the uneven commodity markets created by United States and European domestic agriculture subsidies. If biofuels are unable to fill the gap for transport energy requirements, the increasing pressures placed on fossil fuels are likely to interrupt industrialisation with bust and boom cycles resulting from spikes in energy prices (Woods et al. 2010). Nonetheless, unless a set of sustainability implementation guidelines, understandable to all affected stakeholders, steeped in practical design solutions, is agreed by all stakeholder representatives, the opportunity for local affordable energy and sustainable enterprise development through biofuels may be lost.

1.4 Aim and Objectives

The overarching aim of this thesis is to recognise opportunities and limitations to the successful implementation and achievement of biofuel (first generation) development sustainability principles in sub-Saharan Africa, and to help understand solutions to limitations.

To achieve the aim evokes the development of a conceptual framework that can help address identified challenges. Through a review of academic and grey literature concerning development and biofuel discourses, theories are examined for their utility (rather than their strengths and weaknesses) to facilitate an understanding of the sustainability challenges in the context of informing biofuel implementation in sub-Saharan Africa. These objectives are systematically and cumulatively researched and discussed through five peer reviewed papers (Table 1.1) (four have been accepted for publication and one is in the review process). These objectives combine to identify strategies to achieve the overarching aim.

Five objectives are proposed:

1) Identify theoretical discourse exhibiting an interest in both sustainability and development in sub-Saharan Africa, and develop a conceptual framework that can facilitate the challenges for the successful implementation of biofuel sustainability principles.
   a) Ascertain theories that can advance an understanding of the integrated social, environmental and economic sustainability aspects in relation to biofuel development in emerging economies.
   b) Identify theoretical aspects that have utility to inform biofuel sustainability implementation, including principles defining limitations and diagnostic aspirations.

2) Explore approaches towards the implementation of sustainable biofuel development in sub-Saharan Africa; especially, to reconcile and integrate diverse interests of different stakeholders affected by biofuel developments.
   a) Examine meaningful approaches for which to assess and monitor the sustainability of biofuel cultivation in sub-Saharan Africa.
   b) Ascertain approaches towards fair participation and equitable cost and benefit sharing between stakeholders of biofuels developments.
3) Examine the relationships of biofuel developments and their effects on socio-economic and environmental sustainability via case studies in the sub-Saharan Africa country of Zambia.
   a) Identify limitation and opportunities and examine the sustainability of biofuel developments in sub-Saharan Africa.
   b) Examine stakeholder power relations and how it is distributed between stakeholders affected by biofuel developments.
4) Ascertain local and national implementation opportunities and constraints of sustainable biofuel cultivation via case studies in the African developing country of Zimbabwe.
   a) Examine limitations and opportunities to enhance local enviro-socio-economics through biofuel cultivation.
   b) Ascertain local community integrity influenced by the uneven power relations concerning biofuel development.
5) Discuss limitations and opportunities for biofuel development to achieve sustainability in sub-Saharan Africa including solution designs (for further debate and research) to address specified limitations.
   a) Identify the limitations that impede the effective implementation of sustainability assessment initiatives.
   b) Examine approaches demonstrated in wider institutional settings to offer solution designs to address sustainability limitations and support opportunities for the implementation of biofuels.

During the review of existing literature for this thesis, comprising well over 300 references, particular concerns were often highlighted in need of some resolution. The research questions, RQ1 to RQ6, are derived through themes commonly raised in the literature as significant limitations to the sustainability of biofuel development in the sub-Saharan Africa. These questions, communicated individually or collectively by the many authors (Amezega 2010; Borras et al 2010; Diaz-Chavez 2011; Eden 2010; Elgahali 2007; Forsyth 2008; Gallagher et al. 2008; German et al. 2011; McMichael 2010; Vermeulen and Cotula 2010a; von Maltitz et al. 2009) need solutions in order to move forward the task of addressing the five objectives in response to achieving the overarching aim. The outcomes from the research regarding the questions are subsequently discussed in Section 7.2.

- RQ 1: How have the dynamics between political, economic and knowledge hierarchies reinforced inequality and interrelated with sustainability outcomes?
- RQ 2: How should costs and benefits be attributed and who should decide on their dispersion?
- RQ 3: How can the contrasting views of diverse stakeholders be integrated??
- RQ 4: How can community integrity (livelihoods, health, education and freedom) be maintained?
- RQ 5: What are the impacts of land selection on issues such as inequality, marginalisation and environmental integrity?
- RQ 6: Which theoretical discourse identifies with these sustainability challenges in sub-Saharan Africa?

Sustainability is characterised in this thesis by drawing on the literature (discussed in section 2.1.1 in Chapter 2) and building on concepts of earth democracy (Shiva 2005) relative to biofuels. Earth democracy incorporates the understanding by indigenous cultures worldwide that life is a continuum between non-human and human species, and between the past present and future generations; the earth does not belong to man, man belongs to the earth. The following five principles provide a frame from which to examine theoretical literature to inform sustainable biofuel development in emerging economies (Shiva 2005):

1. Diversity in nature and culture must be defended.
2. Protection of ecosystems and their integrity: sustainably, diversely and for the common good.

3. Decentralised economies: only goods and services unable to be produced locally are traded long distance.
4. Self-governance growing from the bottom up: locals having authority on decisions based on natural resources the environment, sustenance and livelihoods.
5. Respect for all life, human and non-human, people of all genders and cultures, present and future generations (Shiva 2005).

1.5 Scope of the Research

The relationship between biofuel development, sustainability achievement, natural capital systems and socio-economics form the breadth of this thesis. Biofuel production (especially large-scale) is particularly complex owing to its interactional and cross-institutional nature (i.e. agriculture, food security, industry, extensive land use, environmental impacts and interference in daily socio-economic activities of local populations). Owing to a lack of theory in relation to the relatively new subject area of biofuels, the integration of the key perceptions of four relevant theories as regards to sustainable development in emerging economies may provide a theoretical basis to better understand and inform biofuel development the implementation of sustainability principles.

This thesis focuses on first generation biofuel feedstock (bioethanol and biodiesel) mainly derived from plant-based oils. They are often produced from crops cultivated in areas that compete with natural bushland or resources used for food crops. For example, biodiesel production includes crops such as palm oil, Jatropha, soya beans, and bioethanol crops include maize, sweet sorghum, rapeseed and sugarcane (Dauvergne and Neville 2010). Biofuel feedstock sources vary according to geographical locations, and largely follow pre-existing agro-production in those regions.

In Chapter 2, the thesis defines sustainability as an evolving dynamic system. The value of sustainability through biofuel developments are appraised through integrative ethical design approaches towards the harmonisation of the three pillars of the triple bottom line (environmental, social and economic) and ethics. Chapters 3, 4 and 5 draw on these integrative approaches to design and report empirical research by way of case studies.

Chapter 6 links chapters 2, 3, 4 and 5, highlighting potential solutions to sustainability limitations, and presents a conceptual biofuel development framework.

Developing countries, encompassing approximately 5.8 billion (or 83%) of the of the world's 7 billion people (Ray 2007), can generally be classified as countries with a low standard of living, a poor industrial base, and low Human Development Index (Sullivan and Sheffrin 2003).

Community is defined as an endogenous construct identified by project parameters or project-facilitators, or by environment or identified precincts, rather than a physical form (Mansuri and Rao 2004).

Stakeholders may be defined as comprising (EPFL 2011):

- farmers and growers of biofuels feedstock,
- industrial biofuels producers,
- retailers, blenders and the transportation industry,
- banks and investors,
- rights-based NGO's (including land, water, human and labour rights),
- rural development and food security organisations,
- environment and conservation organisations,
- trade unions,
- smallholder farmer organizations and indigenous people's organisations, and
- intergovernmental organisations, governments, standard setters, specialist, advisory agencies and experts.

In the action of addressing the overarching aim, this thesis focussed on stakeholders whose actions are most likely to have the greatest impact on the sustainability outcomes of a project. For example, those stakeholders making on-ground (local livelihood impacting) decisions on a daily basis; those who have the responsibility to ensure the achievement of evolving and dynamic sustainability; those whose livelihoods are directly or indirectly impacted by expert advice or implementation strategies. These include: local communities (i.e. farmers, businesses and service providers), biofuel producers, investors and implementers.

Sustainable development is business over the long-term, rather than following short-term boom-and-bust profit strategies and sustainability is the interrelationship of environmental, social and economic factors in the context of culture or policy (Constance 2010). This thesis regards sustainability not as an end state, but rather an evolving, dynamic system that is embedded in a multifaceted interaction between socio-enviro-economic systems. It reflects a complete system, able to manage and absorb disturbances and stresses without weakening its functionality (Walker et al. 2004). The consideration of stakeholder participation (Dalal-Clayton and Bass 2002) together with the three pillars of environmental, social and economic sustainability is possibly the main characteristic of sustainable development (Diaz-Chavez 2011).

1.6 Research Methods

The methodology used in this thesis is a combination of empirical (primary studies) and qualitative theory (secondary) research. The methodology engaged to achieve the objectives, and hence the overarching aim of the thesis can be characterised as an integration of exploratory (German et al. 2011; Yin 2009), descriptive (Franklin and Downing 2003; Kumar 2005) and explanatory (Schubert 2005; Scoones 2009). Since sustainability science concerning biofuels encompasses many subject areas within social, environmental and economic settings, multiple disciplines are applied to address the overarching research aim. The research methodology is explanatory driven through an engagement of sustainability science and development in emerging economies with aspirations to develop cross-disciplinary (Scoones 2009) and transdisciplinary (Binder et al. 2010; Pezzoli 1997) insights. To gain an overview of biofuel limitations and opportunities this thesis reviews sustainability issues in Africa, including local livelihoods; local environmental issues; land-use and land degradation; energy accessibility and effects on deforestation; hierarchal powers and their influence on local socio-economics; customs and cultures; and marginalisation.

Methods include thoughtful deliberation on transdisciplinary theory application, problem identification, explanatory characterisation and solution generation. A transdisciplinary approach is used to collectively exploit multi-theory perceptions in search of a more inclusive understanding for sustainability principles concerning biofuel development. To achieve the aspirations of holistic explanations and empirical solution designs, the research engages existing cross-disciplinary systems and multidisciplinary stakeholders of a common challenge.

1.7 Limitations of the Research

In this thesis reference to sub-Saharan Africa is deemed to mean Zimbabwe and Zambia, which are examples of countries in this region. Second and third generation biofuels have been circumvented as they are largely not yet considered a commercially viable option (Dauvergne and Neville 2010). Though, an important consideration with regards to the sustainability of an energy source, this research has traversed the debates on off-setting greenhouse gas (GHG) emissions through the cultivation of biofuels. The possible savings that can arise through the correct species choices and sustainable agronomic techniques are fraught with complexities that currently does not allow for any straightforward equation (Lohmann 2008; Storm 2009). Martinez-Alier (2009) implies that carbon offsets are a fictitious commodity that lack verifiability, created in order for the Global North to maintain their lifestyles through the Global South becoming a carbon dump. Regrettably, as Gilbertson et al. (2007) reveal, there are very few peer-reviewed life-cycle GHG studies for many biofuel feedstock species.

Owing to the lack of theoretical discourse regarding biofuel development and energy advancement in sub-Saharan Africa, maintaining focus on a specific theory has its limitations. Gathering dependable data in remote locations in Zimbabwe has many limitations including language, varying perceptions of sustainability, political and social influences and transportation access.

Portraying case studies conducted in two landlocked countries in sub-Saharan Africa as indicative of all developing countries is problematic. Complications arise when developing standardised conventions or sustainability assessment guidelines from each country's unique set of political, economic, cultural and climatic circumstances. In addition, the diverse settings of land availability, land rights, food security and levels of knowledge need to be considered prior to developing biofuel implementation strategies. These different environments distinctive to each country confuse the search for generic limitations and opportunities to achieve the sustainability principles of biofuel development in sub-Saharan Africa.

Several specific limitations extend to the case study element of the research. Firstly, gathering reliable data can be difficult in countries that exhibit political unpredictability, such as Zimbabwe. Cognisant of this, the efforts to maintain valid data included selecting interview respondents that exhibited political impartiality. Secondly, through temporal constraints, the case study research was conducted at a moment in time. However, as an evolving construct, sustainability requires cumulative assessment. Thirdly, the scope of this research did not include an in-depth investigation of the important issue of external impacts from biofuel developments. Examples include influences on downstream waters users affected by water extracted for irrigation purposes, existing businesses, and other enterprise and environments through the movement of workers towards biofuel developments. Interviewing a larger number of local small-scale farmers and local business owners, from further afield, would have added to the diversity of data collected. This may have provided a better understanding of local perceptions and external influences, but was not practical within the constraints of this research project.

This research project focussed on the production of biofuel feedstock segment of the lifecycle of biofuel production, as it poses the greatest threat to the environment and local populations. Power relationships at play between stakeholders, and impacts they pose during the marketing, export and end-use of biofuels, although considered, were beyond the scope of this research. This was mainly due to resource constraints, as was investigating the possible alternate cash crop options available to local populations. Mentioned briefly in section 5.4, the extent to which the vagaries of global economic processes expose the financial sustainability of biofuel projects is both uncertain and difficult to forecast.

1.8 Thesis Structure

The thesis is presented as seven chapters, including an introduction and conclusion. The intermediate chapters facilitate the five research objectives. Objectives 1, 2, 3, 4 and 5 are in essence addressed by chapters 2, 3, 4, 5 and 6 respectively. The overarching aim is addressed cumulatively through the systematic facilitation of the five objectives. Each of these have been written as individual papers, submitted for peer review and accepted for publication (as of 26th April 2013, Chapter 6 remains within the review process) as journal articles. Therefore each chapter comprises its own abstract, introduction, literature review, method, analysis/discussion, conclusion and references. The first and last chapters act collectively to unify the thesis as a coherent body of research demonstrating evidence of research competence, overarching aim, objectives and approach, and identification of the resultant contribution to knowledge. Opportunities for further research are listed. References have been collected and consolidated at the end of the thesis.

The structure of this thesis is acceptable to Bond University as one of several styles for presentation of doctoral research. Although not the traditional approach, the benefit of presenting chapters as individual papers lies in the opportunity to have the work peer reviewed and published prior to thesis submission. Not all topics lend themselves to this style. Each chapter is a replica of the published paper and represents 90% of the effort of the first author in each case. Guidance by the co-authors in reading over the work and making suggestions for improvement is acknowledged, as is the constructive feedback of the expert reviewers.

Chapter 2 characterises sustainability and highlights the sustainability concerns in relation to biofuel production. The chapter examines four relevant theories that may offer utility to develop an underpinning conceptual framework in an effort to more inclusively understand the sustainability of biofuel developments in emerging nations.

Chapter 3 conveys the results of a survey of thirty-eight international experts from biofuels or sustainability disciplines. A reflection of the responses leads to biofuel implementation recommendations emphasising equal participation and the benefits of intermediaries for addressing complex concerns such as the integration of diverse interests of varying levels of stakeholders.

Chapter 4 reports research of two biofuel project cases studies in Zambia. Environmental and socio-economics impacts (possibilities and limitations) are examined through the principles of sustainability and an associated political ecology perspective Chapter 5 articulates the results of research on a large-scale biofuel project cases study in Zimbabwe. Stakeholder hierarchal relationships and their resultant impacts on biofuel advancement are evaluated with respect to land use, marginalisation, equal costs and benefits, local livelihoods and biodiversity.

Chapter 6 gathers primary and secondary evidence via empirical and theoretical research respectively. Drawing on primary research evidenced in chapters 2 through 5, chapter 6 merges the understandings of limitations and opportunities for achieving biofuel sustainability in sub-Saharan Africa. Combining these understandings with a cross-enterprise examination, Chapter 6 discusses a practical way forward for the achievement of sustainability principles for biofuel development in emerging economies. The chapter is completed by offering example solution designs integrated into a conceptualised biofuel implementation framework. Chapter 7, as previously mentioned, concludes the thesis with overall research findings, recommendations, contributions and implications for practice.

Table 1.1 lists the article headings and their publication details.

Table 1.1 Thesis structure

Chapter 1	**Introduction**
Chapter 2	**Title:** Understanding Sustainable Biofuel Development: a sub-Saharan Africa Perspective **Citation:** Duvenage, I., Langston, C., Stringer, L.C. and Dunstan, K. 2012., "Understanding Sustainable Biofuel Development: a sub-Saharan Africa Perspective" (Accepted for publication on 11 December 2012 by the African Journal of Economic and Sustainable Development). (See Appendix D for Editor acceptance and proof amendments)
Chapter 3	**Title:** Towards implementation and achievement of sustainable biofuel development in Africa **Citation:** Duvenage, I., Taplin, R. and Stringer, L. C. 2012, "Towards implementation and achievement of sustainable biofuel development in Africa", *Environment, Development and Sustainability,* vol. 14, no. 6, pp. 993-1012. (see Appendix E for reviewer comments and author responses)
Chapter 4	**Title:** Bioenergy project appraisal in sub-Saharan Africa: Sustainability barriers and opportunities in Zambia **Citation:** Duvenage, I., Taplin, R. and Stringer, L. C. 2012, "Bioenergy project appraisal in sub-Saharan Africa: Sustainability barriers and opportunities in Zambia", *Natural Resources Forum,* vol. 36, no. 3, pp. 167-180. (see Appendix F for reviewer comments and author responses)
Chapter 5	**Title:** Grappling with biofuels in Zimbabwe: depriving or sustaining societal and environmental integrity? **Citation:** Duvenage, I., Langston, C., Stringer, L.C. & Dunstan, K. "Grappling with biofuels in Zimbabwe: depriving or sustaining societal and environmental integrity?", *Journal of Cleaner Production,* DOI – 10.1016/j.jclepro.2012.11.011 (see Appendix G for reviewer comments and author responses)
Chapter 6	**Title:** Sustainability Implementation Barriers for Biofuel Development in sub-Saharan Africa: Moving from Challenge to Opportunity **Citation:** Duvenage, I., Langston, C. Submitted to Renewable and Sustainable Energy Reviews
Chapter 7	**Conclusion**
References	**Consolidated References**
Appendices	

Chapter 2

Understanding sustainable biofuel development: a sub-Saharan Africa perspective

Abstract

Considerable effort has been put into developing sustainability assessment frameworks for biofuel production in developing countries. Nevertheless, their successful implementation remains problematic in sub-Saharan Africa. To address this challenge in this paper, through a thorough examination of academic and grey literature, repeatedly occurring sustainability aspects/issues were drawn from internationally recognised biofuel assessment frameworks. Theoretical framings that corresponded with the interlinking socio-environmental-economic qualities and issues for achieving sustainability through ethical implementation conformity (political ecology, development economics, social capital and institutional economics) were then used to inform development of a conceptual framework that could guide biofuel project implementation in sub-Saharan Africa to address complex sustainability issues. The supporting theories pursue sustainable development through, amongst others, an emphasis on the more equitable dispersal of costs and benefits through transparent networking in rural settings and the integration of contrasting viewpoints of diverse stakeholders in emerging economies.

Keywords: developing countries; sustainability; local communities; livelihoods; equality; sustainable biofuel development; Africa; marginalisation; social, economic; environment.

2.1 Introduction

Access to affordable energy is vital for a nation's development, and a factor that divides populations of developed nations from those in developing nations (Davidson 2011). At the same time, many countries have realised the necessity to diversify energy supplies external to the influences of Organisation of Petroleum Exporting Countries (OPEC) (McMichael 2009; Sinclair 2009). Fossil fuels emit greenhouse gases (GHGs), are uncertain in their supply as well as being a finite resource. Especially since the early 1990s (IPCC 1995), these considerations have, together, driven the pursuit of alternative and renewable energy sources. Metzcalf and Hedin (2007) explain that socially and environmentally sustainable biofuel production has been explored as one possible solution to the energy challenge. While some experts argue that in many developing countries, biofuels provide an opportunity to address poverty and energy issues *(*Johnson et al. 2009), others note that challenges such as food security could be exacerbated by the expansion of biofuel production (Drexler 2008).

Von Braun and Meizen-Dick (2009) are concerned that without efficiently and effectively implementing biofuel projects within the guidelines of a sustainability assessment framework, it is unlikely that acceptable sustainability standards will be realised; and energy-poor people are unlikely to benefit from energy developments in their countries (Mandil and Shihab-Eldin 2010). Indeed, in many developing countries, the situation is complicated further by poor governance (leading to problems such as skills shortages, desertification, poverty and corruption). While the African continent experiences these issues, it nevertheless has significant land (Hoogwijk et al. 2005), a positive feature that presents options for attending to energy needs and food scarcity while also addressing poverty.

As biofuel development is expected to mainly take place in countries vulnerable to socio-economic changes, their biodiversity and populations have most at stake (Lima and Gupta 2009). With the focus on developing nations, if the three central socio-economic issues of poverty, inequality and unemployment are not enhanced in some way, it would be curious to call an investment 'development' (Bass 2011). Elgahali et al. (2007) declare that if the energy divide is to be bridged, there is a need for approaches that are able to determine and unite the different pursuits and views of diverse stakeholder groups, and not just those of the individual investors. Innovative schemes that involve both the investor and local communities, in which risks and rewards are shared, are likely to have the best chance of long-term sustainable impetus. Elgahali et al. (2007) advise that biofuel project assessments need to encircle all affected stakeholders' concerns, understand and represent diverse scales of power that play out in biofuel systems, identifying knowledge gaps for the successful implementation of sustainable biofuel development.

A set of conditions within which to develop agro-biofuel projects that embrace local sustainability (i.e. long-term views, benefitting today and designing for enhanced future welfare), can help to foster sustained project viability and lessen ecological and social disturbance (Porder et al. 2009). A conceptual framework, derived through an examination of theoretical knowledge and empirical studies, is needed to better explain community marginalisation and disparities in costs and benefits owing to desires to access and control resources (Forsyth 2008). Such a framework can be used to guide biofuel projects towards sustainability. Likewise, it can help inform the elaboration of processes that tackle head-on some of the difficulties associated with integrating the contrasting viewpoints of diverse stakeholders.

2.1.1 Sustainability, Policy and Principles

Sustainability, described by Hecht (2007 p.1) as "to keep in existence", is often associated with three pillars – environment, economic and social. These need to exist in harmony for the total system to be sustainable (Hecht 2007), although they are complicated by their complex relationships and interactions with uneven levels of political and economic power across varying temporal and spatial scales**.** Driven largely by political and institutional organisations and activities across different scales, many policies have been developed to guide the quest towards sustainability (Diaz-Chavez 2011). Morrissey et al. (2012) affirm that although policy initiatives at local, regional, national and international levels are important in moving towards sustainability, project specific approaches are equally significant. They remark that despite this, existing integrated approaches for addressing sustainability principles are distinctly weak in managing micro-level implementation at a project level. Although, sustainability indicators (typically encased in assessment frameworks) can be useful to inform policy development (Kitzes et al. 2009), the integration of the three conventional pillars of sustainability is most often driven by policy derived through macro, meso and micro politics (Lozano 2009).

Hawken (2007) believes that we are not separate from nature; all systems are connected; humans are intrinsically linked with nature; without exception, living systems are failing. In discussing implementation approaches Hawken (2007) stresses that sustainability is implied, not as a constraint, but as an opportunity to enhance local livelihoods and natural capital. This is taken from the view of 'strong sustainability', which perceives natural capital as providing some utilities that are not substitutable by man-made capital (Cabeza 1996; Dietz and Neumayer 2007). These utilities, labeled 'critical natural capital', are emphasised by describing sustainability as leaving future generations a store of natural capital larger than or equal to the one enjoyed by the current generation. That is, sustainability is viewed in terms of non-decreasing natural capital (Cabeza 1996; Dietz and Neumayer 2007).

Counter to this concept, 'weak sustainability' regards sustainability as equivalent to a non-decreasing overall capital store. As no restrictions are introduced on the degree of substitutability between man-made and natural capital, no special treatment is specified to natural capital (Cabeza 1996; Morrissey et al. 2012). This paper characterises sustainability through strong sustainability as depicted in Dietz and Neumayer (2007); Henderson (1999 p. 102); Williams and Millington (2004) as "a more decentralised way of life based upon greater self-reliance, so as to create a social and economic system less destructive towards nature."

Chappell and LaValle (2011) and Habib-Mintz (2010) express the need for approaches that can help implement and achieve the sustainability aspects/issues of biofuel assessment initiatives. Although considerable dialogue and effort has been afforded to the identification of biofuel sustainability indicators, their lack of application and achievement is a critical concern (Hecht 2007; Vermeulen and Cotula 2010). Often the identification of indicators takes place through lessons learned in practice (Reed et al. 2006). However, at best they can inform whether a project is heading in the desired direction or whether current activities are unsustainable (Hecht 2007). Ordinarily, they simply alert us to existing problems, without informing us of their origin or how to resolve the problem.

This paper seeks to develop a conceptual framework that can help address some of these challenges. Through a review of academic and grey literature concerning development and biofuel discourses, theories are examined for their utility (rather than their strengths and weaknesses) to facilitate an understanding of the sustainability challenges in the context of informing biofuel implementation in developing countries, in particular, in sub-Saharan Africa (Figure 2.1). We do not attempt to demonstrate a mode of proficiency for the supporting theories, but rather, to draw on their individual and interlinking aspects that are supportive in explaining complex sustainability aspects/issues. Aspects are identified for their recognition of people-environment interactions, emergent political and social relationships (Borras et al. 2010), and how impacts are distributed through the diverse scales of interaction (White and Dasgupta 2010). Numerous entities have developed frameworks to assist the certification and assessment of sustainability for biofuel development. A synthesis of the aspects/issues included in these assessments is used as the basis for comparing and contrasting the utility of the four theories examined.

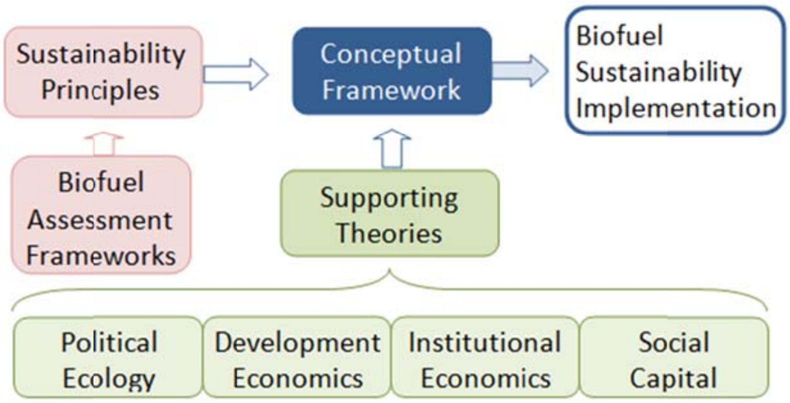

Figure 2.1 Process for developing a conceptual framework **to inform biofuel implementation**

The remainder of the paper is structured as follows: section 2 discusses the sustainability concerns associated with biofuels that repeatedly arise in the literature. Section 3 summarises biofuel assessment aspects/issues and their links to the supporting theories. Section 4 communicates the principles of the selected supporting theories that are relevant to biofuel sustainability aspects/issues. Tables are used to summarise the key points of interest that can be drawn upon to help understand biofuel sustainability implementation challenges. Prior to the conclusion, section 5 discusses sustainability limitations and presents biofuels conceptual sustainability framework.

2.2 Biofuel Sustainability Concerns

Often, decision-making surrounding biofuel development is not holistic and overlooks the importance of comprehensive stakeholder participation – a vital aspect in the quest for more equal distributions of costs and benefits – and centres solely on cost-benefit analyses from a government or industry perspective (Haywood and de Wet 2009). Imperative to biofuels' socio-economic sustainability is transparency, between participating stakeholders to whom costs and benefits are attributed, who decide on the distribution of costs and benefits, and how they are dispersed (von Maltitz et al. 2009).

Contentious land-ownership issues owing to the form of (or lack of) property rights in many developing countries (especially in sub-Saharan Africa) cause uncertainties for land tenure, population marginalisation, project security and livelihoods (Boddiger 2007). Land deals are often performed without the commitment of investors to show transparency or regard for indigenous property and cultural rights. Further research is needed to help understand how different scales of political, economic and knowledge powers reinforce inequalities such as marginalisation (Black, 1990; White and Dasgupta 2010) through the impacts of property rights (both form and security) (Vermeulen and Cotula 2010). The displacements that may result, can affect social sustainability by leaving few livelihood alternatives for locals besides menial labouring bonded to investment companies (McMichael 2010).

Borras et al. (2010) and Eden (2010) point out that unless consideration is directed towards how social-political-economic hierarchal dynamics interrelate with environmental and community integrity (i.e. livelihoods, health, education and freedom), it will be difficult to achieve sustainable biofuel development. Likewise, socio-environmental-economic sustainability issues are likely to persist, unless the issue of integrating the contrasting views of diverse stakeholders can be better explained and tackled (Elgahali 2007; Forsyth 2008). Pertaining to the sustainability of biofuel development, von Maltitz et al. (2009) suggest unearthing a theoretical discourse that identifies with the key impacts (benefits and restraints) and solutions that maintain environmental integrity, sustain livelihoods, and are embedded in the views of social equality.

Through an extensive review of the academic literature on biofuels and development and their role in progressing towards sustainability, concerns were identified as key aspects that repeatedly arose, and which were highlighted as being in need of further research. On this basis, four theories were identified that encompass these aspects, and were explored for their links to the core aspects of sustainability assessment frameworks.

2.3 Sustainability Issues/Aspects

Sustainability aspects/issues, central to sustainable biofuel development, were selected by evaluating internationally recognised biofuel sustainability assessment schemes via a search of the internet. Table 2.1 lists the 17 international biofuel certification and assessment frameworks that were evaluated for their breadth and clarity of sustainability aspects/issues.

Table 2.1 Biofuel assessment initiatives

Regulatory Schemes
EU Renewable Energy Directive (RED)
Renewable Transport Fuel Obligation (RTFO) – UK
Social Fuel Seal – Brazil
NTA 8080 – Sustainably Produced Biomass – Netherlands
Voluntary Schemes
Basel Criteria for Responsible Soy Production
Better Sugarcane Initiative (BSI)
Council on Sustainable Biomass Production (CSBP)
Global Bioenergy Partnership (GBEP)
Green Gold Label 2: Agriculture Source Criteria (GGLS2)
International Sustainability & Carbon Certification (ISCC)
Roundtable on Sustainable Biofuel (RSB)
Roundtable on Responsible Soy (RTRS)
Roundtable on Sustainable Palm Oil (RSPO)
SEKAB Verified Sustainable Ethanol Initiative
Scorecards
IDB Biofuel Sustainability Scorecard
WB/WWF Biofuel Environmental Sustainability Scorecard
Analytical Schemes
Biofuel Environmental Impact Assessment (BIAS) – Analytical Framework

Common sustainability aspects and the issues that may influence their efficient implementation, that were addressed by the seventeen biofuel assessment initiatives were identified. The Food and Agriculture Organisation (FAO) (BEFSCI, 2011) conducted a similar analysis of many of the initiatives listed in Table 2.1, though focusing on fewer and somewhat different sustainability aspects/issues. Based on attention to detail, breadth of sustainability aspects/issues and a focus on developing economies, drawing on the following five schemes also delivers a similar set of aspects/issues:

- RSB Principles & Criteria for Sustainable Biofuel Production (Voluntary) (RSB 2011).
- IDB Biofuel Sustainability Scorecard Sustainability Scorecard (Scorecards), Version Two, Based on the Round Table on Sustainable Biofuel Production, (IDB 2011
- International Sustainability & Carbon Certification (ISCC) (ISCC Association 2010).
- NTA 8080 – Sustainably Produced Biomass – (Regulatory) (NEN energy Resources 2013).
- Biofuel Environmental Impact Analysis (BIAS): Analytical Framework (FAO 2010).

Sustainability aspects and issues identified in the five respective assessment initiatives are displayed in Table 2.2. Academic literature was then examined in an attempt to unearth relevant theories that may assist us to understand these aspects/issues with a view to developing a framework to guide sustainability in biofuel production in developing countries.

2.4 Supporting Theories

This paper draws on the "development of knowledge integration approaches enabling multiple views to be considered" (Raymond et al. 2010 p.1774) to support the achievement of sustainable biofuel production in developing countries. Theories were selected for their interlinking principles that support sustainability challenges in developing nations. Likewise, in an effort to add breadth and depth for understanding macro and micro policy relations and the principles of the three pillars of sustainability in biofuel production, a combination of the diverse principles from four theories were drawn upon. In support of political ecology, which attempts to highlight challenges for achieving sustainability, other theories with similar principles were sought and those that had an interest in providing solutions to

Table 2.2 Sustainability aspects/issues addressed by five initiatives reviewed

	Assessment Initiatives				
Aspects/Issues	**RSB**	**IDB**	**ISCC**	**NTA8080**	**BIAS**
Economics					
Planning/Monitoring	✓	✓	✓	✓	✓
Resource Utility	✓	✓	✓	✓	✓
Viability	✓	✓			
Technology	✓				✓
Marketing	✓	✓			
Management	✓	✓	✓	✓	✓
Best practice/Species	✓	✓			✓
International Relations			✓		
Environmental					
Biodiversity Integrity	✓	✓	✓	✓	✓
Worker migration	✓		✓		
Water/Soil Management	✓	✓	✓	✓	✓
Waste Management	✓	✓	✓	✓	✓
Chemical Use	✓	✓	✓	✓	✓
Land Degradation	✓	✓	✓	✓	✓
Sustainable Agriculture	✓	✓	✓	✓	✓
Social					
Cultural Respect	✓	✓		✓	✓
Sustenance Security	✓		✓	✓	✓
Health	✓	✓	✓	✓	✓
Education/Skills	✓	✓			
Livelihood Quality	✓	✓	✓	✓	✓
Social Disturbance	✓	✓	✓	✓	✓
Equality/Power Relations	✓	✓			
Equal Costs & Benefits	✓				✓
Energy security	✓	✓		✓	
Participation/Networks	✓	✓	✓	✓	
Enterprise Development	✓		✓		
Rural Development	✓	✓	✓	✓	
Marginalisation	✓	✓	✓	✓	✓
Policy					
Optimal Utility		✓	✓		
Compliancy	✓	✓	✓	✓	✓
Enforcement Capacity	✓		✓		✓
Administrative Capacity	✓	✓			✓
Self-reliance					✓
Land Rights	✓	✓	✓	✓	
Ethics					
Efficiency	✓	✓			✓
Accountability	✓	✓	✓		
Transparency	✓	✓	✓	✓	✓
Responsibility	✓		✓		
Comprehensibility	✓	✓	✓		✓
Communications	✓	✓	✓		

these challenges were selected (development economics, institutional economics and social capital). Schubert (2005) points out that key to political ecology, is an in-depth study of social structures. These are debated by Nooteboom (2007) through linkages between political ecology and social capital, and Mansuri and Rao (2004) by emphasising the interrelationships of social capital and institutional economics. Each of these theories therefore shares common ground and each is discussed in turn below.

2.4.1 Political Ecology

Political ecology seeks to explain how power structures, ecological committees and local-level culture are part of broader economic and political structures (Peet and Watts 1996) that have national and international links (Neumann 2009). As a key theory in geography to study human-environmental relations Zimmerman and Bassett (2003), Neumann (2009) and Blaikie and Brookfield (1987) recognise political ecology as an approach that covers socio-economic hierarchies and the role of varying geographical (temporal and spatial) scale to define and explain biodiversity issues.

Owing to the overriding need for access and control over land, space and environmental resources, Tan-Mullins (2007) implies that power relations are central to the approach – especially, the interest in scalar politics concerning insatiable desires for the environment, or more specifically, resources (Molle 2007; Swyngedouw 2007). Scale (geographic, economic, knowledge, political, social) in political ecology remains an evolving conceptualisation (Neumann 2009).

Largely owing to poor governance, uneven trade policies, wealthy countries bestowing subsidies on their farmers, and tariffs placed on finished products, few African countries have benefitted materially from their rich endowment of land and natural resources through biofuel investments or other means (Prabhakar 2008). The study of poverty is a significant concern when understanding that people on the verge of starvation, when seeking new land, are unlikely to consider the state of natural bushland, or in the pursuit of sustenance, the rarity of an animal. These concerns may be exacerbated by biofuel development in sub-Saharan Africa, unless projects strive to consider affected stakeholder concerns equally (Diaz Chavez 2011; Vermeulen and Cotula 2010).

The wider political economy, influencing the grave agricultural status in much of sub-Saharan Africa (i.e. dated agronomic practices, poor yields and land degradation), is considered via chains of explanation at multiple scales (Blaikie and Brookfield 1987; Black

1990). The dependency theory, encompassed by some political ecology theorists (Bryant and Bailey 1997), considers the power relationships between the global North and global South. It argues that power relations of socio-political forces that are at play are intrinsic to the inequality among nations (Black 1990; Ferraro 2008). Prabhakar (2008) says economists who subscribe to the dependency theory, maintain that in order to prosper, poor regions must alter trading ties with developed nations. They argue that the prosperity of North America and Europe relies on the rest of the world remaining in poverty. Sub-Saharan countries are keen to reduce dependence on foreign energy reserves, and to reduce poverty (Ariza-Montobbio et al. 2010).

Major concerns facing sub-Saharan nations are shrinking land resources owing to population increases and competing demands for land from various sectors (food cropping, livestock rearing, urban expansion, land degradation and biofuel production). 'Regional' political ecology, seeks an understanding of the effects these diverse socio-economic hierarchies have on biofuel developments in African developing countries; and their consequential impacts on socio-environmental resilience (Blaikie and Brookfield 1987). Through consideration of a variety of scales, interests of the broad based approach of regional political ecology include processes surrounding land use and consequential causes of land degradation and environmental outcomes, which are a major concern in developing countries – especially sub-Saharan Africa (Blaikie and Brookfield 1987).

Many academic discourses on biofuel development in Africa (e.g. Amezaga et al. 2010; Dauvergne and Neville 2010; von Maltitz and Stafford 2011) discuss marginalisation concerns of small-scale producers, through governmental land expropriations or agri-business interests (Naranjo 2012). Black (1990) and Blaikie (1985) identify two forms of marginalisation. Firstly, small-scale producers enter a capitalistic mode of production. In this case, producers abandon traditional production and, unsustainably, extract surplus from the land (O'Flanagan 1978). In the second case of eco-demographic marginality, local populations are displaced to areas of environmental vulnerability or locations of lower fertility (Wisner et al. 1977). In both cases, locals necessarily over-exploit restricted land resources. These outcomes remain a risk for biofuel projects should sustainability principles fail to be employed. Table 2.3 summarises political ecology perceptions pertinent to some of the complex issues relating to sustainability limitations that affect biofuel implementation in developing countries.

2.4.2 Development Economics

In the search for sustainability, development economics seeks the most efficient allocation of scare resources; and for maximum growth of these resources (Bass 2011) – in other words, maximising utility under conditions of scarcity. Development economics uses economic theory, sociology, political science, anthropology, econometric methods, biology and demographics to study economics in the developing world (Ray 2007).

Table 2.3 Political ecology: Linking sustainability to biofuel implementation in sub-Saharan Africa

Utility of Political Ecology on Sustainable Biofuel Development
Seeks to understand national and international relationships in the context of political, economic and knowledge power structures (Peet and Watts 1996) to assist local economic advancement
Explains the socio-economic hierarchal scales and their effect on environmental issues (Blaikie and Brookfield 1987) in an effort to harmonise environmental, social and economic sustainability
Examines power relations and their impacts through the insatiable need for land and environmental resources (Zimmerman and Bassett 2003), which is a challenge for biofuel cultivation in developing countries
Seeks to explain uneven power relations and uneven cost and benefits, leading to social, environmental and economic inequalities (Bryant and Bailey 1997)
Through chains of explanation (Blaikie and Brookfield 1987), reviews the quandary of agriculture in developing countries (Black 1990), which is further impacted by the expansion of biofuel production
Drawing on the dependency theory, examines the uneven global power relations (Black 1990; Ferraro 2008), thus, pursuing an explanation for environmental degradation and social decline through an uneven distribution of natural resources
Explains sustenance and energy security via self-reliance (Ferraro 2008)
Examines competing land issues through government acquisitions and agro-industry demands that leads to marginalisation (Amazega et al. 2010; Dauvergne and Neville 2010; von Maltitz and Stafford 2011), and the subsequent environmental degradation and social welfare decline
Strives to identify biofuel development processes causing land and environmental degradation (Blaikie and Brookfield 1987)

Unlike many other fields of economics, social and political factors (Todaro and Smith 2006) are included in development economics (Bell 1987; Ray 2007). Amongst others, development economics envelopes: reasons poverty appears alongside affluence (i.e. to what extent is economic growth of developing nations hindered by the activities of wealthy nations) and assesses the causes of corruption (i.e. whether wealth and democracy are related) (Bass 2011). There is a drive to examine success stories of economic development, to ask how we can learn and what can be learnt from past failures, and how sense can be made of the vast inequities within and across borders (Ray 2007). With this knowledge, and a focus on community integrity (e.g. health, sustenance, self-esteem and freedom), development economics strives to turn the cycle of poverty into a virtuous cycle of growth (Sen 1983).

As mentioned in the World Development Report in 1998-1999, it is not just the gap in resources that differentiates developing countries and developed countries but also a disparity in knowledge (World Bank 1999). Arguing that markets on their own can lead to successful economic growth outcomes, Stiglitz (2011) believes that at the centre of successful development is the absorption, accumulation, production, adaptation and transfer of knowledge. He adds, in short, countries should not limit progress by their patterns of endowments (land, labour, capital), but should place an emphasis on entrepreneurship and knowledge. By identifying local sectors that are more amenable to learning, and engendering the learning capacities of citizens, knowledge transformation will be pro-poor (Stiglitz 2011).

Since most people in low-income countries depend on agriculture for their livelihoods, improvements in agricultural technology are central to reducing poverty (Lin 2011). Ruttan (2008) mentions that the leading agricultural resources constraints in the developing world are soil degradation, water scarcity, environmental impacts from agricultural intensification and impacts of climate change. Technology has helped small-scale farmers avoid crop failures through early adverse weather warnings (Kumar 2012), and advice sent via mobile phones on advanced forage and feeding techniques has reduced livestock mortalities (Kahumbu 2011).

Lin (2011) suggests that well-designed policies on social capital development must be an integral part of a country's development strategy. This can assist to upgrade industry to position the economy to fully utilise its resources. Sachs (2008) explains that development economics seeks reasons for poverty beyond the norm of poor governance (regularly code words for 'corruption') and the poor themselves. Table 2.4 summarises the sustainability concerns that development economics seeks to explain, and which can inform implementation approaches for biofuel development in sub-Saharan Africa.

Table 2.4 Development economics: Linking sustainability to biofuel implementation in sub-Saharan Africa

Utility of Development Economics on Sustainable Biofuel Development
Studies developing country economies (Bell 1987)
Reinforces the maximum utility of scarce resources (Bass 2011) – emphasising environmental sustainability
Includes political and social factors (Todaro and Smith 2006), which are both key sustainability limitations for biofuel development in countries with weak property and environmental rights
Studies reason for poverty emergence alongside prosperity (Bass 2011), informing biofuel development on more equitable socio-economic implementation
Explains the interference by developed nations on prosperity of developing nations (Bass 2011) – demands for biofuels in the developed world can influence the sustainability of biofuel cultivation in developing countries
Seeks the causes of corruption and inequities within and across borders (Ray 2007)
Focuses on community integrity (i.e. health, freedom, self-sufficiency) (Eden 2010), which can assist local confidence and enhanced powers for negotiating with biofuel developers
Recognises that the strength of development potential is linked the disparity in knowledge (including technological) (Lin 2011; World Bank 1999)
Strengthens local understanding of biofuel projects by emphasizing the need for education, training and transfer of knowledge (Stiglitz 2011) to help harmonise the three pillars of sustainability
Recognises the need to engender citizen learning capacities (i.e. Agriculture in rural Africa) (Stiglitz 2011)
Investigates past successes and failures to enhance decision making (Ray 2007)
Examines the potential for improved agricultural output (causes and responses) (Ruttan 2008), thus, strengthening environmental sustainability, social welfare and economic wealth

2.4.3 Social Capital

Social capital is described by Putnam et al. (1993: 167) as "trust, networks and norms that can improve the efficiency of society by facilitating coordinated actions that improve the efficiency of society through features of organisation." Social Capital is sometimes inferred as generating assets for poor populations (Dongier et al. 2001). It is thus a stock from which to support economic growth and development via an organisation of links between and among actors (Coleman 1988). Social capital has to be considered within its political and cultural circumstances (Rao 2001), as there is an understanding that norms and trust may differ by groups within a social system (Carolan 2006).

Coleman (1988) believes in building rapport, within communities or unions with other communities, with the belief that quantity and quality of interaction are key sources for strength for the communities' own betterment. Community is defined as an endogenous construct identified by project parameters or project-facilitators, or by environment or identified precincts, rather than a physical form (Mansuri and Rao 2004). Astone et al. (1999) recognise that intra-community ties can provide communities with a common purpose and sense of identity, which advances self-esteem and provides a basis from which to negotiate more even terms.

local notions of what is fair and just and how a project would best benefit communities often varies from those of project implementers and/or project inter-mediators (Harrigan 2004). Likewise, projects that draw on community involvement are no less immune to inequities through disparities in hierarchal power (political, financial and knowledge). In cases of superior political or economic groups within a community, outcomes may be derived at the expense of inferior groups (Woolcock and Narayan 2000), which can reinforce existing inequalities.

Finsterbusch and van Wicklin (1989) found participatory projects to have an intrinsic value – without participation people may benefit but are unlikely to develop from a project in developed economies, suggesting that support may be found through broader institutional settings. Echoing Newman et al. (2002), Kleemeier (2000) argues that the lack of sustainability of participatory projects stems from a lack of support from an external enabling institutional environment. The view of institutionalism is that civil society and the strength of community networks is largely reliant upon institutional environments (Woolcock and Narayan 2000). They add that the quality of formal institutions, under which communities reside, determines the capacity with which communities are able to act for their best interests. Table 2.5 summarises the sustainability concerns that social capital seeks to explain, which can inform sustainability implementation approaches for biofuel development in sub-Saharan Africa.

Table 2.5 Social capital: Linking sustainability to biofuel implementation in sub-Saharan Africa

Utility of Social Capital on Sustainable Biofuel Development
Discusses integrating norms (informal rules), social networking, and transparency (confidence) Putnam et al. (1993), to benefit communities own betterment (Dongier et al. 2001)
Via networking, promotes economic opportunities through increased market efficiency and reduced transactional costs (Coleman 1988)
Promotes cooperative behaviour, generating better societal outcomes (avoiding narrow egoism) (Putnam et al. 1993), which can assist local negotiating power for equal costs and benefits involving biofuel developments
Recognises community participation projects are no less susceptible to exploitation via scales of power (political, financial and knowledge) (Harrigan 2004)
Considers the enhancement of a sense of identity and negotiating strength through social support via inter- and intra-community interaction (e.g. health, jobs, education) (Astone et al. 1999; Putnam et al. 1993), thus, increasing environmental protection, economic opportunity and social wellbeing with regards to biofuel developments

2.4.4 Institutional Economics

To support flows of information, enforce defined property rights and to reduce transaction costs, institutions permit, require or prohibit specific social, economic or political actions. Williamson (2000) considers institutions to include regulatory frameworks, procedural devices, and organisational entities. Formal (laws, rules and constitutions) and informal (norms of behaviour, codes of conduct, conventions) institutions are defined by North (1990) as constraints people enforce on themselves. As economies become more advanced, increased transactions provoke more complications with market partners. This induces a shift from informal institutions towards formal institutions to facilitate fairness and efficiency (Jutting 2003), and emphasises the need to devise policies to improve the links between informal and formal institutions.

According to North (1990), employing appropriate institutional frameworks for projects in developing countries is paramount for achieving sustainability. He adds that the learning process of organisations, the network externalities, and the traditionally shaped subjectivity of issues reinforces the set path for development. Rampant corruption, inequality, insecure property rights, bureaucratic delays, suppressed civil liberties and ethnic tensions are increasingly recognised as barriers to well-being (World Bank 1999). The existence of these conditions undermines well-intentioned efforts of infrastructure development such as roads, communications, hospitals and schools (Woolcock and Narayan 2000). It follows that investment in informal and formal forms of civil and government social capital complements more conventional investments.

The competency of property rights and the propensity to enforce them is argued as key to economic development (Chang 2011). Kimenyi (2011) also points out that secure property rights are not always better for economic development. Chang (2011) argues for sustainable development, the form of property right is as significant as the security of property rights. Owing to the large expanses of land that are needed for cultivating biofuels and the contentious food versus fuel debates, it is essential for biofuel implementers to grasp the different forms of property rights (Boddiger 2007; Vermeulen Cotula 2010).

Institutional economics has largely exhausted itself in attempting to rationalise emerging economics through the perspective of developed country institutions (Maseland, 2011). This signifies that it may be more productive to look at institutions on a country-specific basis. Woolcock and Narayan (2000) advise that the weakness of institutional economics lies with its strength of attending to macro policy concerns – it lacks in-depth micro policy components. For example, they mention that liberties, rights and freedoms are entities inevitably established by governments; rational and proficient bureaucracies are removed from the lives of the poor in many rural communities, and may take years to be developed.

Jutting et al. (2007) suggest that development outcomes cannot be ascribed to an individual institution as they depend on several dynamics. These include the interactions between informal and formal institutions and the actions of powerful individuals, groups or political players (Ostrom 2005). In many developing countries informal institutions may improve efficiency alongside formal institutions; especially in cases of weak law enforcement, or the lack of desire to enforce (Mwangi and Ostrom 2009). In such cases, conforming to law may be achieved by forming committees and partaking in meetings that review issues according to formal rules, however, outcomes are agreed informally (Jutting et al. 2007). This can enhance enforcement effectiveness and reduce resources expended through fruitless debate and players vetoing the process. Jutting et al. (2007) convey an example: in a country that introduces a stronger anti-corruption law, despite lacking the capacity to impose it, informal self-enforcement can take place by way of obligation, expectations of reciprocity, shaming, threats, boycotting and ostracism. Conversely, cases in which countries lack the enforcement capacity or ignore laws such as gender rights, informal traditional laws that customarily contravene these rights take precedence (Ostrom 2005). Table 2.6 summarises the sustainability concerns that institutional economics seeks to explain, which may help biofuel development in sub-Saharan Africa move towards sustainable biofuel development.

Table 2.7 conveys the emphasis that each specific supporting theory places on designated sustainability aspects/issues in relation to biofuel implementation approaches. The interlinking qualities were drawn on to expand understanding of the interrelationships between environmental, social, and economic aspects.

Table 2.6 Institutional economics: Linking sustainability to biofuel implementation in sub-Saharan Africa

Utility of Institutional Economics on Sustainable Biofuel Development
Examines informal institutions (behavioural norms, conventions and codes of conduct) in cases of weak policy compliance and enforcement capacities (North 1990). Biofuel developers can take advantage of weak enforcement capacities unless institutions are in place to ensure equitable costs and benefits
Informal institutions facilitate efficiency and fairness in developing countries until a capacity is reached for a transfer to effective formal institutions (Jutting 2003)
Property Rights – considers the significance of form and security of property rights (Chang 2011)
Considers it to be more productive to examine institutions on a country specific basis (Maseland 2011). This is important as each biofuel project has a unique set of environmental, social and economic challenges
Examines forms of social capital investment to minimise weak governance (e.g. corruption, inequality, insecure property rights, bureaucratic delay) (World Bank 1999). This may provide local stakeholders with a collective negotiating voice and help achieve equality in relation to biofuel development in sub-Saharan Africa
Consideration for macro policy concerns (Woolcock and Narayan 2000) may assist the integration of micro, meso and macro sustainability aspects

2.4.5 Relationships with Sustainability Aspects/issues

Checkmarks in Table 2.7 signify the scale of utility that a supporting theory may have for analysing a designated sustainability principle. Two checkmarks signify that the supporting theory has interests predisposed towards a designated biofuel sustainability principle. A single checkmark signifies that although a supporting theory confers less significance for a designated sustainability principle, the theory is likely to extend considerations that may assist biofuel implementation approaches. The absence of a checkmark may not essentially signify a lack of insight that a theory confers for a principle, but is merely the perception of this paper that the explanations of another supporting theory proffer greater utility for analysing the sustainability principle.

2.5 Discussion

This paper has explored the principles of various supporting theories and the utility they may offer for exploring a broad range of complexities that challenge biofuel implementation in developing countries. An approach was sought that strives for a balanced integration of the three pillars of sustainability; one that is supported by informed ethical policy that can inform biofuel development in sub-Saharan Africa.

Drawing on the political ecology and development economics principles that consider key social capital and institutional economics interests may support a conceptual framework

Table 2.7 Supporting theoretical influences on biofuel sustainability aspects/issues

Aspects/issues	Political Ecology		Development Economics		Institutional Economics		Social Capital	
Economics								
Planning/Monitoring			✓	45			✓	26
Resource Utility	✓✓	28	✓✓	3			✓	25
Viability			✓✓	37			✓	6,31
Technology			✓✓				✓✓	
Marketing	✓	16,35	✓✓	37,45			✓✓	6
Management	✓✓	8	✓	41			✓✓	15
Best practice/Species			✓✓	37			✓✓	26
International Relations	✓✓	7,32,35	✓✓	37,45			✓	37
Environmental								
Environmental Integrity	✓✓	35	✓	44			✓	26, 29
Migration Impacts	✓✓	43,50					✓	29
Land Utility	✓✓	28	✓	3,37			✓	29,45
Waste Control	✓	28	✓	41			✓	26
Chemical Use	✓	28	✓	41			✓	26
Land Degradation	✓✓	8,35	✓	41	✓✓	10, 22,25	✓	29, 45
Sustainable Agriculture	✓✓	38	✓	41	✓	25	✓✓	26,45
Social								
Cultural Respect	✓✓	34	✓	44			✓✓	19,24
Sustenance Security	✓✓	39	✓✓	44				
Health	✓✓	35	✓	4,20,44			✓✓	14,24
Education/Skills	✓✓	30	✓✓	23,45			✓✓	14,17
Livelihood Quality	✓✓	2	✓	44,47			✓✓	14
Social Disturbance	✓✓	43,49			✓	10	✓✓	29
Equality/Power Relations	✓✓	8	✓✓	3,37,45			✓✓	19
Equal Costs & Benefits	✓✓	9	✓✓	3,42	✓	21	✓	15
Energy security	✓✓	39						
Participation/Networks			✓	3	✓✓	12,32	✓✓	36
Enterprise Development	✓	43	✓✓	3,42			✓✓	11,17,45
Rural Development			✓✓	25,37			✓	26
Marginalisation	✓✓	1,38	✓	48	✓	22		
Policy								
Optimal Utility	✓✓	9,16	✓✓	25	✓	21	✓✓	11
Compliancy					✓✓	21		
Enforcement					✓✓	22		
Capacity			✓	5	✓✓	21		
Self-reliance	✓✓	2,39	✓✓	23	✓✓	27		
Land Rights	✓✓	9,46			✓✓	10,21,22		
Ethics								
Efficiency			✓	45	✓	21	✓	36
Accountability	*		✓	18,25	✓✓	10,15,29	✓✓	11
Transparency	✓✓	38	✓	25	✓	21	✓✓	36
Responsibility	✓	49	*		*		✓	13,26
Comprehensibility	*		*		*		*	
Communications	✓	8	✓✓	45	✓✓	10	✓✓	36

Supporting Literature: 1] Amezaga et al. (2010); 2] Ariza-Montobbio et al. (2010); 3] Bass (2011); 4] Becker (1975); 5] Bell (1987); 6] Bigsten et al. (2000); 7] Black (1990); 8] Blaikie and Brookfield (1987); 9] Bryant and Bailey (1997); 10] Chang (2011); 11] Coleman (1988); 12] Commons (1931); 13] Cotula et al.(2008); 14] Dongier et al. (2001); 15] Fafchamps (2006); 16] Ferraro (2008); 17] Fukuyama (2001); 18] Granovetter(1995) ; 19] Harrigan (2004); 20] Jones and Romer (2009); 21] Jutting (2003); 22] Kimenyi (2011); 23] Klein and DiCola (2004); 24] Krishna (2002); 25] Lin (2011); 26] Mansuri and Rao (2004); 27] Maseland (2011); 28] Molle (2007); 29] Mosse (1997); 30] Neumann (2009); 31] Nooteboom (2007); 32] North (1990); 33] O'Laughlan (2008); 34] Peet and Watts(1996); 35] Prabhakar (2008); 36] Putnam (1993); 37] Ray (2007); 38] Robbins (2004); 39] Romanova (2010); 40] Rossioud and Locatelli (2010); 41] Ruttan (2008); 42] Sachs (2008); 43] Schubert (2005); 44] Sen (1983); 45] Stiglitz (2011); 46] Swyngedouw (2007); 47] Todaro (2006); 48] von Maltitz and Stafford (2011); 49] Wisner et al. (1977) ; 50] Zimmerman and Bassett (2003). *Denotes: indirect explanations emerge by drawing on characteristics of the demarcated supporting theory.

that is more inclusively informed on sustainability challenges, and which can be used to avail the implementation of biofuel developments in sub-Saharan Africa. Seeking a more equitable approach for integrating economic, environment and social sustainability, political ecology perspectives on socio-environmental concerns can be synthesised via the micro socio-economic influences of development economics. Likewise, drawing on the macro socio-economic perceptions of institutional economics can maintain a link between broader based policy outlooks and the more localized informal institutional settings. This can assist biofuel implementation to analyse equality and a form of social ordinance in the absence of a formal institutional enabling capacity – especially concerning sub-Saharan African land and resource utility. The relationship of biofuel sustainability aspects/issues and supporting theories to inform biofuel implementation (which can inform policy) are illustrated in Figure 2.2. Institutional Economics (supporting macro elements and institutional settings) in conjunction with social capital (supporting micro and meso elements of local and regional networking) can expand upon and support the explanations derived through development economics in response to sustainability concerns raised by political ecology.

Studying the uneven links of international and national power organisations and the role they play in ecological integrity and respect for local cultures (Peet and Watts 1996; Neumann 2009), may provide explanations for the concerns regarding biofuel investment hierarchal power relations and their adverse impacts on environmental preservation (Borras et al. 2010) and social inequality (White and Dasgupta 2010). An explanation in relation to the root of marginalisation of local communities (Amezaga et al. 2010; Dauvergne and Neville 2010; von Maltitz and Stafford 2011), human-environmental behaviour (Zimmerer and Bassett 2003; Neumann 2009), and livelihood resilience (Wisner et al. 1977), may be derived through the considerations of political ecology of socio-economic hierarchies at varying scales (Black 1990; Blaikie and Brookfield 1987). The discussions through political ecology on the impacts on community integrity and marginalisation (Molle 2007; Swyngedouw 2007; O'Flanagan 1978), through the avid desire for natural capital for biofuel cultivation, may contribute towards social sustainability implementation debates to uphold community integrity (Eden 2010) and offer insights into the distribution of biofuel development costs and benefits (von Maltitz et al. 2009).

Drawing on Black's (1990) and Ferraro's (2008) reasoning through the dependency theory, regarding uneven socio-political power relations between the Global North and Global South, can advance debates concerning insecure property rights (Vermeulen and Cotula 2010), political scalar dynamics impacting environmental and community integrity (Borras et al. 2010; Eden 2010) and the distribution of costs and benefits (von Maltitz et al. 2009; White and Dasgupta 2010). Likewise, Romanova (2010) advises that, through domestication,

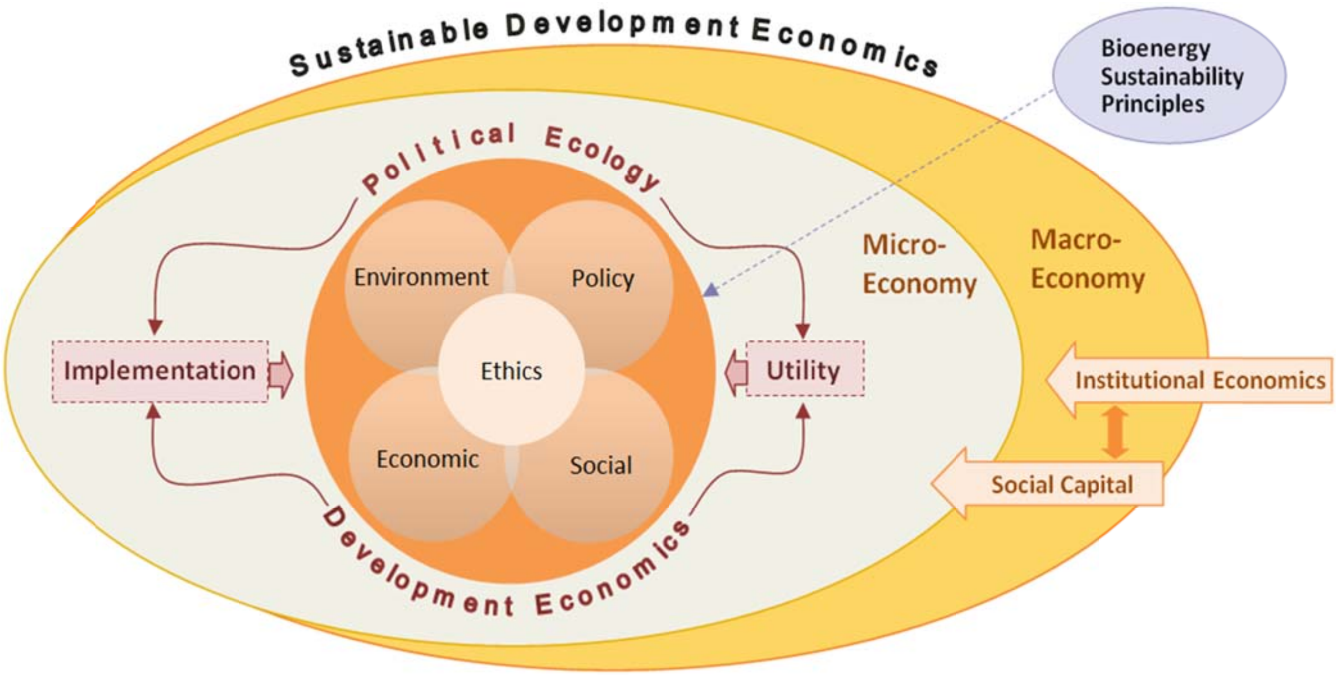

Figure 2.2 Towards a conceptual framework for sustainable biofuel development

nations should strive for energy and sustenance security to offset the uneven costs and benefits seized through uneven power relationships (Bryant and Bailey 1997). This emphasis on the localisation of energy production highlights the need for biofuel implementation approaches that can equally and simultaneously consider the three pillars of sustainability.

By drawing on political and social aspects, development economics' efforts to enhance developing countries' economic opportunities (Bell 1987), can assist the understanding of diverse sustainability viewpoints between players with uneven levels of economic and political power that are involved with biofuel production in developing countries (Elgahali 2007). Dealing with economics in developing countries, and recognising the impacts of political and social factors (Todaro and Smith 2006), development economics can present a base from which to debate the biofuel development activities of wealthy nations (Bass 2011) and their impact on economic and natural capital inequalities (von Maltitz et al. 2009;

White and Dasgupta 2010). Seeking a rationale for surplus and scarcity appearing side-by-side (Todaro and Smith 2006) is important for understanding the complexities surrounding the integration of biofuel development interests between stakeholders of diverse economic, political and knowledge levels of influence (Elgahali 2007; Forsyth 2008).

Also fundamental for understanding diverse viewpoints, the accumulation and transferral of knowledge between different scales of power (World Bank 1999; Stiglitz 2011) transcends towards equitable stakeholder participation. In addition, the recognition that education and knowledge (including technological) must be directed towards learning capacities (Stiglitz 2011) is key to addressing poverty. For example, emphasising agricultural education and knowledge in rural developing nations is pro-poor, and is likely to realise maximum livelihood benefits (Lin 2011) in agriculturally aligned biofuel production. On such occasions, the promotion of sustainable agricultural yields have far from reached their potential in developing countries, and examining the reasons for soil degradation, Ruttan (2008) emphasises the benefits for enhancing agricultural technical knowledge within well-informed policies for social capital development (Lin 2011).

In relation to the implementation of biofuels projects, Coleman's (1988) belief in liberal interaction as a key strength to regulating the balance of negotiating powers (Astone et al. 1999) can inform local notions of 'what is fair and just' (Harrigan 2004). The combination of reinforcing elements of trust, understanding locally accepted rules (informal institutions) and intra- and inter-community networking (Putnam et al. 1993), can support local stakeholders to grasp established sustainability principles, thus, gathering confidence for negotiating more equitable costs and benefits. The promotion of transparent societal networking (Coleman 1988; Putnam et al. 1993), besides reducing transactional costs and increasing marketing opportunities, departs from selfish egotism. This integrated economic interaction, which upholds a sense of identity (Astone et al. 1999), can be further developed in relation to biofuel production in some (social issues restrict this option in several regions Diaz Chavez 2010) sub-Sahara African countries (Harrison et al. 2009) through the formation of cooperatives. These theoretical perceptions of social capital may offer insight into the concerns of enviro-socio-economic equality raised by von Maltitz et al. (2009), and facilitate sustainability by embedding participatory fairness in biofuel implementation approaches.

In relation to contentious property rights, understanding and adopting informal institutional roles in nations that display a weak capacity to administer and enforce formal institutions (i.e. many countries in sub-Saharan Africa) (Jutting 2003), may conceptualise approaches to concerns regarding marginalisation through biofuel development in sub-Saharan Africa (Elghali 2007; Forsyth 2008; Cotula et al. 2008). Through the perceptions of institutional economics, discussing the forms of property rights, in addition to the security of property rights (Chang 2011), informs biofuel implementation approaches that aim to enhance local livelihoods, the security of project tenancy and environmental maintenance. The study of informal institutions on a country-specific basis, (Jutting et al. 2007; Maseland 2011), is likely to have utility for sub-Saharan Africa owing to the variations of macro conditions between countries on many levels, including: political stability; formal institutional enforcement capacity; administrative capacities; property rights; access to natural resources; and a lack of policy standardisation.

2.6 Conclusion

The discourse throughout this paper has maintained focus on a conceptual framework to inform implementation approaches for biofuel sustainability in developing countries in sub-Saharan Africa. Drawing on institutional economics strengthens the development economic perspective on macro concerns. Social interaction and networking, embedded in forms of informal institutions, interlink the interests of social capital and institutional economics.

Sachs's (2008) call for a development economics that centres on growth and that considers equal cost and benefits, especially in disadvantaged communities; one that seeks causes beyond the norms of weak governance and out-dated procedures embedded in local customs, can inform biofuel implementation approaches to help achieve environmental, social and economic sustainability in developing countries. Understandings of social capital and institutional economics interlink with societal norms or informal institutions that are often embedded with the challenges of integrating diverse stakeholder views in sub-Sahara African nations (Forsyth 2008). Drawing on social capital and institutional economics adds depth and breadth to the study of political ecology and development economics in seeking reasons for inequality – why poverty is found alongside affluence.

The concerns of land insecurity through biofuel developments, and the resultant impacts on marginalised communities, can be better understood and avoided if focus is equally placed on the form and the security of property rights. In seeking better forms of sustainability, effective biofuel implementation approaches are more likely if sustainable development is recognised as an evolving inquiry – on a site-specific basis.

The holistic approach of political ecology, and the common themes (e.g. social-political-economic hierarchal dynamics; environmental protection; uneven knowledge, political and economic powers, and their influence on equality; dispersion of costs and benefits, property rights and the impacts on marginalisation and community integrity) referred to by the supporting theories, suggests that to meet sustainability standards and the principles therein, ethical implementation attitudes must be prioritised.

The efforts of political ecology to unearth and understand complex sustainability concerns can be complemented through development economics, which seeks to understand causes and explain responses to the matching developmental inquiries through the examination of past successes and failures. Amalgamating the interests of four supporting theories that displayed interlinking qualities has provided a more inclusive theoretical understanding in an effort to move towards sustainable biofuel development. While this analysis of key theories with regard to biofuel implementation approaches in sub-Saharan Africa may have merit, moving forward the agenda requires empirically based work to bring the concepts together.

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Chapter 3

Towards implementation and achievement of sustainable biofuel development in Africa.

Abstract

Although sustainable bioenergy development in Africa is critically debated, if projects are developed within a credible framework, opportunities for sustainability arguably can arise. This paper presents research on the characteristics of sustainable biofuel projects as provided in the literature and according to expert opinions obtained by way of a survey involving thirty-eight international experts. Participants were selected for their expertise in the fields of environmental, social and economic sustainability relating to biofuels in Africa. The survey results suggest that projects which display a high degree of transparency, incorporate local stakeholder involvement, and ideally include local villagers as partners are more likely to achieve sustainable biofuel production. Experts also indicated that reconciling diverse stakeholder objectives alongside the principles of sustainable development remains an ongoing challenge. A process is recommended for sustainable biofuel development, which attempts to harmonise efficiency, stakeholder interaction and the integration of diverse stakeholder perspectives. To support the process, it is recommended that an advisory/mediating body that acts according to best practice principles would be of great assistance. Such an advisory/mediating body would be conversant with local land, social, economic and environmental conditions, project sustainability and administration, and also advise on biofuel framework educational needs.

Key Words: biofuels; Africa; sustainable development; implementation and achievement; environment

3.1 Introduction

Debate centred on bioenergy seeks a consensus of sorts as countries pursue access to affordable and reliable energy. Oil is not just an economic problem but is increasingly identified as a security concern (Bergquist et al. 2011; Robbins 2011). Contrasting expert opinions on bioenergy production in Africa are exemplified by views stressing that biofuel development competes with resources normally reserved for food production (Shiva 2005), and biofuel production provides an opportunity to develop rural infrastructure in ways that may enhance food security (Lynd and Woods 2011).

Although many biofuels projects do not support livelihood-enhancing benefits to local citizens (Shiva 2005; von Maltitz 2008), and fail to be sustainable across environmental, economic and social dimensions (Uddin et al. 2010), biofuel projects are well into implementation within many African countries including Mali, Malawi, Ghana, Zambia and Zimbabwe (Diaz-Chavez et al. 2010; Mulugetta 2009). Often patrimonial politics and shady deals limit the ability of local communities and interest groups to penetrate and influence policy processes, undermining any form of accountability and transparency (Borras et al. 2010). This can be compounded by local bureaucratic pressure pushing for policy preferences that are not clearly defined; affecting both international investment and local projects. Approaches to manage biofuel projects in a sustainable way are needed that handle the many types of uncertainty with transparency, competence and fairness (Elgahali et al. 2007).

The current lack of implementation and achievement of biofuel sustainability frameworks[1] is a key shortcoming to realising sustainability objectives for biofuel development in Africa (Janssen et al. 2009). Elgahali et al. (2007) explain that guidelines for such a process should ideally entail approaches to projects that draw upon best management practices, assurance schemes and a social, environmental and financial risk assessment in accord with relevant policy and regulations. They emphasise that it is essential to involve all affected stakeholders with their varying perspectives for proposals to gain credibility. Political ecology perspectives consider the unjust allocation of uncertainties, threats and financial

[1] Biofuel assessment frameworks discussed within this article refers to 17 internationally-recognised regulatory frameworks, voluntary frameworks, scorecards and analytical frameworks BEFSCI (2011) and GBEP Task Force on Sustainability (2011).

timeframes engaged in by the different participants (Ariza-Montobbio et al. 2010; Robbins 2004). As such, political ecology can assist a better understanding of the relationships between participants' interactions and their final outcomes.

Lima and Gupta (2009) emphasise the need for a much improved, fair, multilateral policy framework which protects the interests of those with less economic and political power. For stakeholders to be fairly represented, Lima and Gupta (2009) argue that those who speak out against biofuel development should also be allowed representation. A consensus amongst all stakeholders on a shared vision of sustainability and principles for a proposed project is the key challenge facing assessment practitioners (Hope et al. 2003). Schemes that involve the investor and local communities working together, and both sharing the risks and rewards of a project, are often thought to have the best chance of long term sustainability (Gibson 2006).

This paper considers approaches to reconcile and integrate the diverse interests of stakeholders to advance implementation and achievement of sustainable biofuel development in Africa. Three biofuel project types, common to sub-Saharan Africa (Vermeulen and Cotula 2010a), are focused on: 1) Agro-industrial projects which include projects that acquire vast tracks of land to produce, process and distribute feedstock. The local community involvement is often only menial employment opportunities. 2) Centrally-operated projects which involve an investor owning a central processing operation that is supplied by feedstock produced by contracted out-growers. 3) Community-produced feedstock for a community owned processing operation. To gain expert insight, international experts on sustainable biofuel production in Africa were surveyed on biofuel development sustainability in March 2011. Sustainability is a contested term, so rather than be prescriptive, respondents were left to apply their own interpretation. For the purposes of this paper, biofuel development is considered sustainable if across the three pillars of sustainability (environmental, social and economic), the strengths of one (or two) pillar/s does not undermine the other/s (Binder et al. 2010).

The next section reviews the literature that formed the basis from which the survey questions were determined. Following that, the literature on biofuel production in developing countries is reviewed. This is followed by an outline of the research methods, presentation of the survey results and consideration of their implications in advancing sustainable biofuel production. Finally, recommendations are made towards achieving biofuel project sustainability by integrating diverse stakeholder perspectives.

3.2 Agrofuels and Scales of Power

The questions for the survey, reported on later in the paper, were largely determined from literature that discusses the social and environmental sustainability issues in biofuel production focussing on the global South – framed loosely around a political ecology perspective. Through the lens of political ecology, issues such as agrarian change on the basis of economic shifts, production scale and integration, peasant differentiation and class struggles have been raised in relation to biofuel development (Borras 2009). Franco et al. (2010) argue that European biofuel policy is tied in with managerial protocols, targets and conditions, and technological optimism. However, the contradiction between European policy and on the ground reality (Afionis and Stringer in press) has mobilised movements towards production and consumption based more upon the lines of localised energy sovereignty (Borras and Franco 2010).

Often biofuels are too simplistically framed as ‘good’ or ‘bad’, obscuring the tradeoffs across environmental, economic, social and political lines. Ariza-Montobbio et al. (2010) recognise an alarming mismatch between experience in the field and the determined promotion of biofuels by researchers, and national and regional policy-makers in India. Some states (especially in sub-Saharan Africa) that have recently entered into biofuel development and have less coherent bureaucracies and weak ties between domestic elites and the state, are more exposed to the financial interests of multi-national corporations (MNC) (Evans 1995).

Utting and Clapp (2008) reveal that implementation of corporate social responsibility (CSR) policies has tended to be weak by the small percentage of MNCs who have adopted them, particularly in the absence of penalties for noncompliance. They voice concern that the few legal mechanisms in place to hold MNCs more accountable are often invalidated by the defence teams of highly skilled legal advisors. O’Laughlin (2008) questions the ability of capitalistic corporations to act on a basis of social responsibility; and that the pursuit of CSR and profit, is consistent with the promotion of environmental sustainability and the reduction in poverty and inequality. Enquiry grounded in political ecology, seeking to understand the uneven power relationships, and the hierarchal impacts on costs and benefits, which often lead to economic, social and environmental inequalities (Bryant and Bailey 2007; Hall et al. 2009) can be usefully applied to this field of research.

3.3 Biofuel Development Issues

Ernsting (2007) reminds us agrofuel (biofuel) expansion is cementing control over large swathes of land by industrial groups with ruthless reputations of environmental destruction, human rights abuses and labour conditions. The conditions (of both smallholder and industrial operations) under which crops are grown and processed; who profits in field production and in the different phases of processing; and the manner in which workers and smallholders benefit from their inclusion, are significant issues (White and Dasgupta 2010).

Vermeulen and Cotula (2010) explain that proponents of biofuel production speak of utilising 'idle' land in many developing countries, particularly in the global South. However, as shown by Ariza-Montobbio et al. (2010), these areas are often far from idle, and are managed under common property regimes and used to generate livelihoods for the poor, especially women. They argue that, at worst, the internationally recognised right to food should be observed. Where people's food security is dependent on land, land takings must be offset by alternative livelihood assets that would ensure the same level of food security. Colchester and Ferrari (2007) suggest that both cultural and social values of land in Africa, as elsewhere, are unlikely to be captured in purely economic calculations. They explain that despite simplified processes in some countries, investors' perceptions confirm that procedures to acquire land are often unclear and complicated. Also significant problems can arise in identifying the multiple land claims, even in cases where certificates classify land as privately held.

Vermeulen and Cotula (2010) question whether clearer rights over land improve local land users' bargaining power for more equitable outcomes. Even in countries with fairly progressive land rights (e.g. Mozambique and Tanzania), they found that where procedural rights are weak, locals have little influence in defining policy. Framed by the principle of 'free prior and informed consent', they found that current practice in Africa falls well short of global normative standards for consent, consultation and recompense. For example in Madagascar and Ethiopia, the greater voice of local people with the consultation process does not confer consent or any form of authority to endorse or shape investment terms (Vermeulen and Cotula 2010). These factors combine for highly unfavourable negotiations for local communities with regards to investors.

3.4 Biofuel Production Issues in Africa

As a result of several drivers, interest in biofuel production has grown markedly in Africa since 2000, and is likely to continue in the future. For example, insecure fossil fuel supplies have encouraged countries to become increasingly focused on sourcing sustainable alternative fuels outside the Organisation of Petroleum Exporting Countries (OPEC) (O'Connell 2008; Shiva 2005; Sinclair 2009; Snell 2007). The United Nations Convention on Climate Change (UNFCCC) and Kyoto Protocol imperatives to decrease GHG emissions **(**UNFCCC 1992) have also increased political pressure to find alternative energy sources.

While many reports about biofuel development in Africa are largely anecdotal, some reports document land appropriations for commercialisation (Mortimer 2011; Nhantumbo and Salomão 2010). The numerous requests for land to the Mozambique Government to produce sugarcane and *Jatropha curcas L.* to produce biofuel feedstock had by 2009 exceeded 20 million hectares. Although not all requests are granted, 15 ongoing projects seek to grow 500 000 hectares for biofuel feedstock (Arndt 2011). According to some reports an estimated 50 companies have established at least 100 agrofuel projects in sub-Saharan Africa, although figures are likely to be higher, given the lack of accurate data (Carrington and Valentino 2011). In some cases vast quantities of land requested are granted, such as the surrender of 2.8 million hectares of land to China by the Democratic Republic of Congo (Paul et al. 2009). In another case, Mali, Senegal and Guinea have between them relinquished 900 000 hectares to Crest Global Green Energy, a British bioenergy company (Carrington and Valentino 2011).

Many examples of failed sustainability dimensions within biofuel projects in Africa as well as other continents, e.g. Brazil (Franco et al. 2010) and India (Ariza-Montobbio et al. 2010), have been reported. Mwiinga (2010) recounts that more than 3000 former employees and residents of Macha Mission in Choma, Zambia, were displaced and over 100 of their houses were burned down to make way for a large scale *Jatropha curcas L.* cultivation. In the district of Panda, Mozambique, Matavel (2009) relays that in 2009 the Chiaxo community reported that workers on a large scale biofuels project in their region had not been paid for nine months, with Government officials and the biofuel investor Energem blaming this outcome on the Global Financial Crisis. Matavel (2009) also reports that in another community in the Bilene District, Mozambique, a company developing biofuels promised schools, scholarships, hospitals, waterholes with pumping capacity and help for widowed women and abandoned children in 2007, but did not deliver. Two years had passed and none of these promises had materialised by 2009.

In addressing controversial issues such as land tenure in Africa, further lessons can be learned with stakeholders' input, especially from locally affected communities who integrate ecological, social and economic aspects in their daily lives (Haywood and de Wet 2009). Fundamental to advance sustainable development, is adopting an holistic approach that has sound considerations for design, economy, industry, politics, education, and underlying principles of environmental protection (Pereira 2012).

Owing to past project agreements prepared within frameworks which lack transparency, accountability, efficiency and ethical governance (Heckett and Aklulu 2008), rural communities in Africa are suspicious of foreign investors (Fischer et. al. 2009). The feelings of local communities about biofuel cultivation are spelt out by a small scale farmer from Choma, Zambia.

> This Jatropha reminds me of cotton. Many years ago when Dunavant came here, they promised that if we grew cotton, we would be paid lots of money. We stopped growing our maize to make more money from cotton. But when the time to sell it came we were paid very little. We went hungry because we had neglected growing our traditional crop, maize (Josam Ndaambona, cited in Doussou-Bodjrenou et. al. 2007).

NEPAD (2010) recognises that despite African governments' efforts, regulation to ensure the sustainability of biofuel production remains insufficient. Shown below are eight core principles for human development that were advocated in 1997 by the United Nations Development Programme (UNDP 1997):

1. Participation
2. Rule of law
3. Transparency
4. Responsiveness
5. Consensus orientation
6. Equity and inclusiveness
7. Effectiveness and efficiency
8. Accountability

These principles apply to all forms of sustainable development including biofuel production.

Sustainability achievement capacities can be examined through institutional understandings of informal institutions (i.e. codes of conduct, conventions and behavioural norms) (North 1990); especially in cases with countries that display weak governance. The term, 'weak governance', is usually referred to as issues impeding social and environmental and economic development, including inequality, insecure property rights, corruption and bureaucratic delays (World Bank 1999).

3.5 Aims

Drawing on the aforementioned principles, this paper explores sustainability approaches to reconcile and integrate stakeholders' diverse interests, which is often considered a leading constraint to the implementation and achievement of sustainable biofuel development in Africa. The paper also examines CSR through the lens of political ecology, in that there is a more sustainable and less exploitive way of doing things in context of local societal convention, natural ecology, political setting and economic demands (Peet and Watts 1996; Robbins 2004).

3.6 Methods

The following methods employed for research reported in this paper were selected to explore issues regarding sustainable biofuel production in Africa: firstly, a review of the literature on international and African biofuel production, in academic and professional journals, books, reports and United Nation's documents; and secondly, a survey was carried out with 38 sustainability experts, including academics, consultants, policy-makers and NGO representatives, on approaches towards realising sustainable biofuel production in Africa.

So as to include as wide a range of perceptions as possible, in January 2011, 105 experts from a diverse range of backgrounds were invited to respond to a survey questionnaire. They were purposively identified for their international experience, including their expertise relating to sustainable biofuel development in Africa, (most of whom had also contributed to internationally recognised publications). In an effort to encompass experts' knowledge about the core principles of sustainability discussed in the literature, e.g. those principles outlined in UNDP (1997), the experts were selected for their experience in the following areas (see appendix A):

- Environmental Biodiversity (19 % of respondents),
- Social Capacity Building in Developing Nations (21%),
- Economics (13%),
- Agro-production (21%) and
- Sustainable Energy Development (26%).

Most respondents worked for government agencies, academia, consulting and NGOs. Although respondents were selected internationally for their diverse fields of expertise with regard to sustainability and biofuel production, owing to the relatively small participant sample, care was taken not to select respondents affiliated to the private sector. This was in an effort to minimise bias through self-promoting responses. The survey requested names and institutional affiliations on a voluntary basis. As some of the respondents chose to remain anonymous, respondents' institutional affiliations or whether from within or from outside Africa are not presented here.

Of the 105 experts initially contacted, 52 agreed to participate and 38 eventually responded to the questionnaire sent in February 2011, by way of a link to Survey Monkey™, via email. Use of web-based survey software facilitated an efficient collection of responses. Owing to experts being based in both developing and developed countries, it was considered this accessible web-based survey package would provide for ease of response. The questionnaire consisted of three questions (questions 1, 3 and 4) with modified Likert Scale response options, and optional qualitative comments. The remaining six questions (questions 2 and 5 - 9) were open-ended. Responses have been grouped in categories determined during analysis of the findings. Responses were received over a period of six weeks during February-March 2011.

The survey research aimed to establish what experts understood to be the most important biofuel project characteristics, if any, in the successful achievement of sustainability in Africa. Also, it was designed to establish what biofuel production framework criteria would most likely assist in the implementation and achievement of sustainable biofuel development. The survey also sought opinions on various stakeholder concerns including equal participation, project understanding, communications, and bringing together diverse stakeholder opinions (see appendix A).

Outcomes were both quantitatively and qualitatively tabulated for analysis. Likert scale questions allowed for options numbering one to five. For Questions 3 and 4, three responses were excluded in the results, as responses were incomplete.

3.7 Results

With regards to the respondents' affiliations, an analysis of the survey responses did not uncover any evident patterns in relation to them. The survey responses are discussed in the sub-sections below with the first six sub-sections examining Questions 1 to 6, and the final section focuses on three interconnected matters (Questions 7 to 9) relating to reconciling and integrating diverse stakeholder interests. Questions are shown below in bold and italics.

Q1. ***What type of biofuel development do you favour in Africa – if rigorously produced within a sustainability framework?***

Five options were given in response to Q1: 1) *Industrial operations*, to gain economies of scale, offering local jobs 2) *Central projects* and sub-subcontracting to local farmers 3) *Small scale production* by local villagers 4) *Any of the above* projects 5) *None* at all

All survey respondents were in favour of developing at least one type of biofuel project in Africa, although, many recognised that the choice of biofuel project type may be a distinguishing factor for achieving sustainability. For the purposes of tabulation, the cases for which respondents recommended option 4 (Any Project) (13% of total responses) saw each of the three optional project types being awarded with an additional response. In other words, for option 4, three responses (options 1, 2, and 3) were added to the total for calculating the percentage below. Respondent 8 is an example for choosing option 4 with the comment, "if you are taking a national view of biofuel production, I think a mixture of approaches is needed to offer maximum benefits (within a sustainability framework of course!)".

Most people did not see large-scale industrial biofuel projects (recommended by 21% of respondents) as a sustainable option. Marginally higher than centrally-owned projects (36%) (Figure 3.1), 43% of respondents thought small-scale, locally produced and utilised biofuel production projects, would be the most likely to achieve sustainable production.

Three respondents felt strongly, that to achieve equality, local producers should be invited as partners rather than contracted to the project. Respondent 17 stated that "for efficient supply continuity, out-growers schemes with a central project are most likely to achieve sustainability, but not necessarily under subcontract". Four respondents mentioned that for efficiency and to ensure continuity of supplies, centrally owned projects have advantages over communally owned feedstock processing. Typical comments for what would constitute a preferred biofuel project were: "Centrally owned projects gain economies of scale, offering local jobs and ensuring market security" (Respondent 9).

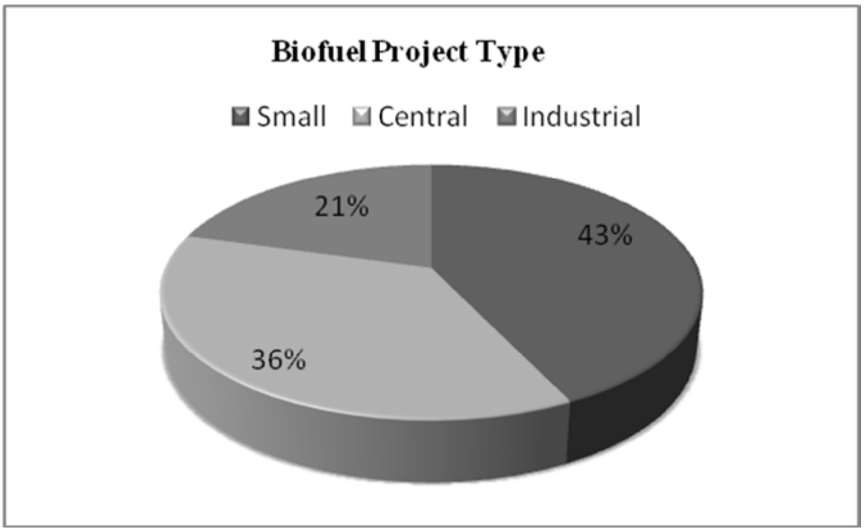


Figure 3.1 Percentages of surveyed experts' responses to the biofuel development project type seen as most likely to achieve sustainability

Q2. ***Do you consider it responsible for an investor who is attempting to sustainably develop biofuels, to engage African countries with weak governance? This may serve as an example for best practice in countries where biofuels are likely to be developed.***

Of the respondents surveyed, 40% said it was reasonable to engage with these countries, 31% suggested it may be possible but with stringent sustainability conditions and 29% replied negatively to any form of involvement. It was emphasised by five respondents in their qualitative responses that utmost transparency and ethical standards should be established. This is emphasised by Respondent 31:

> Provided they uphold ethical standards. These countries are often most in need of development. However the opportunity for exploitation is high. If the company does the correct planning, involves local role-players, pays good wages and is externally audited on good practice, I can see no reason why they should not be involved in countries with weak governance.

The motivations suggested for engagement were the opportunities sustainable biofuels projects present, to display best practice, and for presenting investment opportunities which are not often available under these conditions. Respondent 8 highlighted the issues and discussed recommendations for best practice:

> This may serve as an example for best practice in countries where biofuels are likely to be developed. I think biofuels can provide an investment opportunity and in countries

with weak governance, opportunities are often few and far between. I think in taking a responsible approach, investors should look to other experiences in other (similar) contexts to ensure they are entering into that country with their eyes open to the opportunities, risks and threats.

Q3. *Which organisation/body is most likely to achieve sustainable biofuel development* in those African countries with weaker governance?

The four options given to respondents in response to Q3 were:

A. International sanctioning body
B. Ethical corporate governance
C. NGO involvement in the project
D. Rigorous sustainability criteria by lending institutions

Presented in Figure 3.2 are participating expert responses and correlating percentages for each ranking choice (1 to 4) of the four given options (A, B, C and D). Of the ranking choices 1 to 4, 1 is considered the most likely option and 4 the least likely.

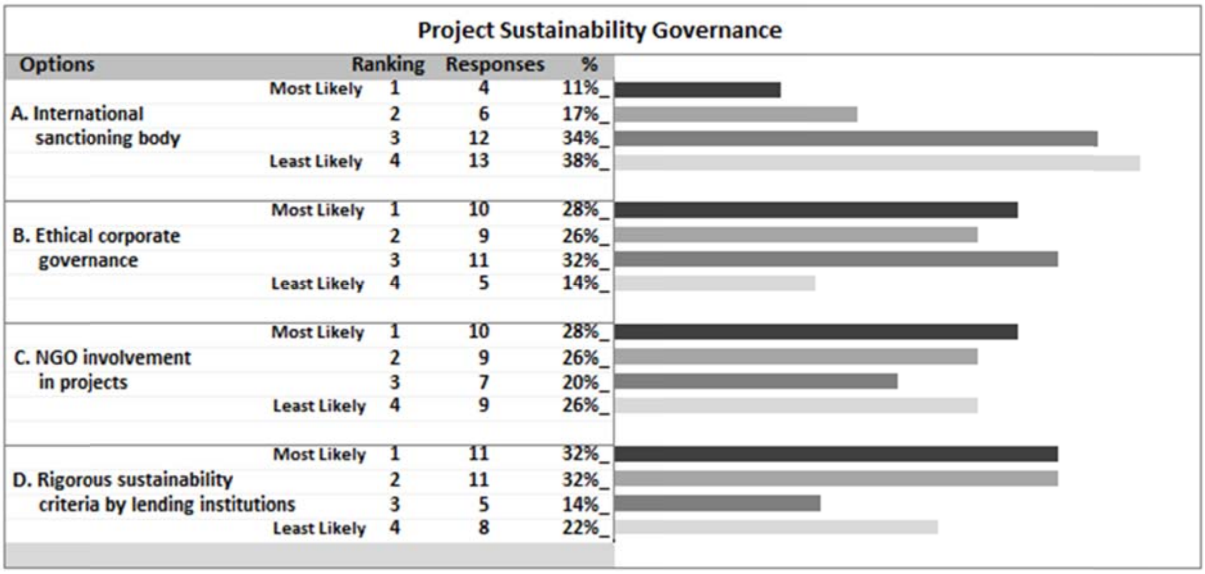


Figure 3.2 Surveyed expert responses and related percentages to given rankings (1-4) for the governance of biofuel project sustainability

Surveyed respondents believed an international sanctioning body to be the most unsuitable option, owing mainly to the difficulties in administration and enforcement. Respondent 5 offered the opinion that "sanctions would be near impossible to enforce because of the huge investment in monitoring, reporting and verification that would be needed". Although corporate ethical responsibility (28%), lending institutions' sustainability criteria (32%) and NGOs (28%) appear to be fairly evenly endorsed as favourable methods for achieving sustainability by survey respondents (Figures 3.2 and 3.3); 26% and 22% of respondents believed that lending institutions and NGOs, respectively, are least able to govern sustainability aspects of biofuel development; whereas only 16% suggested advanced corporate governance as least agreeable.

The surveyed experts' average responses to governance criteria are presented below (Figure 3.3) using methods similar to those of Buchholz et al. (2009). A high average score indicates the criterion is considered by participants as more likely to suitably govern sustainability issues in biofuel development.

The modest preference shown between ethical corporate governance, NGOs and lending institutions, may indicate that to suitably govern biofuel project sustainability requires the integration of best practice of these three options.

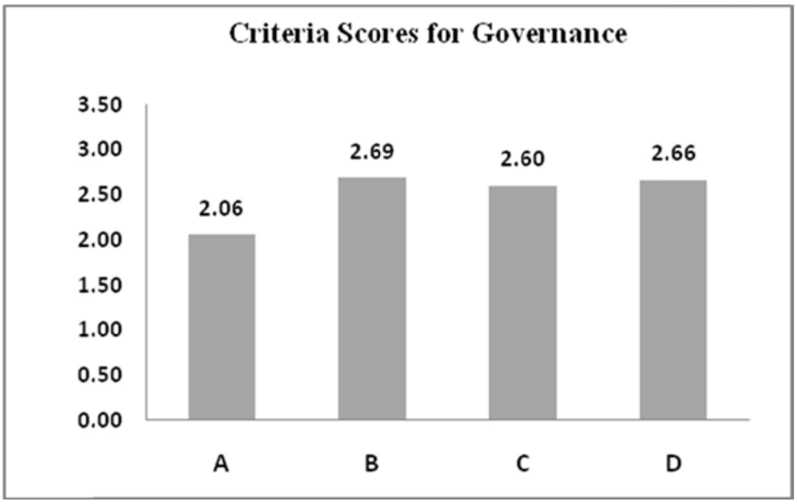


Figure 3.3 Average Criteria Governance Scores

Q4. *Which criteria do you consider would most likely assist in achieving the aims of best practice biofuels production frameworks*?

The surveyed experts were given the following response options:

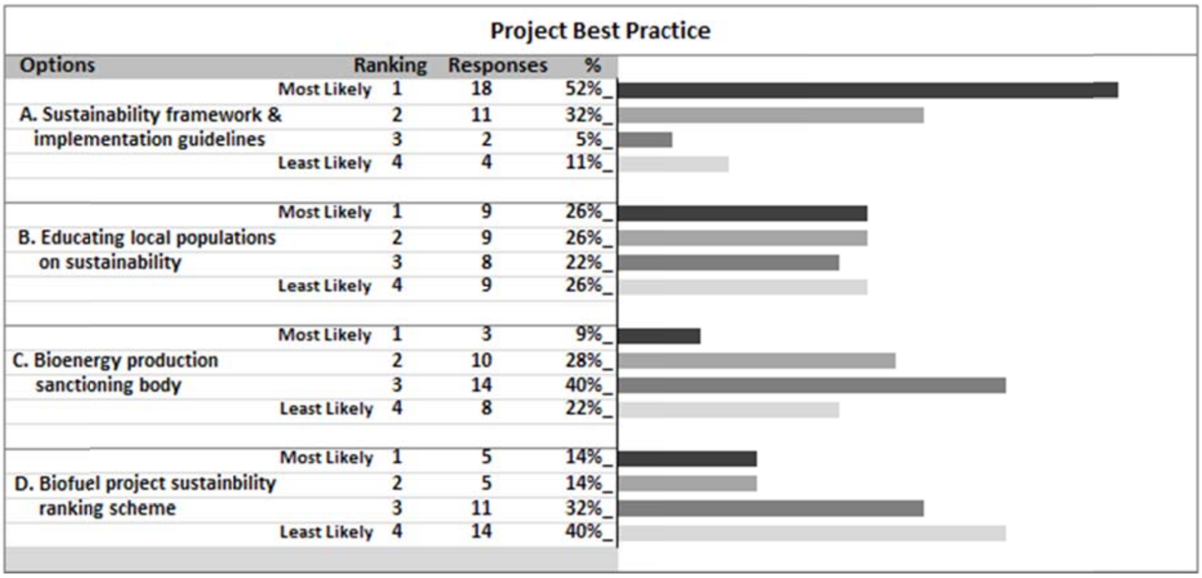
A. Sustainability *framework* including implementation guidelines,

B. *Educating* local populations on sustainability,

C. Bioenergy production *sanctioning* body and

D. Biofuel project sustainability *ranking* scheme

Responses to the choices, A, B, C and D, indicated the respondents' understandings as to which choice, or combination of choices, efforts could be directed to realise sustainable biofuel production. As with Question 3, the four options are displayed below including ranking and number of expert responses and related percentages for each option (Figure 3.4).



Project Best Practice

Options		Ranking	Responses	%
	Most Likely	1	18	52%
A. Sustainability framework & implementation guidelines		2	11	32%
		3	2	5%
	Least Likely	4	4	11%
	Most Likely	1	9	26%
B. Educating local populations on sustainability		2	9	26%
		3	8	22%
	Least Likely	4	9	26%
	Most Likely	1	3	9%
C. Bioenergy production sanctioning body		2	10	28%
		3	14	40%
	Least Likely	4	8	22%
	Most Likely	1	5	14%
D. Biofuel project sustainbility ranking scheme		2	5	14%
		3	11	32%
	Least Likely	4	14	40%

Figure 3.4 Surveyed expert responses and related percentages to given rankings (to 4) for biofuel project best practice

The survey response averages of each criterion are shown below. A high average score indicates great suitability in achieving best practice aims of biofuel frameworks.

Although surveyed experts considered that a sustainability biofuels framework was most likely to achieve sustainability harmonisation, educating affected stakeholders was also considered important. Arising out of the given choices, a sanctioning body and a ranking scheme were deemed as the least suitable options. It was suggested qualitatively by (Respondent 33) that a promising combination for administering biofuel development in Africa might be a sustainability framework with implementation guidelines, and appropriately educating affected stakeholders on its design and application. "To achieve frameworks' sustainability aims, would require an inclusive understanding by stakeholders" (Respondent 33).

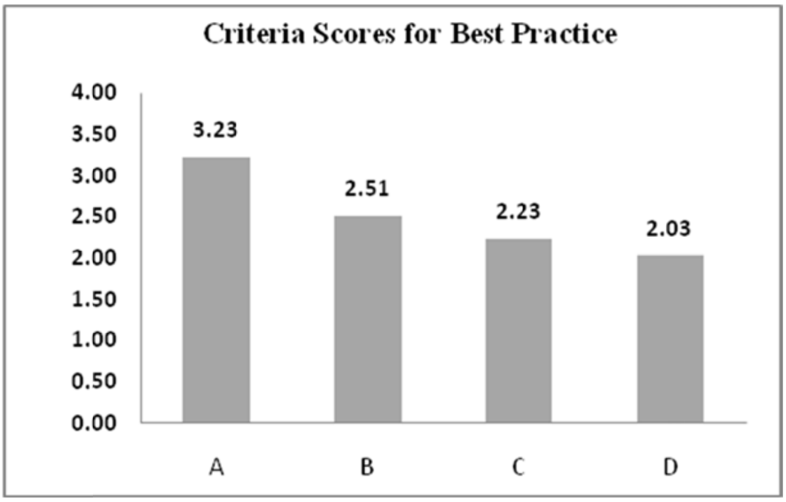


Figure 3.5 Average criteria best practice scores

Q5. ***What reasons do you consider the aims of biofuel production sustainability frameworks are not adequately achieved by biofuel projects?***

To explain why many biofuel developments in sub-Saharan Africa are not adequately meeting the sustainability criteria advocated in biofuel production frameworks, seven key themes were referred to by participating experts. The seven themes and percentages of responses raised are presented in Figure 3.6. Some experts mentioned more than one reason for lack of project sustainability.

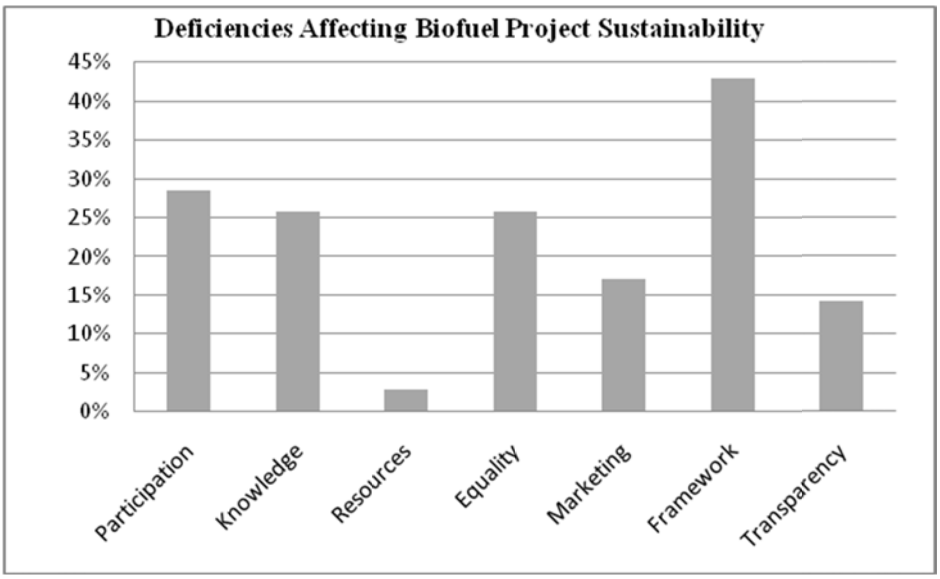


Figure 3.6 Deficiencies affecting biofuel project sustainability

The lack of an adequately conveyed biofuels production framework was deemed the key drawback to achieving sustainability in biofuel production in Africa; however, also of concern to experts were equal opportunity, equality risk and reward, and the appropriateness of knowledge (education). Respondent 23 referred to the typical concerns of inequality: “Communications between parties is not balanced. Ethical business practice is waning. Greed from certain parties; corruption within the planning and implementation stages”. Concerns were raised about a lack of transparency and unequal stakeholder participation, often stemming from poor communication, and leading to confusion and inequality. These concerns are explained by respondents 15 and 21:

> I think the multiple benefits claimed for biofuels (fuel security, trade growth, jobs increase, environmental gains, infrastructure development) leads to confusion about what exactly they are for. This confusion is not only apparent within local communities, but also government and to some extent industry (Respondent 15).

> The processes are designed to profit the companies at the expense of the people who own the land. They are based on misinformation to the communities (Respondent 21).

Q6. ***What approaches would you propose to assist in achieving the sustainable elements advocated by biofuel project frameworks?***

Themes on approaches to assist achieving sustainable elements, advocated by biofuel project frameworks most often referred to by the experts, were identified from the survey results via qualitative analysis. The four main approaches (above 30% of responses) recommended by experts were: a high degree of transparency; improve implementation and educational knowledge; equal participation; adequate biofuel production policy frameworks.

Unsurprisingly, suitable methods raised by the experts for achieving biofuel framework sustainability link with the responses to sustainability deficiencies mentioned in section Q5. These relationships, together with the percentages of respondents who raised particular issues, are shown in Table 1. Column one presents key deficiencies (responses to Q5), and column two presents approaches to assist in achieving biofuel framework sustainability (responses to Q6).

Table 3.1 Sustainable biofuel development challenges

1. Sustainability Deficiencies		2. Sustainability Implementation	
Corporate greed and a lack of social, economic and environmental ***equality***	**26%**	Maintain a high degree of transparency throughout the biofuel project lifecycle	**34%**
Lack of ***implementation*** knowledge	**26%**	Improve implementation and educational knowledge for stakeholder representation	**43%**
Lack of equal ***participation***	**29%**	Ensure equal stakeholder participation, including planning and administration	**31%**
Lack of an adequate policy ***framework***	**43%**	Clear, concise and comprehensive guidelines for policy frameworks	**31%**

Table 3.1 broadly presents biofuel project implementation challenges; experts' concerns primarily focus on local stakeholder involvement and support as being necessary. Respondent 5 suggested that:

> Capacity building at the local level is vital, as well as moves by funders and those responsible for project delivery to look more holistically not only right across the 3 pillars of sustainable development, but also to make long-term time horizon considerations central to projects (Respondent 5).

Respondent 31 reinforces the need for impartiality, open communication and education:

> This must start before project approval. Local stakeholders need to be given impartial information over a number of meetings. They need the opportunity to get informed and impartial advice on plans. Only then can they be expected to give free and informed consent (or rejection). Formalised partnerships need to be entered into with the community where they have substantive and real equity in the project (remember, it is in effect gland that they are bringing to the party). There is a need for unbiased facilitation and sound record keeping of meetings and agreements. Land rights need to be protected (Respondent 31).

Q7. *Representation, communication and integration of diverse stakeholder opinions*

This section deals with the final three survey questions on fairness in stakeholder participation, which is often mentioned in the literature as central to the sustainability success of a biofuel project development.

The three questions and leading responses by surveyed experts are shown below (Table 3.2). They were deemed interrelated, because without examining any one of the three issues, resolving the other two issues would be difficult. Harmonising the three related issues was seen as integral to the successful implementation and achievement of biofuel production frameworks. The number of respondents who raised a particular topic is presented as a percentage below (Table 3.2). Several respondents referred to more than one topic in their qualitative responses.

Table 3.2 Representation, communication and integration of diverse stakeholder opinions

How would you ensure equal representation of selected stakeholders affected by biofuel development in Africa?						
Ensure equal Participation	Mediating body - which is well versed with local conditions and project performance	Through Village leaders and increased awareness	NGOs	Government And Legislation	Ensure legitimacy within a sustainability framework	Transparency & Accountability
47%	**18%**	**21%**	**11%**	**21%**	**21%**	**26%**
How would you ensure efficient and intelligible relations between selected affected stakeholder representatives?						
Participatory Systems from the onset of projects	Prioritise the needs of the majority with legitimate representation	NGOs	Honest mediating brokerage – well versed locally and with sustainability	Delegation of individual responsibility	Distinct guidelines for cooperative agreements	Transparency & Accountability from the outset
32%	**26%**	**3%**	**18%**	**9%**	**18%**	**11%**
How would you integrate diverse points of view of the different biofuel development stakeholder groups?						
Participatory decision making throughout the project	Committee formulation with equal representation	Experts should understand local issues	Use of an intermediary with sustained policies and attention to detail	Education and consensus building	Ensure communications are appropriate to the local population	Develop mutual respect and responsibility, avoiding "them and us"
21%	**24%**	**24%**	**32%**	**26%**	**26%**	**11%**

The results in Table 3.2 indicate that key issues raised were: ensuring equal participation (47% of respondents to Q7); Introducing participatory systems from the onset of projects (32% of respondents to Q8); and use of an intermediary body with sustained policies and attention to detail (32% respondents to Q9). In addition to the important sustainability elements of fair participation, transparency and accountability, surveyed experts raised two interesting recommendations: experts should understand local issues (24% respondents to Q9) and an intermediary body could assist in achieving this. The comment by Respondent 15 emphasises the motive for experts to understand local issues: "It cannot be expected for locals to fully understand the intricacies of expert concepts of large project implementation and achievement."

Suitable approaches to these three closely related issues were seen to be central to upholding efficiency and effective stakeholder participation. Further reference to the qualitative responses to questions 7, 8 and 9 is made within the recommendations section.

3.8 Discussion

The superior economic viability offered by large-scale industrial biofuel projects may may be attractive to investors, but the survey results presented in this paper indicate, that unless effectively implemented within a credible biofuel production framework, they often hold scant assurance for local social development or environmental sustainablility (cf. Bringezu et al. 2009; Ernsting 2007. Since experts supported findings in the literature (e.g. Heckett and Aklilu 2008; White and Dasgupte 2010) that investors have the responsibility to adequately administer environmental and social sustainability procedures, it is a concern that only 28% of respondents regarded improved corporate governance capable of achieving sustainable biofuel development in Africa. In response to issues raised by O' Laughlin (2008), earlier in this paper, surveyed experts indicated that ethical conduct, transparency and authentic communications by developers and stakeholder representatives is needed for local populations to regain confidence from the lows of previously failed foreign investments (cf. Fischer et. al. 2009; Heckett and Aklulu 2008; Matavel 2009).

Understanding the political ecology concerns of an unjust allocation of risks and insecurities (Ariza-Montobbio et al. 2010), through uneven power realationships (political, knowledge-based and economic) (Blaickie 1985), would assist with the important issue raised by respondents – sustainable outcomes are more likely if interest and enthusiasm for the project is equal amongst all stakeholders (Gibson 2006). Many respondents suggested that this can only be attained if stakeholders' representatives are suitably educated in sustainable development and project design. Effective education and active participation throughout a project's lifecycle can help recognise political ecology principles that projects can be implemented less coercively, less manipulatively and more sustainably (Peet and Watts 1996; Robbins 2004).

Drawing on the social capital understanding that cooperative behaviour generates fairer outcomes (Putman et al. 1993), political ecology explanations can help account for the concerns of surveyed experts that education and knowledge should not be considered a one way process that solely informs local stakeholders about project developments (cf, Vermeulen and Cotula 2010) but rather a two way communication process. Through a political ecology approach – i.e taking into account development economics and understanding of reasons for poverty standing alongside affluence (Bass 2011), and institutional economic studies of informal institutions (North 1990) – a basic requirement must be for management and experts alike to be well versed with local aspects (e.g. cultural, climate, agronomy, health, communications, leadership structure and natural habitats). The survey results suggest that improving biofuel project sustainability is unlikely to be achieved without suitably integrating the diverse perspectives of all stakeholders' representatives affected by the development (cf. Borras et al. 2010; Elgahali et al. 2007). Respondents indicated that administering policies within a biofuels framework that advocates, amongst others, sustainability criteria, the fair and efficient integration of different stakeholder interests, may best be served by an advisory/mediating body. Respondents suggested that the advisory/mediating body should administer best practice principles, focusing on attention to detail in sustainability aspects of project design and implementation, and use internationally accepted standards of consultation, consent and recompense (Vermeulen and Cotula 2010).

Drawing on key ethical principles examined from the perspective of knowledge frameworks may provide the base from which a mediating/advisory body could operate to gain the confidence of all stakeholder groups. Arguably, the mediating/advisory body could function effectively by drawing on: the understandings of uneven power relations in political ecology (Peet and Watts 1996; Elgahali, 2007); development economics and its study of effective use of scarce resources (Bass 2011); the explanations of social capital in promoting quality networking, and trust and social norms within informal institutions (Putman et al. 1993); and institutional economics arguments that informal institutions can facilitate efficiency and fairness until capacities are reached to form formal institutions (Jutting 2003).

Stakeholder representatives principally agreeing on an internal and external communication framework within which to operate, (i.e. similar to the belief of Coleman (1988) that building rapport within unions by constantly sharing information) may assist the mediating panel achieve legitimacy in the eyes of all stakeholders. An effective understanding, by the mediating panel, on marginalisation issues and upholding community integrity (i.e. self-reliance, security, equality, health and education) (Amazega et al. 2010; von Maltitz and Stafford 2011), would assist in smoother project implementation for all stakeholders – and is likely to infer trust from local stakeholders.

3.9 Conclusions

This paper has focussed on the results of a survey of expert opinions on integrating diverse stakeholder perspectives for the achievement of biofuel project sustainability. The results of the survey indicate that the importance of upholding the three pillars of sustainability, may best be served by projects displaying efficiency (timely execution of agreed commitments and efficient use of scarce resources), and developed in partnership with local stakeholders within a sustainability framework. Additionally, educating local participants in framework design and implementation should assist in transparency and equitable representation.

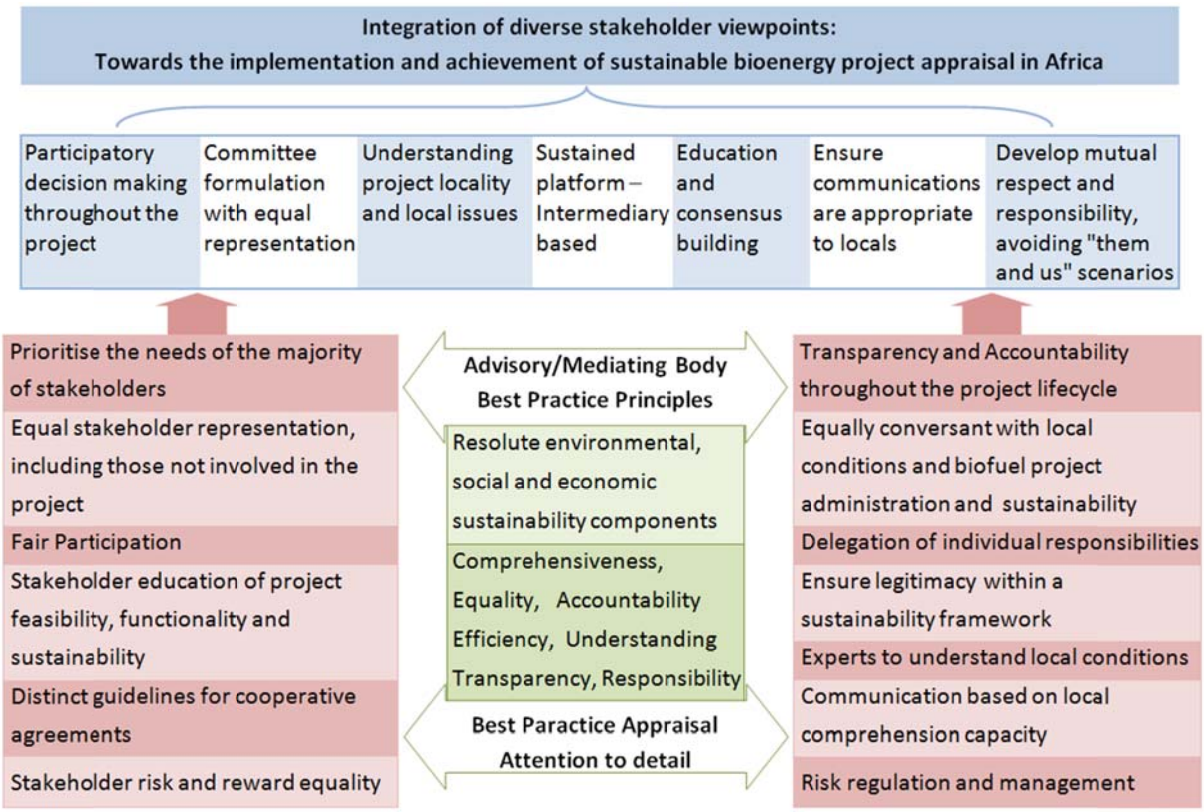
Investment, in countries with weak governance and widespread corruption, by developers with “develop at all costs” motives, will likely result in far reaching environmental and social sustainability insufficiencies. Conversely the research reported in this paper indicates that bioenergy developments exhibiting sustainability principles and transparency, may offer an opportunity to display best practice in African countries which do not often attract investment. According to experts surveyed, strategies should be possible to achieve the sustainability principles of biofuels development in Africa, as well as meeting the demands of investors, experts and local stakeholders. They emphasised credible transparency is more likely achieved through project education, which ensures the identification of individual responsibilities and project accountability.

3.10 Recommendations

Efficient communications assisting transparency, education and representative understanding of project design and administration, together with suitable solutions to equal stakeholder representation, engenders prospects for fair biofuel project participation. Based on Questions 7, 8 and 9 (Table 3.2), recommendations to address the issue of integrating diverse stakeholder viewpoints are presented below (Table 3.3).

The basis of the recommendation is to institute an advisory/mediating body that tends to the important issues of transparency, equal stakeholder representation and adept communications, in addition to assisting the integration of diverse stakeholder interests, without sacrificing efficiency (e.g. unnecessary meetings, work stoppages, conflict and human capital). As the surveyed experts recommended, a holistic and principled advisory/mediating body that pays attention to detail, may assist intertwine and reconcile

Table 3.3 Strategy towards the integration of diverse stakeholder perspectives



ethical project governance with sustainability principles. As interchange is likely to take place at local village level, besides having a good grasp of project aims and administration, the advisory/mediating body should have an informed understanding of local social and environmental sustainability issues as a standard requirement. Although the advisory/mediatory body would need to be financed by investors, for trust and impartiality, funding could be accessed through a holding trust administered by an independent group.

The advisory/mediating body should represent affected stakeholder groups equally, including women, children, the underprivileged and those not directly participating in the project.

Choosing the members and monitoring the work of a mediating panel (on a project specific basis) is not without complications, but applying a political ecology perspective, which also reviews key understandings of development economics, social capital and institutional economics, may improve decisions. It is only by a strategic approach of this kind to biofuel development, that addressing environmental sustainability and the needs of local stakeholders in African nations, as well as other developing countries, can start to begin.

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Chapter 4

Bioenergy project appraisal in sub-Saharan Africa: sustainability barriers and opportunities in Zambia

Abstract

Although there is continuing debate surrounding biofuel feedstock cultivation in sub-Saharan Africa in relation to issues of exploitation, land grabbing, poverty alleviation and energy security, there is a lack of empirical evidence to assess how these debates are playing out in practice on the ground. Drawing on political ecology discourse, this paper examines case studies of biofuel production in Zambia and the effects they have on environmental and social sustainability. During April and May 2011, data were collected on two case study projects involving *Jatropha curcas L.* feedstock cultivation in Zambia. Semi-structured interviews were used to ascertain views from affected stakeholders (local farmers, local environmental, social, and agronomic experts, and investors) on the biofuel projects and their environmental and social impacts. The findings suggest that the uneven distribution of costs and benefits are brought about by imbalances in knowledge, access to resources and the allocation of social and political influence (often associated with broader discourses of development), and this provides a likely rationale for a lack of sustainability in biofuel projects. Drawing on these viewpoints, as well as on field observations, this paper outlines the barriers and opportunities linked to *Jatropha curcas L.* project sustainability.

Keywords: Jatropha; biofuels; Zambia; sub-Saharan Africa; political ecology; scales of power.

4.1 Introduction

The depletion of fossil fuels is a global issue; likewise, the pursuit of national energy security through reducing dependence on certain countries (e.g., those belonging to the Organization of the Petroleum Exporting Countries (OPEC) (da Silva César and Otávio Batalha, 2010), cannot be decoupled from international relations and processes of globalisation. Biofuel crops in the developing world largely target the export market, motivated by the energy consumption needs of other countries (particularly China, the European Union and the United States) and the policy targets they seek to achieve (MISA, 2011; Smeets *et al*., 2008). Over the past five years, biofuel cultivation has seen 40% annual growth, with estimates suggesting that 1-2% of the global land area is now used to cultivate biofuel feedstock (White and Dasgupta, 2010). Indeed, the Agricultural Commodities outlook from OECD/FAO (2011) expects EU biodiesel imports to increase by more than 60% during the period 2011-2020. Much expansion in biofuel cultivation is expected to take place in Africa, raising a number of socio-economic and environmental concerns. These include, for example, fears of land grabbing linked to assertions of neo-colonialism (Borras *et al*., 2010; von Braun and Meizen-Dick, 2009), fears of food insecurity — particularly if biofuel feedstock replaces food crops (Boddiger, 2007; Diaz-Chavez, 2010; Fischer *et al*., 2009); and concerns about land degradation (Cotula, 2010; Vermeulen and Cotula, 2010).

Kant and Wu (2011) relate that to meet transportation energy needs, ambitious biofuel planting programmes in India (in 2003) and China (in 2006) encouraged millions of small-scale farmers to plant *Jatropha curcas L*. They report discontinuance by 85% of the *Jatropha* farmers by 2011. When due diligence processes are ignored, even projects adopted in good faith can be in danger of becoming obsolete (Kant and Wu, 2011). In the case of Tanzania, receiving advice to suspend biofuel development pending a suitable legal scheme to govern lending decisions (Kitundu, 2011), the Government formed the National Biofuels Task Force (NBTF) to navigate a process for development of biofuel project guidelines to help regulate the haphazard nature of biofuel production in Tanzania and formulate national policy (Kitundu, 2011).

Although many government guidelines like those in the Tanzanian case are available, alongside biofuels sustainability assessment procedures and frameworks that stipulate key principles, criteria and indicators for biofuel sustainable production (Table 4.1), the lack of implementation of these schemes is often considered the limiting factor to sustainable production (Harrison *et al.*, 2009; Janssen and Rutz, 2011; Vermeulen and Cotula, 2010). Furthermore, the environmental, social and economic dimensions of sustainability are also covered by the various schemes to different extents.

Table 4.1 Biofuel assessment schemes (initiatives)

Regulatory Schemes
EU Renewable Energy Directive (RED)
Renewable Transport Fuel Obligation (RTFO) – UK
Social Fuel Seal – Brazil
NTA 8080 – Sustainably Produced Biomass – Netherlands
Voluntary Schemes
Basel Criteria for Responsible Soy Production
Council on Sustainable Biomass Production (CSBP)
Better Sugarcane Initiative (BSI)
Global Bioenergy Partnership (GBEP)
Green Gold Label 2: Agriculture Source Criteria (GGLS2)
International Sustainability & Carbon Certification (ISCC)
Roundtable on Sustainable Biofuels (RSB)
Roundtable on Responsible Soy (RTRS)
Roundtable on Sustainable Palm Oil (RSPO)
SEKAB Verified Sustainable Ethanol Initiative
Scorecards
IDB Biofuels Sustainability Scorecard
WB/WWF Biofuels Environmental Sustainability Scorecard
Analytical S
Bioenergy Environmental Impact Assessment (BIAS) – Analytical Framework

Source: BEFSCI (2011) and GBEP Task Force on Sustainability (2011a)

This paper assesses the barriers and opportunities in relation to sustainable biofuel production in Zambia, using case study research (Chaiklin, 2000; Yin, 2009) through the lens of a political ecology approach (Bryant and Bailey, 1997; Peet and Watts, 1996; Robbins, 2004), in an attempt to better inform debate with empirical evidence. Identifying with the normative understanding in political ecology in that “there is likely a less exploitive, less coercive, and more sustainable way of doing things” (Robbins, 2004:12), this paper examines contrasting extents of power and participation at different levels, and explores how this affects the sustainability of biofuels development with regard to food security, energy accessibility, and local community confidence. The research presented in this paper accordingly examines power imbalances and how the ensuing ineffective implementation of biofuel projects linked to these imbalances can affect environmental and social sustainability within site-specific cases in Zambia. The study unpacks the reasons for biofuel project implementation disappointments and the impact on local populations. In addition, opportunities are examined for rural energy production to assist local livelihoods and reduce the impacts that natural timber harvesting has on deforestation.

Participation in projects, led by those pursuing a particular agenda, tends to be passive (Amezaga *et al*., 2010; Stringer *et al*., 2006; 2007). Although challenging, a necessary undertaking is to recognise and balance the power dynamics through facilitation of active participation in biofuels projects, as the extent to which marginalized groups are included in project design and implementation is directly conveyed through anticipated social impacts (Amezaga *et al*., 2010).

The focus of this paper is on sub-Saharan Africa, specifically Zambia. Rising populations, poor governance, low levels of development, land degradation and desertification (which have long been associated with food insecurity; Stringer, 2009) mean societies in sub-Saharan Africa remain the most vulnerable on the planet (Gisladottir and Stocking, 2005). According to IFAD (2011), the highest incidence of rural poverty in the world occurs in sub-Saharan Africa: in 2008, 433 million or 87.2% of the total sub-Saharan rural population lived on less than US$2 a day and 306 million or 61.6% survived on US$1.25 a day (Nwanze, 2010). Even if agricultural yields are dramatically improved, small-scale farmers cannot hope to elevate themselves out of poverty with low value food crops (Sitko *et al*., 2011). Cultivating biofuels such as *Jatropha* may provide a mechanism to build adaptation options to climate change for the economically poor, and provide options for sustainable energy development especially for countries that rely on the export of their scarce natural resources, for example, most African countries (Ejigu, 2008; Amigun *et al*., 2011).

One such biofuel crop that is receiving increasing attention globally is *Jatropha curcas L. Jatropha* is a bush that grows up to six metres tall, with oil bearing qualities. It is a deciduous woody plant belonging to Euphorbiaceae family, and has a life span of about 50 years (de Jong, 2010). *Jatropha* grows naturally in many semi-arid environments, and is acclaimed for its ability to be produced under marginal conditions (i.e., arid soils and poor rainfall), high oil content, non-browsable qualities and little need for agronomic management (Kant and Wu, 2011). Brittaine and Lutaladio (2010), da Schio (2010) and Renner and Winckler (2007) suggest that *Jatropha* has poverty reduction qualities, can be used to regenerate degraded land, and can be produced under marginal growing conditions; these contrast with the views of Ariza-Montobbio *et al*. (2010), Gaia-Movement Trust Living Earth Green World Action (2007), and Spöttle and Vissers (2010), who argue that *Jatropha* is not easily produced in less than ideal conditions. Nonetheless, they also argue that it is unlikely *Jatropha*, if grown as a conventional field crop, can be produced viably (Dyer *et al*., 2012).

Lack of access to affordable energy is often cited as one reason for poverty and a barrier to development in many sub-Saharan Africa, and biofuels have been posited as a way to address this challenge (Davidson, 2011; Wang, 2011). The marginalisation of communities (Dauvergne and Neville, 2010), their inability to access alternative means of affordable domestic energy supply rather than wood (Hunt *et al*., 2010), in addition to poor governance, all contribute to deforestation in sub-Saharan Africa. Uneven power distribution within the governance system is largely responsible for deforestation (linked to domestic energy use in sub-Saharan Africa), through the marginalisation of communities (exclusion by the state; Dauvergne and Neville, 2010), and their inability to access alternative means of affordable energy (Hunt *et al*., 2010). The relations between different actors, their varying positions of power, and the role of external investors and governments need to be considered when analysing project risk and benefits (White and Dasgupta, 2010). The authors acknowledge that different groups of people relate to the value of ecology and resources differently under varying circumstances (cf. Franklin and Downing, 2003).

This paper first explores the power relations surrounding biofuels in Africa, focusing on biofuel cultivation in sub-Saharan Africa and providing background information on Zambia. Next, the research process is discussed, followed by presentation of the research findings in the form of a qualitative narrative of the biofuel case studies. Finally, the extent to which the uneven distribution of costs and benefits are influenced by social and political factors is evaluated alongside the extent to which sustainable *Jatropha* cultivation can effectively offer alternative local biomass energy options to wood, through domestic processing or communal energy generation.

4.2 The political ecology of biofuels

Political ecology seeks to explain how power structures, local committees and local level culture, which all impact on the local environment, are part of broader economic and political structures (Peet and Watts, 1996) that have national and international links (Neumann, 2009). This paper recognises that "political ecology is divided and ambivalent in its attitude towards and engagement with environmental and social policy" (Walker, 2006:382). Rather than analysing only local and proximate causation of environmental degradation and inadequate social welfare, this paper draws upon concepts from political ecology in tracing causes to broader systems by researching at multiple scales through "chains of explanation" (Blaikie and Brookfield, 1987; Yin, 2009). Bryant and Bailey (1997) made three observations within their conceptualisation of political ecology that have relevance to biofuel debates: (1) costs and benefits associated with environmental change are distributed unevenly; this in turn, (2) reinforces or reduces existing social and economic inequalities; and subsequently, (3) holds political implications resulting in further altered power relationships. Drawing on these observations, this research aims to inform the development of more socially aware biofuel policies and investments at the local level, in the context of community societal regulations, the natural ecology, political environment, and economic demands (Peet and Watts, 1996).

Debating environmental conflicts, local communities often express disparate economic discourses. However, the dominant discourse is that of the privileged elites in power, and alternative forms of values tend to be suppressed (Martinez-Alier, 2009).This trend plays out in the biofuels context too. Sustainability schemes (including those in Table 4.1) are often developed by those with an interest in pursuing biofuel cultivation, without necessarily involving those with different values and whose livelihoods are affected by shifts in land use (Dauvergne and Neville, 2010; Stringer *et al*., 2008).

The demands that biofuel development places on natural resources and societies, including the impacts of land-use change and climate change, have global dimensions (Smeets *et al*., 2008). Several discussions in the literature underscore that the global North benefits from the use of biofuels while the global South experiences social, political, and environmental disorder caused by biofuel production (e.g., Lima and Gupta, 2009). Moyo (2009) presents a contrasting view that biofuels represent a development opportunity. She suggests biofuels could help Africa enter the international scene, by more efficiently utilising their natural resources and adding value to the usual practice of exporting resources in their raw form, thus creating job opportunities through enterprise in producing end-user commodities. These contrasting views highlight the importance of case-study based research that provides empirical data to investigate the diverse perspectives.

Unequal representation, a lack of participation and unequal cost and benefit distributions for local actors in previous agro-developments have affected sub-Saharan African governments' and local citizens' confidence with foreign investment (Doussou-Bodjrenou *et al*., 2010; Fischer *et al*., 2009). The same challenges are seen in biofuel cultivation. In cases where smallholders are engaged in feedstock production in emerging biofuel industries, no real benefits have materialised according to German *et al*. (2010). In addition, corruption and a lack of implementation of biofuels sustainability frameworks have frustrated progress towards sustainable development (Janssen and Rutz, 2011). As German *et al*. (2010) disclose, in countries such as Zambia and Ghana, where customary rights are recognised by law and chiefs may decline or concede land leases or transfer permanent land ownership, irregularities are common. In practice, chiefs lack political know-how and skills to negotiate favourable terms when swayed by promises of "development" and although powerful relative to the people in their chiefdom, chiefs remain weak players in the biofuel chain of explanation.

4.2.1 Biofuels in Zambia

Zambia, located in southern Africa, is among the planet's 31 landlocked developing countries, of which 15 are found in Africa (UN-OHRLLS, 2011).This landlocked status raises the importance for Zambia of access to locally produced energy. The expense and complexities of negotiating commodity imports and exports through neighbouring countries increases both fuel insecurity and the volatility of oil prices. Zambia is among the world's 48 least developed countries (LDCs) (Stringer *et al*., 2012a), of which 33 are from Africa. Zambia has a rural population around 65% and approximately 64% living below the poverty line (US$2/day). These statistics largely characterise many countries in sub-Saharan Africa, particularly in central southern Africa. Although every country has a unique set of conditions, the 'snapshot' data collected in this research can nevertheless assess the current conditions and whether they seek to create an enabling environment for sustainability to be pursued.

Zambia has 25,889,921 ha of agricultural land, of which 5,305,929 ha (20.5%) is suitable for cultivation (Central Intelligence Agency, 2011). These figures bear out the large amounts of available and suitable land for agriculture in Zambia. Although 85% of the country's labour force works in the agricultural sector, only 21.5% of GDP comes from agricultural produce. The main food crops produced are maize (corn), sorghum, groundnuts, sunflowers and vegetables. Zambia, like other countries in southern Africa, faces serious environmental challenges, including deforestation, soil erosion and desertification (Diaz- Chavez, 2010; Sinkala, 2011; Stringer *et al*., 2012b).

The energy policy introduced by the Zambian Government in 2007 contained a number of measures linked to biofuels. These are shown in Table 4.2. In addition, the inclusion of woodfuel policy measures was brought about by the environmental concerns regarding the nearly 300,000 hectares of deforestation occurring every year in order to meet local energy demands in Zambia (UN-REDD, 2011).

Table 4.2 Basis of Zambian bioenergy policies introduced in 2007, including biofuel and woodfuel policies

Policy measures for woodfuel	Improve management of woodlands and forests as sustainable sources for woodfuel
	Improve the technology of charcoal production and utilization
	Promote appropriate alternatives to woodfuel and reduce its consumption
	Promote use of agro and timber residues for combustion and gasification
	Improve revenue collection from the woodfuel industry
Biofuel policy measures	Make biofuels part of the National fuel mix
	Ensure security of supply and stabilization of prices of fuels by promoting the utilization of biofuels for transport as an alternative to petroleum
	To ensure availability of data and information on market demand, resource assessment and applicability of biofuels
	Provide a legal and institutional framework for the biofuels subsector
	Support investment in Biofuels industry through appropriate incentives
Biofuel implementation measures	Biofuel policy objectives have been defined
	Biofuels are defined as 'fuel' under the Energy Regulation Act
	The Ministry of Energy & Water Development is developing a long term Energy Strategy (2009- 2030) that includes biofuels
	Within the national economy, biofuels are to be defined as a priority sub-sector

Source: (Kalumiana 2008)

The national energy policies have been designed, *inter alia*, to promote bioenergy cultivation, for electricity generation, to support alternative fuels for transport as well as alternative fuels to wood fuel, especially in isolated rural areas. The bioenergy strategy aims to, *inter alia*, provide economic incentives for accelerated biofuel development; enhance the role of biofuels in national energy security; increase the percentage of biofuels in the national energy mix; attract funding for investment; and enable participation of vulnerable groups into the biofuel industry (Sinkala, 2007).

Following the 2007 energy policy, in April 2011, the Zambian Government issued a policy on liquid fuel ratios of up to 5% biodiesel and 10% bioethanol to be blended by 2015 (Ministry of Energy and Water Development, 2011). These targets received attention from local and foreign investors (governments and private) interested in growing and exporting biofuel feedstock cultivated in Zambia; they were seeking to meet the demand that arose from legislation on local blending ratios, and biofuel targets set by the US and EU (Afionis and Stringer, 2012; Doussou-Bodjrenou *et al*., 2010). Kalumiana (2008:3) states that the Zambian Government should "ensure environmentally sustainable exploitation of biomass resources by ensuring efficiency through better management and introduction of new sources such as biofuels".

Kalumiana (2008 p.3) also points out the issues of social and environmental significance in relation to the biofuels industry in Zambia. In the recent past, poor implementation of biofuel projects has caused many investors to close down operations (Doussou-Bodjrenou *et al*. 2010; Sisay 2010; Wilkes and Blake 2011). The limited employment opportunities in Zambia force many people who lose jobs when biofuel projects closedown to enter the charcoal industry (relying on the deforestation of natural timbers), an industry upon which rural populations and marginalized city dwellers rely (von Maltitz and Stafford, 2011; World Bank, 2009).

4.3 Methods

In an effort to standardise the methods employed for the analysis of case studies in this research, 17 international biofuel certification and assessment schemes (voluntary and regulatory) were evaluated (these are listed in Table 4.1); five (shown below) were selected on the basis of their attention to detail and comprehensiveness in addressing environmental, economic and social criteria:

1. RSB Principles & Criteria for Sustainable Biofuel Production (Voluntary) (Round Table on Sustainable Biofuels, 2011)
2. Global Bioenergy Partnership (GBEP) (Voluntary) (GBEP Task Force on Sustainability, 2011b)
3. NTA 8080 – Sustainably Produced Biomass – (Regulatory) (NEN energy Resources 2013)
4. IDB Biofuels Sustainability Scorecard (Scorecards), Version Two, Based on the Round Table on Sustainable Biofuel Production, (Inter-American Development Bank, 2011)
5. Bioenergy Environmental Impact Analysis (BIAS): Analytical Framework (Food and Agricultural Organisation (FAO) 2010)

The criteria and indicators in these five sustainability assessment schemes were adopted for the purpose of this research. From the five chosen schemes, common themes and best practice principles were identified, integrated and adapted, to frame the criteria and indicators used to assess sustainability. Data collected from interviews with local farmers (see appendix B), local industry experts (see appendix G) and field observations relating to the case studies were analysed and scored against criteria indicators. A study of the literature provided the researchers with an insight into crop species (both food and energy) that may offer preferable options in meeting social, environmental and economic sustainability goals (e.g., maize and sweet sorghum; Diaz-Chavez, 2010).

4.3.1 Case studies

The selection of case study biofuels projects within Zambia were made using the following criteria (adapted from German *et al*., 2011): (1) presence of biofuel feedstock cultivation in areas displaying an appreciable amount of poverty; (2) biofuel projects displaying characteristics similar to more widely based biofuel operations through sub-Saharan Africa, (i.e. outgrower schemes and marketable feedstock cultivation); (3) biofuel feedstock grown in isolated locations with a high dependability on woodfuel (linked to high deforestation rates in surrounding areas). Applying these criteria resulted in the identification of two

Jatropha projects that remain operational and may significantly affect biofuel production in Zambia.

Table 4.3 General aspects of the researched case studies in Zambia[2]

	D1 Oils	Southern Biopower
Position	14° 25.0 South; 31° 28.3 East	16°52.3 South; 26°49.7 East
Type of schemes (Processing type)	Out-grower (Central)	Commercial and Out-grower (Central)
Distance to processing	100 – 400 km	450 km
Accessibility	Poor – distances, roads in disrepair	Poor – distances, roads in disrepair
Purpose of the development	Social and Economic	Economic
Present scale of operation	Small – hedges, research site, fields	Small – hedges, poor field cultivation
Expansion potential	Medium – viability issue	Small – viability issue
	D1 Oils operates as an alternative energy crop company based in London, United Kingdom. The public company engages in low-cost, sustainable, fuel-crops, and operates in Europe, Asia Pacific, Africa and India. D1 Oils has signed contracts for the cultivation of Jatropha with small-scale outgrowers for biofuel feedstock in many areas in Zambia. Matongo (2007) reported that Jatropha under cultivation undertaken by D1 Oils by 2007 was 70, 900 hectares within the following regions: Shikatebta chiefdom Chongwe; Kasama, Northern Province; and Solwezi, North Western Province. However, as of May 2011 this has dropped to a mere one hundred farmers, who cultivate an area from a hectare down to a few lines of Jatropha.	Southern BioPower Ltd. was founded as a Zambian company in early 2005 by development-oriented and environment-conscious German and international investors, together with local partners, originally under the name Handford Investment Ltd. The Company re-focussed its core business interest in 2006 on the production of renewable energies, and in particular biodiesel out of Jatropha oil, mainly for the local fuel market in Southern Province. It has its central operation within the coordinates near Choma where it operates a commercial farm. The majority of Jatropha seed used for biodiesel production is collected from outgrowers in the Southern, Northern and Eastern Provinces.

Source: Authors' elaboration

[2] As of April 2013 the case study, D1 Oils has closed operations in Zambia. Southern Biopower has diversified operations into waste biogas systems in Livingstone, Zambia in partnership with Livingfalls BioPower Ltd (2013).

The case study locations marked A and B (Figure 4.1), include areas where interviews with local villagers were conducted. General aspects and background information on the case study projects are presented in Table 4.3.

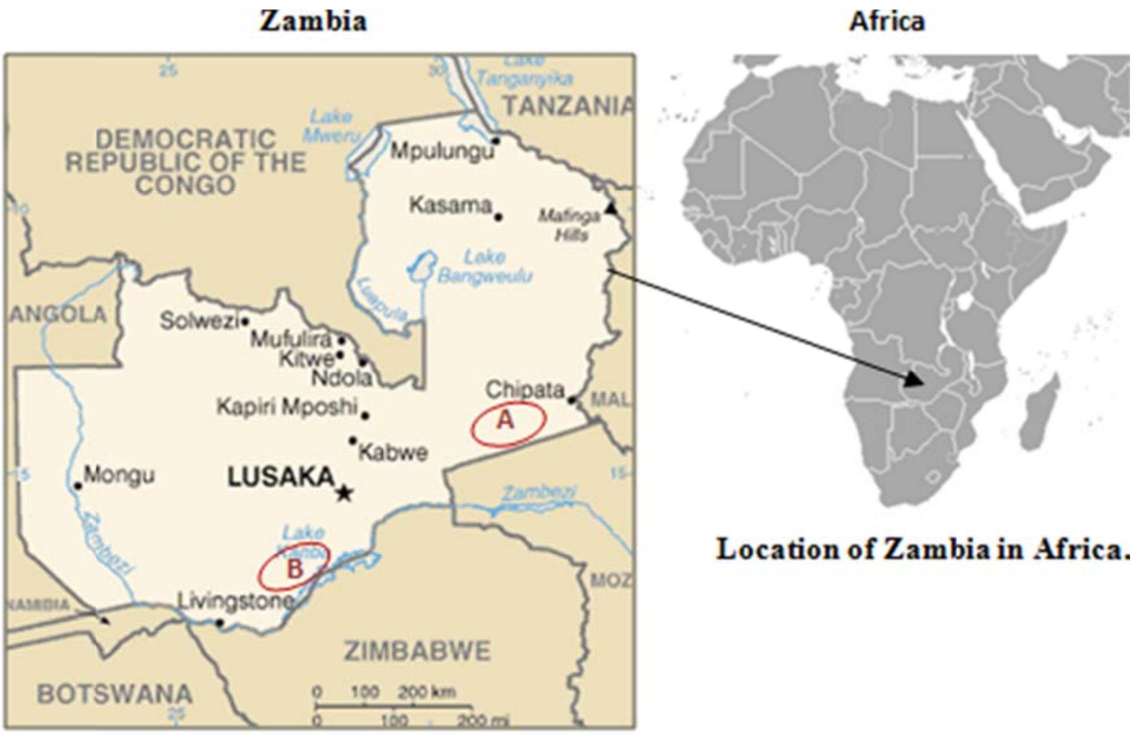

Figure 4.1 Localities of bioenergy cases: A-D1 Oils; Eastern Zambia, B-Southern Biopower; Southern Zambia

Source: Central Intelligence Agency (2011).

4.3.2 Interviews

As most rural roads in Zambia are in disrepair and can be impassable during the rainy season (November to March), data collection was conducted during April and May 2011. In addition, crop formation could be observed in April and early May, as the majority of crops were mature but not harvested. Interviews were conducted with biofuel consultants, agronomic experts, social researchers, and farmers and project administrators affected by, or involved in, the two selected case studies. A snowball sampling method (Biernacki and Waldorf, 1981) was adopted for selecting interviewees. Initially, semi-structured interviews were conducted with the chairperson and committee members of the Zambian Biofuel Association. Newly acquired contacts from these interviews were then approached to participate in interviews in relation to the selected case study projects.

Eleven people, including, local experts, consultants, and project administrators were interviewed before the main data collection period advanced to undertake semi-structured interviewees with local farmers. A snowball sampling approach led to interviews taking place with administrators and agronomists of companies who had attempted to produce biofuel feedstock since 2006 but who had since discontinued operations.

4.3.3 Local interviews

A few names of local farmers growing *Jatropha* were collected from the 11 biofuel consultants, agronomic experts, social researchers, and farmers and project administrators involved in interviews during the first stage of the research. These initial farmers were invited to participate in the interview process. The introduction of the snowball sampling method then led to further local interviewees. Following this process, participants from 42 villages in the case study locations were interviewed. Village leaders provided directions to farmers cultivating *Jatropha*, resulting in 14 *Jatropha* growers in Eastern province and 10 in Southern province being interviewed. Interviews aimed to gain a broad but candid perspective of local landholders in areas that had been affected, or may be affected, by future biofuel agro-investments. Although on 18 occasions interviews were conducted in villages without evident *Jatropha* cultivation at the time of the interview, many of the interviewees had previously grown *Jatropha*. Inclusion of those people provided the viewpoints of farmers who had been affected by poor implementation strategies (agronomic or administrative) and who had experienced the effects of uneven power relationships between stakeholders at different levels. On all occasions, regardless of whether *Jatropha* cultivation was present or not, interview themes were directed towards local social and environmental integrity, including topics such as deforestation, energy concerns, land use and cropping (see appendix B).

Sustainability relating to investment projects was addressed in depth, with particular attention paid to: (1) project developmental concerns — participation, understanding, marketing, communications; (2) access to energy—type of energy used, distances to collect woodfuel, time to collect; (3) extent of deforestation; (4) security of land tenure and who is it controlled by; (5) preferred system for decision-making, type of representation, structure of meetings and discussions; (6) if investment is favoured, the preferred project type and structure; (7) land use and land availability; and (8) food security and crop yields.

Of the total 42 village interviews held with household heads, 17 (41%) were with women. The questions were formatted in such a way as to be understood by local citizens in order to avoid misunderstandings owing to contrasting levels of education and knowledge. This also assisted in lessening misinterpretations on the few occasions a translator was enlisted. Interviewees elaborated on their replies if they so wished and comments relevant to the study were noted in detail to enrich the data.

4.4 Results

This section analyses the outcomes of research at different economic, political and knowledge scales of power by following "chains of explanation" (Blaikie and Brookfield, 1987;Yin, 2009) in order to identify a more sustainable way of implementing biofuel projects in sub-Saharan African countries.

Along with criteria and indicators, societal, environmental and economic sustainability evaluations for the two case studies are respectively displayed in Tables 4.4, 4.5 and 4.6. Results were derived through interviews with local villagers and case study project representatives. The scoring definitions (1 to 4) applied to the four-point scale for evaluating the sustainability criteria in Tables 4.4, 4.5 and 4.6 are:

1. *Very good* — Comprehensive risk assessment; efficient risk avoidance and response strategies; comprehensive research, implementation and monitoring of best sustainability practices.
2. *Good* — Assessment of risks; risk avoidance and response strategies; research, implementation and monitoring of best sustainability practices.
3. *Fair* — Signs of assessment of risks; signs of risk avoidance and response strategies; signs of research, implementation and monitoring of sustainability practices.
4. *Poor* — No best sustainability practices assessment of risks; no risk avoidance and response strategies; no research or implementation and monitoring of sustainability practices.

Table 4.4 Sustainability society criteria and evaluation scores, and evaluation indicators

Society Sustainability Criteria			Society Evaluation Indicators
Criteria	**D1 Oils**	**SOUBIO**	
Number of local jobs	4 –Extension and research	4 –central processing	Local employment opportunities. Security of employment. Full or part time
Skilled local jobs	4	4	Skilled (above baseline wages requiring developed skills or responsibilities) jobs for local people
Local enterprise advancement	Soap making, processing, distribution	Biodiesel and biogas production	Manufacturing, services (transport, food, machinery, repairs, processing, entertainment)
Training	3 - Agronomic	4	Ongoing improvement of skills and employer promotion from within the company
Education advancement (Schools)	4	4	Adequacy of schools for local children (are schools efficient, are educators trained, education expansion planned, accessibility of school to communities)
Health advancement	4	4	Adequacy of hospitals and medical assistance (Accessibility, expertise and improved facilities)
Transparency	2	3	Understanding of local people versus the aims of developers (also evaluated by field observations)
Equal representation	3	4	Manner in which representatives were chosen. Comprehensiveness of stakeholders representation
Participatory decision making	3	4	Manner and timeliness of meetings. Ability of representatives to influence decision making. Importance given to local environmental and social issues. Active participation.
Accountability	2	3	System of individual responsibility for achievement (and accountability for lack of achievement)
Food security	2	2	Adequacy of land for both food and cash crops. Labour to sufficiently look after food crops in addition to cash crops. Impact on food crops with limited inputs. Timeliness of income generation (ability to purchase food in months of food scarcity). Weather resilience.
Access to energy	3	3	Accessibility to energy (lights and cooking). Cost of energy. Time savings in accessing energy
Equal risk and reward	2– Inputs and extension	3	Equal profit in cultivation and processing, equal environmental and economic influence. As the project progresses are benefits mutual amongst actors
Ability to diversify - species and marketing	4	4	Local actors' abilities to enter into different markets and abilities to decide on crop species
Efficiency	3	3	Timely implementation of agreements and operation
Migration	2	2	Impact of worker migration towards the project. In cases of dispossession, migration of land holders
Obsolescence	4	4	Viability – local situation should default occur

Source: Authors' elaboration.

Table 4.4 shows societal criteria and indicators and the evaluated scores of societal values in relation to effects from biofuel production case studies. Table 4.5 indicates scoring factors in relation to environmental impacts from the implementation processes of the two case study companies. Table 4.6 indicates the scores for project viability and implementation processes to enhance economic sustainability within the case study communities.

The results shown in Tables 4.4, 4.5 and 4.6 indicate social and sustainability limitations for both case study projects. Indirect impacts have not been discussed in this paper given that the infancy of the projects means that the full effects are still to be realised.

Table 4.5 Environmental sustainability criteria and evaluation scores and environmental sustainability indicators

Environmental Sustainability Criteria			Environmental Evaluation Indicators
Criteria	**D1 Oils**	**SOUBIO**	
Water impacts	n/a	n/a	Additional water requirements, either for additional people or for irrigation purposes. Effect on the environment. Measures to reduce water use
Land use	2	2	Suitable cultivation practices and species choices to protect erosion
Land availability	2	2	Adequacy of land for cropping (with best practice agronomy, i.e. Poorly cropped land is considered excess land)
Soil status	2	2	The status of soil nutrients and structure vs. potential to improve soil status. Protection of soil. (Rotations, perennial crop, erosion by water, wind, compaction, water logging and soil biodiversity loss) Soil cover
Degradation	1	1	Deforestation (positive impact) Effects on sensitive ecologies
Chemical and fertiliser use. Waste use	3	2	Quantity of chemical and synthetic fertilisers used, opportunity for alternate options (use waste as fertiliser). Biomass use

Source: Authors' elaboration.

Senior administrators of D1 Oils in Zambia (interview on 13 May 2011) revealed that having invested approximately US$60 million for developing 20,000 to 25,000 hectares of *Jatropha* since 2006 in Zambia, D1 Oils carried out an assessment of production in 2009. The analysis showed that almost all *Jatropha* either had perished or would unlikely amount to a harvestable crop. In 2009, D1 Oils fundamentally changed their Zambian programme with a considerably reduced scale and increased attention to detail. They established four demonstration farms in the Eastern districts, set up extension workers, and involved women as buyers. These developments may enable local populations (both men and women) to small-scale farmers' land and management situations, D1 Oils assessed farmers' capabilities and potential for involvement in *Jatropha* cultivation (senior administrators of D1 Oils, interview on 13 May 2011). Only farmers who had the management capabilities and land empower themselves, through education and knowledge, to improve energy self-sufficiency, enhance lifestyles and expand job opportunities. Through discussions and observations of capacity to adequately produce both food and energy crops were invited to cultivate small "manageable" areas of *Jatropha* (i.e., 10% to 25% of their cropping area).

Table 4.6 Sustainability economic criteria and evaluation scores, and economic sustainability indicators

Economic Sustainability Criteria			Economic Evaluation Indicators
Criteria	**D1 Oils**	**SOUBIO**	
Viability	4	4	Profitability of business model for the investors but more importantly the local people, allowing for the generation of local enterprise. Water quantity and input and marketing factors that may affect viability
Logistics	4	4	Road reparability. Distance and accessibility of transporting feedstock to processing facilities
Management	2	3	Proficiency to exercise best practice appropriate to feedstock species, soil status and climate conditions
Introduction of best agronomic practices	2	4	Introduced best practice principles. Research to improve local practice. Commitment to extension services
Appropriate species	3	3	Best production options for the site; suitability. Integration effectiveness into local cultural systems. Suitable for local capabilities. Resilience to variable weather trends
Local access to finance	3	4	Availability of loans to local people. Assistance with inputs, harvesting and transport.
Price determination	4	4	Ability to negotiate prices or pricing structure transparency. Monopsony (Limited to a single buyer)
Asset compensation	n/a	n/a	Transparent land and asset compensation. Person, better or equally, able to provide food security. Arbitration process
Additionalities	3	3	Enhanced value of biofuels operation over standard production normally in place (baseline production)

Source: Authors' elaboration.

D1 Oils provided *Jatropha* seedlings and inputs and followed up with agronomic advice. This contrasts with some previous exploitative and costly biofuel developments in Africa, which have resulted in many thousands of local farmers being dissatisfied (senior agronomist for Oval, interview in Lusaka on 13 May 2011; see also Stringer *et al.*, 2012b). In these cases, developers without explanation or warning abandoned these local farmers, who had expended labour for two years without compensation. Two examples of such exploitive behaviour are the German-based Flora EcoPower biofuel company's controversial biofuels project in Fedise, Ethiopia, which was abandoned and left many disgruntled employees without remuneration (Sisay, 2010); and the case of BioShape, Netherlands, which paid villagers in the Kilwa district, Tanzania, unfair prices of US$5.8-US$6.67 per hectare for land and trees (Ndosi *et al*., 2008) whereas the going rate was nearly US$1,500 per hectare in 2011 (Wilkes and Blake 2011).

Interviews also revealed the financial viability of the two case study companies, Southern Biopower and D1 Oils, is threatened by the lack of reliable feedstock supplies, logistics, yields, research, implementation and knowledge of local conditions. This is a similar fate that has befallen many biofuel operations in sub-Saharan Africa, for example, Marli Investments, Zambia (Doussou-Bodjrenou *et al*., 2010), Flora EcoPower biofuel, Ethiopia (Sisay, 2010), BioShape, Tanzania (Ndosi *et al*., 2008) and Oval in Zambia (senior agronomist for Oval, interview in Lusaka on 13 May 2011). These closures have considerably affected local people's confidence in outside investors, particularly in cases where food crop cultivation made way for cash crops. International investment brings with it, to the local level, risks that accompany broader-scale global economic systems.

A senior administrator of D1 Oils in Zambia (interview on 3 May 2011) explained that D1 Oils was attempting to improve current plantations and not repeat the pitfalls experienced by many *Jatropha* plantations that are now unproductive in Zambia, such as incorrect planting methods, poor climate and soil choices and poor research and extension services. This contrasts with Southern Biopower's strategy of waiting for previously established crops to reach maturity for their feedstock supplies. At an interview on 12 May 2011, a Southern Biopower representative stated: "We advertise a great deal to let [feedstock outgrowers] know we are in the market to purchase seed but we don't go there, we don't have to tell them how to plant; they know".

Many local outgrowers mentioned that cultivating *Jatropha* as a perennial crop was attractive because it provided much needed income prior to the harvesting of food crops. *Jatropha* is usually harvested in January and February every year and the harvesting of food crops usually begins in April. Typical out-grower interviewee comments were:

It is helpful to acquire cash for household supplies before the new harvest, especially in years we experience drought (Nyapanda Settlement Scheme, interview on 2 May 2011).

If we misjudge our food needs, and run short prior to the next harvest, the cash from *Jatropha* will allow us to buy food and house supplies. (Mumbi village, Eastern Zambia, Interview on 1st May 2011).

We have to find jobs to feed our family, for soap and health problems in the months before harvesting our crops; but jobs are hard to find. In the future, *Jatropha* may help us with money when food is short (Katete, Eastern Zambia, 30th April 2011).

4.4.1 Local farmer interviews and observation analysis

Local farmers mentioned that *Jatropha* cultivation largely did not interfere with labour for food crops, except for those who cultivated beans. Sickness (primarily HIV/AIDS, malaria and diarrhoea) during the growing season renders people unable to tend their crops, but with perennial crops such as *Jatropha*, an income (although diminished) can be derived. This is illustrated by a farmer from Kanyande village, Eastern Zambia:

My maize crops have grown poorly. I have had malaria this summer and was unable to weed my crops or complete maize plantings, but even though I was not able to apply fertilisers and chemicals, the *Jatropha* will still produce seeds (Kanyande village, 10 May 2011).

Prices paid for *Jatropha* seed appear to be an issue for local people and may prevent further expansion of its cultivation. Biopower offers a fixed price of 8% of the diesel price in Zambia. This works out as approximately US$0.12 per kg of seed, which is divided between the farmer (US$0.10) and the buying agent (US$0.02). At these prices, the potential return per hectare is approximately US$500 from a good yielding crop (5tonnes of seed per hectare) of *Jatropha*. However, these yields have yet to be achieved on a commercial scale, with better *Jatropha* crops only achieving 3t/ha. These returns are well below the potential of more established crops. For example, in Zambia, a good yielding crop of maize by small-scale growers (at 4t/ha) achieves approximately US$1,000 per hectare (FEWS NET, 2011) and a good yielding cotton crop (2t/ha), returns US$1,280 per hectare (*Times of Zambia*, 2011). In addition, other crops (i.e., beans) that can offer more than one harvest per year under certain growing conditions are likely to provide more viable land use options.

Nevertheless, comparisons with other cropping options need to be carried out in sitespecific settings owing to the variability of water and energy requirements. Due to the lack of knowledge, local growers are persuaded to carry investment risks by cultivating a crop of unknown qualities, and often without the knowledge of how to cultivate the crop. In return, they receive low economic benefits that are unlikely to significantly enhance local livelihoods.

Southern Biopower explained their pricing structure: “we cannot afford to pay more otherwise it will not be viable because of our costs”, namely, long distances (over 400 km) to collect seed, poor roads, and the vast dispersion of farmers makes it difficult to collect seed. In addition, *Jatropha* does not produce seed for three to four years, and unless inter-row cropped, no income is realised off plots under cultivation.

> I have planted groundnuts between the *Jatropha* because we receive no money for three or four years. It is also good for weed control. I am hoping *Jatropha* will give me money in future to educate my children (Nyatuwono Village, Eastern Zambia, 11 May 2011).

4.4.2 Jatropha cultivation: Opportunities and impediments

Almost all interviewees, except those living on the outskirts of towns, confirmed the researchers’ observations that land availability in Zambia was not an issue. This was also confirmed by the chairperson of Zambia Biofuel Association (interview 12 May 2011), who informed that Zambia has one of the highest land per capita ratios in the world (ranked 19th with 0.45 ha per capita). With a low percentage of the available arable land currently utilised, a high percentage of soils suitable for diverse cropping, and a favourable growing climate, it bodes well for Zambia to meet its food and energy production needs.

D1 Oils (interview 4 May 2011) (see appendix G), the chairperson of Zambia Biofuel Association (interview 12 May 2011) (see appendix G), and Southern Biopower (interview 12 May 2011) (see appendix G), spoke of the importance of choosing the right model for *Jatropha* cultivation for the viability of projects (e.g., agro-industry, small-scale or hedgerow planting). They suggested that not enough research and knowledge is available for a reliable production handbook to enable *Jatropha* to be grown with commercial success. The chairperson of Zambia Biofuel Association (interview 12 May 2011) suggested: “Species such as sugar cane, palm oil, maize and sorghum all have ‘cook books’ (handbooks), but *Jatropha* has none”. There are many ideas as to what may be the best methods for *Jatropha* production but one common aspect is that *Jatropha* should be grown in hedges bordering villages, fields, vegetable gardens and kraals (fenced enclosures where livestock is kept at night). In this manner, land does not compete with food production (Dyer *et al*., 2012). Although, hedgerow cropping may be more economically viable, it is unlikely that enough *Jatropha* seed can be produced to assist communities to generate their own electricity from this source. The lack of technical knowledge impacts on project efficiency, which affects investment viability and the delicately balanced livelihoods of farmers.

As *Jatropha* plants are poisonous and inedible to livestock, and grow thickly, they can be grown as hedges to keep livestock away from crops. This may help to reduce deforestation as traditional timber fences need to be replaced every 4 to 5 years due to termite damage. In addition to *Jatropha* hedges being fertilised through cattle manure, topsoil or biomass being washed into root-zones, *Jatropha* assists with erosion control as well as providing additional seasonal income. To expand biofuel feedstock supplies and to spread knowledge of biofuel cultivation, D1 Oils intends to introduce *Jatropha* hedge cultivation to schools, whereby students learn current best practices, and transfer the concept to their respective villages.

Of the twenty-four *Jatropha* small-scale crops observed during the research visit in 2011 in the Eastern and Southern provinces, twelve (50%) had almost no signs of growth, owing to either one or a combination of poor agronomic techniques, poor soil choices and neglect. Six (25%) crops had signs of weak growth but required much attention before realising any harvestable feedstock; four (17%) should produce a small amount of feedstock but only if agronomic practices are improved and two (8%) had responded well to good practices, with good leaf coverage and signs of seeding.

To provide an overall view of *Jatropha* cultivation, yields from traditional crops and the rates of deforestation were examined on the land of the interviewed farmers. The mean yield of the staple crop, maize (the most significant crop grown in Zambia), of farmers observed in this research was 2.05 tonnes per hectare. Approximately only 20% (Eastern province 26% and Southern province 14%) of the natural vegetation remained on the 42 interviewees’ farms. It was also determined from interviews that an average of 27 minutes was spent every day collecting woodfuel for domestic energy purposes. With depleting energy resources on farms, locals are likely to be forced to progressively fell natural timbers from farther afield to meet their energy needs. Improving maize yields from the low 2.05 tonnes per hectare and providing a portion of land for growing energy crops to meet demand will greatly assist in slowing the rate of local deforestation.

4.4.3 Biofuel project implementation: Power relationships

Although companies' (e.g., Marli, Oval and Bedford) mission statements clearly stated the importance of enhancing local communities' livelihoods, there was no evidence of participatory decision-making involving local affected stakeholders. Past administrators of Oval (Oval administrator, interview 15 April 2011; Oval agronomist, interview 13 May 2011) divulged that projects were poorly implemented, and that many farmers had been encouraged (through power imbalances framed by uneven knowledge) to join the *Jatropha* scheme. A former administrator for Oval in an interview asserted on 15 April 2011:

> I knew the company was exploiting the local populations and I made it clear to the directors from Perth in Australia that their lack of interest in the welfare of locals was immoral. All they were interested in was the rapid progress of *Jatropha* cultivation. Realising project implementation procedures were unsustainable, I resigned.

Seven of the local villagers interviewed in the Southern Province mentioned negotiations and deals had taken place with chiefs and governing officials, namely, those actors with more power than average citizens. Through imbalances in political power and knowledge, locals were led to believe that if they joined the *Jatropha* project it was for the interests of the whole community, and if they did not join they would lose out on an excellent opportunity. Locals were largely excluded from participating in the project design and implementation process.

Since 2009, D1 Oils have improved their social governance by forming discussion groups where information on agronomy and suitable production processes are openly debated through two-way dialogue (senior administrator of D1 Oils, interview 7 May 2011; 8 local participants; interviews from 10 to 12 May 2011). This approach allows relationships that are more trustworthy to develop, which may help mitigate the uncertain futures that come with ecological change. In addition, investors and locals sharing knowledge helps to reduce exploitation across different levels and groups, and opens up opportunities to produce *Jatropha* in a manner more conducive to local social and environmental sustainability.

In contrast to the short-term view of failed projects in Zambia, D1 Oils considered food security a priority from the perspective of project sustainability. An emphasis was placed on the rights of communities indirectly impacted by projects, those of weaker groups and the rights of gender. The risks for the local farmers supplying feedstock to D1 Oils are largely labour efforts, limited marketing options, and land utilisation on an unproven crop. Exposure to food production is largely via labour being dispersed from food crop cultivation, impacting on efficient agronomic practices and marketing. D1 Oils invests resources in extension services, supplying seedlings, chemicals and fertiliser, and provides a market. Although the company has attempted to recoup their investment by signing 10 year contracts with growers, the enforcement infrastructure is weak in Zambia. D1 Oils risk crop failure and other buyers' tempting growers to part with their contracted seed by offering immediate cash (a common practice among cotton and tobacco producers in many Africa countries, e.g., Mozambique, Tanzania, Zambia, and Zimbabwe).

In an effort to achieve financial viability, Southern Biopower is unable to assist with inputs and extension services to growers (interview with a Southern Biopower representative 12 May 2011); and owing to company structure (distances and processing costs), prices paid for seed are unlikely to raise the quality of livelihoods. Although the "cash for seed" offered by Southern Biopower is timely in helping locals with much needed cash (prior to harvest), the financial power relations at play do not allow locals a say on the prices they receive for seed, the timings at which transactions occur, or whether processed oils and by-products are utilised locally. In addition, the sustainability efforts of other companies are likely to be undermined if they are unable to secure feedstock from their financial and extension efforts.

4.5 Discussion

This paper has strived to shed light on issues surrounding biofuel project sustainability and biofuel crop failures in Zambia, examining these issues through a political ecology lens. Two *Jatropha* projects were analysed on multiple levels at which different forms of power are manifest. Imbalances were found to result from uneven finances and resources, knowledge, and political power; and the associated, unevenly balanced distribution of social and environmental relationships.

The socio-economic theme that *Jatropha* cultivation is a pro-poor activity — a theme that is often used to legitimize *Jatropha* production (Ariza-Montobbio *et al*., 2010) — is questioned through the political ecology discourse (Martinez-Alier, 2009; Pichler, 2011). Further to the interviews with local farmers and investing companies, physical evidence of *Jatropha* cultivated in fields, research plots, and demonstration farms indicates that in Zambia, *Jatropha* is not the favourable biofuel crop portrayed in much of the literature (Brittaine and Lutaladio, 2010; da Schio, 2010; Renner and Winckler, 2007).

Jatropha grown on marginal soils grew poorly, and often with no signs of harvestable seed. However, many *Jatropha* hedges that were planted correctly (Ariza-Montobbio *et al*., 2010; de Jong, 2010) and had access to nutrients, either accidentally (i.e., wash from kraal manure or top soils from gardens and yards) or applied, showed signs of strong growth. All interviewed stakeholders suggested *Jatropha* grown in hedgerows is the only approach that may sustainably benefit local livelihoods — and moderate deforestation — until research and field trials demonstrate environmental and economic feasibility. Although *Jatropha* hedgerow planting is highly unlikely to assist foreign countries to improve their fuel security, this approach may benefit all social groups without inhibiting food production, especially groups with low adaptive capacities and those who are unable to afford inputs or alternative energy sources. Local populations can also benefit with alternative marketing options through soap production or local processing, especially in cases where biofuel investment companies fail and leave a market vacuum.

Although neither case study project had introduced a platform for active participation by groups with different relative decision-making powers (Amezaga *et al*., 2010), interviewees revealed attempts to improve upon the sustainability oversights (of past failed projects) (also referred to by Diaz-Chavez, 2010; Doussou-Bodjrenou *et al*., 2010); German *et al*., 2010; Ndosi *et al*., 2008). However, no matter how much is invested in social sustainability efforts at the local level while a project is operational, global scale processes linked to the prevailing political and economic climate can override everything. Just as farmers are exposed to risks (e.g., crop or market failure), unpredictable global economic processes expose investors in biofuel projects to risks as well. Uncertainties linked to the most appropriate cultivation model and the role of external investment and links to international power processes should be factored into social sustainability assessments.

Using and attempting to advance political ecology via case study research, this paper identifies that bioenergy projects that display unsustainable social and environmental behaviour (Ndosi *et al*., 2008; Robbins, 2004), or that perform cursory planning or lacklustre implementation procedures, can result in social disharmony and reinforce existing power relations, which together are likely to result in financial losses and project failure. In response to the concerns expressed by local interviewees regarding exploitive performance, in which a more powerful group exploited a less powerful group, D1 Oils reassessed their strategy by openly communicating with and involving local stakeholders in decisions that affected communities and the project's feasibility. Fundamental issues, including gender rights, and the rights of those not involved (but who are affected by projects), were seen by D1 Oils as key to developing sustainable biofuel projects.

Field observations and interviews with local people and investor companies suggest that the motive to desist the exploitive and coercive behaviour referred to by Robbins (2004) underpins the basis for creative project design and efficient implementation — central for local populations to gainfully inherit from the disturbances to their livelihoods from biofuel developments. Also, as suggested by a senior administrator of D1 Oils (interview 7 May 2011) and the chairperson of Zambia Biofuel Association (interview 12 May 2011), the sustainability of a biofuels development is largely influenced by the chosen project model, on a site-specific basis.

4.6 Conclusion and recommendations

The biofuel industry (and in particular where *Jatropha* is used) involves enterprise that has many sustainable energy aspirations; however, the industry has many lessons to learn. Without resources for intensive research and extension, viability issues will likely confine the industry to hedge and fence cultivation. In doing so, *Jatropha* is likely to have only a negligible impact on helping to reduce deforestation. Examination of more suitable cultivars (e.g., sweet sorghum) would assist in advancing commercial biofuel production, unless *Jatropha* is cultivated with secondary functions in mind (e.g., soil erosion, fencing or domestic energy purposes). Retaining feedstock processing and biofuel use within the environs of *Jatropha* cultivation is likely to improve biofuel viability and energy security, particularly in remote areas.

Transparent communications and implementation, lucid to local stakeholders, will likely inhibit the coercion of local players into joining predetermined models of feedstock cultivation. Local stakeholders enter into contracts with conviction based on information recommended by developers. Project failure can be attributed largely to a lack of understanding of local circumstances in relation to the growing conditions for chosen crops, poor species suitability and incomplete knowledge communicated by developers. The sustainability of biofuels development in Zambia hinges upon more proportionate allocations in costs and benefits and awareness of economic and environmental equality pertaining to multi-scale power relations. This paper suggests that projects that invest in understanding local social and environmental issues and that permit the space to negotiate a more even representation (that takes into account the viewpoints of all affected stakeholder) are likely to gain from local stakeholders' appreciating the shared benefits in supporting implementation effectiveness. Given the likelihood of multiple scale causality and the necessity to resolve a wide range of tensions across levels and spatial scales, a temporal quantitative analysis is needed to better understand the social and environmental evolutionary effects from more inclusive approaches of cultivating *Jatropha*.

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Chapter 5

Grappling with biofuels in Zimbabwe: depriving or sustaining societal and environmental integrity?

Abstract

Some commentators on biofuel cultivation in developing countries suggest biofuel development may cause exploitation and marginalisation. Others suggest that on occasion biofuels can be a suitable option to advance local development. It is critical to broadly understand local conditions and sustainable biofuels implementation before determining development options specific to different biophysical, environmental, societal and power settings. In particular, there is a need to reflect on less exploitive, more equitable opportunities that uphold community integrity. This paper examines biofuel project implementation opportunities and impediments in a developing country in sub-Saharan Africa: Zimbabwe. Interviews were conducted in Zimbabwe with villagers, investors and other local stakeholders affected by a biofuel sugarcane case study project. The project was identified as having significant influences (positive and negative) on Zimbabwean rural populations. The article argues that through local education and capacity building, biofuel initiatives can uphold environmental and societal worthiness if developed in conjunction with effective sustainability design and implementation approaches. However, project sustainability, specific to localities, needs to be temporally verified for indirect impacts and socio-economic and environmental equality, with particular focus on gender issues and under-privileged groups.

Keywords: Developing countries; Marginalization; *Jatropha*; Sugarcane; Power; Biofuel; Zimbabwe

5.1 Introduction

As a result of climate change and energy security concerns, investments in biofuels have grown substantially in recent years (Dyer et al., 2012). Biofuels can be defined as processed fuels derived from biomass for purposes of electricity, transport and heating (Vermeulen and Cotula 2010). Feedstock options include biodiesel crops such as palm oil, *Jatropha*, soya beans, and bioethanol crops including maize, sweet sorghum, rapeseed and sugarcane (Dauvergne and Neville 2010). Many analysts see biofuels as a sustainable development option that provides opportunities for rural economies to grow and for small-scale farmers to prosper (Dauvergne and Neville 2010; Haywood et al. 2010; Zah and Ruddy 2009). However, in sub-Saharan Africa (including Zimbabwe), where inequality is already evident (Cotula et al. 2008), land faces a number of competing pressures for use in food production, fuel production, conservation, carbon sequestration and so on (Thomas et al. 2012).

In response to the concern for the recent wave of sugarcane expansion across sub-Saharan Africa, Watson (2011) conducted research that concluded that between Zimbabwe, Zambia, Tanzania, Mozambique, Malawi and Angola there is six million hectares of land that offers contemporary potential to expand sugarcane. The 600 000 thousand hectares of land suitable and available for sugarcane production in Zimbabwe as identified in Watson's (2011) study clearly indicates that land is unlikely to be a limiting factor to take advantage of sugarcane's bioenergy potential to enhance rural livelihoods, reduce reliance on energy imports and provide new development pathways. However, Diaz-Chavez et al. (2011) advise that before investment decisions are made in areas of water scarcity assessments to safeguard biodiversity and rural livelihoods must be carried out. This research focuses on a sugarcane project in Zimbabwe, a first generation biofuel feedstock option for ethanol production.

Afionis and Stringer (2012) and Ribeiro and Matavel (2009) identify the need for further independent research to verify the oft-misinformed literature with regard to biofuel cultivation as a sustainable biofuel feedstock option. Similarly, although rural livelihoods are central to biofuel debates, there is a lack of empirical data on the ethanol (sugarcane) industry, and its opportunities to widen national energy autonomy and to extend local agrarian economics in sub-Saharan Africa. This scarcity of information encourages speculation on a large scale and debates are frequently theoretical and governed by preconceived conceptions (Deininger 2011).

Batana (2010), Moyo (2009) and Taylor (2009) consider that development aid has had very little impact on sub-Saharan Africa's growth and welfare, stressing that to free itself from the cycle of poverty, sub-Saharan Africa should focus on transparent infrastructure development for a sustainable and continuous stream of income, through raising revenues by increasing the capacity for jobs, education and enterprise (Amigun and Musango 2011). A reliable and sustainable energy source is vital for underpinning such development (Von Blottnitz and Curran 2007). Carmody (2010) argues that biofuels can help sub-Saharan Africa guard against insecure energy supplies; strengthen autonomy; save scarce foreign resources; alleviate poverty; offer energy choices beyond wood and charcoal; enhance agricultural practices; and provide for better health and education (Hall et al. 2009). Empirical data and robust investigation are needed to investigate these claims.

Biofuels may well help mitigate rural poverty, likewise, they can also increase demand for possession of land in the agricultural sector and raise the likelihood of land conflicts (Cotula et al. 2008). Many opponents of biofuels are of the opinion biofuel investments are unable to proceed in harmony with local environmental and social sustainability (German et al. 2011; Lee et al. 2007; von Braun and Meinzen-Dick 2009), especially regarding agrofuels (Franco et al. 2010). Already-marginal communities that disproportionately bear the costs of industrial biofuel production are often not included in the value chain (Attah 2011), supporting the argument thatcosts and benefits should be shared equally amongst affected stakeholders if conflicts are to be avoided (Gallagher et al. 2008).

Current policies in many developing countries do not ensure that new biofuel production is located in areas that avoid environmental harms in the form of soil and water degradation, nor are there safeguards in place to ensure they do not undermine livelihoods (Amigun et al. 2011; Franco et al. 2010; Haywood et al. 2010; Mandil and Shihab-Eldin 2010; Zah et al. 2009). Attempts to direct agricultural expansion (for both food and energy) to areas of land considered marginal or unutilised face significant implementation and enforcement challenges (Hall et al.

2009; Sala et al. 2009). Vermeulen and Cotula (2010) point out that although there is ample evidence to suggest small-scale farmers have the ability to seize new market opportunities, there are occasions on which large-scale agrofuels may be the most suitable option. For instance, in some cases local conditions are unsuited to agricultural production or too isolated to warrant small export markets.

Due to the large variations in circumstances, assertions made about what is the most appropriate biofuel business model, can only be applicable to specific biophysical, environmental and societal settings (Vermeulen and Cotula 2010). Indeed, literature critical of biofuel cultivation often fails to discuss alternative energy options to combat high rates of deforestation and land degradation. This is a vital omission considering that one factor in the imbalance of wealth is uneven access to affordable energy (Davidson 2011).

This paper presents empirical case study research on a sugarcane biofuel project and analyses its surrounding social and environmental impacts with a view to informing policy (of governments, lending institutions, NGOs and private sector institutions). While acknowledging the unique characteristics (Buchholz et al. 2009) of the case study project in Zimbabwe, an attempt to expose biofuel project limitations and to explore more sustainable and more equitable opportunities (Eden 2010), community integrity is examined alongside uneven power relationships (qualitatively assessed through discussions with varying levels of stakeholder groups). Community integrity is understood to include gender equality, survival in healthy homes, work places and ecosystems, gendered environmental rights, conflicts over natural resource issues, and family fragmentation from pressures of work commitments (Eden 2010).

In April and May 2011, primary empirical data were conducted through field observation, interviews and discussions with stakeholders operating at different levels who were affected by the biofuel project. Reflecting the arguments of Moreno-Peñaranda and Kallis (2010) – not to assume that commercial agriculture has negative social consequences – the influences a changed agro-ecology has on local livelihoods was analysed, paying due attention to apportionment and relocation (Ariza-Montobbio et al. 2010). Our findings suggests that biofuels developed and monitored within the confines of sustainability guidelines can offer socio-economic and environmental opportunities if equal representation, leading to equal costs and benefits, are emphasised.

5.1.2 Political Ecology of Biofuels

Assessments of land degradation grounded in political ecology approaches identify the different processes by which local farmers degrade their environments as a result of their marginalisation (Blaikie 1985). This can emerge through a process in which marginalised groups (i.e. small-scale farmers) are disempowered and lose the ability to make their own decisions, either through state intrusion in their local economy, or by persuasion to join international economic and monetary systems (Blaikie 1985). This paper acknowledges the political ecology concept of eco-demographic marginalisation – meaning that through uneven power relationships, local farmers can be displaced to locations that are more vulnerable (Dauvergne and Neville 2010; Stringer et al., 2008). Hence, whether small-scale farmers are forced to over-utilize land resources through advancing agro-industrialisation or persuasion to relinquish their land by governing elitists is an issue in need of further clarification (Black 1990; Franco et al. 2010). Grounded in data in the form of interviews and observation, this paper seeks to identify "less coercive, less exploitive and more sustainable ways of doing things" (Robbins 2004 p.12).

The following sections report on empirical research that seeks a better understanding of how biofuel development can influence livelihoods (positive and negative), land use and natural capital utility. The national context of Zimbabwe is set out and an introduction to the case study project is provided. The methods, results and conclusions of the research are then presented.

5.2 Zimbabwe

Zimbabwe is among the planet's 31 landlocked countries, of which 15 are found in sub-Saharan Africa (UN-OHRLLS 2011). Many of these countries are highly exposed to both fuel insecurity and volatility of oil prices. Zimbabwe is among the world's 48 least developed countries (LDCs), of which 33 are found in sub-Saharan Africa. With a rural population around 62% and approximately 68% living below the poverty line (USD $2 per day), Zimbabwe largely characterises many developing countries in sub-Saharan Africa.

Zimbabwe, which is afflicted by weak governance (Moyo 2009), faces grave environmental degradation on account of deforestation, soil erosion, land degradation, air and water pollution, serious poaching and poor mining practices (Mambo and Archer 2007; Masara 2011). Like many developing countries, Zimbabwe imports almost all its oil needs, drawing heavily on scarce foreign currency (CIA 2012). Although the country's fuel blending target is 10% for both diesel and ethanol by 2017 (Esterhuizen 2010), as of April 2012, a comprehensive biofuels policy had not yet been formulated.

Like most of sub-Saharan Africa, many rural communities in Zimbabwe are unable to access national electricity grids. In Zimbabwe, most natural forest degradation is for domestic energy use; however responsibility also lies with land clearing for cotton cultivation and wood use for tobacco curing. Zimbabwe has one of the highest deforestation rates on the planet (FAO 2011) with 330 000 hectares of natural forestland felled every year for energy use (Kwaramba 2011). These concerns run deeper in the context of other environmental challenges, including declining agricultural output and high soil degradation rates (Stringer 2009).

5.2.1 Agro ecological Regions

Zimbabwe is divided into five natural ecological regions (Figure 5.1), largely based upon the climate and the ensuing cropping suitability. Region I (most productive) is likely to incur reliable rainfall and suitable temperatures for most types of crop production, whereas in region V (least productive) farming is only suited to grazing natural pastures, as the rainfall in this region is usually too unreliable for even drought resistant grain and fodder crops.

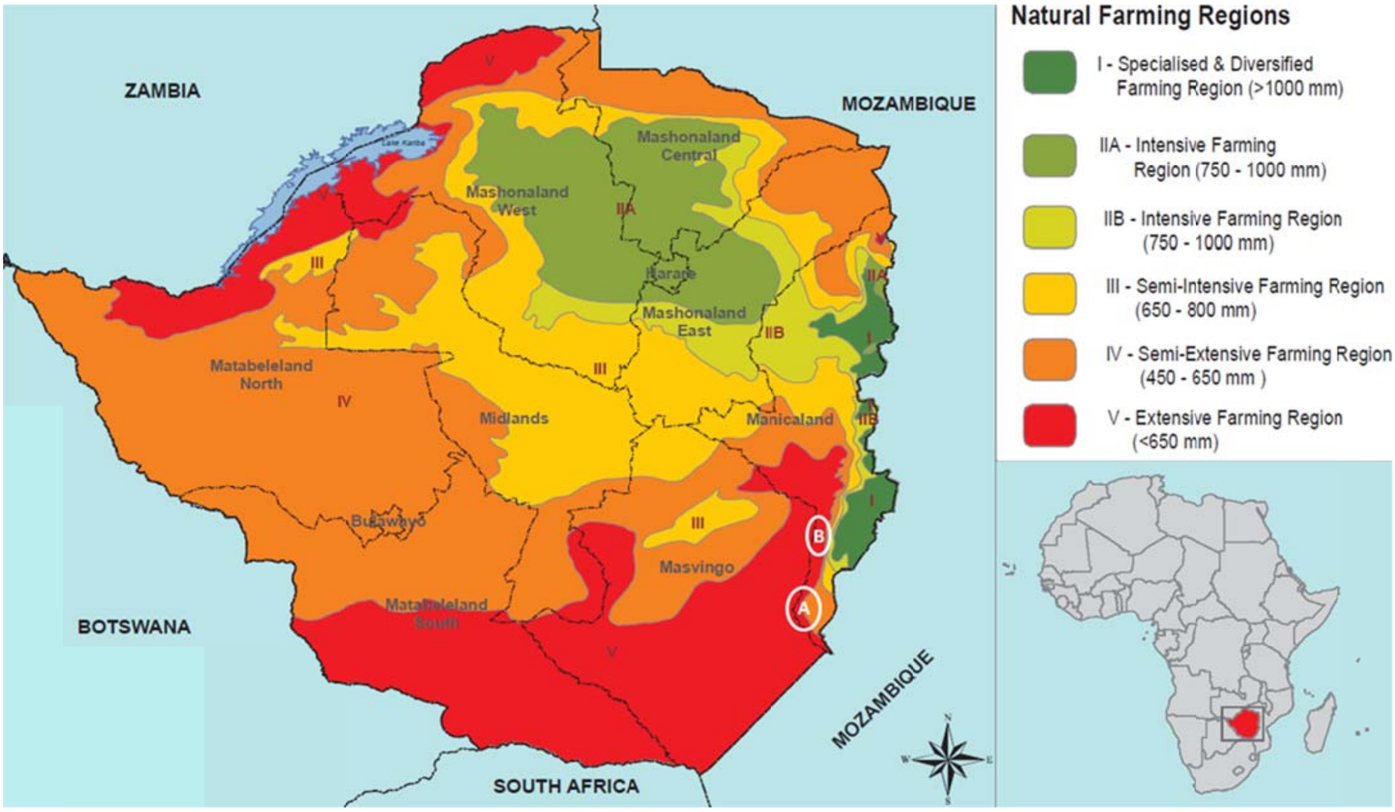

Figure 5.1 Natural ecology (farming) regions of Zimbabwe and case study areas: A - Green Fuel. Chisumbanje ; B - Green Fuel, Middle Save

5.2.2 Green Fuel Case Study Background

The case study in this research was chosen for its potential to markedly impact rural environments, primarily due to its extensive need for land and social capital. There was broad public interest in the project, which has received contrasting reports in the press (e.g. Chikari 2008; Esterhuizen 2010; Sibanda 2009). The locations of the operations are marked in Figure 5.1.

Green Fuel is the first large-scale ethanol producing factory in sub-Saharan Africa, manufacturing anhydrous ethanol from sugarcane to supply Zimbabwe and the region (Green Fuel 2012). Feedstock is produced through a programme that includes both small-scale outgrowers and an agro-industrial project. The operation is situated in the districts of Chisumbanje and Middle Save, which lie within the natural agro-ecological region V in

Manicaland Province, Zimbabwe. Rainfall of <450mm per annum limits the district to extensive animal rearing farming operations.

The company acquired land by securing a 20+20 year Build-Operate-Transfer arrangement with the government parastatal, Agriculture Research and Development Authority (ARDA) (Pers. Comm., Green Fuel Director). Green Fuel opted for previously cultivated fields and irrigation schemes (belonging to ARDA) that were in need of comprehensive refurbishment owing to obsolescence through neglect. In addition, Green Fuel acquired land from local farmers contiguous to ARDA land.

5.3 Methods

Through onsite observations and interviews with affected stakeholders in Zimbabwe in April/May 2011, this research gathered qualitative evidence on the effects this agrofuels project has had on the three pillars of social, environment and economic sustainability.

Table.5.1 Sustainability criteria derived through the integration of sustainability initiatives

Criteria			
Social	**Environment**	**Economics**	**Ethics**
Cultural Respect	Environmental Integrity	Species Suitability	Efficiency
Food Security	Migration Impacts	Resource Utility	Accountability
Health	Water Management	Viability	Transparency
Education/Skills	Soil Management	Technology	Comprehensibility
Livelihood Quality	Waste Management	Management	Communications
Social Disturbance	Chemical Use	Best Practice	
Equality/Power Relations	Land Degradation	International Relations	**Policy**
Equal Costs & Benefits	Sustainable Agriculture	Marketing	Optimal Utility
Energy security			Compliancy
Participation			Land Rights
Rural Development			Enforcement Capacity
Marginalisation			

Based on four internationally recognised sustainability certification frameworks (chosen for their comprehensiveness) (BEFSCI 2010): 1. Bioenergy Environmental Impact Analysis (BIAS): Analytical Framework (FAO 2010); 2. Global Bioenergy Partnership (GBEP) (GBEP 2011); 3. RSB Principles & Criteria for Sustainable Biofuel Production (RSB 2011); and 4. IDB Biofuels

Sustainability Scorecard, Version Two, Based on the Round Table on Sustainable Biofuel Production, (IDB 2011), common sustainability criteria and indicators themes (see Table 5.1) were integrated to frame the core questions for the interviews. Selecting the four frameworks makes an effort to harmonise some of the many international sustainability initiatives linked to bioenergy (Janssen and Rutz 2011; Scarlat and Dallemand 2011). The interview questions and observations were designed to better understand the limitations and opportunities of biofuel project planning and implementation for sustainability criteria (see Table 5.1). Examples of the interview questions are provided in Table 5.2.

Table 5.2 Examples of interview questions to both local inhabitants and investor representatives to understand the effects on criteria presented in Table 5.1

Is there concern for the security of land tenure?
Is there participation from all affected stakeholders? If yes, how is each group represented?
How is the water accessibility and quality?
What type of energy do you use? What is the availability?
Are agreements efficiently implemented?
What is the status of the soil and biodiversity?
Are livelihoods improving (e.g. health, education, food security and access to energy)? If yes, how?
What impact is the project having on food security?
What types of jobs are available? Is training offered?
What are the local livelihood norms? What is your career preference?
How does the project affect gender issues?

5.3.1 Interviews with Investor Representatives

Open-ended interviews were conducted with representatives holding positions of authority or expertise who could highlight any project implementation issues (e.g. public relations officer, management, directorship, and investors). In total six interviews were conducted with Green Fuel representatives. Meetings with case study representatives were held either onsite, or at staff offices in Harare, Zimbabwe.

Past and present aspects of the case studies were discussed with particular reference towards social and environmental sustainability. An understanding of sustainability concerns, such as, equality issues relating to benefits for local stakeholders as the project matures, eutrophication from agricultural run-off and water accessibility were also sought. The infancy of the Green Fuels ethanol project (initiated in 2008) limited the analysis to the recent past, as it was too young to assess the medium to long-term operational impacts on sustainability.

5.3.2 Local Inhabitant Interviews: Green Fuel

To gather local perspectives on the perceived suitability and fairness, aptness of communications, representation and participation, semi-structured interviews were conducted with personnel in close geographical proximity to both Green Fuel operations as shown in Figure 5.1. Initial participants were chosen by approaching local farmers neighbouring (and likely to be impacted by) the operations. Thereafter, participants were chosen purposively using a snowball sampling method (Biernacki and Waldorf 1981). Other local interviewees, including law enforcement officers, business people and persons in positions of responsibility (e.g. extension services or non-governmental organisations representatives), were chosen randomly. Interviews were conducted on an individual basis in open spaces familiar to interviewees, in settings of least distraction. Almost all interviewees requested anonymity. Interviews were followed by field observations of villages and land holdings belonging to interviewees to observe local detrimental and beneficial social and environmental effects, through project implementation.

Due to unpredictable politics in Zimbabwe, to maintain ethical standards and participant wellbeing, voice recordings and note taking were avoided during most interviews. Interviews were instead written up immediately upon leaving the local area. The sincerity of local people's opinions rested largely on the ability to ensure the interviewees' anonymity. Equally important to preserve data validity, was attentiveness to external variables (Kumar 2005). For example it was noted if participants had a financial stake in biofuel development, were political prejudiced or if they were influenced into responding subjectively. In cases of assumed subjective responses, the researchers attempted to validate the data through discussions with other interviewees and with physical observations.

Of the 34 local villagers interviewed, 15 (44%) were women (all heads of the households) (see appendix C). The interviews consisted of short, undemanding, closed questions and more open discussions relating to local environmental and livelihood issues, which may be influenced by the chosen biofuel case study project. Interviews with local villagers lasted between 30 and 60 minutes.

As journalists, researchers and NGOs have been detained over the past few years in Zimbabwe for investigating themes such as food security, corruption, human rights or land (e.g. Dugger 2010; Sithabile 2011; Zimbabwe Situation 2011), direct questions on these issues were avoided. The interview process first discussed unprovocative themes such as weather patterns, employment, social issues (e.g. health and education) and families. Discussions were then steered towards topics including food, livelihoods, agricultural sustainability options and environmental issues. Finally, the topics of land distribution, power relations and the advancement of community integrity were discussed.

5.4 Results

Green Fuel has a ready market in Zimbabwe and South Africa for the projected 2012 production of 40 million litres of ethanol, as well as for the final projected output of around 450 million litres per annum within 10 years (Green Fuel operations manager, interview, 27 April 2011). In addition, the biogas from the four proposed ethanol-processing plants will provide 42 Megawatts (MW) of electrical power to the national grid. Many local communities will benefit from access to reliable electricity for the first time. This significantly assists with the enhancement of community integrity in the form of alternative domestic energy other than wood, increased natural capital utility and alternative income generation opportunities. This supports Moyo's (2009) notion of countries in sub-Saharan Africa providing for themselves through innovation and self-generating income opportunities.

Efficient operational performance by Green Fuel (i.e. achieving sugar cane yields of 150 tonnes per ha) attracted finance from lending institutions in April 2011, to the value of USD 150 million, to facilitate the completion of the implementation phase. The company expects to be in a position to self-finance itself within two years; and by 2014 would have recovered its capital costs (interview, 27 May 2011). Savings in foreign currency and costs of up to 50% have been achieved by the company's establishment of an engineering factory (that employs 100 local people), which manufactures equipment for irrigation, as well as 60% of the machinery for the ethanol processing plants.

Before embarking on the production of ethanol, Green Fuel investigated other livelihood options including the potential for producing food crops with the assistance of irrigation in an effort to ensure optimal use of natural capital. In Middle Save, in 2008, they administered trials that consisted of 1000 hectares of irrigated maize (corn) and wheat, and achieved yields of six and five tonnes per hectare respectively. Financially, this proved an unviable cropping option. Furthermore, when compared to maize and wheat, sugarcane had greater water to energy conversion efficiencies. For example, water/maize conversion is 833m^3/mt of biomass (97m^3/GJ) and sugarcane is 154m^3/mt of biomass (22 m^3/GJ) (Stone et al. 2010).

Water for irrigating the two sugarcane opreations is drawn from the Save River, and during drier months, the river is replenished by water released from four upstream dams. Four further dams are planned to enable project expansion. In addition to supplying water for irrigation, one planned dam (Condo dam) will supply 40MW of electricity through hydropower generation (Green Fuel operations manager, interview, 27 April 2011).The two operations in Chisumbanje and Middle Save serve to exemplify the limited impact that aid has in Zimbabwe (Moyo 2009). On two previous occasions, foreign development aid (through NGO organisations) had refurbished the irrigation schemes but on each occasion, within three years, both schemes had collapsed (Green Fuel Director, interview, 27 May 2011; interview, extension officer 28 April 2011).

5.4.1 Local Livelihoods and Agro-production

Owing to low rainfall (450mm per annum), a short two-month growing season, frequent mid-season droughts and excessive heat, farming practices in Chisumbanje and Middle Save often fail to sustain of the local populations (95% of local interviewees). One interviewee conveyed the farming challenges in the semi-arid locations of the Green Fuel operations:

> The rain has been very poor this year and our crops have failed again. This happens most years and even our livestock has no grass for grazing. The goats and cattle are eating the leaves in the trees. We need aid to feed our families because our harvest will not last for six months (Interviewee Mv7, 25 April 2011).

Local Chisumbanje and Middle Save farmers primarily rely on cotton, maize, sorghum and livestock to make a living. Due to local cash scarcity, owing to the limited livelihood options and poor growing conditions, bartering produce is a regular activity. The seven hectares of land most people have in order to produce enough to survive (but not enough to effectively to lift them out of poverty) , is too demanding for a family to efficiently cultivate; thus, there is a need for food imports, handouts and other ways to obtain food. Due to the stress of weed infestations (cf. Stringer et al. 2007), the need for timely fertiliser applications and pest control, generally, one person is only able to efficiently cultivate one hectare of field crops (AGRITEX officers' interviews, 29 April 2011; Expert agronomist interview, 16 April 2011). A farmer explained:

> Maize and Sorghum in the area has failed except for some farmers who planted early, but I do not think their food will last until next year's harvest. Even though we try and plant more, we have no money for inputs and the rainfall is less than previous years (Interviewee Mc4, 23 April 2011).

5.4.2 Livelihood Concerns

The data collected in this research support the findings of studies undertaken by Green Fuel that suggest the primary concerns of local farmers were crop failure, market isolation and a lack of secure markets for their produce(see appendix C). Of the 34 local farmers interviewed who were affected by Green Fuel's operations, 26 (76%) achieved maize crops of less than half a tonne per hectare. This did not include farmers who had departed to surrounding areas, cities or neighbouring countries in search of work. All interviewees complained of a poor climate for growing food, and said that many crops planted late in the season had withered before seed was able to form. Other issues mentioned by interviewees included the need for new land because their land had been degraded and was deemed 'infertile' (19 interviewees, 56%); a need to move closer to regular work (12 interviewees, 35%); transport was highly irregular (34 interviewees, 100%); health and hospitals were inefficient (34 interviewees, 100%); and animosity between local leaders and local farmers was problematic (due to a lack of openness). Materials and high costs were stated as drawbacks to higher education options by 31 interviewees (91%). Figure 5.2 displays the key livelihood concerns commented on by local small-scale farmers (see appendix C).

It was found that 21 (62%) of farmers believed that agricultural extension workers were corrupt (e.g. inputs meant for villagers were kept for themselves or sold privately), inexperienced, or had duties that extended beyond their capacities to provide extension services efficiently (e.g. responsibility of approximately 200 to 250 farmers per extension officer). Seven interviewees and an AGRITEX officer stated that the government often used food aid to gain local political advantage. Owing to indistinct land tenure policies in Zimbabwe, 24 (71%) people interviewed

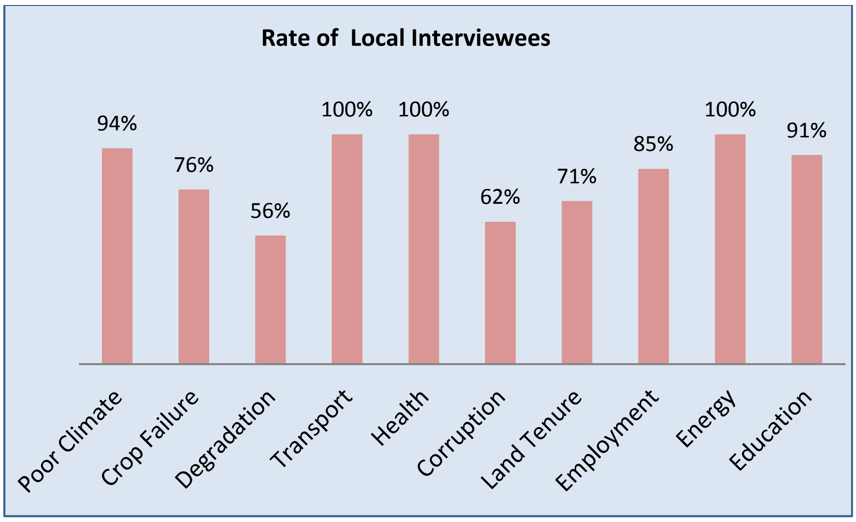

Figure 5.2 Key livelihood concerns of local small-scale famers

were concerned about the loss of land and uncertain futures: particularly with the introduction of the Green Fuels biofuel operations. Furthermore, 29 (85%) farmers expressed formal employment or alternative business opportunities as a career preference over small-scale farming. One interviewee related the typical concerns of local farmers:

> Our soils and rainfall are very poor and it is difficult to produce enough food or cash crops to survive. This area is very short of money and we have no job opportunities to buy soap and medicines. We would prefer employment to farming in this area. The new biofuel project may help with jobs but we are not yet sure of the problems it will cause, or whether many locals will be given jobs (Interviewee Mv10, interview, 26 April 2011).

5.4.3 Social Policies

To facilitate a comprehensive communication structure for affected stakeholders, the Joint Ethanol Project Advisory Committee (JEPAC) was established by Green Fuels. JEPAC representation includes law enforcement representatives, government, traditional leadership, social and environmental experts and Green Fuel management.

Seven (21%) of the local interviewees confirmed Green Fuel had efficiently adhered to their commitments of refurbishing schools and health facilities, drilling bore-holes and introducing community irrigation schemes. Interviewee Mc6 (interview, 25 April 2011) pointed out a field with irrigation stating, “We are pleased to have irrigation again as we should produce better crops”. Green Fuel also provides free transport for workers to work and return from up to 80 km away on a daily basis.

Typical viewpoints of hopes for better futures are summed up by a local business owner, (personal communication, 28 April 2011), discussing the issue of local trade, “business is improving and we have many start-up businesses”. A local law enforcement officer (personal communication, 29 April 2011) disclosed that “since people have been able to get jobs through the ethanol project, local crime has dropped by up to 95%”. Everybody in the area mentioned the prospect of electricity due to the Green Fuel operations, as presently, the few who are fortunate enough to have access to this energy source, experience inconsistent supplies.

5.4.4 Agro-Livelihood Accessions

The Green Fuel director (interview, 27 May 2011) divulged that as part of the agreement between local farmers and Green Fuel, 10% of the total cultivated/irrigated ARDA land (uncontested land) will be permanently allocated to local farmers. This equates to 5000 ha (half a hectare each to 10, 000 farmers) between the Chisumbanje and Middle Save operations. However, as is the situation in many sub-Saharan African countries (Sagar and Kartha 2007), this does not provide security of land tenure, owing to the uncertainty of land rights in Zimbabwe (public relations officer, interview, 27 May 2011 (see appendix G); 24 (71%) of local interviewees). In the case of outgrowers engaging in the scheme, in return for seven hectares of rainfed land they will receive 0.5 hectares of fully irrigated land. Free permanent irrigation (designed for minimal technical input to ensure permanent functionality) is supplied for a 0.5 hectare area of any crop of the farmer’s choice. However, if the farmer decides to cultivate sugarcane, in addition to irrigation inputs, technical backup will be provided. Emphasising transparency, farmers are paid for harvested sugarcane in line with world sugar prices (Green Fuel operations manager, interview, 27 April 2011). To confer general sugar trends in recent years, prices rose 68% (US5.58cents per pound to 9.36 cents per pound) in the five years from 2002 to 2007 and during the following five years from 2007 to 2012 it has risen by 116% (9.36 cents per pound to 20.21 cents per pound) (Index Mundi 2012. The positive perception of locals who have received irrigation is affirmed by a local farmer (interview, 28 April 2011), “for the first time in six years we are able to irrigate and are confident of better crops”. The Green Fuel public relations officer pointed out (see appendix G):

> We (Green Fuel) are confident that through the community irrigation schemes we will be taking care of the community needs and they will see that it is important for the project to be preserved over time. We are bound to experience resistance to change until people realise the benefits accruing from the process. It is our responsibility to ensure they understand how the concept works (Green Fuel public relations officer, interview 27 May 2011).

Agreements between Green Fuel and local farmers were negotiated through JEPAC on the assumption that each person has less land, but with the appropriate inputs, will increase output;

and this, alongside access to irrigation throughout the year, mitigates crop failure, hence, advancing food security and livelihoods. In addition, the 7000 anticipated jobs (predominantly secure and full-time) within the Chisumbanje and Middle Save operations provide livelihood diversification opportunities for local communities. To circumvent exploitive corporate social responsibility (CSR), which includes the syndrome in developing countries of "low-paid jobs keeping people in poverty" (World Bank et al. 2009), Green Fuel is training people for internal promotion opportunities (Green Fuel operations manager, interview, 27 April 2011). The Green Fuel public relations officer declared:

> We are making sure that we are not developing an island of money in a sea of poverty. Historically, what has been happening is that most business entities have not been aware that the community element needs to be involved, so that you don't create a bunch of jealous people who want to rip the whole thing apart because they don't have anything to show for (Green Fuel public relations officer, interview, 27 May 2011).

5.4.5 Gender Equality

The deeply embedded gender inequality, which is inherent in many sub-Saharan Africa traditional cultures, is entrenched amidst the powerful traditional leadership in Zimbabwe (Arndt et al. 2011; Green Fuel Public relations officer, interview, 27 May 2011). Relating to Green Fuel's biofuel project, gender issues of prime concern to all female interviewees (n=15) included loss of land, lack of inputs, inequitable employment opportunities, and unfair apportionment of irrigated blocks. In Zimbabwe (as with many sub-Saharan African countries), women can often only access land through their husbands or fathers. Upon the death of their husbands, traditional leaders decide whether to deny the surviving women access to land (Kachika 2009). Green Fuel has yet to consider the limited representation of women on JEPAC (currently less than 10%), however, the company's public relations officer insists their intention is to help educate and influence local communities on the value of fair participation – without interfering or upsetting sensitive local customs.

> We have been so focused on just putting the capital into developing everything that we haven't had much time to reflect on the gender pattern that would affect the beneficiation

> process. The men 'sort of take over', but I would have to confidently say the issue that women are fairly considered, is something that we will have to seriously look into; otherwise we will have issues hounding us throughout the whole process (Green Fuel public relations officer, interview, 27 May 2011) (see appendix G).

5.4.6 Agro-production Environmental Policies

In aiming for sustainable agricultural cultivation, Green Fuel has introduced a reduction in negative environmental impacts through modern cultivation technologies and maximisation of land use (enhancing input and yield efficiencies); mechanised harvesting (no cane 'burn-offs'); avoidance of land use changes (including deforestation); introduction of zero tillage and precision farming techniques; and reuse of by-products while waste is converted into biogas and fertilisers. Although soil and water quality had been assessed by the company and will continue to be monitored, soil and water degradation is not anticipated (Green Fuel interview, 27 May 2011).

5.4.7 Environment

Almost all the rural people interviewed diversify their income streams with other forms of enterprise linked to the environment, including bush-meat harvesting, bee keeping (honey production), timber harvesting, natural medicines, sand harvesting, gold prospecting and beer brewing. Most enterprises are wholly reliant on the natural resource base, either for harvesting (i.e. medicines, timber, bush-meat and bees) or for exploitation (i.e. gold and sand). Owing to illegal forest derived income activities, statistics in Zimbabwe were difficult to come by, however it was stated by a law enforcement officer (personal communication, 29 April 2011) and seven local interviewees that most young men in the area seek alternate forms of income to farming, and this includes illegal timber and bush-meat harvesting in neighbouring conservancies. Interviewee Mv4 (interview, 1 May 2011) divulged that "the lack of income options forces young people to poach animals and cut wood for sale to locals and in the towns. To flush out animals they burn the grass in drier months." By producing and supplying local electricity and providing alternate income generating options, Green Fuel anticipates deforestation rates and unsustainable bush food harvesting techniques to reduce correspondingly to the biofuel project's development (interview, 29 May 2011).

5.5 Discussion

By way of a case study analyses (Chaiklin 2000; Yin 2009), this paper aimed to inform, on a site specific basis, opportunities and impediments of biofuel project development in Zimbabwe. This section discusses the multiple perspectives concerning biofuel implementation and their links to social and environmental integrity. As the research was conducted at a single point in time it is difficult to draw concrete conclusions on the future sustainability of the project. Since sustainability is a conceptual process (Strange and Bayley 2008) with principles across space and time and an end goal with sub-objectives focussed on bettering conditions (e.g. health, social exclusion and livelihoods) and avoiding the depletion of resources (Hawken 2007), ongoing monitoring and assessment is needed to determine the environmental and social sustainability of Green Fuel's operations. As the project matures and expands, analysing sustainability becomes more important as impacts are likely to magnify. This is especially important for external and indirect environmental and socio-economic impacts not encompassed in this research (e.g. downstream water users, riverine habitats, local impacts from dam construction, movement of labour away from other livelihoods and timber harvesting).[3]

The 'snapshot' data collected in this research can nevertheless assess the current conditions and whether they seek to create an enabling environment for sustainability to be pursued. Inherent dangers associated with poor governance create a threatening investment context in Zimbabwe. Green Fuel's decision to use land that had been previously cultivated and largely underutilised lessens impacts on biodiversity loss, land use change, contentious land tenure conflicts and reduces the threat of marginalisation and disempowerment of local farmers. As

[3] Green Fuel has had political interference during 2012. This has heavily interfered with production and development. The project has reopened and is back in production (4th April 2013). As of 23rd April 2013 the political issues have been seemingly been resolved and increases in production are planned (Biofuels Digest 2013).

the operations are located on predominantly idle land within a largely unproductive agro-ecological region that experiences market isolation and few sustainable livelihood options, they can support the argument for introducing agro-production that can enhance local livelihoods (Moreno-Pen˜randa and Kallis 2010; Vermeulen and Cotula 2010), in part redressing land degradation and exploitation concerns raised by Amigun et al. (2011), Ariza-Montobbio et al. (2010), Franco et al. (2010) and Haywood et al. (2010). The company's promotion of efficient irrigation techniques also reduces environmental impacts through energy and water savings and the risks of eutrophication, salinisation and nitrogen and pesticide toxicity (Diaz-Chavez et al. 2011).

The structures put in place to ensure permanent irrigation functionality and inputs are likely to enhance local enterprise and livelihoods for local farmers. This is especially critical as climate change impacts are likely to worsen already weak growing conditions for crops in the case study area (Makadho 1996). Improvements, such as these, which take into account management and expertise capacities, can advance Moyo's (2009) suggestion of sub-Saharan Africa empowering itself via infrastructure development that produces sustained incomes (Amigun and Musango 2011). Such improvements present opportunities to enhance community integrity though greater knowledge and human capital, and more stable incomes (i.e. crop security via irrigation). In turn, these present a socio-economic base from which to negotiate fairer costs and benefits for local stakeholders.

Important for the future success of the Green Fuel project in a dynamic political climate, is the arrangement between Green Fuel and ARDA: on maturation of the operational phase, land will be returned to the original owners, ARDA. As significant shareholders (through holdings in ARDA), the Zimbabwean Government will benefit financially by assisting with the efficient implementation of social and environmental sustainability – without needless political intrusion.

The results presented in this paper suggest that the choice of project design and equal active participation (action upon local view points), on a site specific basis, decidedly impacts on social and environmental sustainability. Local financing, management, processing and marketing (Dauvergne and Neville 2010), circumvents uneven power relations linked to 'remote governance' (Neumann 2009) through economic influences of the global North (Hollander 2010). This can improve accountability, national fuel security, and livelihood opportunities, hence, efficiency and the triple bottom line. Locals are likely to take greater interest, and recognise the benefits of upholding environmental, social and economic sustainability via value adding natural capital (processing end-user products), and domestically absorbing the economic benefits.

Through the daily transportation of workers, Green Fuel has tempered socio-economic issues caused by the in-migration of labourers (Fischer et al. 2009) such as the disintegration of family units (Eden 2010). New local livelihood opportunities also lessen social and environmental disturbances that can otherwise develop by locals migrating to cities and neighbouring areas in search of employment (Ariza-Montobbio 2010; Eden 2010). To lessen exacerbation of existing poverty through menial employment and the oft opaque protectionism that goes with it (Boyd and Watts 1997), Green Fuel has essentially fulfilled the 'equal opportunity' agreements shaped through JEPAC. Their actions included refurbishing schools and health facilities, establishing training colleges and drilling bore-holes. With the assistance of education and training (Hall et al. 2009; Carmody 2010), skilled job opportunities that arose through the development of an engineering enterprise and the biofuel project offering internal career promotions in a country with the world's lowest employment rate (CIA 2012), supports the 85% of small-scale farmers who specified other livelihood opportunities as a preference over small-scale faming.

More secure cropping (irrigation) and the introduction of sustainable agricultural practices can improve local vulnerabilities and the situation of 'desperation' (e.g. reliance on handouts, lack of employment and poor health), which are often seen as a determinative for coercion and exploitation (Eden 2010; Robbins 2004), usually facilitated through varying scales of knowledge and uneven power relationships (Franco et al. 2010; Robbins 2004). Considering that access to affordable energy often inhibits lifestyle advancements (Davidson 2011), the biofuel project's introduction of reliable local energy (electricity) in a country plagued by erratic energy supplies allows for these opportunities to take place.

Although respecting local customs and opting local leaders onto an advisory/mediating body, may not necessarily yield the equal legal terms identified as important by Vermeulen and Cotula (2010), they have merit in assisting with openness and accountability in a country that lacks formal institutional capacities. Local input is essential for selecting sustainability indicators to accurately understand what is important locally, since the indicators selected by "development experts" may not be relevant to local conditions (Carruthers and Tinning 2003). Forming a local growers' cooperative (including equal active gender participation) with members on an advisory/mediatory body that exhibits a proficient understanding of local conditions, culture, biodiversity and socio-economics) and project design and administration, can synthesise implementation transparency, equality (legal representation) and efficiency (Cotula et al. 2008).

5.6 Conclusions

Contrasting reports on agro-production in Zimbabwe are often underpinned by the respondent's take on the knowledge they reported. This paper has shown that agrofuel bioethanol projects, developed within a framework with sustainability implementation approaches, on a site-specific basis, can improve community integrity, advance sustainable livelihood opportunities and provide a viable alternative energy options for countries with suitable environmental and social conditions. The structures put in place by the case project to ensure permanent irrigation functionality and inputs have the potential to enhance local enterprise and livelihoods for local farmers. However, interviewees understandably had concerns with Green Fuel's medium- to long-term social and environmental outcomes. Although contrasting viewpoints unearthed in the literature show the difficulties in making and keeping all stakeholders happy, what is important is that individuals are able to recognise coercive behaviour and avoid accepting below fair compensation or reward. This can empower local stakeholders to make their own informed decisions.

5.7 Recommendations

Based on the data that emerged from the case study in Zimbabwe, this paper stresses that biofuel project design and implementation should be reserved until a comprehensive sustainability analysis (on a site-specific basis) determines the appropriateness of biofuels for the country and locality. The most suitable project model can then be developed. Further research, on an annual basis, into areas such as external impacts, gender equality, environmental degradation (deforestation, soil quality and water quality, chemical toxicity) and livelihood status, can provide valuable sustainability information on the limitations and opportunities for current and future project planning and implementation.

Forming a mediatory/advisory body representative of all stakeholder groups and developing a sustainability monitoring system can help compensation arrangements to be analysed across a range of temporal and spatial scales. As projects mature and expand this can ensure costs and benefits are equally calculated in a manner that is understandable to local stakeholders. A cooperative that comprises representatives directly affected by the development, are deemed trustworthy by cooperative members and exhibit fair gender representation, presents the opportunity to dispel the concerns of an unequal dispersion of costs and benefits. To reduce initial suspicions, improve trust and ensure responsibilities of the cooperative are to its members, payment to the cooperative and intermediaries can arise through apportioning an agreed amount of the biofuel project's profit to all participating stakeholders.

To impress fair gender rights on local customs and culture, although fraught with difficulties, the influence conferred to cooperative representation (through the advisory/mediating body) can aid a steady transgression towards social and environmental equality. Equally important, a 'feel good' situation can arise where locals recognise the company has an interest in their concerns. In the case of Green Fuels, initiating the agreed initiatives for the well-being of local populations by refurbishing schools and irrigation schemes through the early implementation stages of the project helped to achieve this.

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Chapter 6

Sustainability implementation barriers for biofuel development in sub-Saharan Africa: moving from challenge to opportunity

Abstract

Implementation challenges continue to inhibit the successful achievement of biofuel sustainability initiatives in sub-Saharan Africa countries. In an effort to unearth key limitations, a review of the sustainability and biofuel development literature was extended by case studies in sub-Saharan Africa and a survey of sustainability and biofuel experts. This research, founded upon four supporting theories with interests in sustainability and development in emerging economies, framed efforts to understand the limitations and to seek solutions to inform biofuel practice. The outcome comprises initiatives (approaches, methods, processes) that may offer utility to assist diverse challenges affecting various stages of biofuel implementation. A conceptual biofuel developmental process and relevant key stakeholders that can influence the performance and sustainability outcomes of implementation approaches at the different developmental stages is also presented.

Keywords: sustainability; biofuel development; implementation; stakeholder equality; sub-Saharan Africa; developing countries.

6.1 Introduction

The expansion of biofuels driven by the European Union and United States calling for initiatives to significantly increase the proportion of biofuels use in transport has raised concerns for their social and environmental impacts traversing all phases of the supply chain (Diaz-Chavez 2011). Other arguments that favour biofuel expansion include energy source diversification, low-carbon emissions, security of energy supplies, restoration of degraded land and alternate markets for agrarian goods (Davidson 2011; Wang 2011).

The concerns raised for biofuels bring a unique opportunity to rethink the production systems and global governance of both energy and agriculture (Bastos Lima 2008). The biofuel debates should inspire a broader discussion on global energy governance in general, which at present remains limited (Prabhakar 2008; Von Braun and Meizen-Dick 2009). The concept of land 'potentially available' for agriculture and in particular for expanded bioenergy production is hugely complex. Owing to large areas of uncertainty that remain regarding the overall impacts and benefits of biofuels, Dragun and Tisdnell (1999) suggested that international action is needed to improve data, models and controls to understand and manage effects. Regardless of the technological progress, unless measures are introduced in the planning stages to ensure sustainable cultivation and processing practices, social and ecological harm elicited by biofuel developments are likely to outweigh potential advantages (Haywood et al. 2010).

Though international biofuels assessment and certification initiatives have recently seen rapid growth, incongruously, inconsistencies in implementation have risen through a lack of devices and approaches that are able to harmonise the different initiatives (Scarlat and Dallemand 2011). Inconclusive implementation approaches and the selection of ambiguous sustainability indicators cause inconsistent interpretations and enforcement issues. Janssen et al. (2009) stressed that the lack of existing implementation approaches is a key shortcoming to realising principle sustainability objectives for biofuel development in Africa. To avoid unjustifiable restrictions and distortions to biofuel development opportunities in emerging economies, they propose the urgent need for the harmonisation of the large number of sustainability certification/assessment initiatives and an internationally accepted practicable approach for the implementation and achievement of these initiatives.

A key problem with biofuel verifications systems is that they respond to legal and commercial regulations but are unable to evaluate each country's finer details in relation to current environmental, cultural, social and legal circumstances (Diaz-Chavez 2011). Harrison et al. (2009) stated that many sustainability assessment methods lack transparency and practical operation for most stakeholders. Moreover, Buchholz et al. (2007) added that overwhelming complexity and quantity of data in decision-making can breed scepticism for stakeholders. Moyo (2009) and O'Laughlan (2008) recommended that a system comprehensible to local citizens that includes efficiency in application, accountability in operation, transparency in negotiation, fairness in revenue and responsibility for the environment offers the best means of achieving project sustainability aims.

Although an influential mechanism, adopting a market-based certification process is insufficient to ensure biofuels are efficiently developed within producer nations (von Maltitz and Stafford 2011). In addition, Haywood et al. (2010) advocated that a national strategy should include an approach that assesses the socio-economic and environmental suitability for land use options in a transparent and inclusive manner (active participation of affected stakeholders). Since possible external influences, imperfect knowledge of the system subtleties or inadvertent consequences can all place stress on the scheme's resilience, Haywood et al. (2010) further suggested the need for an ongoing monitoring system, which is supported by adaptive management. They recommended the tool to be applied broadly to all proposed and existing projects, at all levels, and must be applied retrospectively to analyse the sustainability application of existing practices. Similarly, Scarlat and Dallemand (2011 p.1644) advised that:

> Besides strong and enforceable criteria, key to achieving sustainability goals are the structure and operation of the certification systems to avoid weak implementation and verification practices. A detailed set of procedures is required to be developed and implemented as part of the sustainability standard.

Gibson (2006 p.275) proposed that planning should occur throughout all stages, engaging the broadest range of participants in discussion, deliberation and debate for a process that "provides integrative, sustainability-centred guidance, methods and tools to help meet the key practical demands of assessment work, including identifying key crosscutting issues and linkages among factors".

This paper reports key limitations that challenge biofuel developments in emerging economies to effectively implement sustainability principles. Identifying the limitations is a step towards examining and establishing methodologies (i.e. processes and methods) that can help achieve sustainability goals. As part of the agenda to help address the often cited challenges of biofuel implementation, highlighted as in need of further research, the paper aims to introduce "knowledge integration approaches enabling multiple views and multiple methods to be considered" (Raymond et al. 2010 p.1774). As a secondary aim, a set of methods/approaches are presented for further debate or empirical observation. These methods can be drawn upon as a means to confront the challenges that arise at various stages of a biofuel development process.

Diaz-Chavez (2011) emphasised that biofuels are not the only commodity to which certification schemes should be applied, as all productive systems must contribute to poverty reduction and sustainability. Bastos Lima (2008) concurred by implying that sustainability standards conceived for biofuels could well apply to the rest of the sector, where activities of much larger scale are not nearly as scrutinised. Sustainability is a conceptual process (Strange and Bayley 2008) with principles across time and space and an end goal with sub-objectives focussed on bettering conditions (e.g. livelihoods, health and employment) and avoiding the depletion of resources, poverty, social exclusion and unemployment (Hawken 2007). The main achievements of sustainable development are its motivation for stakeholder participation, linking together the three pillars of environmental, social and economic sustainability (Dalal-Clayton and Bass 2002).

While, sustainable development is a universal challenge, many concepts can only be defined regionally and locally (Dalal-Clayton and Bass 2002) and are largely aspirational (Munro 1995). Sustainability is not considered an end state, but rather an evolving, dynamic system that is embedded in a multifaceted interaction between socio-environmental systems. It is where the complete system is able to manage and absorb disturbances and stresses without weakening its functionality (Walker et al. 2004). This paper characterises sustainability through strong sustainability as depicted by Dietz and Neumayer (2007); Henderson (1999 p. 102) and Williams and Millington (2004) as "a more decentralised way of life based upon greater self-reliance, so as to create a social and economic system less destructive towards nature."

6.2 Methods

The method employed in this paper can be described in five parts (shown in Figure 6.1). Firstly, through an examination of international discourse on biofuel assessment and certification initiatives a set of sustainability criteria are uncovered and used as a basis for this research. Secondly, primary efforts to uncover limitations to the successful implementation of biofuel sustainability initiatives are derived through a review of academic and grey literature and the results of research of the four case studies and a survey of international experts. Thirdly, the review of four supporting theories (political ecology, development economics, institutional economics and social capital) are examined in an effort to understand and seek solutions to the uncovered sustainability implementation limitations. Fourthly, framed within the combined perceptions of the supporting theories, example initiatives, based on prior empirical performance within various domains (e.g. mining, wildlife management, agriculture, education and rural and urban development), are evaluated for utility to address the limitations. Finally, as a secondary objective, a conceptual biofuel developmental implementation process is presented. Corresponding key stakeholders' representation (not exhaustive) likely to influence sustainability outcomes at different stages of the implementation process are identified for further debate.

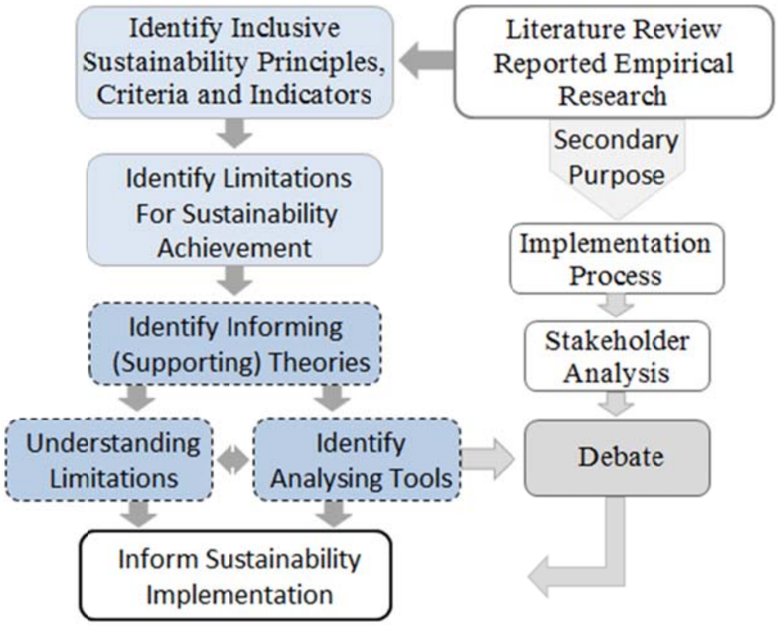

Figure 6.1 Aims and methodological process for this research

Factors that inhibit the implementation of biofuel sustainability initiatives are identified using the following methods:

1. Through a review of academic and grey literature (e.g. empirical research, institutional reports, science papers, case studies in developing nations and NGO reports on implementation design),
2. Examining the results of four case studies on biofuel development in sub-Saharan Africa - two in Zambia, reported in Duvenage et al. (2012b) and two in Zimbabwe, reported in Duvenage et al. (2012c), and
3. Survey of international sustainability and biofuel experts, reported in Duvenage (2012a),
4. Theories that support sustainable development in emerging economies, discussed in Duvenage et al. (2012d).

6.3 Sustainability Limitations for Biofuel Implementation

Dalal-Clayton and Bass (2002) stated that to achieve sustainability necessitates structural change involving political, social and economic activities, and includes improved marketing strategies, growth that favours the poor and removal of policies that negatively impact the environment. Janssen and Rutz (2011) proposed the following recommendations to avoid unjustifiable burdens and restrictions on biofuel development opportunities in developing countries:

1. the harmonisation of the large number of certification initiatives is urgently needed so that developing nations are not excluded from the emerging biofuels trade via trade barriers and distortions,
2. an internationally accepted practicable approach to avoid adverse biofuel production impacts, and
3. additional research on the impact of various aspects of biofuel production.

Duvenage et al. (2012a) identified that 71% (25 of 35) of respondents of an expert survey suggest that mandatory schemes for biofuel production would unlikely influence its sustainability for several reasons including the costs of administration and the capacity of emerging nations to administer and enforce sanctions. One respondent expressed the view that mandatory sustainability legislation is fraught with challenges that would require resources well beyond the means of many developing countries for effective monitoring, verification and reporting. Enforcement in each developing country is a challenge that not even the certification schemes are able to resolve (Diaz-Chavez 2011). For example, a number of developing countries led by Brazil and Argentina have filed a complaint through the European Union insisting the World Trade Organisation refrain from legislating on which land they can use for biofuel production (Harrison 2008). Diaz-Chavez (2011) commented that a leading problem with biofuel verification systems is that they respond to legal and commercial regulations but they are unable to evaluate each country's finer details in relation to current environmental, cultural, social and legal circumstances. She recommended that in countries without the capacity to enforce policy, the introduction of a market-based scheme may be a more powerful enforcement mechanism than legislative schemes.

Mol (2007) and Dauvergne and Neville (2010) warned that certification initiatives that do not include local concerns (even voluntary certification schemes) are limited and are likely to exacerbate the land tenure issues for local populations. Moret et al. (2006) concurred by stating that developments not supportive of participation, local sustainable development, traditional cultures and respect for local ways of life are not supported by communities – especially in cases where meaningful decisions are made without their input. There is a tendency for locals to oppose developments along the lines of ethical-based debates and rights (Amigun et al. 2011). However, they add, involuntary imposed developments, unfamiliar technology, lack of public participation, and selfish corporate-directed benefits tend to increase conflict and a lack of trust. The Energy Working Group of the Brazilian Forum of NGOs and Social Movements (FBOMS) proposed further research to arrest these uncertainties (Amigun et al. 2011).

Considering the history of foreign investment in Africa (Duvenage et al. 2012b), it would be strange for locals to believe that capitalistic corporations can be relied upon to act on a basis of social responsibility (White and Dasgupta 2010). Six (2005) and Zand (1972) explained that a breakdown in trust does not occur from debate and conflict but through a lack of openness. Though there is a growing call from politicians and scientists for a biofuels sustainability certification mechanism, Janssen and Rutz (2011) highlighted the many implementation issues that still remain. For example, how to:

- implement sustainability schemes in developing countries without limiting the development opportunities?
- avoid unjustified (administrative) burdens on biofuel producers?
- limit sustainability certification costs to tolerable levels?
- design sustainability schemes to ensure equity for smallholders?

An expert responding to a survey for achieving biofuel sustainability in sub-Saharan Africa (Duvenage et al. 2012a) referred to the following implementation issues as in need of research: lack of ethical practice; uneven knowledge powers leading to confusion and disproportionate benefits; and a lack of transparent planning and implementation. Several other expert respondents added that uneven active participation and unclear communications leads to confusion and inequality. Mansuri and Rao (2004) advise that an issue in need of research is how development organisations apply the everyday participatory practice of integrating contrasting perspectives of diverse stakeholders in project implementation. Integrating the different interests in addition to the challenge of harmonising the integration of sustainability goals is difficult to achieve in practice (Diaz-Chavez 2011). Elghali et al. (2007) reiterated that an evaluation that is of interest, is not whether a process suits the wishes of an individual stakeholder, but whether the process is able to combine and reconcile diverse objectives.

Although frameworks should be designed to have cumulative assessment criteria, if the first stage of the assessment (i.e. before project implementation) is not carried out effectively and efficiently, viability and sustainability can be affected (Haywood and de Wet 2009). Identifying principles and criteria for a sustainability vision at the start of the assessment provides the analytical systems and robustness necessary later in the sustainability assessment process (Haywood and de Wet 2009). An appropriate selection of indicators within a framework provides the base for thoroughness, transparency and accountability (Diaz-Chavez 2011). They are employed for producing, analysing, comparing and sharing information, and can deliver a suitable basis for the measurement of sustainability.

Paavola (2008) suggests that sustainability principles should be considered at micro, mezzo and macro levels to add integrity and depth. The challenge is to integrate a variety of methods and approaches to develop a process that is 'user-useful' whereby scientific viewpoints are considered alongside local viewpoints, and in a manner logical to all stakeholder representation (Raymond et al. 2010). Buchholz et al. (2009) expressed concern that consensus is often reached by the different expert professions on how indicators are scored and ranked within sustainability aspects, except on the practicality of the aspect (Buchholz et al. 2009).

Haywood and de Wet (2009) pointed out that further lessons can be learned amongst the stakeholders, especially from locally affected communities who integrate the ecological, social and economic aspects in their daily lives. Regrettably, participation is often a public event, can be intimidatory and can be shaped to serve narrow agendas through power relations regarding authority and gender; especially if participants collude beforehand to manipulate a consensus on a problem definition to serve their own interests (Mansuri and Rao 2004). Genuine participation may lead to psychological duress as it can require the most disadvantaged groups taking a position that is contrary to the most powerful groups' interests (Mansuri and Rao 2004).

They add that participatory roles are often sidelined if the process is treated as a means to legitimise formerly established priorities – usually to comply with the expectations of donors to implement such procedures in their developments. The challenges in taking a sustainability assessment approach are therefore both practically and intellectually challenging but future planners have to take this path for sustainable development to become a reality.

Table 6.1 Limitations and the challenges to sustainability achievement

Limitations	Challenges
Legislation Frameworks	Mandatory legislation, under conditions of weak administrative and enforcement capacity (often the case in sub-Saharan Africa) are unlikely to have value, especially in cases that will for governance is lacking.
Sustainability Assessment	Selecting sustainability principles, criteria and indicators that are suitable for different project types that encompass micro, mezzo and macro conditions is challenging, nonetheless, they are key to form a frame for efficient implementation, assessment and monitoring – factors central to sustainability.
Equitable Power and Trust	The difficulties of balancing uneven levels of power are further challenged in societies that deal with wide margins of economic, knowledge and political power (e.g. developing countries in sub-Saharan Africa).
Integrating Diverse Viewpoints	Contrasting levels of knowledge and understanding further challenge the demands of integrating the different interests of diverse stakeholder groups. The difficulties increase under circumstances that stakeholders lack knowledge for sustainability concepts.
Effective Participation	Participation should actively close the divergence between community needs and what it attains. The challenge is to enact this without negatively affecting project efficiency.
Harmonising Sustainability	Implementation needs to entwine and harmonise the three pillars of environmental, social and economic sustainability. Strengthening one principle must be achieved without compromising the integrity of others.
Monitoring Sustainability	As projects mature, monitoring sustainability is important to understand its progress. The challenge comes with the need to develop a system that is thorough, apposite and understandable to all levels of stakeholder representation.
Equal Cost and Benefits	Deriving equal cost and benefits requires free and informed agreements among all stakeholder representation. Compromising is difficult without an equal understanding between stakeholders of the values of natural resources (i.e. land and water), social capital and markets.
Ethical Practice	Ethical conduct (i.e. transparency, accountability and understanding) through all phases of biofuel development is central to reinforce trust, reduce conflict and ensure equality.

Table 6.1 presents the challenges alongside the limitations to the achievement of biofuel sustainability principles/initiatives in developing countries as discussed in this section.

6.4 Supporting (Informing) Theories

To form a more inclusive frame within which to pursue understandings and solutions to the limitations for achieving biofuel sustainability initiatives, this paper draws on four supporting theories: namely political ecology, development economics, institutional economics and social capital. This section expands on the discourse of Duvenage et al. (2012d) regarding the combined interests of the four theories and their link to understanding the limitations to biofuel sustainability in developing nations. The relationship between biofuel sustainability principles

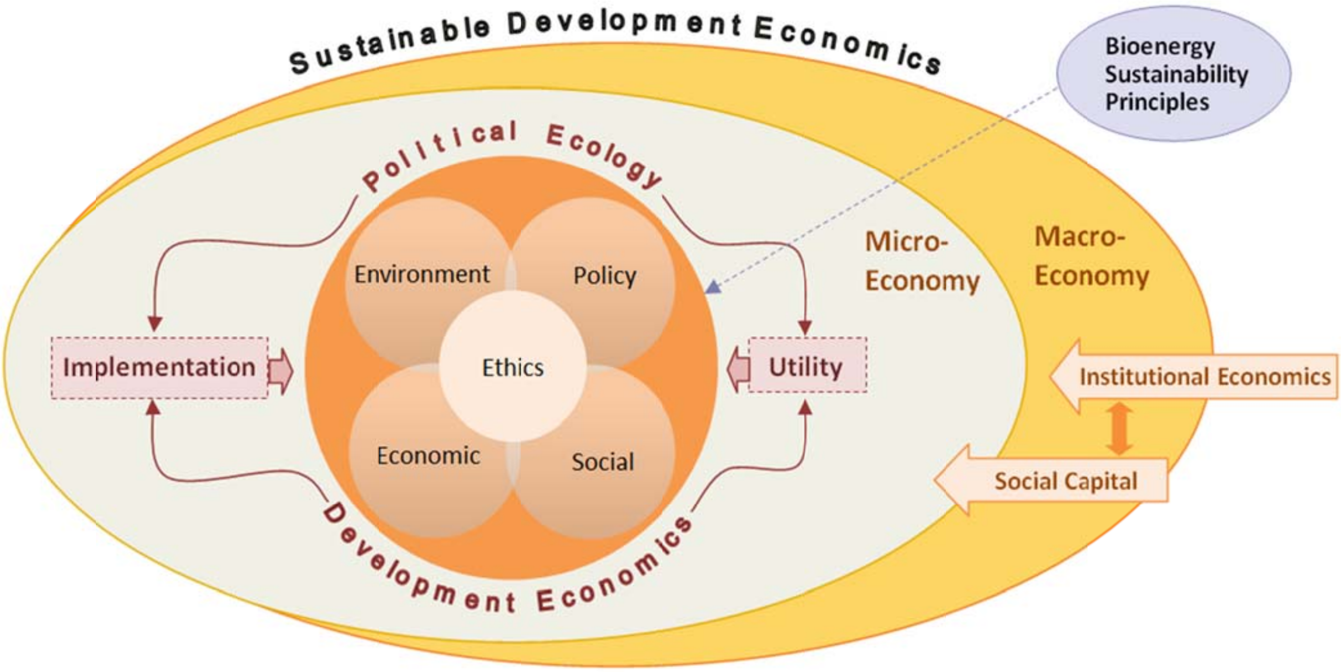

Figure 6.2 Towards a biofuel development conceptual framework

(Duvenage et al. 2012a)

and supporting theories are illustrated in Figure 6.2. Essentially, institutional economics (supporting macro elements and institutional settings) in conjunction with social capital (supporting micro and meso elements of local and regional networking) can expand upon and underpin the explanations derived through development economics in response to sustainability concerns raised by political ecology (Duvenage et al. 2012d).

Blaickie and Brookfield (1987) based regional political ecology on the concept of marginality – where the revenues from locally produced raw materials are not evenly distributed amongst local populations and where population demands on natural habitats are high. de Soysa (2002) suggested that it is not the act of partnering the exploitation of naturals resources, but hedonism, that is the cause of conflicts over a more equal distribution of resource wealth. The dire economic effects felt by developing countries from the current global crisis has generated a demand for research for incessant development thinking, which achieves sustainable dynamic growth that encompasses all societal groups to eliminate poverty (Lin 2011). The key to political ecology is an in-depth study of social structures to explain environmental changes in the context of various actor interests, discourses and actions from a global and historical perspective (Schubert 2005). It attempts to understand the socio-economic hierarchal scales and their effect on environmental issues (Blaikie and Brookfield 1987) in an effort to harmonise environmental, social and economic sustainability.

In addition to the analysis of resource access through use of power (especially gender allocation), Schubert (2005) believed that political ecology is an approach that examines political conflict at different administrative levels and environmentally induced conflict. He adds that owing to the importance placed on the theme of gender equity, power relations (economic, political and knowledge) are examined in the context of environment and society.

Granovetter (1995) maintained that societies experiencing sparse trust leads to inefficient economic systems. In cases where general trust is absent, legal institutions tend to be careful when dealing with unknown persons (Bigsten et al. 2000; Fafchamps 2006). Supporting the notion, Six (2005) and Zand (1972) mention that opportunities for mutually beneficial enterprise are usually hindered either through agents unable to find each other or through agents unable to trust each other. Breakdown in trust does not occur from debate and conflict but through a lack of openness (Fafchamps 2006). Aptitudes to comply with expectations of customary trusting behaviours are distinguished as intentions to perform competently and in good faith (Nooteboom 2007). Krishna (2002) pointed out that social capital notions such as norms and trust are not generalisable, and must be understood within specific cultural and political contexts. Reporting research on social exclusion, Hall et al. (2009) suggested that trust and equality could be improved by engaging impoverished communities early in the implementation stages of a rural development project.

Based on empirical studies, institutional economics perceives low-income countries should empower rural societies to play a stronger role in establishing and imposing rules to address vulnerabilities in rural settings (Agrawal and Gibson 1999). Buchholz et al. (2009) suggested that to achieve an expert sustainability indicator consensus a more practical-oriented exchange is needed between stakeholder scales and discipline. The failure to engage local communities in development projects has seen development and donor agencies come under increasing disapproval (Morse 2004). Fraser et al. (2006), state that participatory approaches generate a comprehensive list of useful indicators, and in the process communities become more empowered.

Moreover, in developing countries, the poor are often not represented by the available formal institutions (Jutting 2003). Based on empirical work, Fafchamps (2006) reveals that owing to the minor role legal institutions play in many African countries, informal institutions are especially important. Institutional economics examines informal institutions (behavioural norms, conventions and codes of conduct) in cases of weak policy compliance and enforcement capacities (North 1990). Linking formal and informal institutions becomes more imperative in light of Chang (2011) and Vermeulen and Cotula (2010) proclaiming that more secure property rights do not always empower citizens or enhance economic development.

Qualitative evidence suggests intermediaries can substitute institutions to compensate for the lack of formal institutions by supporting dependable relationships, thus, facilitating project transparency and efficiency (Mansuri and Rao 2004). Nooteboom (2007) advised that as misunderstandings between parties can easily arise due to disappointment in expectations, trust in intermediaries by all parties (especially in competence) is imperative to their success. He added that a mediatory body needs to facilitate trust building as well as preserving equality between altruistic and self-interest sources and maintain competence under conditions of adversity.

Mediating bodies are important for dealing with beneficiary frontline groups in assembling workable participatory processes – mobilising communities, ensuring legitimate representation, structuring the capacity for coordinated action, and if necessary expel exclusive domination (Mansuri and Rao 2004). Mosse (1997) cautioned external agencies from attempting to transform social and political dynamics without first thoroughly appreciating local facets as severe consequences can replace a disrupted social equilibrium, without a better replacement. To maintain a chain of transparency and confidence in 'knowing' for future contribution in decision-making, participation should extend beyond the initial phase into the implementation and monitoring processes (ELARD 2012).

As most programmes planned for increasing participatory implementation are not designed for people lacking formal education, research is needed to develop approaches that include such societies (Hall et al. 2009). The notion that enhancing knowledge is a primary source of growth is even more convincing in developing countries (Stiglitz 2011). Curtailing the disparity in knowledge between developing and developed countries is inherently linked to beneficial externalities or knowledge spill-overs. There is no reason for developing countries to restrict themselves by a lack of natural endowments, as their chief endowments are knowledge and entrepreneurship (Fukuyama 2001). Stiglitz (2011) challenged developing countries to learn from the lessons of the previous few decades, as countries have had financial success from policies different from the standard economic models that anticipated convergent growth.

Inclusive, long-term sustainable growth is the prime force reducing poverty in developing countries and for converging with developed nations (Lin 2011). Sustained growth may be necessary for poverty reduction, yet, as growth is not always pro-poor, developing broad-based policies that engender learning capacities of all persons are likely to be more aligned to be pro-poor (Stiglitz 2011). In view of development, Stiglitz (2011) declared the choice is not between ideal governments and ideal markets but between imperfect governments and imperfect markets (especially in many sub-Saharan African nations). He stated that systems in which the two interact effectively with each other must be researched, as they are to be treated as complementary by serving a check on each other.

Reflecting on the idea of conditional convergence, developing countries are well positioned on the assumption of diminishing returns to capital – weak economies with lower capita per person will develop more rapidly (Lin 2011). Owing to a complete lack of reasonable energy options for most peasant communities there is a need to explore options for biofuels, within the context of an energy programme based on local needs, in order to grasp these opportunities (Franco et al. 2010). Nevertheless, as supporting theories (e.g. Chang 2011; Lin 2011) and reported research of biofuel case studies (Duvenage et al. 2012b and Duvenage et al. 2012c) and the expert survey (Duvenage et al. 2012a) suggested, the efforts discussed in this section are likely futile unless emphasis is placed on ethical conduct (e.g. efficiency, accountability, transparency, responsibility and understanding) as key to achieving sustainability principles.

6.5 Examples of Analysing Initiatives

6.5.1 Sustainability Principles, Criteria and Indicators

Sustainability initiatives were examined in response to the suggestions of Diaz-Chavez (2011) and Haywood et al. (2010) that essential to achieve sustainable biofuel development is the selection of a set of sustainability principles, criteria and indicators that encompass and integrate the three pillars of economic, social and environment sustainability. The initiatives comprised 17 internationally recognised biofuel assessment frameworks analysed and discussed in Duvenage et al. (2012d), BEFSCI (2011) and the GBEP Task Force on Sustainability (2011). The following four initiatives, based on their thoroughness for principles and criteria (see Table 6.2), are examples of effective frameworks within which to plan, implement and monitor biofuel projects:

- RSB Principles & Criteria for Sustainable Biofuel Production (Voluntary) (Round Table on Sustainable Biofuels 2011).
- IDB Biofuel Sustainability Scorecard Sustainability Scorecard (Scorecards), Version Two, Based on the Round Table on Sustainable Biofuel Production, (Inter-American

Development Bank 2011)

- International Sustainability and Carbon Certification (ISCC) (ISCC Association 2010).
- Biofuel Environmental Impact Analysis (BIAS): Analytical Framework (FAO 2010).

Since indicators selected by “development experts” are unlikely to be relevant to local conditions it is necessary for local input to select indicators that accurately measure what is locally important (Carruthers and Tinning 2003). Generating a comprehensive indicator index through participatory approaches (Fraser et al. 2006) to measure sustainability criteria can enhance confidence in local societies and empower local representation (Agrawal and Gibson 1999; Buchholz et al. 2009). The selection of the four frameworks is an effort to instigate the suggestions of Janssen and Rutz (2011) and Scarlat and Dallemand (2011) for the need to harmonise the many biofuel sustainability initiatives.

A respondent of an expert survey (Duvenage et al. 2012a) suggested a need for a ’multilateral biofuel governance framework‘ designed for flexible transitional use between different enterprises by combining resources and bringing best practice together to advance sustainable development. These sectors can learn sustainability implementation initiatives from each other in relation to concepts discussed in political ecology such as conservation, community-based natural resource management and corporate social responsibility. For example the framework engineered by the Convention on International Trade in Endangered Species: Flora and Fauna (CITES) may offer an option within which to base biofuel development (refer to Table 6.3) – particularly for nations that lack formal institutions. CITES was developed between 1963 and 1973 and reached prominence in 1975 in response to concerns at the rate at which many wildlife species were threatened with extinction owing to unregulated international trade (Jenkins 2002). It is an international agreement, to which countries adhere voluntarily, which has a membership currently standing at 175 countries (CITES 2012). Although parties that have agreed to be bound by the convention are legally bound to implement the convention, it does not substitute for national laws. In effect, it provides a framework to be respected by the parties, who are required to develop their own legislation to ensure national implementation of CITES (Jenkins 2002).

Table 6.2 Sustainability aspects/issues addressed by four initiatives reviewed

Criteria	Assessment Initiatives			
	RSB	IDB	ISCC	BIAS
Economics				
Planning/Monitoring	✓	✓	✓	✓
Resource Utility	✓	✓	✓	✓
Viability	✓	✓		
Technology	✓			✓
Marketing	✓	✓		
Management	✓	✓	✓	✓
Best practice/Species	✓	✓		✓
International Relations			✓	
Environmental				
Environmental Integrity	✓	✓	✓	✓
Migration of workers	✓		✓	
Water/Soil Management	✓	✓	✓	✓
Waste Management	✓	✓	✓	✓
Chemical Use	✓	✓	✓	✓
Land Degradation	✓	✓	✓	✓
Sustainable Agriculture	✓	✓	✓	✓
Social				
Cultural Respect	✓	✓		✓
Sustenance Security	✓		✓	✓
Health	✓	✓	✓	✓
Education/Skills	✓	✓		
Livelihood Quality	✓	✓	✓	✓
Social Disturbance	✓	✓	✓	✓
Equality/Power Relations	✓	✓		
Equal Costs & Benefits	✓			✓
Energy security	✓	✓		
Participation/Networks	✓	✓	✓	
Enterprise Development	✓		✓	
Rural Development	✓	✓	✓	
Marginalisation	✓	✓	✓	✓
Policy				
Optimal Utility		✓	✓	
Compliancy	✓	✓	✓	✓
Enforcement Capacity	✓		✓	✓
Administrative Capacity	✓	✓		✓
Self-reliance				✓
Land Rights	✓	✓	✓	
Ethics				
Efficiency	✓	✓		✓
Accountability	✓	✓	✓	
Transparency	✓	✓	✓	✓
Responsibility	✓		✓	
Comprehensibility	✓	✓	✓	✓
Communications	✓	✓	✓	

(adapted from Duvenage et al. 2012d)

6.5.2 Convention on International Trade in Endangered Species (CITES).

Table 6.3 Distinguishing between the CITES framework and modifications for biofuel development (drawing on political ecology perspectives)

	CITES	Biofuels
Administration	Each party is required to designate at least one – management authority to administer certification and at least one scientific authority to advise on the effects of trade on the status of species".	Mediatory authority to administer certification and at least two scientific authorities to advise on the sustainability status (one on social and one on environment).
Set of criteria for the regular discussion and determination of implementation effectiveness	*Highly threatened species.* Trade to be controlled to avoid species utilisation incompatible to survival. Species protection where assistance of other CITES parties have been asked to help control trade.	*High-risk biofuel development.* Determine measures for levels of environmental and social risk to avert exploitation. Certification and monitoring to help control international biofuel trade.

(Adapted from CITES 2012)

The external context by which the CITES policy would work (adapted relevant to biofuel development) includes Millennium Development Goals, Rio Principles, biofuel marketing dynamics and national poverty reduction strategies (UNEP 2007). Internal factors include the integration of the certain factors between science and policy raised by Raymond et al. (2010). For example, the regulation of biofuel production methods, non-detrimental and legal land acquisitions, market monitoring, market review, reporting systems, certification and legislation enforcement (UNEP 2007).

Accepting and adapting the CITES initiative relevant to biofuel production can introduce an internationally recognised certification process, 'Convention on International Trade in Biofuels' (CITB), providing a dependable framework that can standardise best practice implementation approaches for biofuel assessment and monitoring systems (Mansuri and Rao 2004). From within the framework stakeholders can build trust through effective interaction in situations of imperfect governments and markets (Stiglitz 2011) – especially in cases that lack formal institutions (Jutting 2003; North 1990).

Table 6.4 displays the core sustainability principles that underpin CITES modified for utility for biofuel production.

Table 6.4 Core principles underpinning CITES policies (adapted for biofuel development)

Party-driven: The review is a voluntary process conducted by participating countries.
Capacity building oriented: the project is neither prescriptive nor linked to compliance mechanisms.
Results oriented: the project focuses on outcomes that will help the effective implementation of biofuel projects
Interdisciplinary: Biofuel-related policies and mechanisms are interdependent and involve different disciplines. Effort is made to strengthen the links between science and policy by integrating different disciplines and types of knowledge, ecology, law, economy, other social sciences and traditional knowledge.
Stakeholder-oriented: Particular importance is attached to stakeholder participation as a crucial element to increase the likelihood of the recommendations being accepted and implemented. The range of stakeholders includes rural poor organisations, cooperatives and community-level committees, representatives of indigenous people, as well as non-governmental organisations, social and environmental consultants, investors, relevant national and multilateral organisations and government bodies.
Partnership oriented – involving the coordinated participation of different actors from affected locals, governments and developers.

(Adapted from Jenkins 2002; UNEP 2007)

Table 6.5 displays the themes by which CITES endeavours to facilitate the member parties.

Table 6.5 Facilitation aims of CITES for member parties displayed alongside modifications for biofuel development

Develop a systematic understanding of existing biofuel development sustainability policies and practices and other relevant national policies that have an impact on sustainable biofuel achievement.
Assess the overall relevance, coherence and effectiveness of the different measures used to implement biofuel sustainability policies and the coherence of these measures with those of other policies
Increase understanding of the environmental, social and economic impacts of sustainable biofuel sustainability policies and identify measures to optimize the beneficial nature of those impacts
Identify opportunities to improve the content and implementation of sustainable biofuel sustainability policies.

(Adapted from CITES 2012)

Adopting the principles in Table 6.4 and implementing the aims of CITES (adapted for biofuel development) shown in Table 6.5 can assist developing countries address the sustainability principles raised in the literature. For example, see Table 6.6.

Table 6.6 The potential biofuel sustainability benefits by drawing on the CITES policy framework reviewal process

Environmental
Contribution to conservation and sustainable management for biofuel projects (Haywood et al. 2010)
Recovery of soil status and cropping yield enhancement through improved agro-production practice (Chang 2011)
Integrated management plans for food and energy security (Stiglitz 2011)
Production systems that do not remove incentives to conserve natural habitats (Rossiaud and Locatelli 2010)
Social
Opportunities for local communities to benefit from the sustainable use of natural resources and quality markets (Diaz-Chavez 2011)
Contribution to poverty reduction (Jutting 2003)
Sustainable livelihoods for local communities (Hawken 2007)
Empowerment and participation of rural poor (Dala-Clayton and Bass 2002)
Equitable benefit sharing (risk and benefit) (Moyo 2009)
Economic
Valuation of intrinsic and economic values of habitats and commodities (Diaz-Chavez 2011)
Facilitation of legal agreements (ethical business conditions) (Diaz-Chavez 2011)
Increased awareness of consumers and producers for values (O'Laughlan 2008)
Improved interaction between affected stakeholders (Gibson 2006)
Policy
Mainstreaming sustainable biofuel development policies into national development planning (von Maltitz and Stafford 2011)
Building coherence between biofuel policies and wider policies (Janssen and Rutz 2011)
Facilitating the development and implementation of better informed/sound policies (Scarlat and Dallemand 2011)
Contribution to relevant UN Millennium Development Goals
Institutional
Enhanced capacity and understanding of sustainable biofuel development design and implementation (Harrison et al. 2009)
Improved governance (i.e. decision-making and cooperation) (Fafchamps 2006)
Knowledge sharing with other bound parties (Janssen and Rutz 2011)

(Adapted from CITES 2012)

6.5.3 Bottom-up Design, Top-down Implementation

The recurring failures of top-down environmental and social management performances have motivated an interest in bottom-up approaches (Bryant 2011; Fraser et al. 2006). They suggest that instigating the developmental process in a top-down manner while allowing indicators to be developed in a bottom-up manner educates and empowers local people. ELARD (2012) does not consider the bottom-up approach as a substitution for or in conflict with top-down approaches, but rather as integrated support in pursuit of sustainable development. They defined the bottom-up method as the participation of local stakeholders in decisions regarding the allocation of priorities to be supported for their local area.

For local groups to effectively check against indiscriminate activities by governments and other players, greater involvement and authority needs to be channelled towards local communities (Agrawal and Gibson 1999). A crucial element of the bottom-up method is the capacity building of local citizens including education, training, raising awareness, the familiarisation of the strengths and constraints of the locality by local inhabitants, and the participation of diverse groups with different viewpoints in founding lucid sustainability indicators and suitable actions for a local development strategy (ELARD 2012). Fraser et al. (2006) suggested using a modest and transparent aggregation method that is lucid for diverse circumstances that must directly and promptly transpose into a formal implementation process. Uphoff (1992: 273) perceptively identified the value of reciprocally drawing on top-down and bottom-up methods in pursuit of sustainable development:

> Paradoxical though it may seem, 'top-down' efforts are usually needed to introduce, sustain, and institutionalise 'bottom-up' development. We are commonly constrained to think in 'either-or' terms – the more of one the less of the other – when both are needed in a positive-sum way to achieve our purposes.

The notion of bottom-up design, top-down implementation and shared monitoring may provide a system for inclusive participation without negatively affecting efficiency (ELARD 2012). In addition, the technique may address concerns for conflict arising through confusion (Nooteboom 2007) and mounting inequality (de Soysa 2002) as related biofuel development mature.

6.5.4 Intermediaries

Patient efforts by a mediating body to develop participation between local communities and outside developers can reap significant dividends (Deepa 1995). The basis to select and introduce a mediating body must include the performance of important matters of transparency, adept communications, equal stakeholder representation and the integration of diverse stakeholder perspectives (Duvenage et al. 2012a). An expert responding to a survey (Duvenage et al. 2012a) recommended that:

> an holistic and principled mediating body that pays attention to detail, may assist to intertwine and reconcile ethical project governance with sustainability principles. As interchange is likely to take place at a local village level, besides having a very good grasp of project aims and administration, as a standard requirement, the advisory/mediating body should also have a very good understanding of local social and environmental issues.

The mediating body, funded in a manner that preserves trust and impartiality, needs to equally represent all stakeholder groups, including those indirectly affected by the project. The conceptual framework (Figure 6.3) discussed in Duvenage et al. (2012a) presents a strategy, with the assistance of a mediatory body, towards addressing the difficulties of integrating the varied interests of diverse stakeholder groups.

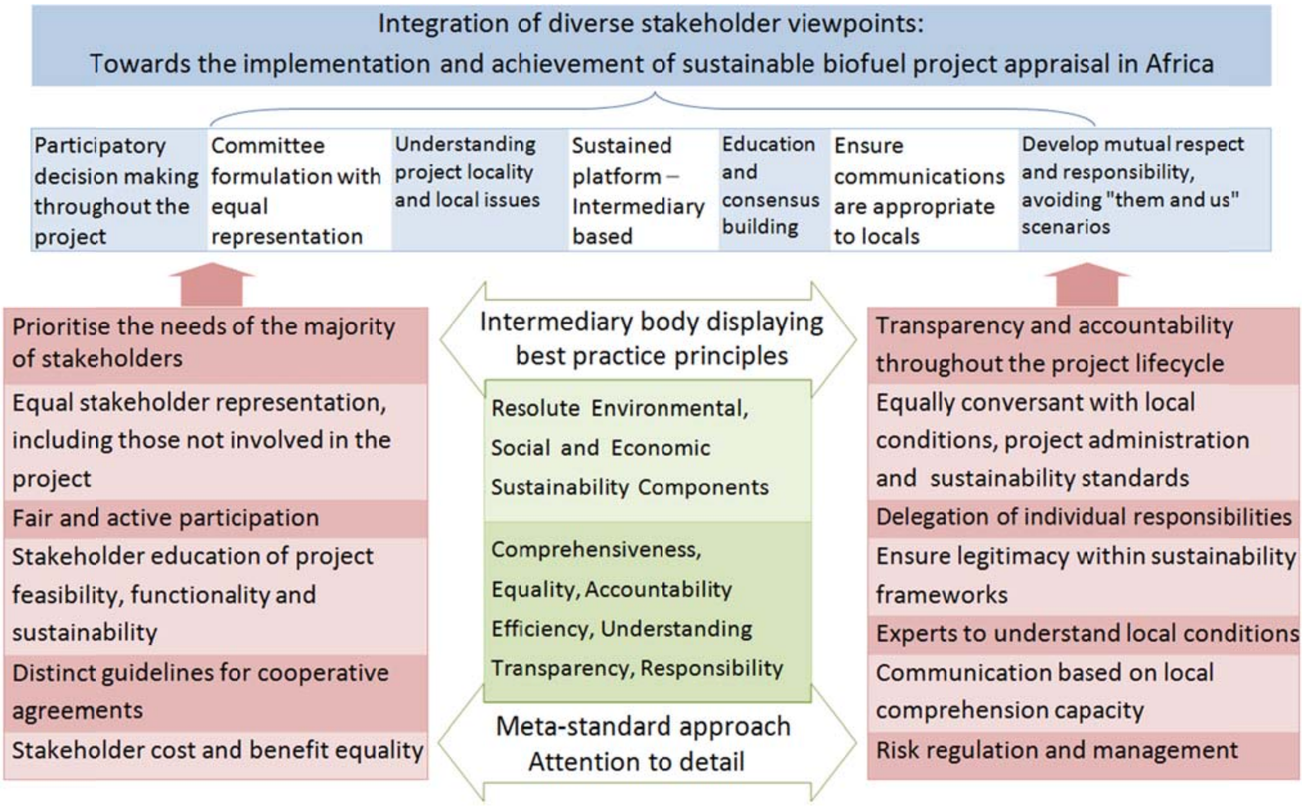

Figure 6.3 Strategy towards the integration of diverse stakeholder perspectives
(adapted from Duvenage et al. 2012b)

6.5.5 Q Methodology

Tools such as Q methodology can be implemented to assist a more balanced understanding of biofuel project costs and benefits between stakeholders with different levels of education, knowledge and perceptions (Hall et al. 2009; Stiglitz 2011). Providing a standard set of statements understandable to all participant levels, Q methodology can be most useful to build participatory confidence and transparency at a local level. The process is a method of science subjectivity, which was first used for measuring perspectives on future flood management on the Rhine (Raadgever et al. 2008) to provide a more in-depth analysis of human subjectivity issues (Amin 2000). Q methodology aims to address the concerns discussed in political ecology (Forsyth 2008) and social capital (Mosse 1997) of objectively identifying the shared perceptions and explicitly recognising individual perceptions via quantitative methods (Raadgever et al. 2008). A set of cards (Q-sample) is developed according to the phenomenon being researched and ranked on a 'scaled sorting matrix'. The sample can be in the form of imagery or statements (Previte et al. 2008).

The ranking procedure occurs with participants applying statements in an order according to how much they agree or disagree with them. The Q-sample size varies according to the study; the number of issues examined or depth of information required. The sorting matrix is symmetrically ranked in a form of quasi-normal distribution from -6 to +6 or determined numbers according to sample size (Previte et al. 2008). The participants keep positioning the statements on the matrix until satisfied with the ranking (Amin 2000). The point of the procedural step of having zero in the centre is to induce statements that are insignificant according to participant perspectives (Previte et al. 2008). The greater the emotive perspective for a statement the further it is positioned towards the two extremes on the matrix (most disagreeable – -6 or agreeable – +6). Statements achieving zero carry the least subjective significance (Amin 2000), and can define indicators that hold the least significance. The factors that emerge from the Q methodology interactive process are 'operational definitions' of preferences, opinions and experiences of participants. Statements can be analysed, tabulated and conclusions documented quantitatively or qualitatively, providing a balanced analysis of the perceptions for a bottom-up design, and conveyed for top-down implementation.

6.5.6 Sindex

To harmonise the three pillars of environmental, social and economic sustainability it is important to employ holistic techniques (Blaikie and Brookfield 1987). Yet, current biofuel development primarily engages profitability and the financial bottom line. Recognising environmental, social and economic principles, sustainability criteria can be evaluated and monitored for sustainability performance within a single decision paradigm (Langston 2012).

Recognising the triple bottom line method, a practical tool was developed to calculate a sustainability index by analysing multiple criteria (Langston 2012). The following four key criteria are analysed by the tool for assessing the sustainability of projects and facilities: maximising viability; maximising utility (functional performance); efficient resource use; and minimising habitat impact.

The option to adapt the tool to any number of unique conditions for biofuel development may assist the analysis of long term sustainability growth (Lin 2011), subsequently discussed in section 5.7. Providing latest data on the progress of a given set of sustainability principles, criteria, or indicators that can be understandable to participant representatives (Fraser et al. 2006) with at least a high school level of education, can help communities towards fairer negotiating powers (Agrawal and Gibson 1999).

6.5.7 Post-Occupancy Evaluation (POE)

Concern for a lack of retrospective follow-up on project performance, the Royal Institute of British Architects (RIBA) published a POE handbook in 1965 (RIBA 1965) for evaluating project progress (poor and successful) with the aim of improving existing projects and or the design of future projects (Hadjri and Crozier 2009). POE is defined by (Preiser 2002) as a process of methodical data gathering, analysis and an evaluation with explicitly specified performance principles. Loosely defined, POE represents any activities that generate an interest for understanding how a project performs, including the fulfilment of stakeholders' expectations of design and implementation (Vischer 2001). The central purpose of POE is to help understand the relationships between project facilities, project operation, stakeholder values and the environment (Hassanain et al. 2010).

Over the past 30 years several POE techniques have been developed and studied (Leaman and Bordass 2005), evolving into a standard approach that comprises gathering data on stakeholder interests through means such questionnaires, focus groups and in-situ observations (Preiser 2001). POE used by the U.S. Army Corps of Engineers in the 1970s and the Disney Corporation from the 1970s to the present, has progressed from a one dimensional process to a multi-level, multifaceted system integrating various facets of sustainability (Meir et al. 2009). The Disney Corporation applies POE to improve operational conditions and predictors for their key business drivers through establishing measurement indicators and the resultant knowledge databases *(Zimring and* Rosenheck *2001)*.

POE aims to facilitate many forms of integration central to harmonising environmental, social and economic sustainability. The following integration objectives of POE can contribute to the various complex sustainability issues of biofuel development (e.g. Diaz-Chavez 2011; Haywood and de Wet 2009) and to the understandings of supporting theories (e.g. Buchholz et al. 2009; Schubert 2005; Stiglitz 2011):

- integration between design, implementation and operation;
- integration of stakeholders, particularly investors, administrators, mediators and locals;
- integration of the different sustainability disciplines;
- integration of tools and methods, with suites of quantitative and qualitative traditions;
- integration of objective and subjective project performance and their measurement and experience;
- bringing notions and goals closer to implementation and achievement; and
- merging research with practice (Vischer 2001; Meir et al. 2009).

Vischer (2001) recommends an effective POE approach must consider the following aspects, which may provide a basis for an efficient monitoring approach for biofuel developments:

- a standardised, reliable and simple way for collecting data;
- decide on relevant indicators before project initiation;
- clarify at the outset who are the involved stakeholders and communicate results accordingly;
- inform stakeholders of the purpose of data gathering (i.e. environmental quality, stakeholder; satisfaction)
- devise efficient ways of gathering data;
- clearly define resources to ensure activities present quality data;
- standardise relevant data to analyse on a comparative basis; and
- design data collection according to the understanding of stakeholders.

The process, adapted from previous work by Hassanain et al. (2010) and Preiser (1995) that increases data validity through triangulation outcomes via different investigating methods, can add value as a participatory approach for monitoring the sustainability of biofuel developments, and is illustrated in Table 6.7.

Table 6.7 General processes for quality evaluation approaches

Conduct an in situ Observations
↓
Perform Focussed Group Discussions
↓
Conduct Interviews with Stakeholders
↓
Develop and Execute Questionnaires
↓
Analyse Gathered Data
↓
Stakeholder Representation Meetings
↓
Develop Action Plans to Improve Performance

(Adapted from Hassanain et al. 2010; Preiser 1995)

The leading benefits of POE for developing countries with regards to biofuel developments include addressing the following challenges raised in the literature:

1. *short term:* identification of solutions to problems; proactive management responses to stakeholders' values (Amigun et al. 2011); and improved stakeholder attitude through the active participation in appraisal processes (Dauvergne and Neville 2010),

2. *medium term:* improved design and understanding the consequences of design performance (ELARD 2012), and

3. *long term:* sustainability measurement and monitoring; enhanced databases; criteria and standards (Diaz-Chavez 2011); and improved measurement through quantification.

Notwithstanding the spread of purposes, Zimmerman and Martin (2001) suggest that, the primary advantage for conducting POE is the delivery of useful knowledge to support the aims of a constant cycle of improvement.

6.5.8 Enterprise Initiatives

The difficulties to ensure natural resources and benefits derived through biofuel developments are evenly distributed enlarge as developments mature (ELARD 2012). Political ecology, development economics and social capital discourse characterise unequal benefits as distribution imbalances in, inter alia, knowledge and access to finance. In December 2006, Muhammad Yunus (founding member of the Grameen Foundation) won the Nobel peace prize for restructuring how to bank with the 'unbankable' (Moyo 2009). Capital is loaned to villagers on the notion that villagers have one thing in common – a community of interdependence and trust (Ketola 2010).

The Grameen scheme works with groups from within a community rather than an individual (Ketola 2010). An individual within the group is leant money for a period of one year, and only once the money is repaid on expiration of the period the next individual within the group receives a loan (Moyo 2009). The idea is that it is in the interests of the group as a whole to repay the loan. Only the individual is responsible for the loan but each group is implicitly liable in the sense that the behaviour of a group individual affects the group as a whole (Ketola 2010). The group often repays for defaulting individuals and collects the money in the future. In Bangladesh 97% of loans are given to women. As of 2009 the scheme only experienced a two percent default rate (Moyo 2009).

Developing enterprise partnerships with project revenues, implemented along the principles of the Grameen scheme, may generate opportunities to address the concerns of unfair allocations of benefits from biofuel developments (Dauvergne and Neville 2010). Establishing joint ventures that link biofuel development with local enterprise can assist community interests remain compatible with the interests of developers. This can assist industrial opportunities to remain local with the benefits of an established cliental. In addition, in order to maintain the efficiency of local industries (important for the overall success of the biofuel development), developers are likely to strive to advance much needed training and expertise (Fafchamps 2006) in accord with the expanding biofuel development. Likewise, locals having a vested 'cooperational' interest are more likely to strive for the sustainability success of both the biofuel development and local industries.

6.5.9 E-technology

The manner in which information travels and the way business is conducted worldwide, has been revolutionised by digital technologies *(Lamoureux 2012).* "For a farmer good information is time sensitive" (Lamoureux 2012 p.1). The lack of timely and reliable technology in Africa has hindered contemporary farming opportunities, best practice, marketing and social networking capabilities (Williams 2009). The SEACOM and East African Marine Cable System (EASSY) fibre optic cable covering 17 000 km of fibre optic technology launched in 2009 to directly connect Southern and Eastern Africa with Europe and Southern Asia *(*Magambo 2007) is likely to unlock new opportunities in e-technology for much of sub-Saharan Africa.

While the internet and computers have been slow to reach remote rural villages, cell phones are becoming a popular assisting farming 'tool' (Nierenberg 2011). For example, an application has been designed to send small-scale dairy farmers individualised messages reminding them of their cows' feeding and gestation schedules, market updates and best practice advice (Kahumbu 2011). A system called Mobile Transactions has allowed isolated farmers in Zambia without bank accounts the ability through mobile phones to make purchases and receive payments electronically, as well as building a credit rating (Nierenberg 2011).

The difficulties for disseminating information in sub-Saharan Africa by radio and TV include: poor reception; the variations in levels of understanding; messages are sent when farmers are in their fields; the many diverse languages spoken; and the generalisation of messages (Opara 2008). Developing a mobile phone network between affected stakeholders of a biofuel project can lessen confusion (Schubert 2005) and through addressing a number of concerns raised in the literature and discussed by supporting theories. For example:

- *Transparency and trust* (Amigun et al. 2011; Diaz-Chavez 2011; Fafchamps 2006) – via greater individual involvement and direct communications (reducing the repetition of conveying information broadly).
- *Efficiency operation* (Mansuri and Rao 2004) – less costs and latest knowledge: for example, an individual that has the ability to promptly communicate faulty or suspicious activity to a central administration, via messaging or imaging transferral, can save time and resources.
- *Effective (active) Participation* (ELARD 2012; Raymond et al. 2010; Stiglitz 2011) – presents an opportunity for active stakeholder involvement, trust and effective representation.
- *Timely and logical communication* (Nooteboom 2007) – providing outgrowers and employees timely knowledge for aspects such as breakdowns, commodity prices and payments and significantly lessen misunderstandings and confusion.

6.5.10 Stakeholder Analysis

Stakeholders should be classified according to the extent they are affecting, or will be affected, by the phenomenon in question (Chevalier and Buckles 2008). Although it is not always practical to involve all stakeholders, and at times a line must be drawn (Clarke and Clegg 1998), care must be taken to avoid accidently omitting relevant stakeholders of the biofuel phenomenon. Reed et al. (2009) recommended three phases and six steps through which to proceed a typical stakeholder analysis (Figure 6.4). Recognising the context by which they are directed, participatory approaches to stakeholder analysis necessitate an iterative approach, providing feedback between the first and second phases shown in Figure 6.4 (Reed et al. 2009).

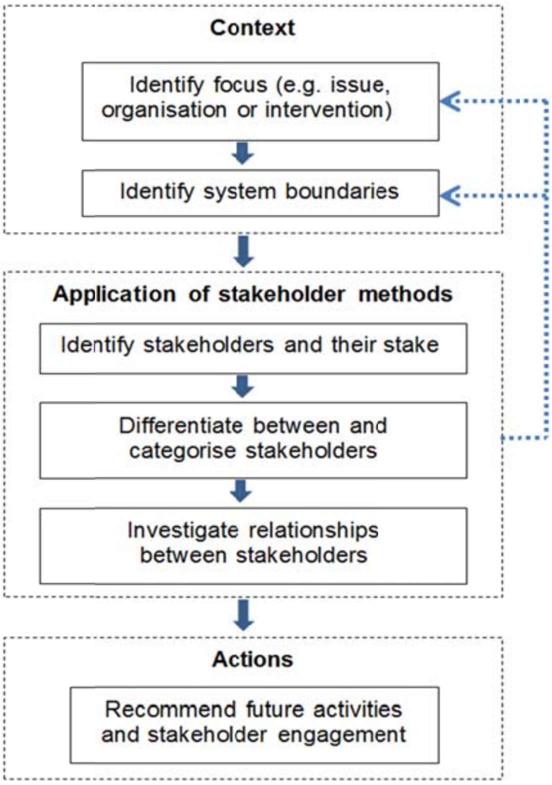

Figure 6.4 Key methodological procedures required for stakeholder analysis

Source: Reed et al. 2009

6.6 Proposed CITB Framework

A conceptual biofuel development process (CITB framework) is introduced to illustrate approaches that may offer potential design solutions for biofuel sustainability limitations. In addition to the conventions of CITES, employing approaches such as the examples in Figure 6.5, the CITB framework can form a platform for a set of implementation guidelines to help offset the limitations for achieving sustainability initiatives.

Further debate is sought on key stakeholders introduced in Figure 6.5, which are indexed according to the influence they are likely to impose on the various stages of a biofuel implementation process. Consideration of the literature (especially the perceptions of analysing stakeholders by Reed et al. 2009 and reported research (Duvenage et al. 2012a; Duvenage et al.

2012b; Duvenage et al. 2012c; Duvenage et al. 2012d) the following stakeholders (and symbols) are identified as actors most likely to influence the effects analytic initiatives have on the various stages of implementation. The legend comprises: A - Local Representatives; B - Mediator/Advisor; C - Investor/Developer; D - Government Agents; E - Local Leaders; F - Environmental Experts; G - Social Experts; H - Economic Experts; I - Lending Institutions; J - Extension services; K – NGOs; L – Indirectly affected stakeholders

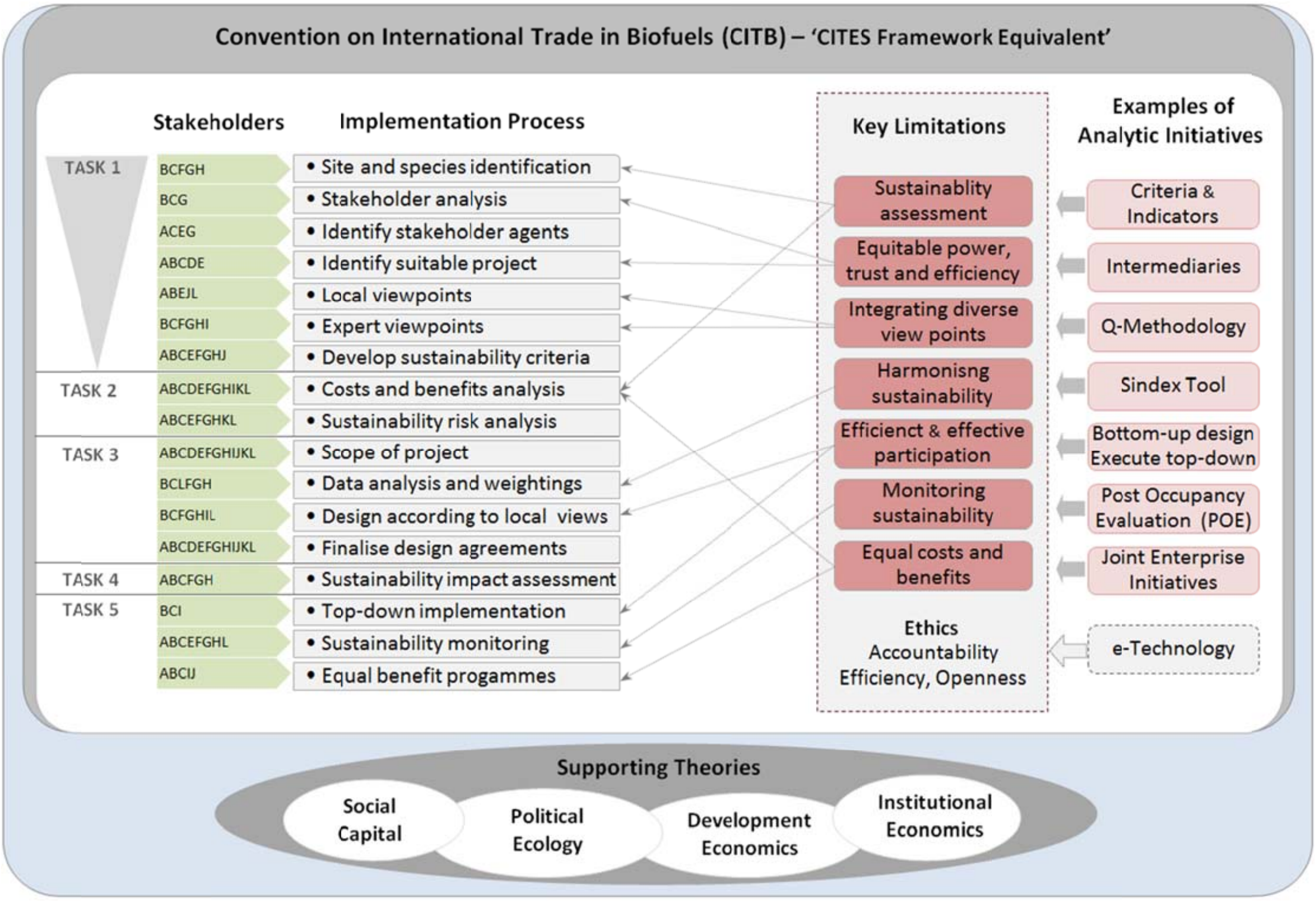

Figure 6.5 Conceptual sustainability framework: Towards understanding solutions to sustainability limitations

The basis from which the decisions for selecting criteria and indicators should ask – what good is it doing (advantages) and for whom; what harm is it doing (disadvantages) and to whom. This may be achieved by drawing on indicators of a suitable assessment framework and fine-tuning them with local active participation for individual projects according to micro, mezzo and macro characteristics.

If sustainability limitations mentioned in this paper are not addressed it is unlikely that sustainable biofuel development will be attained in developing countries, especially sub-Saharan Africa. Persistent inequality and conflict are likely unless implementers strive for an equal distribution of benefits throughout the life-cycle of the biofuel project. Even if various initiatives presented as examples in section 5 may have merit addressing key biofuel sustainability limitations, can at least inform implementation of available processes that are based upon the perceptions of theories exhibiting sustainability principles in relation to development in emerging economies.

Alternative to mandatory schemes, a voluntary scheme that presents a structure from which to gain certification for green production and gain entry into European markets can also provide best practice guidelines for biofuel production (and other commodities e.g. agriculture, mining, aquaculture) for domestic consumption. Pariah states or countries without the capacity to enforce sanctioning options are likely 'more willing' to join a convention that endorses voluntary conditions on member states. This may prove especially suitable if biofuels finger printed with "green" (sustainable) credentials hold higher economic value.

This research recommends the attachment of a set of implementation guidelines for sustainability assessment and certification initiatives to assist practitioners implement and achieve advocated sustainability principles. The guidelines should be adaptable to diverse biofuel development aims and the variances in micro, meso and macro conditions and include methods, tools and processes that can be drawn on to help achieve the objectives of sustainability initiatives. Applying the guidelines in an effective (active) participatory manner can remove the "them and us" developmental syndrome in emerging nations, lessening hierarchal power and the insecurity and distrust that comes with it. The guidelines assemblage should include effective participation procedures and stakeholder selection approaches to ensure an inclusive and effective representation. The aims of applying a set of implementation guidelines is not to force upon a landscape a given development but rather to formulate a set of approaches to cultivate a development that is fitting for a given landscape.

6.7 Recommendations and Conclusions

Primarily, this research attempted to unearth key sustainability limitations that have and continue to hinder the aims of sustainable biofuel development in sub-Saharan Africa. As a secondary purpose, and a way to move forward the research, the following three implementation activities have been examined and concepts have been volunteered to stimulate theoretical debate or empirical research. Firstly, a skeletal biofuel implementation process; secondly, although non-exhaustive, stakeholders considered influential to various phases of the implementation process; and thirdly, a set of initiatives (approaches/tools) to help address key biofuel sustainability limitations. Although the project implementation process is derived through a series of literature examination, case study research and responses through an expert survey, the progression is inconclusive, and needs further debate and adaption for each unique set of conditions.

The basis from which the decisions for selecting criteria and indicators should ask – what good is it doing (advantages) and for whom; what harm is it doing (disadvantages) and to whom. This may be achieved by drawing on indicators of a suitable assessment framework and fine-tuning them with local active participation for individual projects according to micro, mezzo and macro characteristics.

If the sustainability limitations mentioned in this paper are not addressed it is unlikely that sustainable biofuel development will be attained in developing countries, especially sub-Saharan Africa. Inequality and conflict are likely to persist in future in cases that developments do not ensure an equal distribution of benefits throughout the life-cycle of the project. Even if the various initiatives presented as examples to address key biofuel sustainability limitations have merit to assist practitioners, at a minimum they can inform debate of available processes that are framed within supporting theories relevant to sustainability and development in emerging economies.

Alternative to mandatory schemes, a voluntary scheme that presents a structure from which to gain certification for green production and gain entry into European markets can also provide guidelines for best practice for biofuel production (including other commodities e.g. agriculture, mining, aquaculture) for domestic consumption. Pariah states or countries without the capacity to enforce sanctioning options are likely 'more willing' to join a convention that endorses voluntary conditions on member states. This may prove especially suitable if biofuels finger printed with "green" (sustainable) credentials hold higher economic value. Although, schemes such as CITB are likely to be financed by investors, "for trust and impartiality, funding could be accessed through a holding trust administered by an independent group" (Duvenage et al. 2012b). The resources required to finance and administer schemes such as CITB may often reach beyond the means of smaller projects. Nonetheless, the concept can be useful, even in a simplified form that is realistic to the project's capabilities.

This research recommends the attachment of a set of implementation guidelines for sustainability assessment and certification initiatives to assist practitioners implement and achieve advocated sustainability principles. The guidelines should be adaptable to diverse biofuel development aims and the variances in micro, meso and macro conditions and include methods, tools and processes that can be drawn on to assist achieve the objectives of sustainability initiatives. Applying the guidelines in an effective (active) participatory manner can remove the "them and us" developmental syndrome in emerging nations in sub-Saharan Africa. This lessens hierarchal power trends and the insecurity and distrust that comes with it. The guidelines assemblage should include effective participation procedures and stakeholder selection approaches to ensure an inclusive and effective representation. The aims of applying a set of implementation guidelines is not to force upon a landscape a given development but rather to formulate a set of approaches to cultivate a development that is fitting for a given landscape.

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Chapter 7

Conclusion

7.1 Research Findings

The pursuit for energy security is driving demand for alternative sources, including an interest in biofuels in sub-Saharan Africa, which has incited divisive debate amongst experts and practitioners alike. The advancement of biofuels is ongoing, and with finite sources of fossils fuels, market demands for alternate transport energy are likely to continue increasing. This is especially important considering 80% of international energy requirements are in the form of fuel (coal, gas, oil). Likewise, the pursuit for alternate domestic energy sources away from woodfuels in developing countries is acutely dire. Biofuels may provide an option to these challenges in some cases, especially in southern central sub-Saharan Africa. Adopting this avenue raises many reservations, yet these uncertainties also suggest opportunities. Whilst the path to attain equitable biofuel development remains untrodden, the analysis provided in this thesis elucidates key sustainability concerns and offers constructive contributions towards the effective implementation and achievement of alternate energy options that observe the principles of sustainability.

The overarching research aim is to *recognise opportunities and limitations to the implementation and achievement of biofuel development sustainability principles in sub-Saharan Africa and to help understand solutions to limitations.* The findings provide an understanding of diverse challenges threatening the successful implementation of sustainability principles for biofuel developments in emerging economies. They comprise sensitive issues such as the marginalisation of communities, equal participation between stakeholders, equitable cost and benefit sharing, food versus energy tensions and the underlying issue of integrating the different views of diverse stakeholders.

Owing to the international interests in secure energy supplies, it appears certain biofuel production is here to stay and expand in the future. The thesis has logically researched different biofuel sustainability concerns in Zambia and Zimbabwe to gain a fair and meaningful outline needed to move forward the agenda for sustainable biofuel development. The achievement of the overarching aim is demonstrated through the discussion of the objectives founded in Chapters 2 – 6.

7.1.1 Objective 1 *Identify theoretical discourse exhibiting an interest in both sustainability and development in emerging economies, and develop a conceptual framework that can facilitate the challenges for the successful implementation of biofuel sustainability principles.*

An analysis of academic and grey literature to seek theoretical discourse that emphasises biofuel sustainability and development in emerging economies unearthed theories to construct a new a conceptual framework. Four theories were identified as relevant to this research. Political ecology (section 2.4.1), a problem-driven theory concerned with sustainability challenges in emerging economies, helps explain socio-economic scales of power and their resultant impacts on natural biodiversity. Development economics (section 2.4.2) can complement political ecology through its explanatory and solution-driven examination of success stories for, inter alia, the efficient allocation of scare resources and reasons for the vast inequities within and across borders. Drawing on social capital (section 2.4.3) compliments sustainability theories through macro and micro concepts regarding socio-economic relationships. Likewise, institutional economics (section 2.4.4) explains the value that informal institutions offer under circumstances of administrative and enforcement capacities, which can lead to the weak formal institutional settings often found in sub-Saharan Africa.

A reasonably inclusive set of sustainability principles was derived through the integration of five internationally recognised biofuel sustainability assessment/certification frameworks. Harmonised through the four supporting theories, these principles provided the platform from which to develop and evaluate approaches for informing biofuel implementation. Chapter 2 concluded by presenting a conceptual framework (Chapter 2, Figure 2.2) from which to inform the implementation of sustainability principles in relation to biofuel development in sub-Saharan Africa.

The focus of the research remained towards perceptions that offered a broad selection of micro and macro sustainability principles/criteria and which respected ethics as central to policy procedures. The underlying aspirations of such a framework are to assist biofuel implementation and recognise principles for socio-economic equality and environmentally responsive outcomes. Integrating the interests of the four supporting theories provides a conceptual framework that highlights the limitations for biofuel development in sub-Saharan Africa through political ecology and attempts to recognise ethical solution designs through the combination of development economics, institutional economics and social capital.

7.1.2 Objective 2 *Explore approaches towards the implementation of sustainable biofuel development in sub-Saharan Africa; especially, to reconcile and integrate diverse interests of different stakeholders affected by biofuel developments.*

Altogether, surveyed expert respondents were in favour of biofuel production in Africa; however perceptions varied towards the nature of development. Considering debates on stakeholder equality, food security and marginalisation, experts suggested the type and scale of biofuel projects would influence sustainability outcomes. Though small-scale projects were favoured ahead of agro-industrial projects, 80% of experts favoured the concept of partnerships between local stakeholders and developers. Most respondents advocated holistic participation as essential for achieving socio-economic and environmental sustainability.

Strengthening the underlying motivation for this research, the expert respondents stated that although sustainability assessment frameworks were a promising tool, they poorly represent to the diverse array of affected stakeholders with different levels of understanding and varying perceptions regarding the biofuel development phenomenon.

Local citizens in the case studies have lost faith in the ability of foreign investors to uphold corporate social responsibility principles, which highlights the significance of education and transparency. Understanding the concepts of sustainability through effective education combined with equal active stakeholder participation can assist locals advance the political ecology conviction that in order to achieve sustainability, developments must emphasise less coerciveness and more transparency. Considering that sustainability outcomes are more likely if interest for a development is equal between stakeholders, opportunities must be sought to address the difficulties of integrating the different interests of diverse stakeholders. Unless policy makers, experts and developers strive to fully understand local conditions, biofuel developments are likely to encounter future conflicts through a lack of socio-environmental equality.

Expert respondents emphasised, inter alia, the introduction of an advisory/mediating body as a possible solution to this. The advisory/mediating body must display proficiency for sustainability science and strive for a widespread understanding of both local conditions and the implementation of the related biofuel project. Chapter 3 concluded by presenting a strategy for active participation and the integration of the different interests of diverse stakeholders.

7.1.3 Objective 3 *Examine the uneven power relations of biofuel developments for their effects on socio-economic and environmental sustainability via case studies in the sub-Saharan Africa country of Zambia.*

Although only farmers who had the land capacity and management capabilities to effectively produce food and energy crops were invited by investors to cultivate Jatropha in Zambia, this research unearthed evidence of socio-economic shortcomings. Weak planning threatened the viability of the case study projects, largely through insufficient flows of feedstock owing to incorrect species choices and a lack of knowledge for local conditions and related agronomic practices. A similar fate has befallen many previous biofuel projects in Africa; many of which had failed to include local stakeholders from participating in project planning and design. However, based on the evidence derived through the case studies, a prime reason for project failures in Zambia is that Jatropha is not yet a viable option for commercialised biofuel production.

Local growers are encouraged to carry investment risks on crops of unknown qualities and often without the capacity to effectively cultivate them. In such cases any socio-economic benefits are unlikely to advance livelihoods. Conversely, informed species choices and methods for biofuel cultivation can assist secure local energy supplies and reduce the rate of deforestation. For example, cultivating Jatropha in the form of hedges contiguous to field crops, vegetable gardens or cattle pens can offer many local advantages to small scale producers. The durable and inedible Jatropha plant resourcefully acts as a livestock fence in addition to a source of oil for fuel or soap-making. Cultivated in this manner, plants acting as water erosion inhibitors are naturally fertilised by field and livestock residues.

7.1.4 Objective 4 *Ascertain local and national implementation opportunities and constraints of sustainable biofuel cultivation via case studies in the African developing country of Zimbabwe.*

The fourth objective called for evidence for sustainability opportunities and drawbacks for the implementation of large-scale biofuel developments in African developing countries. Through the Green Fuel case study in Zimbabwe this research identified that under definitive sustainability guidelines large-scale biofuel projects can offer socio-economic and environmental advantages. The biofuel development principally selected uncontested land that lay in an agro-ecological region normally only suited to livestock rearing. The local population primarily live in conditions of scarcity; on land that is increasingly degraded through erosion, deforestation and soil structural and nutrient degeneration.

The biofuel development has provided hope for alternate livelihood options, away from the trappings of food production in unsuitable conditions and diminishing access to natural resources. The opportunities for training and secure skilled job allocation can advance livelihoods and lessen the migratory impacts on families in pursuit of work. Although, a limited opportunity for small-scale farmers, the research recognised that the provision of a fully serviced portion of irrigated land by the biofuel case study project, in exchange for typically low-productive land, can improve local livelihoods through more secure food or cash crops.

The research identified local social benefits can extend beyond job opportunities. In the case of Green Fuel, the local health and educational facilities are rejuvenated. Law authorities, experiencing a large reduction in crime, can direct their expertise to more community useful activities. A local micro-economic climate is formed by self-generating enterprise through retaining service industries for biofuel projects and the needs of local employees (such as health, educational and biofuel project staff). The generation of electricity for local consumption from 'leftover' biogas enables the above mentioned opportunities and presents the potential to reduce local deforestation.

7.1.5 Objective 5 *Discuss limitations and opportunities for biofuel development to achieve sustainability in developing nations including solution designs (for further debate and research) to address specified limitations.*

This objective called for reflection on previous research reported in the previous chapters, supported through a transdisciplinary (Binder et al. 2010; Pezzoli 1997) literature analysis, to present holistic approaches towards the achievement of sustainability principles. Solutions designs were sought for the limitations to the successful implementation of principles and criteria of sustainability assessment frameworks. To achieve and monitor sustainability, the selection of an inclusive set of principles and criteria emerged through the analysis of assessment initiatives. These principles and criteria provided a platform from which to analyse and select theories to help understand and investigate solution designs.

The integration of the nominated theories (political ecology, development economics, institutional economics and political capital) essentially encompassed the broad multidisciplinary sustainability characteristics for biofuel developments in emerging nations.

The four theories provided the breadth for understanding development complexities in relation to harmonising social, environmental and economic sustainability. The challenges included stakeholder relationships and the integration of their diverse viewpoints; the integration of macro and micro socio-economics; effects of uneven hierarchal power relationships and methods for their neutralisation; the significance of socio-economic and environmental equality through informal institutional processes; ethical policy measures and approaches for their achievement; and the implications and approaches for effective participation towards equal cost and benefits.

It was considered that developing solution designs may help towards better understanding opportunities and concerns raised through theoretical analysis and empirical research reported in Chapters 2–5. Using a transdisciplinary method, cross disciplinary approaches (analytic initiatives) that exhibited flexible characteristics and were receptive to application in developing countries were identified. The approaches embedded in the CITB conceptual framework presented in Chapter 6 were proposed as potential solutions to the key limitations to implementation of sustainability principles. Informed by the four supporting theories and developed within modified conventions of CITES, the conceptual CITB framework attempts to link key actors, activities and sustainability limitations to potential solution designs at critical stages of a biofuel development process.

7.2 Discussion

The findings of the research objectives are integrated in this section by means of discussing the outcomes of the research questions (section 1.4). These understandings and solutions were unearthed through research conducted in addressing the objectives, reported in chapters 2 to 6, in response to achieving the overarching aim. Solutions to the six research questions – important to achieving the overarching aim – were considered in the design of the research in response to each of the objectives.

As previously discussed regarding the objectives, the research questions were addressed through a systematic and cumulative approach of: (a) identifying theory that recognises sustainability science and development in emerging economies towards a proposal of a conceptual framework from which to inform biofuel development; (b) recognising and characterising the opportunities and limitations for the implementation and achievement of sustainability principles of biofuel developments in emerging economies through an analysis of the literature and empirical research by way of survey and case studies; and (c) proposing potential solution designs that can constitute a conceptual biofuel implementation framework. Sustainability principles and criteria derived through an analysis of biofuel sustainability assessment frameworks provided the platform for sustainability science and the rationale behind the research.

RQ 1: *How have the dynamics between political, economic and knowledge hierarchies reinforced inequality and interrelated with sustainability outcomes?*

Sustainable biofuel development is unlikely in Zambia and Zimbabwe unless planning throughout all stages of implementation engages the broadest range of participants in a process of discussion, deliberation and debate. Through open understanding and participatory dialogue, projects that display planning considerations that strive to meet the socio-environmental demands conveyed in chapters 2 and 6, on a site-specific basis, have potential for sustainable outcomes. In other words: *a biofuel development that is likely to achieve socio-environmental sustainability is not a project forced into a given landscape but a project suitable to a given landscape and implemented within a set of suitable guidelines.* In all cases, sustainable development is only likely to be achieved if implementation ideologies are driven by ethical sustainability science that emphasises equality and the harmonisation of the social, environmental and economic perspectives.

This research uncovered a lack of confidence by experts (Harrison et al. 2009; von Braun and Meizen-Dick 2009) and local populations (Appendix B, Local small-scale farmer interviewees 2 and 13, Southern Province, Zambia) in Zambia and Zimbabwe for the abilities of foreign developers to exhibit corporate social responsibility. This is of concern considering sustainability outcomes are more likely in cases that participation and interest for the project is equal amongst all stakeholders (Doussou-Bodjrenou *et al*. 2010; Fischer *et al*. 2009; Janssen and Rutz 2011). Socio-economic assessments need to factor the influences of uneven political economy power relations and their link to unpredictable international financial markets. An informed mediating/advisory body was recognised as an option to advance corporate social responsibility through (section 3.8), inter alia, transparency, efficient stakeholder communications, impartial representation towards costs and benefits and an equal understanding for project design (encompassing environmental and socio-economic sustainability) and local conditions (section 3.10).

RQ 2: *How should costs and benefits be attributed and who should decide on their dispersion?*

Recognising that stakeholder analysis and agreement on the fair allocation of costs and benefits during the production of biofuel feedstock is especially complex, the assistance of approaches such as bottom-up design; top-down implementation (sections 6.5.3), post occupancy evaluation (section 6.5.7; Hassanain et al. 2010) and joint enterprise initiatives (Section 6.5.8), may provide platforms from which to begin. Through the assistance of cooperatives and intermediaries local individuals must be educated to recognise coercive behaviour and be empowered with the capacity to negotiate fair cost/benefit distributions.

RQ 3: *How can the contrasting views of diverse stakeholders be integrated?*

With the promotion of flexible performance, away from mechanised thinking towards systemic thinking (Fiksel 2003; Duplessis 2008), informed intermediary participation becomes an important implementation tool for socio-economic and environmental settings unfamiliar to either developers or local citizens. This thesis recognised the difficulty of satisfying all the contrasting viewpoints of different stakeholders, and in this regard, dynamic participation (action upon views) of local citizens was shown to be important. Through the efforts of intermediaries drawing on approaches and methods such as ‘bottom-up design, top-down execution’ (ELARD 2012;

Bryant 2011) and Q-methodology (Raadgever et al. 2008), projects developed in partnership with local communities are more likely to integrate and achieve the interests of diverse stakeholder groups as well as avoid future conflict (Respondent 31, Chapter 3, section 3.7, Q6). It is through an approach of this nature that biofuel development can begin to address the contrasting perceptions of socio-economic and environmental sustainability in Zambia and Zimbabwe or other sub-Saharan Africa countries.

RQ 4: *How can community integrity (livelihoods, health, education and freedom) be maintained?*

Emphasising community participation through cooperatives that are fairly represented on an intermediary panel may move towards impartially defining equal costs and benefits. This is especially important for large-scale biofuel developments that can display persuasive behaviour through uneven levels of knowledge and understanding (Sisay, 2010; Putman et al. 1993). In addition to creating employment, small-scale biofuel projects that process feedstock and retain fuel use locally can increase local energy security, reduce transportation costs, reduce deforestation and in remote rural areas provide a commodity that carries a premium. However, owing to local inexperience and a lack of resources and skills, production inefficiencies were observed to remain a major obstacle (Respondents 9 and 17, Section 3.7, Q1). Conversely, developers of large-scale projects need to be held accountable for social and environmental upheaval (Utting and Clapp 2008), especially in cases where deals are made with local and national governing bodies without an informed approval of local citizens. As a potential solution to preserve transparency, accountability and efficiency, the introduction of a 'bottom-up design and top-down execution' approach (ELARD 2012; Bryant 2011) with the assistance of an advisory/mediating body (Amazega et al. 2010; von Maltitz and Stafford 2011) can form a base to build local knowledge and a transparent communication network from which to negotiate the interests important to local communities. In such cases, large-scale biofuel projects developed in suitably assessed areas that emphasise equal costs and benefits advance the quality of livelihoods through, inter alia, health, education, skilled and secure job opportunities, increased food security and enterprise development.

RQ 5: *What are the impacts of land selection on issues such as inequality, marginalisation and environmental integrity?*

Research reported in section 5.5 suggested as a prerequisite, biofuel projects must opt for previously cultivated and largely underutilised land for reducing the threats that detrimentally impact the environment and local communities. To avoid conflict with food production and biodiversity, developers must strive to locate projects in agro-ecological regions unsuited to food production or regions of market isolation (Vermeulen and Cotula 2010). In addition, projects that help reverse soil and environmental degradation trends (through improper land-use systems) can have many potential socio-enviro-economic benefits (e.g. improved soil structure and fertility), leading to crop yield increases and the promotion of best practice (section 3.7, Q4 and Figure 3.4). The selection of the most appropriate biofuel project scale and feedstock species will largely depend on site-specific conditions.

RQ 6: *Which theoretical discourse identifies with these sustainability challenges in sub-Saharan Africa?*

Sustainability concerns in sub-Saharan Africa countries essentially include environmental protection, dispersion of costs and benefits, political-knowledge-economic hierarchal dynamics and their influence on equality, property rights and the impacts on marginalisation and community integrity. Four supporting theories were identified. Complementing the efforts of political ecology to understand socio-economic and environmental concerns (Zimmerman and Bassett 2003; Neumann 2009; Blaikie and Brookfield 1987), the perceptions of development economics (Bass 2011; Ray 2007), institutional economics and social capital (Dongier et al. 2001; Harrigan 2004; Putnam et al. 1993) help to understand causes and explain responses to economic, social and environmental sustainability challenges. Providing a more inclusive theoretical base, the integration of the multi-theory qualities led to the formation of a conceptual framework from which to understand and implement the diverse sustainability limitations and opportunities of biofuel development in emerging economies. Arguably, an intermediary body conversant with local conditions and project implementation may best serve sustainable biofuel development by understanding the principles of sustainability through this conceptual framework.

7.3 Contribution to Knowledge

Through an analysis of the contrasting views of biofuel developments in developing countries, concerns arise for both ethics and clarity regarding environmental, social and economic sustainability. Often underpinned by individual interests, opponents paint a grim picture of biofuels in developing countries, and promoters suggest biofuels as the opportunity for sub-Saharan Africa to become an energy powerbase. Ensuing discussions with colleagues and patrons at renewable energy assemblages highlighted the uncertainty with regards to opportunities and limitations of biofuel cultivation.

Owing to these discussions and an interest in natural environments and sustainable agriculture, the pursuit began for understanding the opportunities and limitations of biofuels in developing countries. More specifically, the original aim of the thesis was to develop an inclusive biofuel sustainability assessment initiative attached with a set of guidelines. This work highlighted that comprehensive assessment frameworks had since been developed by many interested international institutions, however a key outstanding issue remained – the successful implementation and achievement of such frameworks. With the idea of facilitating the achievement of biofuel sustainability principles (derived principally through the assessment frameworks) in sub-Saharan Africa (with a focus on Zambia and Zimbabwe), this research began a pursuit to elucidate limitations and seek opportunities.

In response to unearthing significant limitations to the opportunities that can be explored through biofuel production in developing countries, solution designs (analysing initiatives) have been presented (section 6.5). The integration of concepts, approaches and methods developed in this research offer increased clarity and potential solutions for a way to move forward the implementation and achievement of sustainability principles in relation to biofuel development in sub-Saharan Africa. The following examples summarise the more significant contributions by this research, which were reported in each of the intermediate chapters:

- The development of a conceptual framework that provides a more comprehensive theoretical base for biofuel development in sub-Saharan Africa (Chapter 2)
- Approaches for selecting a mediatory body, and manner by which the body may be most effective (Chapter 3)
- Reasons for biofuel project failures in sub-Saharan Africa, and potential solutions to achieve biofuel development sustainability (Chapter 4)
- The sustainability of biofuel developments is not dependent on the scale, but rather the nature of project and the manner in which it is implemented (Chapter 5)
- An integrated conceptual framework offering solution designs in response to the more significant limitations to biofuel development uncovered by this research (Chapter 6)

Having examined the principles of sustainability (section 2.3; 2.4), theoretical discourses were analysed to better understand the concepts of sustainable biofuel production in developing countries. Owing to a lack of theory specific to biofuels, the research drew on the strengths of four theories to achieve a more inclusive underpinning frame. Combining and entwining the four theories delivered a balance between recognising sustainability concerns, understanding causes and explaining responses. Political ecology (section 2.4.1), development economics (section 2.4.2), social capital (section 2.4.3) and institutional economics (section 2.4.4) were integrated to form a new conceptual framework (Figure 2.2) from which to analyse the sustainability principles of biofuel development.

As interchange is likely to take place at a village level, a mediating/advisory body that grasps the notions depicted by the four supporting theories can assist to integrate the contrasting views of diverse stakeholders (Respondents, section 3.7, Q7; Table 3.2). This intermediary body, demonstrating an informed understanding of local conditions and project design and implementation, can provide the association for equal stakeholder interaction needed to address the wide-range of tensions across political, economic and knowledge hierarchal levels. The approaches (section 3.10; Table 3.3) for selecting the body and via which the body may most effectively operate provides a platform from which to circumvent misunderstandings, inequality and conflict. Through means such as this, in conjunction with biofuel developments exhibiting ethical social and environmental responsibility, opportunities arise for sub-Saharan Africa countries to develop more secure alternate local and national energy supplies. Given the assistance of intermediaries and credible transparency and trust combined with educating local stakeholders on project design and values, the demands of both developers and local stakeholders can be met.

The research conducted in Zambia (section 4.5) highlighted that Jatropha is not the model crop under less than ideal conditions as was often suggested in the literature (Brittaine and Lutaladio 2010; da Schio 2010; Renner and Winckler 2007). Until further research is conducted on Jatropha varieties, soil types, water needs, pests and yield potential, it is not considered a viable commercial biofuel cropping options. Conversely, the research recognised that Jatropha planted as hedge-rows posed a potential benefit for small-scale farmers (section 4.5). The oil from hedgerows that is reserved for local processing and consumption can generate local enterprise and an alternate energy options. Nevertheless, it is unlikely to provide quantities large enough to satisfy local energy demands.

The examination of case studies provided the understanding that unless efficient and transparent planning and implementation involves the active participation of all stakeholder groups, sustainable biofuel development is likely to remain problematical. Emphasising community participation (Stringer et al. 2006) through cooperatives that are fairly represented (Cotula et al. 2008) on an intermediary panel may move towards impartially defining equal costs and benefits. This is especially important for large-scale biofuel developments that can display coercive behaviour through uneven levels of understanding (Dauvergne and Neville 2010; Franco et al. 2010).

Large-scale biofuel projects developed within the guidelines of sustainability can improve community and environmental integrity. However this is reserved for projects that display suitable design and implementation approaches on a site-specific basis, for example, reversing land degradation trends (including deforestation and soil exploitation) and areas not predisposed to food cropping. This research emphasised that financially viable biofuels are unlikely to be produced on degraded land, meagre growing conditions or under weak management. The selection of project type and implementation suitable to the location decidedly affects the sustainability outcome of the project.

Chapter 5 identified the potential to allocate fairer costs and benefits over the life-cycle of a biofuel project, through the development of mutual enterprise and equal stakeholder interest in the success of the project (section 5.5). Retaining service industries locally provides integration between affected stakeholders. Stakeholders that share a common interest in a project are likely to strive in harmony for its success (section 5.5).

Given that local communities are currently impacted owing to a lack of empirical reporting on biofuel production in developing countries, this thesis offers timely research. The structure of the proposed conceptual CITB framework (section 6.6; Figure 6.5) demonstrates key limitations to sustainability at various implementation stages and probable stakeholders likely to affect solution design outcomes. The trans-disciplinary potential solution designs (analytic initiatives) (section 6.5) presented in the conceptual CITB framework help to move forward debate and approaches to achieve sustainability principles in biofuel development in sub-Saharan Africa. Linking the solution designs to sustainability limitations (section 6.6), the implementation process and stakeholders responsible for their application, provides practitioners (e.g. experts, NGOs, government agencies and local consulting agents, developers and implementers) with a platform from which to develop biofuel implementation policy and guidelines.

7.4 Implications for Practice

The aim of the research was centred on the application of findings. This thesis recognised that research is essentially incomplete until applied to a practical environment to advance the situation. The objective has been to recast findings into a practical context. Recommendations for further empirical research in a practical setting are discussed in section 7.5.

The conceptual framework can form the platform from which to begin further analysis and eventual application in practice. Through the four supporting theories and empirical research, this thesis uncovered ways that may assist practitioners to integrate diverse stakeholder interests towards equal representation and dynamic stakeholder participation.

The findings from the case studies and expert survey have provided biofuel implementers in sub-Saharan Africa (and internationally) access to empirical knowledge that may help avoid implementation oversights costly to local socio-environmental settings. In addition, this research has conveyed a concept that to achieve sustainability project design needs to be appropriate to local conditions. Likewise, the findings of this thesis (i.e. inappropriate project choice, environmental and social costs and benefits through biofuel development, benefits for engaging intermediaries and the advantages for effective participation and representation) delivers awareness to biofuel practitioners of the limitations for achieving sustainability. This presents an opportunity through approaches that circumvent or address the limitations to improve resource utility and lessen the likelihood of conflicts through approaches that circumvent or address the limitations.

Practitioners (e.g. government agents, developers, experts, academics and NGOs) may benefit by applying, if not wholly, segments of the proposed conceptual CITB framework for policy development or biofuel project planning and design purposes. The application of solution design initiatives articulated in section 6.5 may help advance methods or define new approaches to assist the implementation of sustainability principles at the various phases of the biofuel implementation process.

7.5 Directions for Further Research

This thesis has revealed several useful and interesting future research prospects. The options for research are based on criteria classified high in importance but short in practicality and reliability. Further research on each of the solutions designs discussed in section 6.5 and presented in the CITB conceptual framework may elucidate practical options to address key limitations at critical stages of the biofuel implementation process. Applying the various approaches to further case study situations can provide empirical evidence with respect to their practical utility. Relevance to other developing countries is an obvious area for investigation.

Considered high in importance for achieving biofuels sustainability principles, further investigation into a voluntary multilateral biofuel governance framework designed for flexible transitional use across disciplines is suggested. A framework that has two sets of attached guidelines lucid and practical to developing countries may be appropriate: the first for administrative compliancy procedures; and the second for the implementation and achievement of sustainability principles for biofuel development.

In regard to the second set of guidelines, research is needed to improve active stakeholder participation while maintaining efficiency; for instance, in the form of the 'bottom-up design, and top-down implementation. A related line of research on advisory/mediatory bodies could usefully examine mechanisms to safeguard stakeholder trust through efficient communications, transparency and dynamic participation to enable equal representation. In the same vein, sustainability is a concept requiring perpetual monitoring, thus an examination of the post occupancy evaluation concept may offer systems to effectively observe the dynamics of biofuel sustainability life-cycles – especially concerning external impacts, gender equality, natural resource maintenance and the allocation of socio-economic cost and benefits. Although the solution designs discussed in section 6.6 have demonstrable value in cross-disciplinary (Scoones 2009) activities, their practical utility for biofuel sustainability implementation remains to be explored.

In order to avoid future conflicts, methods need to be explored for stakeholders to analyse and agree on the fair allocation of environmental and socio-economic costs and benefits over the lifecycle of the biofuel project. This is especially important for projects that continue to expand in scale and value over an extended period (several years). Gender inequality in sub-Saharan Africa remains a key limiting factor for achieving social equality. To explore a standardised biofuel policy for developing countries, useful research must include injurious gender characteristics through customary and cultural beliefs in relation to biofuel developments.

As noted in section 5.5, the concerns for socio-environmental impacts through staff migration trends prompted developers to transport staff to work on a daily basis. Nevertheless, the impacts from population growth through the expansion of service industries need to be studied for health effects owing to water accessibility and an increasing burden on the natural environment.

Presently, information remains inconclusive on land use and water use owing to the limited empirical reports in developing countries. There is an opportunity to investigate the potential land and water available for biofuel production on country-specific basis. A study that emphasises land and water use in relation to food security and local socio-economic and environmental costs and benefits would be a useful contribution towards local and regional biofuel policy design.

7.6 Final Reflections

Biofuels can offer sustainable energy options in developing countries, however, opportunities are being frustrated through weak design and implementation strategies. The situation persists with much uncertainty and sustainable biofuel production remains problematic. The adoption of the CITB framework (Figure 6.5), or part thereof, is designed to assist stakeholders of diverse backgrounds and interests to participate in recognising and achieving solutions to biofuel sustainability limitations. From a platform such as this, weak project design can be addressed and opportunities for sustainable biofuel development can arise.

The poverty issues in sub-Saharan Africa appear to be worsening, and are likely to continue, owing to rising populations and continued natural resource deterioration at the hands of dated farming practices, corrupt governance and desperate survival measures. Soil degradation, deforestation, energy shortages, poaching and depletion of water supplies is expected to accelerate owing to the lack of the pragmatic implementation of sustainability. The challenge to reduce poverty is for experts not to publish research that is confined to theory or censure, but to support opportunity by providing pragmatic solutions (i.e. bridge the gap between academia and practice); solutions that recognise the reasons for poverty (i.e. corruption, lack of education, environmental degradation, lack of reliable energy trade imbalances and marginalisation through uneven power relations); and that ethically implement and achieve social, environmental and economic sustainability. Owing to complex social and environmental variations within countries and across borders, the best chance of achieving these goals is by only drawing on expertise that displays a broad understanding of specific biofuel project settings (internal and externalities).

This research suggested there is sufficient land in sub-Saharan Africa, in many situations, to satisfy both food and energy needs. Presently the use of land in sub-Saharan Africa is well below ideal in relation to the following viewpoints: inter alia, soil degradation; poor cropping yields; conditions unsuited to cultivated species; deforestation and water use. Biofuels offers rural populations in Sub-Saharan Africa (70% of the African population (World Bank 2010)) a real opportunity to improve neglected agriculture infrastructure and to compete in world commodity markets. For example, sub-Saharan Africa can cultivate a product (biofuels) that is in high demand in the northern hemisphere. In addition to attracting competitive economic returns through strong demand, this product is presently not affected by the unfair trading created by oversupplies through the European and North American farming subsidies.

Regions that constantly experience crop failure, owing to poor growing conditions, would do well to lift themselves out of poverty by selecting more feasible cropping options. Well-designed biofuel projects may offer such a cropping opportunity. Regardless of project scale, biofuels implemented with the help of approaches and frameworks presented by this research, can offer a realistic local and/or national energy option.

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Appendix A Expert Survey Questions and Responses

Respondent's Backgrounds	Environmental/ Biodiversity	Bioenergy	Economics	Agro-production	Social Capital Building

		QUESTION 1
	RESPONDENTS	**What biofuel development in Africa do you favour if rigorously produced within a sustainability framework?** **A. None not at all** **B. Small scale production by local villagers** **C. Central projects and subcontracting to local farmers** **D. Industrial operations, to gain economies of scale, offering local jobs** **E Any project**
1	**Environmental Management**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers
2	**Nature Conservation**	Small scale production by local villagers
3	**Environment and Natural Resource Management**	Central projects and sub-subcontracting to local farmers
4	**Ecologist**	Small scale production by local villagers c. Central projects and sub-subcontracting to local farmers d. Industrial operations, to gain economies of scale, offering local jobs. (This is always context specific and depends on the purpose of the operation (production for local/domestic use and/or for export markets)
5	**Environmental Policy**	b. Small scale production by local villagers c. Central projects and sub-subcontracting to local farmers d. Industrial operations, to gain economies of scale, offering local jobs e. Any project - if you are taking a national view of biofuel production, I think a mixture of approaches is needed to offer maximum benefits (within a sustainability framework of course!)
6	**Environmental and Sustainability Scientist**	Central projects and sub-subcontracting to local farmers Industrial operations, to gain economies of scale, offering local jobs
7	**Environmental Scientist**	Projects should be considered carefully and decided upon by the positive environmental impacts they are likely to displace.
8	**Development Consultant; Focus on Environment**	Caution for any biofuel development must be the foremost consideration. Site specific considerations for each case.
9	**Biofuel Producer, engineering Environmentalist**	Small scale production by local villagers Industrial operations, to gain economies of scale, offering local jobs. Other: Whether produced at small or large scale, an operation has to be sustainably carried out so that, at the end of the day, all players would experience a NET positive result.

10	**Sustainable Energy Access Experts Assessments**	Small scale production by local villagers
11	**Biofuels Project Planner**	Central projects and sub-subcontracting to local farmers
12	**Energy and Development Consultancy**	Small scale production by local villagers
13	**Biofuel Standards**	Industrial operations, to gain economies of scale. It can probably be a mix, but in order to get the industry of the group and to get commitment from the fuel industry, industrial operations are important.
14	**Sustainability Assessment**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers Industrial operations, to gain economies of scale, offering local jobs Other (Please comment) Outgrowers scheme with a central projects, but not necessarily under subcontract.
15	**Lifecycle Assessment**	Central projects subcontracting to local farmers Industrial operations, to gain economies of scale, offering local jobs. You do not define biofuels upfront, so I assume that you are using a restrictive definition, with only first generation biodiesel and first generation bioethanol included.
16	**Energy Systems**	Small scale production by local villagers. Central projects and subcontracting to local farmer
17	**Bioenergy**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers
18	**International Political Economy of Development**	Small scale production by local villagers
19	**Commodity Market Analyst**	Small scale production by local villagers
20	**Project Economics and Sustainability**	Central projects and sub-subcontracting to local farmers Genuine partnerships, working together as one, not as two different bodies trying to compromise
21	**Policy Analyst and Economist**	Small scale production by local villagers This is especially so when local farmers produce biofuels to promote rural development e.g., ude of multifunctional platforms.
22	**Economics of water, agriculture, biofuels**	Any project
23	**Sustainable Development**	Small scale production by local villagers
24	**Agricultural Consultancy**	Small scale production by local villagers Central projects and sub-subcontracting to local farmer Most of the African population are small scale farmers specially my country Ethiopia. so, it is better to start with small scale by local villagers which will be sustainably. side by side it is also important to have a central project.

25	**Rural Development**	Central projects and sub-subcontracting to local farmers
26	**Sustainability Systems Analyst**	Any project
27	**Researcher on African Agrarian studies**	Small scale production by local villagers Industrial operations, to gain economies of scale, offering local jobs
28	**Plant and Soil Scientist**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers Industrial operations, to gain economies of scale, offering local jobs All of the above would be subject to a number of conditions, i.e. non are automatically good or bad. Rather each would have to be reviewed within its circumstance.
29	**Biofuel Agrarian Irrigation Engineering**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers
30	**Agronomist: Sustainable Agriculture**	The implementation of crop is what is important. The crop most suited to the conditions available. The type of project is important rather than the size.
31	**Researcher on Sustainability-Resource Sector**	Any project
32	**Natural Resource Management**	Small scale production by local villagers with a little investment intervention that can help to share management techniques and the skill and the marketing.
33	**Land Tenure and Policy Development**	Small scale production by local villagers
34	**Consortium for Capacity Building**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers Industrial operations, to gain economies of scale, offering local jobs
35	**Bioenergy and Land Use**	Any project
36	**Sustainability and Capacity Building**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers Farmers already use dry biofuels as a source of energy for their livelihoods. I would like the introduction of liquid or gas biofuels to support the energy transition of the rural communities. The value added will help not only the rural economy but also the country as a whole.
37	**GIS mapping - Area suitability for biofuel cultivation**	Small scale production by local villagers Central projects and sub-subcontracting to local farmers Depends on the feedstock. Oil from local villagers growing Jatropha for e.g. can be used to generate electricity for the village. Sub-contracting local farmers to grow sugarcane for e.g. generates an income
38	**Climate Change, Agriculture and Food Security**	Any project One difficulty would be "indirect impacts" and displacement effects to other locales, which would need to be handled within the sustainability framework.

		QUESTION 2
	RESPONDENTS	**Do you consider it responsible for an investor who is attempting to sustainably develop biofuels, to engage African countries with weak governance?**
1	**Environmental Management**	Maybe : The sustainable biofuels project could become a 'best practice' example but not doubt bribes would need to be paid to establish the project which calls into question ethics associated with sustainability
2	**Nature Conservation**	No
3	**Environment and Natural Resource Management**	No: weak governance and sustainable are exclusive concepts. Its near impossible to attain sustainability in an environment of weak governance
4	**Ecologist**	Any investor has to make choices. In case he decides to invest in a country with weak governance I guess he is aware of the problems his going to face and, therefore, has considered potential difficulties in his planning.
5	**Environmental Policy**	This may serve as an example for best practice in countries where biofuels are likely to be developed. I think biofuels can provide an investment opportunity and in countries with weak governance, opportunities are often few and far between. I think in taking a responsible approach, investors should look to other experiences in other (similar) contexts to ensure they are entering into that country with their eyes open to the opportunities, risks and threats and that they should be looking across sectors (beyond biofuels) to learn from e.g. conservation and Community-based natural resource management; CSR in relation to mining etc. There is often a tendency to remain focused in a particular sector or country when experiences are there to be learned from more broadly!
6	**Environmental and Sustainability Scientist**	Foresure, what an investor may see as weak governance may but be what that country perceives. If government is bypassed, this will only lead to disaster.
7	**Environmental Scientist**	Only if there is a strong understanding of the risks. Land is a highly political issue in Africa.
8	**Development Consultant; Focus on Environment**	Most weak governance results in biodiversity loss and social inequalities.
9	**Biofuel Producer, engineering Environmentalist**	Yes: if the investor can present a win-win project, and take transparent measures in its operations.
10	**Sustainable Energy Access Experts Assessments**	Yes: It is important from the very early stages to involve governments even if they have weak governance. First weak governance can always be improved. this is important to ensure fair sharing of the benefits for investor, government and local people

11	**Biofuels Project Planner**	Yes
12	**Energy and Development Consultancy**	Maybe: I think in countries with weak governance, sustainable small-scale interventions can still work well. The problem with large-scale interventions or investments is that rely on a greater degree to on a strong, independent and efficient bureaucracy to regulate them - which is clearly not always present.
13	**Biofuel Standards**	No: It is very likely that the locals on the ground will reap very little benefit out of these investments. I.e. limited impact on rural livelihoods, apart from some jobs....
14	**Sustainability Assessment**	It cannot be judged as that. Many countries (not just in Africa) have weak governance but this should not be an excuse. The companies should be looking for the adequate conditions to promote these projects and sometimes governance is put of the hands of the investors.
15	**Lifecycle Assessment**	Maybe: Depends on the investor's motives and ethical compass.
16	**Energy Systems**	Maybe: But the risks are huge, including reputational risks.
17	**Bioenergy**	No
18	**International Political Economy of Development**	No: Investing in countries with weak governance is irresponsible. It is also irresponsible to invest in land owned by communities, since you displace them. It is also irresponsible to invest on government land, since it has a purpose - like forests, reserves and parks. In short, most countries percieved to have free land do not have it, and that is why these investments lead to conflict.
19	**Commodity Market Analyst**	Yes: do so with transparency. expose attempts by officials to seek bribes.
20	**Project Economics and Sustainability**	Maybe: Corrupt officials are not to be trusted at any stage. Can work but risky. On condition the morals and ethics are maintained at all stages
21	**Policy Analyst and Economist**	No: The African country with weak governance is unlikely to benefit from such engagement
22	**Economics of water, agriculture, biofuels**	Maybe: 1. It would seem like a risky investment 2. Low risk that infrastructure would remain with the project; long term risk of non-sustainable practices 3. external governance to support country-level weak governance -- ngo's; international oversight
23	**Sustainable Development**	No :Not without accountability towards the local population
24	**Agricultural Consultancy**	Maybe (: leave alone such projects, it is very difficult to implement small projects in a country where governance is very poor. When thinking sustainability, Stakeholders should involve voluntarily. In weak governance it is hard to bring stakeholders together. From investors point of view, it is possible to bring such project a reality even in a weak governance are in place. The ethics of the approach is the determining factor.
25	**Rural Development**	No: Likely to be hijacked by the ruling elite. It is for the people not for the governance that is why the investors who are involving in such sustainable projects is responsible

26	**Sustainability Systems Analyst**	Yes
27	**Researcher on African Agrarian studies**	Yes: It is possible to sustainably invest in biofuels provided stakeholder consultative processes are undertaken and proof and guarantee are given that local communities and economy stands to benefit
28	**Plant and Soil Scientist**	Yes: provided they uphold ethical standards. These countries are offer most in need of development. However the opportunity to exploit is high. If the company does the correct planning, involves local role-players, pays good wages and is externally audited on good practice, I can see no reason why they should not be involved in countries with weak governance.
29	**Biofuel Agrarian Irrigation Engineering**	yes , but consideration for the temptation of unethical behavior, difficulties in operating in these environments is both time consuming, unpredictable and costly. There is a high risk of local populations being manipulated
30	**Agronomist: Sustainable Agriculture**	I do not understand the intricacies of some of the politics in Africa. If best practice cultivation is applied it should be beneficial.
31	**Researcher on Sustainability-Resource Sector**	Maybe: but expect inefficiency and up and downs to appear within the respective system
32	**Natural Resource Management**	No: Any weak government can't realize any effective and sustainable development strategy.
33	**Land Tenure and Policy Development**	No
34	**Consortium for Capacity Building**	Maybe: It depends on the resolve of that investor and their preparedness to play a longer game.
35	**Bioenergy and Land Use**	Yes: But they must be principled and stick to those principles. The only way to achieve this is to be totally transparent and include respected NGOs
36	**Sustainability and Capacity Building**	Maybe: It depends on the definition of weak governance. If the problem of governance is related to the situation in Somalia, it might be insecure for the investor as well. However, if the company is governed by high standard of ethics, it might even lead to the creation of best practices for other companies to follow.
37	**GIS mapping - Area suitability for biofuel cultivation**	Yes: if they don't, some other investor who may be less scrupulous will.
38	**Climate Change, Agriculture and Food Security**	Maybe: Some large resource-extracting companies can make valid claims to have improved and stabilised governance, or at least set good working examples, in countries with weak governance.

		QUESTION 3
	RESPONDENTS	**Which of the following criteria do you consider most likely to assist in achieving the aims of best practice biofuels production framework?** **A. Sustainability framework including implementation guidelines** **B. Educating local populations on sustainability** **C. Bioenergy production sanctioning body** **D. Biofuel project Sustainability Ranking Scheme** **E. Any Project**
1	**Environmental Management**	Sustainability framework including implementation guidelines A-1; B-2; C-3; D-4; E-
2	**Nature Conservation**	Sustainability framework including implementation guidelines A-2; B-3; C-1; D-4; E-
3	**Environment and Natural Resource Management**	Sustainability framework including implementation guidelines A-1; B-3; C-2; D-4; E-5
4	**Ecologist**	Sustainability framework including implementation guidelines. Again, this is all context specific, and the ranking can change case by case A-4; B-2; C-3; D-1; E-
5	**Environmental Policy**	A-2; B-3; C-4; D-1; E-5
6	**Environmental and Sustainability Scientist**	A-2; B-1; C-3 D-4;
7	**Environmental Scientist**	Training and research extension workshops.
8	**Development Consultant; Focus on Environment**	Education of stakeholders on the overall project considerations should be prioritised. This includes the framework is structured and what it hopes to achieve.
9	**Biofuel Producer, engineering Environmentalist**	Sustainability framework including implementation guidelines A-1; B-2; C-3; D-4; E-
10	**Sustainable Energy Access Experts Assessments**	Sustainability framework including implementation guidelines A-3; B-4; C-1; D-2; E-
11	**Biofuels Project Planner**	Educating local populations on sustainability A-2; B-1; C-3; D-2; E-
12	**Energy and Development Consultancy**	Educating local populations on sustainability A-4; B-3; C-2; D-1; E-
13	**Biofuel Standards**	Sustainability framework including implementation guidelines A-1; B-3; C-2; D-4; E-

14	**Sustainability Assessment**	A-2; B-1; C-4; D-3;
15	**Lifecycle Assessment**	Other: Market instruments - rules that make a difference to the financial bottom line. A-1; B-4; C-5; D-3; E-2 I would regard charcoal and biogas as biofuels too, but am giving my answer here as applying to that restrictive definition.
16	**Energy Systems**	Sustainability framework including implementation guidelines. Rigorous tracking of supply chain A-4; B-1; C-2; D-3; E-
17	**Bioenergy**	Educating local populations on sustainability A-2; B-1; C-4; D-3; E-3
18	**International Political Economy of Development**	Sustainability framework including implementation guidelines A-2; B-1; C-3; D-4; E-
19	**Commodity Market Analyst**	Educating local populations on sustainability A-1; B-2; C-3; D-4; E-
20	**Project Economics and Sustainability**	Sustainability framework including implementation guidelines A-1; B-2; C-4; D-3; E-
21	**Policy Analyst and Economist**	Bioenergy production sanctioning body A-2; B-1; C-3; D-4; E-
22	**Economics of water, agriculture, biofuels**	Other: The property rights structure to drive reliability of the investment and corresponding governance is critical A-1; B-4; C-3; D-2; E-
23	**Sustainable Development**	A-1; B-2; C-4; D-3; E-
24	**Agricultural Consultancy**	Sustainability framework including implementation guidelines A-4; B-5; C-2; D-3; E-1.
25	**Rural Development**	Sustainability framework including implementation guidelines. Important to set a framework for ensuring household food security with the implementation of the chosen strategy to avoid all land being dedicated to the biofuels enterprise. A-2; B-4; C-3; D-1; E-
26	**Sustainability Systems Analyst**	Educating local populations on sustainability A-5; B-4; C-3; D-2; E-1
27	**Researcher on African Agrarian studies**	Bioenergy production sanctioning body A-1; B-3; C-2; D-4; E-
28	**Plant and Soil Scientist**	Sustainability framework including implementation guidelines A-1; B-2; C-4; D-3; E
29	**Biofuel Agrarian Irrigation Engineering**	Sustainability framework including implementation guidelines A-1; B-2; C-4; D-3; E-

30	**Agronomist: Sustainable Agriculture**	The implementation of a pilot project that displaces best agricultural practices and then training the locals.
31	**Researcher on Sustainability-Resource Sector**	Sustainability framework including implementation guidelines A-2; B-5; C-3; D-4; E-1
32	**Natural Resource Management**	Sustainability framework including implementation guidelines A-1; B-5; C-4; D-2; E-3
33	**Land Tenure and Policy Development**	Educating local populations on sustainability A-1; B-3; C-2; D-4; E-
34	**Consortium for Capacity Building**	Biofuel project "Sustainability Ranking Scheme" Clear national strategy connected with international best practice A-1; B-4; C-3; D-2; E-
35	**Bioenergy and Land Use**	Sustainability framework including implementation guidelines need to remember that biofuels are a relatively small issue and we should not overburden local people in the rural areas of developing countries A-1; B-4; C-3; D-2; E-
36	**Sustainability and Capacity Building**	Sustainability framework including implementation guidelines A-3; B-1; C-2; D-4; E-
37	**GIS mapping - Area suitability for biofuel cultivation**	Educating local populations on sustainability. The guidelines and criteria are more appropriate to large sclae operations. A-3; B-5; C-2; D-4; E-1
38	**Climate Change, Agriculture and Food Security**	Other : Legal and economic incentives for compliance by businesses throughout the value chain A-1; B-2; C-3; D-4; E-

		QUESTION 4
	RESPONDENTS	**Which of the following do you regard as most likely to achieve sustainable biofuel production in those African countries with weaker governance?** **A. International sanctioning body** **B. Ethical corporate governance** **C. NGO involvement in the project** **D. Rigorous sustainability criteria by lending institutions** **E. None of the above. Add Comments.**
1	**Environmental Management**	Strong international sanctioning body A-4; B-2; C-1; D-3; E-
2	**Nature Conservation**	Advancement of ethical corporate governance A-3; B-2; C-1; D-4; E-
3	**Environment and Natural Resource Management**	Rigorous sustainability criteria by lending institutions A-1; B-4; C-5; D-3; E-2
4	**Ecologist**	Rigorous sustainability criteria by lending institutions It depends all on the context. Hence, ranking can change from one case to another A-1; B-3; C-2; D-4; E-
5	**Environmental Policy**	A-4; B-3; C-2; D-1;
6	**Environmental and Sustainability Scientist**	A-2; B-3; C-4; D-1;
7	**Environmental Scientist**	Understand the systems in place in the country and local areas. Ensure the communications remain open and leave no areas for doubt.
8	**Development Consultant; Focus on Environment**	Ethical corporate governance is very often absent in Africa. I do not believe they can be relied upon. I think it has to be a combination of systems.
9	**Biofuel Producer, engineering Environmentalist**	Rigorous sustainability criteria by lending institutions Capacity building of key decision makers and drivers in Government. A-2; B-1; C-4; D-3; E-
10	**Sustainable Energy Access Experts Assessments**	Strong NGO involvement in the project A-4; B-2; C-1; D-3; E-
11	**Biofuels Project Planner**	Strong international sanctioning body A-3; B-2; C-1; D-4; E-
12	**Energy and Development Consultancy**	Other: Stronger role for trade unions, farmers associations and community groups. A-3; B-2; C-1; D-4; E-

13	**Biofuel Standards**	Advancement of ethical corporate governance A-3; B-4; C-2; D-1; E-
14	**Sustainability Assessment**	A-4; B-3; C-1; D-2;
15	**Lifecycle Assessment**	Strong NGO involvement in the project A-5; B-2; C-3; D-1; E-4
16	**Energy Systems**	Strong international sanctioning body. Rigorous tracking of supply chain A-2; B-3; C-4; D-1; E
17	**Bioenergy**	Advancement of ethical corporate governance A-5; B-1; C-2; D-3; E-4
18	**International Political Economy of Development**	It has to be locally based for local use, in order to be sustainable. Commercial will never be sustainable A-5; B-3; C-2; D-4; E-1
19	**Commodity Market Analyst**	Rigorous sustainability criteria by lending institutions A-4; B-1; C-3; D-2; E-
20	**Project Economics and Sustainability**	Advancement of ethical corporate governance A-3; B-1; C-4; D-2; E-
21	**Policy Analyst and Economist**	Strong NGO involvement in the project A-3; B-4; C-1; D-2; E-
22	**Economics of water, agriculture, biofuels**	Marketable demand for sustainably produced biofuel A-3; B-1; C-2; D-4; E-
23	**Sustainable Development**	A-4; B-1; C-2; D-3;
24	**Agricultural Consultancy**	Advancement of ethical corporate governance A-3; B-1; C-4; D-2; E-5.
25	**Rural Development**	Strong international sanctioning body A-4; B-3; C-1; D-2; E-
26	**Sustainability Systems Analyst**	Strong NGO involvement in the project A-3; B-2; C-4; D-5; E-1
27	**Researcher on African Agrarian studies**	Strong NGO involvement in the project A-2; B-4; C-3; D-1; E-
28	**Plant and Soil Scientist**	Advancement of ethical corporate governance This depends on if there are alternate markets or if all fuel can only be sold through certified markets. so in trueth unless more detail is given on exactly what any option above means in practice, this question is difficult to answer in a meaningfull way A-4; B-2; C-3; D-1; E-
29	**Biofuel Agrarian Irrigation Engineering**	Advancement of ethical corporate governance Sustainable projects will only be achieved if a holistic approach is stringently followed. A-3; B-1; C-4; D-2; E-

30	**Agronomist: Sustainable Agriculture**	To achieve frameworks' sustainability aims, would require an inclusive understanding by stakeholders. This would require suitable education on all aspects of the biofuel project and the local situation.
31	**Researcher on Sustainability Resource Sector**	Rigorous sustainability criteria by lending institutions A-4; B-3; C-1; D-2; E-
32	**Natural Resource Management**	Rigorous sustainability criteria by lending institutions A-1; B-5; C-2; D-4; E
33	**Land Tenure and Policy Development**	Strong NGO involvement in the project A-4; B-2; C-3; D-1; E-
34	**Consortium for Capacity Building**	Strong NGO involvement in the project Capacity and organisational development at community level including support to co-operative and producer associations A-3; B-4; C-2; D-1
35	**Bioenergy and Land Use**	Rigorous sustainability criteria by lending institutions A-3; B-4; C-2; D-1; E-
36	**Sustainability and Capacity Building**	Strong international sanctioning body A-2; B-4; C-3; D-1; E-
37	**GIS mapping - Area suitability for biofuel cultivation**	Rigorous sustainability criteria by lending institutions Policy dedicated to Biofuels needs to be formulated and an independent Biofuels Task Force established to advise relevant government minister on whether to grant permits to applications to use large tracks of land for biofuel feedstock production A-1; B-3; C-4; D-2; E-5
38	**Climate Change, Agriculture and Food Security**	Strong international sanctioning body A-2; B-3; C-1; D-4; E-

		QUESTION 5
	RESPONDENTS	**Please offer your ideas on why many biofuel projects do not adequately achieve the objectives of biofuel production frameworks?**
1	**Environmental Management**	Local stakeholder considerations are neglected.
2	**Nature Conservation**	Lack of knowledge from experts and clearly communicating goals
3	**Environment and Natural Resource Management**	Limited markets and the unit production cost of biofuels which is still significantly higher that of fossil fuels. Increasing demands of sustainability only make the cost higher.
4	**Ecologist**	Firstly, there are not that many biofuel projects really up and running. Secondly, I think one cannot generally say that there is evidence that many do not adequately achieve the objectives you are referring to.
5	**Environmental Policy**	Projects are often tied to funding requirements in such a way that project delivery becomes a box-ticking exercise where there is insufficient time/resources to do more than the minimum required. Sanctions would be near impossible to enforce because of the huge investment in monitoring, reporting and verification that would be needed.
6	**Environmental and Sustainability Scientist**	Not enough interest and not enough knowledge to actually implement the projects
7	**Environmental Scientist**	Environmental factors are not carefully considered. The impacts this can have on local biodiversity can be far reaching. This affects local populations as well.
8	**Development Consultant; Focus on Environment**	Lack of environmental and agronomic understanding, and a lack of planning
9	**Biofuel Producer, engineering Environmentalist**	There is great selfish interest by governments, companies and individuals involved in the fossil fuels value chain so that the American phrase "Don't mend it if it ain't broken" prevails in many cases. A laissez faire (leap-service?) approach to biofuels agendas are therefore what you often notice.
10	**Sustainable Energy Access Experts Assessments**	Lack of effective policies, strategies and regulatory frameworks and strong instituional framework
11	**Biofuels Project Planner**	From the private sector point of view, there is inadequate 'patient' capital invested into the industry to 'wait' for long term returns.
12	**Energy and Development Consultancy**	I think the multiple benefits claimed for biofuels (fuel security, trade growth, jobs increase, environmental gains, infrastructure development) leads to confusion about what exactly they are for. This confusion is not only apparent within local communities, but also government and to some extent industry.
13	**Biofuel**	Poor policy framework with limited incentives

	Standards	
14	**Sustainability Assessment**	There is little information on how they are working currently. There are different froms of production but in some countries in Africa is still too early to know the whole benefits.
15	**Lifecycle Assessment**	I do not know of any such projects
16	**Energy Systems**	No clear criteria; inadequate supply chain tracking; poor governance
17	**Bioenergy**	Because of inadequate involvement of local community, like during initial planning of the project and in advance awareness related to short and long term benefit of the project .In general the projects need to be designed and implemented in a way local community be a direct beneficiary of the outcome of the project.
18	**International Political Economy of Development**	The processes are designed to profit the companies at the expense of the people who own the land. They are based on misinformation to the communities
19	**Commodity Market Analyst**	they are funded by foreign organizations; they acquire land by illegal means; they put farmers at risk to market pricing
20	**Project Economics and Sustainability**	Communications between parties is not balanced. Ethical business practice is waning. Greed from certain parties, corruption within the planning and implementation stages
21	**Policy Analyst and Economist**	Lack of national policies and strategies for safeguarding sustainable biofuel production.
22	**Economics of water, agriculture, biofuels**	Demand for product; need massive scale to justify transport to other markets. Subsidies are still largely aligned with 'traditional' petroleum-based fuels
23	**Sustainable Development**	They are not transparent or patient
24	**Agricultural Consultancy**	we have had some biofuel projects which are not successful in Ethiopia. The main reasons are the projects were not well designed and not able to see the grass root at all. the other reason is the stakeholders are not consulted
25	**Rural Development**	Benefits to small holder farmer do not offer adequate incentives.
26	**Sustainability Systems Analyst**	Economic incentivisation needs to be put in place to encourage producers in Africa.
27	**Researcher on African Agrarian studies**	Lack of all-inclusive stakeholder participation in planning, implementation and monitoring and evaluation of biofuel projects
28	**Plant and Soil Scientist**	The economics of the operation policy insecurity, especially as related to mandatory blends. poor governance, both corporate and national. Investors trying to make a quick buck, this is especially true for Jatropha when proper research was not done.

29	**Biofuel Agrarian Irrigation Engineering**	Planning and communication with all stakeholders. Unequal interest in the project between stakeholders
30	**Agronomist: Agriculture**	Expertise is lacking for the conditions on the ground. A lack of understanding by investors.
31	**Researcher on Sustainability Resource Sector**	lack of developing realistic sustainable cropping systems on a large scale, which includes a ready infrastructure
32	**Natural Resource Management**	May be they have started without having clear objective in the sustainable energy development.
33	**Land Tenure and Policy Development**	Not sufficiently anchor with the owners, users and holders of rights over land and the producers that are well known for their roles in the production process
34	**Consortium for Capacity Building**	Weak regulatory frameworks and mixed messages from policymakers and donors/financiers.
35	**Bioenergy and Land Use**	Interesting - can you justify this statement empirically. There has certainly been intense scrutiny on foreign investment-led biofuel projects, some of which have been highly controversial (e.g. Tana River in Kenya). In my view much of this has been overblown and it has severely stifled investment that is very much needed- particularly in infrastructure
36	**Sustainability and Capacity Building**	I think the biofuels strategies of many African countries as well as those strategies by the African union are only on paper. For example, the African Union strategy states that biofuels will transform the rural energy system that is based on biomass into clean energy. In reality, it is the foreign investors that are pushing the farmers, the nomads and the wild life reserves that are creating potential conflicts.
37	**GIS mapping - Area suitability for biofuel cultivation**	Investors do not do their homework properly. e.g. in one area in Zambia, people are unable to harvest the biofuels crop properly because it needs harvesting at exactly the same time of year as they need to prepare the soil and plant their food crops. They do not have enough local labour to do both
38	**Climate Change, Agriculture and Food Security**	Because they (a) are voluntary and (b) confer little if any market advantage

		QUESTION 6
	RESPONDENTS	**What would you propose to assist biofuel projects to achieve framework objectives?**
1	**Environmental Management**	No Response
2	**Nature Conservation**	Implement program with informed knowledge from all stakeholder perspectives
3	**Environment and Natural Resource Management**	An enabling policy environment
4	**Ecologist**	Difficult to say in general terms, depends on the specific case and the areas you are looking at. For instance, there are specialized firms which can assist in carrying out environmental impact assessments etc.
5	**Environmental Policy**	Capacity building at the local level is vital as well as moves by funders and those responsible for project delivery to look more holistically not only right across the 3 pillars of SD but also to make long-term time horizon considerations central to projects.
6	**Environmental and Sustainability Scientist**	Not enough interest and not enough knowledge to actually implement the projects
7	**Environmental Scientist**	Strong environmental and social guidelines. Ones that take extreme conditions into account, i.e. climate and politics.
8	**Development Consultant; Focus on Environment**	Attention to detail to all social and environmental aspects
9	**Biofuel Producer, engineering Environmentalist**	To promote and propagate live successful examples to the public who in turn would put pressure on governments to take workable approaches.
10	**Sustainable Energy Access Experts Assessments**	Yes, could share our experience in participating in different studies and actual field implementation experiences to assist biofuel projects to achieve framework objectives
11	**Biofuels Project Planner**	The government and the private sector need to collaborate more closely so that the industry can grow on more sustainable basis.
12	**Energy and Development Consultancy**	More training for groups truly representative of poorer stakeholders and stricter obligations on companies to integrate them into decision-making processes.
13	**Biofuel Standards**	It will really depend from one project to the next, but if there is merit, then yes
14	**Sustainability Assessment**	It depends on the goal of the project, community level, private initiative, government initiative, mixed (private and gov). Depending on the goals and how feasibility studies are done in order to consider all env, social and economic issues will be achieved.

15	**Lifecycle Assessment**	People who know local conditions and who care about real development.
16	**Energy Systems**	Rectifying the failings listed in the previous question
17	**Bioenergy**	Local biofuel production task force that may include agricultural research centers, agricultural and rural development offices, agricultural Colleges and universities, and local community leaders would be useful to achieve biofuel objectives. Creating local level framework would be more beneficial for sustainability of biofuel than regional or national framework.
18	**International Political Economy of Development**	They should be developed for local use at community and national levels. They have failed as a viable investment due to the assumption that there is available land for the venture in Africa and other developing countries
19	**Commodity Market Analyst**	Fingerprint the biofuels so that the location of origin can be found. as there are all kinds of deals made over other energy sources and their adverse impacts on the environment, one can expect same misdeeds for biofuel production
20	**Project Economics and Sustainability**	Ethical governance, More transparency, fairness and guidelines for all parties
21	**Policy Analyst and Economist**	No Response
22	**Economics of water, agriculture, biofuels**	Integrated regional production/demand hubs. Demonstrate economic base to drive next-tier service industries
23	**Sustainable Development**	Accountability to the local population
24	**Agricultural Consultancy**	in the biofuel projects, the objectives should look first the grass root communities issues then better design the objective based on this. I think this mainly help in the success of this project.
25	**Rural Development**	Involve local participation.
26	**Sustainability Systems Analyst**	Economics needs to be thoroughly explored and clarified.
27	**Researcher on African Agrarian studies**	Include all relevant stakeholders at all levels of biofuels projects
28	**Plant and Soil Scientist**	This must start before project approval. Local stakeholders need to be given impartial information over a number of meetings. They need the opportunity to get informed and impartial advice on plans. Only then can they be expected to give free and informed consent (or rejection). Formalised partnerships need to be entered into with the community where they have substantive and real equity in the project (remember, it is in effect their land that they are bringing to the party). There is a need for unbiased facilitation and sound record keeping of meetings and agreements. Land rights need to be protected

29	**Biofuel Agrarian Irrigation Engineering**	Better information and communicating the information. Avoid misunderstandings
30	**Agronomist: Sustainable Agriculture**	Intense planning and affiliation with best practice .
31	**Researcher on Sustainability Resource Sector**	you need coop growers, sustainable cropping systems, processing facilities, and the growers must be able to earn a guaranteed profit.
32	**Natural Resource Management**	Open/ transparent experience sharing and the development support.
33	**Land Tenure and Policy Development**	Community involvement
34	**Consortium for Capacity Building**	There is not a glib answer to this. Many levels of challenges are faced. What are "framework objectives" also.
35	**Bioenergy and Land Use**	Clear standards and frameworks for implementers but also a more balanced view emerging from NGOs and the international press- in practice it means that they need to recognise the multiple pressures on land (some of which are new).
36	**Sustainability and Capacity Building**	The main objective and measurement of biofuels development should solve the rural energy problem and contribute to rural livelihood sustainability. Many rural communities put energy security in par with food and water security. I think those should be the objectives of any framework for biofuels development.
37	**GIS mapping - Area suitability for biofuel cultivation**	Research into where to grow, what to grow, what scale, who should be producing, etc and what developments need to be put in place to avoid detrimental environmental impacts, benefits locals, move the harvest out and process it.
38	**Climate Change, Agriculture and Food Security**	Shift from voluntary to compulsory frameworks, alongside relevant economic incentives for companies to comply and, better still, to be ahead of legislation

		QUESTION 7
	RESPONDENTS	**How do you propose that local stakeholders in Africa could be adequately represented in biofuel project developments?**
1	**Environmental Management**	Leaders of local villages, NGO representatives and government officials at all levels should be involved in stakeholder meetings and ideally decision-making ie participation and not consultation
2	**Nature Conservation**	With an individual or body with knowledge of all project perspectives as go between
3	**Environment and Natural Resource Management**	The national legislation should provide for participation of locals in all agrarian undertakings, including biofuels projects
4	**Ecologist**	I take questions 8 and 9 together: These are issues common to almost all development projects. There is a huge literature out there on participatory decision-making to draw on for biofuel projects as well.
5	**Environmental Policy**	Any multi-stakeholder process needs to build on existing institutions so a good way to start would be to do a stakeholder analysis to look at who the main groups are, then to follow up with an institutional analysis to see who could act as a representative for each group. Accountability and legitimacy are other considerations when talking about representation and these too would need to be ensured. Starting with what's already there is generally useful though. In addition, the choice for certain groups not to participate is also empowering and important. The key thing is they are given the chance to be represented by someone legitimate.
6	**Environmental and Sustainability Scientist**	Difficult question. Traditional engagement needs to change substantially to be more ethically and locally more appropriate to the actual stakeholders in order to get there buy in and knowledge
7	**Environmental Scientist**	Only by engaging the leaders and have an agreement that all members should be equally represented right from the outset.
8	**Development Consultant; Focus on Environment**	Discourse should be carried out at the local level.
9	**Biofuel Producer, engineering Environment-alist**	Prioritization of participatory feedstocks with diverse products that directly address needs of the majority.
10	**Sustainable Energy Access Experts Assessments**	Local stakeholders could be adequately represented through developing strong local institutional frameworks i.e. cooperatives, local biofuels processing and marketing companies. Governments should enforce agreed regulations to protect local stakeholders
11	**Biofuels Project Planner**	They should see biofuel as another alternate to poverty reduction and the sole means.

12	**Energy and Development Consultancy**	More training and awareness-raising initiatives to demonstrate how they can be effective at imagining, articulating and advocating certain policies. Required representation on project-specific 'supervisory boards'.
13	**Biofuel Standards**	Ensure proper public-private partnerships with well-designed policy frameworks right from the start.
14	**Sustainability Assessment**	They could be engaged at different parts of the supply chain and with the local communities contributing to properly monitor the projects but this needs resources and most of the time that is the problem.
15	**Lifecycle Assessment**	Through ownership of part or all of the project
16	**Energy Systems**	This might be an appropriate role for NGOs or international agencies.
17	**Bioenergy**	They should be part of the project.
18	**International Political Economy of Development**	In Africa there are very few people who are inclined towards biofuels production. The whole venture must be re-designed so that they are transparent from the start and are not negotiated by governments which often cheat that there is idle land in Africa only to end up displacing communities. So, it has to go back to the drawing board and include all stakeholder
19	**Commodity Market Analyst**	they should be adequately compensated for their work and must be given small plots as backup for food production
20	**Project Economics and Sustainability**	Equal representation at palnning stages. Treated as equals.
21	**Policy Analyst and Economist**	Formation of interest groups in biofuels e.g., biofuels association
22	**Economics of water, agriculture, biofuels**	NGO's - passionate advocates 2. Local Education 3. Finance - outside 'skin in the game'
23	**Sustainable Development**	With spokesperson with integrity and equal standing in project decision making
24	**Agricultural Consultancy**	they should be included in the initiation face of the projects.
25	**Rural Development**	Afford stakeholder equity ownership.
26	**Sustainability Systems Analyst**	Via NGOs as a first step
27	**Researcher on African Agrarian studies**	They should take full responsibility of the projects in terms of ownership with external agents merely playing a facilitating/financing role
28	**Plant and Soil Scientist**	conduct up-front formal sustainability assessments.
29	**Biofuel Agrarian Irrigation Engineering**	Experts need to treat local knowledge respectfully

30	**Agronomist: Sustainable Agriculture**	All locals should be educated to a higher understanding and on best practice.
31	**Researcher on Sustainability Resource Sector**	i am not familiar with Africa on the whole. one needs to break the question into regions or countries-Africa-is too general.
32	**Natural Resource Management**	Allow to involve the African people in any of the forums made and the strategic programs designed.
33	**Land Tenure and Policy Development**	Through co-management and benefits sharing
34	**Consortium for Capacity Building**	Co-ops, producer associations, consumer associations, local government/leadership. These are all options, which may be relevant depending on the circumstances. Community organisation and collective action and bargaining are key.
35	**Bioenergy and Land Use**	The projects need strong stakeholder involvement and stringent frameworks to generate that involvement - although not yet for biofuels see www.planvivo.org - I'll email you a separate list of sustainability standards or scorecards which we developed as part of a piece of work for GEF
36	**Sustainability and Capacity Building**	First of all we should not that current generation biofuels feedstocks are land intensive. If we want local stakeholders to have real representation they should have secure ownership of their land. Many people in Europe and the middle east think that most African land does not have an owner. The local stakeholder that enter into contracts with biofuels entrepreneurs should also have access to legal representation.
37	**GIS mapping - Area suitability for biofuel cultivation**	Once an area has been identified as suitable for investment, need to go on the ground and deal with who the community thinks represents them, even if this means dealing only with men when you think women should be involved given that they will be the ones preparing the land and planting. i.e. respect local customs and authorities
38	**Climate Change, Agriculture and Food Security**	Under principles of Free, Prior and Informed Consent. Additionally to be included in formulation of sustainability frameworks and legislation.

		QUESTION 8
	RESPONDENTS	**To reduce inefficient communication, how would you envisage equal participation and representation between stakeholders involved in biofuel projects?**
1	**Environmental Management**	I think that this is impossible as the project developers and financers will be dominant. However, stakeholder meetings from project scoping and inception onwards would assist in promotion of participation
2	**Nature Conservation**	Body or person with knowledge of all project perspectives bringing to together all stakeholders
3	**Environment and Natural Resource Management**	Legislative measures, with a clear institutional setting
4	**Ecologist**	See no. 7
5	**Environmental Policy**	I guess I've already partly answered that above. Using participatory methods to identify preferred means of communication and managing expectations of all groups would be key in addressing efficiency concerns. I don't think reaching equal participation is necessarily needed (after all, each stakeholder has a different role to play and it's difficult to know what is meant by "equal").
6	**Environmental and Sustainability Scientist**	
7	**Environmental Scientist**	Use committees that are trusted by individual groups. Have a body that is familiar with all aspects of the operation and local biodiversity and communities to balance the dialogue.
8	**Development Consultant; Focus on Environment**	At each stage of development ensure all stakeholders communicate their concerns and act on them in a participatory manner.
9	**Biofuel Producer, engineering Environment-alist**	(As in previous answer)
10	**Sustainable Energy Access Experts Assessments**	Empowerment of the institutions through clear regulations and structures based on careful consideration and mainstreaming of gender issues
11	**Biofuels Project Planner**	There will not be equal participation because some people/investors are risking huge sums of money. What is needed is equitable participation in which locals are widely consulted and involved as partners.
12	**Energy and Development Consultancy**	Experts and practitioners should communicate at the local level. It cannot be expected for locals to fully understand the intricacies of expert concepts of large project appraisal and achievement
13	**Biofuel**	No Response

	Standards	
14	**Sustainability Assessment**	It has to be agreed in each country and maybe for each project. Some national stakeholders are always included but not the local ones. It requires meetings and engagement, again sometimes difficult in some places.
15	**Lifecycle Assessment**	Do you mean inefficient or ineffective communication?
16	**Energy Systems**	This is one of the reasons to refer smaller scale projects
17	**Bioenergy**	create task forces.
18	**International Political Economy of Development**	For a long time such projects have been designed outside Africa with scanty details. This is why they fail, due to outlandish assumptions. They must be designed in Africa by Africans if they have to succeed. They must be transparent, and provide space for negotiations on equal terms - not beneficiary and benefactor relations
19	**Commodity Market Analyst**	very difficult to do
20	**Project Economics and Sustainability**	All concerns, considered equally. Respect for all players. Equal incentives
21	**Policy Analyst and Economist**	Holding of regular meetings to share experiences
22	**Economics of water, agriculture, biofuels**	The governance structure will need to bring the stakeholders together in a proactive manner, even if it means traditionally opposing camps are included
23	**Sustainable Development**	A spokesperson with thorough knowledge of locals and project aims to speak on behalf of stakeholders
24	**Agricultural Consultancy**	communication is vital for success in any projects, to reduce such inefficiency in communication, better to identify the active stakeholders in such projects first and organize a brainstorming workshop among the stakeholders in each countries, then develop the ideas through online communication
25	**Rural Development**	No Response
26	**Sustainability Systems Analyst**	Difficult - working from grass roots organisations (which tend to be NGOs) would help.
27	**Researcher on African Agrarian studies**	All stakeholders should be represented at all levels of the project and notions of transparency and accountability need to be upheld

28	**Plant and Soil Scientist**	There is need for an "honest broker" in negotiations. Somebody who can represent the communities interest and ensure that they have an equal voice. Communication must not just come from the company, after all they have vested interests in the outcome and will therefore give it a positive spin. There is a need to balance this with independent facts (including possible independent research) – in part a well run and unbiased impact assessment could aid in this, though there are operational and philosophic problems with the EIA approach (i.e. paid by client, not covering social issues etc)
29	**Biofuel Agrarian Irrigation Engineering**	Transparency and mutual and equal dialogue
30	**Agronomist: Sustainable Agriculture**	Transparency and dialogue.
31	**Researcher on Sustainability Resource Sector**	money talks and money must be initially guaranteed to some degree based upon crop or size of planted areas..
32	**Natural Resource Management**	use all media possible
33	**Land Tenure and Policy Development**	it is necessary, but rarely achieved because of the different levels of capacities between the stakeholders engaging.
34	**Consortium for Capacity Building**	Real consultation mechanisms built in to development processes.
35	**Bioenergy and Land Use**	needs to be carried out through a standard that sets out how stakeholders should be involved from the start - cooperative agreements are a good start
36	**Sustainability and Capacity Building**	It depends on the kind of relationship that is created. However, farmers should have access to the market information.
37	**GIS mapping - Area suitability for biofuel cultivation**	Extensive use of mobile phones. Local farmers (including women) need to be supplied with these and an amount of airtime
38	**Climate Change, Agriculture and Food Security**	Yes, there is always a trade-off between full participation and efficiency. The main route to efficiency is via legitimate representatives (i.e. either selected/voted for by their constituency, or considered legitimate by their constituency in some other way; unfortunately this is often not the case for local leaders who represent only parts of their constituencies, hence may need to look to less traditional leadership e.g. through credit groups, womens' groups, church etc)

		QUESTION 9
	RESPONDENTS	**Do you have any ideas on how to bring together the different perspectives of local populations and experts?**
1	**Environmental Management**	Issues like water resource availability and food security for the local community need to be considered in the design of the project i.e. water and food supply should not be negatively impacted
2	**Nature Conservation**	As in 7 and 8 Intermediary with no allegiance to any individual stakeholder
3	**Environment and Natural Resource Management**	Consensus building through structured discourses
4	**Ecologist**	See no. 7
5	**Environmental Policy**	The key thing I think is to provide space/a platform for those who are interested at each level to come together. This needs to happen throughout a project process (not just at the end!). Local people can be experts too so it's important not to set things up in a situation where certain knowledge are seen as "better" than others.
6	**Environmental and Sustainability Scientist**	The experts need to change their perspectives and try and understand the environmental issues facing the local population. Experts cannot expect the local people to understand them, they need to change their means of communicate that is appropriate to the community, only in this way can knowledge be transfer between both parties
7	**Environmental Scientist**	Experts, advisors, developers and locals must equally understand the interests of each other.
8	**Development Consultant; Focus on Environment**	As in nos. 7 and 8.
9	**Biofuel Producer, engineering Environment-alist**	By taking the route of participatory feedstocks, players develop responsibility and collectively work to succeed. All would treat the industry as a common goal rather than "them" vs "us".
10	**Sustainable Energy Access Experts Assessments**	At each stage of biofuels development and business, it is important to involve all key stakeholders at all levels through the development and strengthening of local institutions through private public partnerships arrangement
11	**Biofuels Project Planner**	Consultations of the locals is the best method in which their economic interest are balanced against that of investors. Investors will always be needed because they deploy capital that governments lack or unwilling to deploy

12	**Energy and Development Consultancy**	think there should be a greater emphasis on listening to what local populations want rather than deciding from the outside what they need. The terrain over which they meet must be more even, discussing day-to-day lives and the realities of living in that particular area rather than the technicalities of biofuels and promises of financial return. By doing the latter, I feel too much ground is ceded to the authority of the expert and the potentially misleading claims.
13	**Biofuel Standards**	Training and extension services - relying on partnerships with locals to convey message over time.
14	**Sustainability Assessment**	Focus groups are needed to involve all the locals and at least let them know what is going on. The experts can summon to the meetings and have the meetings regularly. Although in many parts of Arica this requires resources as they are expected to be compensated for the time they allocate to the meetings.
15	**Lifecycle Assessment**	"Experts" to spend some time with local populations - if the project so requires.
16	**Energy Systems**	Nothing new
17	**Bioenergy**	Regular, e.g. annual, biofuel workshop, conferences, etc that would bring all parts together to discuss all aspects of the project.
18	**International Political Economy of Development**	The issue is about consultations and respect. Consultations that lead to mutual agreement
19	**Commodity Market Analyst**	have agreements and social contracts between them. have third parties as objective arbiters and for transferring funds at a fair rate.
20	**Project Economics and Sustainability**	Transparency, Equal opportunity, equal representation, education
21	**Policy Analyst and Economist**	Through stakeholder meetings or workshops
22	**Economics of water, agriculture, biofuels**	Need to determine the basis for connection -- how will you make the 'expert' relevant/ how do you take the local perspective and create an actionable item consistent with the project trajectory.
23	**Sustainable Development**	Mutual spokesperson as in no.7
24	**Agricultural Consultancy**	first better to have a local representative in the country, then organize a workshop in that particular country which allow the participation of all stakeholders in the issue
25	**Rural Development**	Involve the stakeholders in focus group discussions.
26	**Sustainability Systems Analyst**	No response
27	**Researcher on African Agrarian studies**	Experts need to let local people play a leading role in setting the development agenda while the external agents try to capitalise on common aspects and points of agreement

28	**Plant and Soil Scientist**	There are many ways, good interdisciplinary research is clearly one i.e. involving social, and economic research as well as just technical research. Using participatory approaches to scope the terms of reference for research can also help. I.e. the questions of relevance might be very different from what the technocrat envisioned. Obviously promoting open dialog in an environment where interaction is encouraged and where all stakeholder groups are represented is important e.g. woman need a say as do the poor. Preventing domination by the community elite in all debates is important. i.e rural chiefs and/or local civic structures may have vested interests in a project, though this may not be in the best interest of their subjects.
29	**Biofuel Agrarian Irrigation Engineering**	Mutual and deeper understanding and although initially resource heavy, it will pay off in the long term.
30	**Agronomist: Sustainable Agriculture**	As in question 8.
31	**Researcher on Sustainability Resource Sector**	need to have a template that has worked on a sustained basis, which can be modified for the respective area.
32	**Natural Resource Management**	No Response
33	**Land Tenure and Policy Development**	Institutionalised approaches for systematic engagement
34	**Consortium for Capacity Building**	There is a need for intermediaries which can be from NGOs, CBOs, universities or other institutions with local presence but ability to communicate with outside experts as well as local community members.
35	**Bioenergy and Land Use**	The implementation of standards such as planvivo's stipulates how this should happen. Novel ways are things like citizen's juries
36	**Sustainability and Capacity Building**	If by local population is meant to be the feedstock producers, what is required is information and capacity building. The role of experts is often representing the investors who can pay them consultancy money while the local producers are promised that there will be market for their produces. I believe that if the experts train the local producers in the various aspects of biofuels they can articulate their ideas and protect their interest.
37	**GIS mapping - Area suitability for biofuel cultivation**	Experts visiting the field and interacting with the local populations. Time consuming initially but worth it in the long run as relationships established that you can fall back on if you have problems later
38	**Climate Change, Agriculture and Food Security**	Co-learning, co-production of knowledge is the ideal - but difficult in practice. A useful recent text is Knowledge Democracy: Consequences for Science, Politics and Media.

Appendix B Local Small-Holder Questions and Interview Responses: Zambia

Interview Schedule of Local Inhabitants Affected by Biofuel Projects in Zambia (A section of the semi-structured interviews conducted).

1. What crops do you grow and why do you grow them?
2. What are your agronomic techniques?
3. What sources of energy do you have and how accessible and affordable is the energy?
4. What is your food situation, and how could food security be improved?
5. What is your water situation?
6. Would you be conducive to alternate crops or agronomy practices to improve food and energy security?
7. What are your concerns for investors coming into your district?
8. What type of participation and communications would you consider most suitable for local populations?
9. What is the land tenure, can it be improved and what is the land availability?
10. What type of local governance is used and does the local population have influence on decision making?
11. What bioenergy project would you consider suitable and how do you expect it to be financed, governed and communicated.
12. What type of risk and reward would you consider fair to all parties?

(EZ) = Eastern Zambia
(SZ) = Southern Zambia

Local Small-scale Farmer interviews in Eastern Province, Zambia

1. LOCAL INTERVIEWS – Thematic Analysis (EZ2)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Jatropha(J),	Average
Maize Yields/Reasons		2 Tonnes/ Poor land choice, steep slope, fertiliser	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 150 kg ha Compound, 150 kg of AN	
Chemicals		Disease on Jatropha	
Erosion		Minimal	
Ecology		30% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure poor	
Would change for better options be considered		Yes	
Land availability		1.25 Hectares (Near Town)	
Land requirements		1.75 Hectares	
Finance availability		D1 Oils supplies seed and inputs for Jatropha	
Limitations		Finance, land	
Corruption		A little	
Water accessibility		400m well and river	
Thoughts on investment concerns		Want investment, but with training and inputs. We are not sure when the buyers are coming to buy our seed and the price is not enough.	
What type (if any) project would be suitable		I am happy with Biofuels but am not sure what it really means and if we will make money.	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		Locally, nearest town, use hired transport, work in town so aware of prices	
Food concerns, reasons		Part time work brings in enough when food is scarce	
Energy			
Types of energy used		Wood for cooking, candles and paraffin	
Accessibility/ Availability		Wood within 800 metres	
Cost of soap , cooking fuel and lights		40 000 Kwacha per month	

2. LOCAL INTERVIEWS – Thematic Analysis (EZ3)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Vegetables(V), Jatropha(J), Goats (Ch).	Poor
Maize Yields/Reasons		0.5 Tonnes/ Sickness, laziness, weeding, ferts, timing	
Soils		Sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha Compound, 50 kg of AN	
Chemicals		None	
Erosion		On lands with a 5% slope	
Ecology		10% natural, remainder cleared	
Degradation		Soil structure poor, roads are eroded	
Would change for better options be considered		Yes	
Land availability		4 Hectares	
Land requirements		2 Hectares	
Finance availability		Difficult, Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Finance, inputs and timing	
Corruption		Yes, Inputs, Finance	
Water accessibility		Water from stream and well-100 metres	
Thoughts on investment concerns		Want investment, but only with backup support and agreed pricing structure. The companies buying Jatropha are helpful but the communications from them are poor (D1 Oils and Southern BioPower)	
What type (if any) project would be suitable		Any	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		No crops for sale	
Food concerns, reasons		No Maize Jan to march, Eat vegetables	
Energy			
Types of energy used		Wood for cooking, candles for lighting	
Accessibility/ Availability		Wood 500 m	
Cost of soap , cooking fuel and lights		20 000 Kwacha per month	

3. LOCAL INTERVIEWS – Thematic Analysis (EZ4)			
Observation			
Crops	Jatropha Growth	(M), Groundnuts(GN), Sweet potato(SP), Chickens(Ch), Jatropha(J), Veges(V).	Good
Maize Yields/Reasons		2 Tonnes	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN	
Chemicals		For insects and diseases on Jatropha	
Erosion		Not noticeable	
Ecology		5% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average poor roads	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		Well 100 metres, town 1km	
Thoughts on investment concerns		Want investment, but not without consultation and a say in what we do. There is not much understanding on how Jatropha works. D1 Oils is trying to show us how to grow properly. The demonstration farm is helpful in how to grow Jatropha	
What type (if any) project would be suitable		Any	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		Locally, nearest town, use hired transport, not sure of best prices, want cash, will negotiate	
Food concerns, reasons		Sometimes before harvest	
Energy			
Types of energy used		Wood for cooking, solar panel for lights	
Accessibility/ Availability		Wood within 900 metres-Ample	
Cost of soap , cooking fuel and lights		25 000 Kwacha per month	

4. LOCAL INTERVIEWS – Thematic Analysis (EZ5)			
Observation			
Crops	Jatropha Growth	Maize, Groundnuts, Sweet Potato, Chickens, Jatropha, Vegetables	V.Poor
Maize Yields/Reasons		3 Tonnes/ poor soils. Very high percentage of sand	
Soils		Sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 150 kg ha Compound, 175 kg of AN	
Chemicals		For diseases on Jatropha	
Erosion		Sheet	
Ecology		5% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure poor	
Would change for better options be considered		Yes	
Land availability		2.5 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		Well 150metres, borehole 1km	
Thoughts on investment concerns		Want investments and new ideas, but is wary of past failures (tobacco). Not sure when the companies are going to come to buy. D1 Oils offers inputs and training but Southern BioPower just comes to but the seed. We may sell to them	
What type (if any) project would be suitable		Jatropha	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		Locally, nearest town, use hired transport, listen to others	
Food concerns, reasons		No, have excess for sale	
Energy			
Types of energy used		Wood for cooking, candles, paraffin	
Accessibility/ Availability		Wood within 1km	
Cost of soap , cooking fuel and lights		40 000 Kwacha per month	

5. LOCAL INTERVIEWS – Thematic Analysis (EZ6)			
Observation			
Crops	Jatropha Growth	Maize, Chickens(Ch), Jatropha(J), Veges(V), Pigs	Average
Maize Yields/Reasons		2 Tonnes	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha Compound, 100 kg of AN	
Chemicals		None	
Erosion		Not noticeable	
Ecology		25% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		1 Hectare	
Land requirements		1 Hectare	
Finance availability		None	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		Borehole 1km	
Thoughts on investment concerns		None	
What type (if any) project would be suitable		Any	
What type of committee structure would be suitable		Meeting with locals and investor	
How and where do you market your crops		Nothing for sale, use bicycle	
Food concerns, reasons		Eat what is available, do run low at times	
Energy			
Types of energy used		Wood for cooking, candles and paraffin	
Accessibility/ Availability		Wood within 300 metres	
Cost of soap , cooking fuel and lights		35 000 Kwacha per month	

6. LOCAL INTERVIEWS – Thematic Analysis (EZ7)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Chickens(Ch), Jatropha hedges, Veges, Cotton, Guavas	Good
Maize Yields/Reasons		2 Tonnes/ Knowledge	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Minimum till	
Fertilisers		75 kg ha Compound, 125 kg of AN	
Chemicals		None	
Erosion		gully	
Ecology		35% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge, sickness, inputs, transparency	
Corruption		Yes with inputs etc	
Water accessibility		Borehole 500 m	
Thoughts on investment concerns		Want investment, closer communications, uncertainty is a worry. We do not see the companies except when they want seed so we do not know when they will arrive or if they will come at all.	
What type (if any) project would be suitable		Any, with less work, perennial	
What type of committee structure would be suitable		Meetings with investors often	
How and where do you market your crops		Locally, nearest town, negotiate with cash and ease of sale	
Food concerns, reasons		No	
Energy			
Types of energy used		Charcoal for cooking, parrafin	
Accessibility/ Availability		Wood within 200 metres-Ample	
Cost of soap , cooking fuel and lights of energy and soap		50 000 Kwacha per month	

7. LOCAL INTERVIEWS – Thematic Analysis (EZ8)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Sweet potato(SP), Chickens(Ch), Jatropha(J), Veges(V).	Poor
Maize Yields/Reasons		1 Tonnes	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN	
Chemicals		For insects and diseases on Jatropha	
Erosion		Not noticeable	
Ecology		5% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		4 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser	
Limitations		Time and management	
Corruption		Certain amount	
Water accessibility		River 300m	
Thoughts on investment concerns		Transparency. Companies do talk to us but it is difficult to understand what is really happening. The way Southern BioPower pays us is difficult to understand	
What type (if any) project would be suitable		Perennial, cash crops	
What type of committee structure would be suitable		Meeting with locals and investor	
How and where do you market your crops		Locally, nearest town, collection and hired transport	
Food concerns, reasons		No concerns	
Energy			
Types of energy used		Wood for cooking, candles and batteries	
Accessibility/ Availability		Wood within 100 metres-Ample	
Cost of soap , cooking fuel and lights		40 000 Kwacha per month	

8. LOCAL INTERVIEWS – Thematic Analysis (EZ9)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Jatropha, Chickens(Ch), Cotton(C), Veges(V).	V. Poor
Maize Yields/Reasons		0.5 Tonnes	
Soils		Loams	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Manure	
Chemicals		On Cotton, 2 sprays	
Erosion		Sheet	
Ecology		40% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		5 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		50m well and borehole	
Thoughts on investment concerns		The company must stay with us as they often change their minds, Understanding exactly what is expected is difficult if it is a new crop	
What type (if any) project would be suitable		Whole village involvement, We maintain control of the land and fair prices are agreed on.	
What type of committee structure would be suitable		Meetings with village	
How and where do you market your crops		Locally, nearest town, use hired transport, not sure of best prices, want cash, will negotiate	
Food concerns, reasons		Jan to march, May misjudge requirements when selling or need money for an emergency	
Energy			
Types of energy used		Wood for cooking, candles and batteries	
Accessibility/ Availability		Wood within 100m	
Cost of soap , cooking fuel and lights		25 000 Kwacha per month	

9. LOCAL INTERVIEWS – Thematic Analysis (EZ10)	
Observation	
Crops	Maize, Groundnuts, Goats, Cotton, Sweet Potato
Maize Yields/Reasons	0.75 Tonnes
Soils	Clay sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Hoe
Fertilisers	Very little, plus a little manure
Chemicals	For insects and diseases on Jatropha
Erosion	Not noticeable
Ecology	75% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soils are degraded
Would change for better options be considered	Yes
Land availability	20 Hectares
Land requirements	1 Hectares
Finance availability	None
Limitations	Knowledge and Finance
Corruption	Have heard it is bad. I do not receive fertiliser that the government said is available
Water accessibility	Well 400m
Thoughts on investment concerns	Not sure
What type (if any) project would be suitable	Any
What type of committee structure would be suitable	Meeting with locals, chiefs
How and where do you market your crops	None for sale
Food concerns, reasons	Yes some of the year, sell timber for money
Energy	
Types of energy used	Wood for cooking, candles
Accessibility/ Availability	Wood within 100 metres-Ample
Cost of soap , cooking fuel and lights	10 000 Kwacha per month

10. LOCAL INTERVIEWS – Thematic Analysis (EZ11)	
Observation	
Crops	Maize(M), Groundnuts(GN), Sweet potato(SP),
Maize Yields/Reasons	2 Tonnes
Soils	Clay sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 50 kg ha Compound, 100 kg of AN
Chemicals	none
Erosion	Not noticeable
Ecology	25% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	7 Hectares
Land requirements	1 Hectares
Finance availability	None
Limitations	Knowledge and Money
Corruption	Yes
Water accessibility	Borehole 800m
Thoughts on investment concerns	Only with back up and extension and if they do not want our land
What type (if any) project would be suitable	Not sure but maybe food crops
What type of committee structure would be suitable	Meeting with locals, chiefs, local government and investor
How and where do you market your crops	Locally, nearest town
Food concerns, reasons	Jan to April
Energy	
Types of energy used	Wood for cooking, Candles and Paraffin
Accessibility/ Availability	Wood within 400 metres
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

11. LOCAL INTERVIEWS – Thematic Analysis (EZ12)			
Observation			
Crops	Jatropha Growth	Maize(M), Sorghum, Jatropha	Poor
Maize Yields/Reasons		1 Tonnes	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		50kg an	
Chemicals		No	
Erosion		Not noticeable	
Ecology		5% natural, remainder cleared	
Degradation		Most animals and birds have been hunted	
Would change for better options be considered		Yes	
Land availability		5 Hectares	
Land requirements		1 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		Stream 200m	
Thoughts on investment concerns		Want investment and advice	
What type (if any) project would be suitable		Any but not sure which would be best. Need someone to advise us	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		Locally, collected	
Food concerns, reasons		Jan to march, May misjudge requirements when selling or need money for an emergency	
Energy			
Types of energy used		Wood for cooking, candles and batteries	
Accessibility/ Availability		Wood within 1.5 km	
Cost of soap , cooking fuel and lights		20 000 Kwacha per month	

12. LOCAL INTERVIEWS – Thematic Analysis (EZ13)	
Observation	
Crops	Maize(M), Groundnuts(GN), Cotton, Chickens, Cattle
Maize Yields/Reasons	2 Tonnes
Soils	Clay loam
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Reduced tillage
Fertilisers	Manure
Chemicals	For insects and diseases on Jatropha
Erosion	Not noticeable
Ecology	10% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure Good
Would change for better options be considered	Yes
Land availability	4 Hectares
Land requirements	3 Hectares
Finance availability	Government offers subsidised fertiliser and subsidised ploughing
Limitations	Knowledge
Corruption	Certain amount
Water accessibility	Well/river 200m
Thoughts on investment concerns	Want investment, but with technical knowledge and continuity
What type (if any) project would be suitable	Biofuel projects. I think Jatropha, but I need helpto produce. My crops are not good
What type of committee structure would be suitable	Meeting with locals, chiefs, local government and investor
How and where do you market your crops	Locally, nearest town, use hired transport, cash negotiation
Food concerns, reasons	Some years Nov to April, but others none. May misjudge requirements when selling or need money for an emergency
Energy	
Types of energy used	Wood for cooking, batteries and paraffin
Accessibility/ Availability	Wood and Charcoal 300m
Cost of soap , cooking fuel and lights	60 000 Kwacha per month

13. LOCAL INTERVIEWS – Thematic Analysis (EZ14)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Sweet potato(SP), Chickens(Ch), Jatroha(J), Paprika	Average
Maize Yields/Reasons		3 Tonnes	
Soils		Loamy sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Harrow	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN	
Chemicals		For insects and diseases on Jatropha	
Erosion		Yes, gully	
Ecology		80% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		3 Hectares	
Land requirements		2 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing (FAO, PAM)	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		borhole 350m	
Thoughts on investment concerns		Want investment, but not without consultation and good understanding of how the partnership works	
What type (if any) project would be suitable		Any kind of crops but must be profitable	
What type of committee structure would be suitable		Transparency, locals, and company	
How and where do you market your crops		Locally, nearest town, company collects paprika	
Food concerns, reasons		Sell Paprika and Charcoal when needed	
Energy			
Types of energy used		Wood for cooking, paraffin, batteries	
Accessibility/ Availability		Wood within 150 metres-Ample	
Cost of soap , cooking fuel and lights		30 000 Kwacha per month	

14. LOCAL INTERVIEWS – Thematic Analysis (EZ15)	
Observation	
Crops	Maize(M), Tobacco, Bees, chickens and cattle
Maize Yields/Reasons	4 Tonnes
Soils	Loams
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 200 kg ha Compound, 50 kg of AN and manure
Chemicals	For insects and diseases on Jatropha
Erosion	Not noticeable
Ecology	40% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure poor, timber cut for tobacco production
Would change for better options be considered	Yes
Land availability	6 Hectares
Land requirements	2 Hectares
Finance availability	Government offers subsidised fertiliser and subsidised ploughing
Limitations	Knowledge
Corruption	Certain amount
Water accessibility	6 months well 100m, 6 months borehole 1km
Thoughts on investment concerns	Want investment, Have much experience of uncertainty and deception, coercion (Cotton, Dunavant). It must be fair between the company and our community
What type (if any) project would be suitable	Cash and preferably perennial
What type of committee structure would be suitable	Openness and meetings with no doubts of who is to benefit and by who
How and where do you market your crops	Locally, nearest town, use hired transport to deliver tobacco
Food concerns, reasons	No concerns
Energy	
Types of energy used	Wood for cooking, paraffin, batteries and candles
Accessibility/ Availability	Wood within 800 metres-Ample, Charcoal
Cost of soap , cooking fuel and lights	100 000 Kwacha per month

15. LOCAL INTERVIEWS – Thematic Analysis (EZ16)			
Observation			
Crops	Jatropha Growth	Maize(M), Sorghum, Groundnuts(GN), Veges, Cotton, chickens, Jatropha, goats	Poor
Maize Yields/Reasons		5 Tonnes	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN, Manure	
Chemicals		For insects and diseases on Jatropha and cotton	
Erosion		Sheet erosion	
Ecology		30% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure poor	
Would change for better options be considered		Yes	
Land availability		10 Hectares	
Land requirements		4 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing (FAO, private companies)	
Limitations		Knowledge, inputs, corruption, transparency	
Corruption		Yes	
Water accessibility		Well 20m, river 100m	
Thoughts on investment concerns		Only without open understanding and discussion and if it is not a problem to sell the crops (marketing can be slowly and unpredictable), it must not interfere with other crops unless it is a much better cash crop.	
What type (if any) project would be suitable		Any crop that is for cash	
What type of committee structure would be suitable		Meeting with locals, investor and government	
How and where do you market your crops		use hired transport, contracted and cash	
Food concerns, reasons		No unless an emergency arrives and need to sell product (illness)	
Energy			
Types of energy used		Wood for cooking, solar panel for lights	
Accessibility/ Availability		Wood within 500 metres-Ample	
Cost of soap , cooking fuel and lights		80 000 Kwacha per month	

16. LOCAL INTERVIEWS – Thematic Analysis (EZ17)			
Observation			
Crops	Jatropha Growth	Maize(M), Jatropha	V. Poor
Maize Yields/Reasons		0.5 Tonnes	
Soils		Sandy loams	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Hoe	
Fertilisers		None	
Chemicals		Diseases on Jatropha	
Erosion		Not noticeable	
Ecology		All cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		1 Hectares	
Land requirements		0.5 Hectares	
Finance availability		None	
Limitations		Inputs	
Corruption		It seems as though it is everywhere	
Water accessibility		Stream 500m	
Thoughts on investment concerns		Want investment, but am not sure about it.	
What type (if any) project would be suitable		Any which is suitable to whole village	
What type of committee structure would be suitable		Meeting with local villagers and investors	
How and where do you market your crops		None for sale	
Food concerns, reasons		Yes from November to April	
Energy			
Types of energy used		Wood for cooking and light	
Accessibility/ Availability		Wood within 1.2 km	
Cost of soap , cooking fuel and lights		10 000 Kwacha per month	

17. LOCAL INTERVIEWS – Thematic Analysis (EZ18)			
Observation			
Crops	Jatropha Growth	Maize(M), Groundnuts(GN), Cotton, Chickens, Jatropha	Poor
Maize Yields/Reasons		2.5 Tonnes	
Soils		Clay sands	
Vegetation		Hyaarhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha compound, 100 kg of AN, manure	
Chemicals		None	
Erosion		Sheet	
Ecology		30% Regrowth	
Degradation		Most animals and birds have been hunted, soil structure is poor	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing	
Limitations		Knowledge	
Corruption		Certain amount	
Water accessibility		Well 250metres, borehole 2km	
Thoughts on investment concerns		Want investment, with transparency and long term outlook, clear understanding, backup extension services	
What type (if any) project would be suitable		Crops good for drought and a good marketing system	
What type of committee structure would be suitable		Meeting with locals, training and clear strategy	
How and where do you market your crops		Locally, nearest town, use hired transport, not sure of best prices, want cash, will negotiate	
Food concerns, reasons		In droughts about 4 months	
Energy			
Types of energy used		Wood for cooking, wood, paraffin, charcoal	
Accessibility/ Availability		Wood 1km	
Cost of soap , cooking fuel and lights		30 000 Kwacha per month	

18. LOCAL INTERVIEWS – Thematic Analysis (EZ19)			
Observation			
Crops	Jatropha Growth	Maize(M), Munemo beans, Chickens (Ch), Jatropha(J), Veges(V). Goats(G)	V.Poor
Maize Yields/Reasons		3 Tonnes	
Soils		Sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough, reduced tillage	
Fertilisers		Average 100 kg ha Compound and manure	
Chemicals		For insects and diseases on Jatropha	
Erosion		Not noticeable	
Ecology		50% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		6 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser and subsidised ploughing, Private	
Limitations		Knowledge, training, lack of transparency	
Corruption		Yes	
Water accessibility		Well 50metres, town 2km	
Thoughts on investment concerns		Want investment, but not without consultation and a good idea of the future. Cotton is good because we know we have a market but prices are very poor	
What type (if any) project would be suitable		Any. Jatropha is difficult because we do not know what yields will be gained and if it is profitable.	
What type of committee structure would be suitable		Meeting with locals, chiefs, local government and investor	
How and where do you market your crops		Locally, nearest town, use hired transport, not sure of best prices, want cash, will negotiate	
Food concerns, reasons		Jan to march, May misjudge requirements when selling or need money for an emergency	
Education		Lack of teachers, leave at grade 7, Cost of soap , cooking fuel and lights	
Energy			
Types of energy used		Wood for cooking, paraffin and batteries	
Accessibility/ Availability		Wood within 100 metres	
Cost of soap , cooking fuel and lights		20 000 Kwacha per month	

19. LOCAL INTERVIEWS – Thematic Analysis (EZ20)	
Observation	
Crops	Maize(M), Sweet potato(SP), Chickens(Ch)
Maize Yields/Reasons	1 Tonnes
Soils	Clay sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Manure, 50kg compound, 50 kg of An
Chemicals	None
Erosion	Not noticeable
Ecology	Cleared
Degradation	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	2 Hectares
Land requirements	1 Hectares
Finance availability	Government offers subsidised fertiliser and subsidised ploughing
Limitations	Inputs
Corruption	Very bad
Water accessibility	Borehole 800m
Thoughts on investment concerns	Want investment, well explained and fair to all
What type (if any) project would be suitable	Any that will help the locals but would not want to remove maize crops.
What type of committee structure would be suitable	Meeting with all people, chief, government, locals and companies
How and where do you market your crops	Locally, nearest town, self delivery
Food concerns, reasons	Jan to April
Energy	
Types of energy used	Wood for cooking, candles, paraffin
Accessibility/ Availability	Wood within 200 metres-Ample
Cost of soap , cooking fuel and lights	15 000 Kwacha per month

20. LOCAL INTERVIEWS – Thematic Analysis (EZ21)	
Observation	
Crops	Maize(M), Groundnuts(GN), Cotton, Paprika, Goats, Ducks, Sweet potatoes
Maize Yields/Reasons	3 Tonnes
Soils	Clay loams
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN, Manure
Chemicals	For insects on cotton
Erosion	Sheet
Ecology	10% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure poor
Would change for better options be considered	Yes
Land availability	2.5 Hectares
Land requirements	1.5 Hectares
Finance availability	Government offers subsidised fertiliser
Limitations	Knowledge, inputs
Corruption	Yes
Water accessibility	Stream 100m and Borehole 1.5km
Thoughts on investment concerns	Want investment, but with local input and benefit
What type (if any) project would be suitable	Perennial for cash such as Jatropha, but it is too new and I have no knowledge of it. Cotton is not very profitable and sometimes the buyers cheat us.
What type of committee structure would be suitable	Local meetings and knowledge mixed with investor ideas
How and where do you market your crops	Locally, nearest town
Food concerns, reasons	In dry years, sometimes
Education	Too expensive, schools far away, until grade 7, must start work, lack of jobs.
Energy	
Types of energy used	Wood for cooking, batteries, candles
Accessibility/ Availability	Wood within 400 metres
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

Local Small-scale Farmer interviews in Southern Province, Zambia

1. LOCAL INTERVIEWS – Thematic Analysis (SZ2)	
Observation	
Crops	Maize(M), GN, SP.
Maize Yields/Reasons	1 Tonne
Soils	Loamy sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN
Chemicals	No
Erosion	Gully
Ecology	20% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	3 Hectares
Land requirements	1 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Access to inputs and distances
Corruption	Certain amount
Water accessibility	borehole 700m
Thoughts on investment concerns	Yes we want it to help us. We are unable to get help for our crops so any help will be good for us
What type (if any) project would be suitable	Any that we know how to grow properly
What type of committee structure would be suitable	Government, locals and investor
How and where do you market your crops	Locally, nearest town, use hired transport, not sure of best prices, want cash, will negotiate
Food concerns, reasons	At times when weather is not good.
Education	Improving, good for boys but not girls, jobs are short, Want to get educated
Energy	
Types of energy used	Wood and charcoal for cooking, paraffin
Accessibility/ Availability	Husband trades charcoal in Lusaka 700m
Cost of soap , cooking fuel and lights	40 000 Kwacha per month

2. LOCAL INTERVIEWS – Thematic Analysis (SZ3)			
Observation			
Crops	Jatropha Growth	Maize, Jatropha, Vegetables, Sunflower	V. Poor
Maize Yields/Reasons		0.5 Tonne	
Soils		Loamy sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN	
Chemicals		No	
Erosion		Not noticeable	
Ecology Degradation		25% natural, remainder cleared	
		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs and Knowledge	
Corruption		Yes	
Water accessibility		Well 400m	
Thoughts on investment concerns		Want investment, but am not sure about how we will be helped. I have heard of other stories where people have planted but the buyers have not come to buy the seed. (Jatropha)	
What type (if any) project would be suitable		To help locals, with inputs and training	
What type of committee structure would be suitable		Government, locals and investors	
How and where do you market your crops		Whoever will but with cash	
Food concerns, reasons		Sometimes	
Education		Improving, little reason to go to school	
Energy			
Types of energy used		Wood and charcoal for cooking, batteries, candles	
Accessibility/ Availability		Wood within 100 metres,	
Cost of soap , cooking fuel and lights		35 000 Kwacha per month	

3. LOCAL INTERVIEWS – Thematic Analysis (SZ4)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, Goats, Jatropha	V. Poor
Maize Yields/Reasons		0.5 Tonne	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 10 kg ha Compound, 10 kg of AN, manure	
Chemicals			
Erosion		None	
Ecology		5% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure is ok	
Would change for better options be considered		Yes	
Land availability		3 Hectares	
Land requirements		2 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs and transparency,	
Corruption		Certain amount	
Water accessibility		River within 100m	
Thoughts on investment concerns		Want investment, to help locals with better cropping. Would need to have meetings so that all people understand the situation so we can make good decisions	
What type (if any) project would be suitable		Energy, Food, Cash crops	
What type of committee structure would be suitable		Government, locals and investor, chief	
How and where do you market your crops		Local miller collects	
Food concerns, reasons		No	
Education		Boys until 17 girls when they want to leave	
Energy			
Types of energy used		Wood for cooking, paraffin	
Accessibility/ Availability		Wood within 200 metres	
Cost of soap , cooking fuel and lights		25 000 Kwacha per month	

4. LOCAL INTERVIEWS – Thematic Analysis (SZ5)	
Observation	
Crops	Maize(M), GN, SP, pumpkins, turkeys, goats
Maize Yields/Reasons	1 Tonne
Soils	Clay loam
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Reduced till and Plough
Fertilisers	Average 200 kg ha Compound, 200 kg of AN
Chemicals	No
Erosion	Sheet
Ecology	10% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure good
Would change for better options be considered	Yes
Land availability	2 Hectares
Land requirements	2 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives, hard to come by
Limitations	Time, tractor power
Corruption	Appears to be in many places
Water accessibility	Two places we have wells 300metres
Thoughts on investment concerns	Want investment, with a good clear understanding
What type (if any) project would be suitable	I have heard of biofuels but am not sure how it would work but would like to try it if is good. I heard a company provided seed but did not return again
What type of committee structure would be suitable	Government, locals and investors
How and where do you market your crops	Locally, and to the millers in town
Food concerns, reasons	No
Education	Important, particularly to learn how to grow with conservation
Energy	
Types of energy used	Wood for cooking, paraffin and candles
Accessibility/ Availability	Wood within 400 metres
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

5. LOCAL INTERVIEWS – Thematic Analysis (SZ6)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, Jatropha, Cotton, Turkeys,	Average
Maize Yields/Reasons		5 Tonne	
Soils		Loams	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 200 kg ha Compound, 200 kg of AN	
Chemicals		No	
Erosion		Gully	
Ecology		20% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs and distances	
Corruption		Certain amount	
Water accessibility		Stream 50m	
Thoughts on investment concerns		Want investment, Jatropha may give us oil and money from a crop that needs little work after two years. Prices are a concern and so is the yields but we are not sure how to grow this crop so we can only wait and see what comes of it.	
What type (if any) project would be suitable		Any,	
What type of committee structure would be suitable		Close liaison with locals	
How and where do you market your crops		Locally, nearest town, use hired transport, only for cash	
Food concerns, reasons		No	
Education		Want the children to improve their lives	
Energy			
Types of energy used		Charcoal, paraffin	
Accessibility/ Availability		Easy to purchase	
Cost of soap , cooking fuel and lights		20 000 Kwacha per month	

6. LOCAL INTERVIEWS – Thematic Analysis (SZ7)	
Observation	
Crops	Maize(M), GN, tobacco, vege, cattle
Maize Yields/Reasons	3 Tonne
Soils	Sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Manure, 100 kg of AN
Chemicals	On tobacco
Erosion	Gully
Ecology	5% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure poor
Would change for better options be considered	Yes
Land availability	3 Hectares
Land requirements	2 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Expertise, training, inputs
Corruption	In areas
Water accessibility	Borehole 100m
Thoughts on investment concerns	Yes but only with a company that gives us inputs and training. The prices must be fair. Our crops need to improve but we have little help
What type (if any) project would be suitable	New crops and with increased yields and good profits.
What type of committee structure would be suitable	Locals, advisors
How and where do you market your crops	Locally, nearest town, use hired transport, company contract
Food concerns, reasons	Sometimes on some years.
Education	Important kids go to school until money runs out Grade 7 to 10
Energy	
Types of energy used	Wood for cooking, solar for lights
Accessibility/ Availability	Wood within 100 metres
Cost of soap , cooking fuel and lights	10 000 Kwacha per month

7. LOCAL INTERVIEWS – Thematic Analysis (SZ8)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, veges, Jatropha, turkeys, ducks, pigs	Poor
Maize Yields/Reasons		2 Tonne	
Soils		Loams	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha Compound, 150 kg	
Chemicals		No	
Erosion		sheet	
Ecology Degradation		15% natural, remainder cleared	
		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		2 Hectares	
Land requirements		1 Hectares	
Finance availability		None	
Limitations		Access to inputs and extension services	
Corruption		With officials	
Water accessibility		Well 300m, stream 400m	
Thoughts on investment concerns		Want investment, transparent and extension services and training. I am trying Jatropha because we need cash for education and hospitals	
What type (if any) project would be suitable		Perennial, cash crops	
What type of committee structure would be suitable		Government, locals, local leaders	
How and where do you market your crops		Locally, town	
Food concerns, reasons		January and February if we have sold too much maize for health and soap.	
Education		Too expensive, important for boys	
Energy			
Types of energy used		Wood for cooking, paraffin batteries	
Accessibility/ Availability		Wood within 300 metres	
Cost of soap , cooking fuel and lights		30 000 Kwacha per month	

8. LOCAL INTERVIEWS – Thematic Analysis (SZ9)	
Observation	
Crops	Maize(M), GN, Veges, Turkeys, tobacco, Goats, Chickens
Maize Yields/Reasons	0.5 Tonne
Soils	Clay sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN
Chemicals	yes
Erosion	Sheet
Ecology	30% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure poor
Would change for better options be considered	Yes
Land availability	40 Hectares
Land requirements	10 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Access to inputs and transport, roads, training
Corruption	Certain amount
Water accessibility	50m well
Thoughts on investment concerns	I am growing tobacco and it helps with cash but it I had lots of disease so the yields are very poor.
What type (if any) project would be suitable	Energy, cash crops or something that we only want to plant once (perennial)
What type of committee structure would be suitable	Government, locals and investor, leaders
How and where do you market your crops	Locally, town, use hired transport, Lusaka
Food concerns, reasons	None
Education	Education, college
Energy	
Types of energy used	Wood for cooking, electricity for lights
Accessibility/ Availability	Wood within 100m
Cost of soap , cooking fuel and lights	20 000 Kwacha per month

9. LOCAL INTERVIEWS – Thematic Analysis (SZ10)	
Observation	
Crops	Maize(M), Groundnuts, Turkeys, Ducks, Vegetables, Tobacco
Maize Yields/Reasons	2 Tonne
Soils	Loams
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN, manure
Chemicals	On Tobacco
Erosion	Gully, Sheet
Ecology	10% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	20 Hectares
Land requirements	5 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Access to inputs and transport
Corruption	Certain amount
Water accessibility	Well 50m
Thoughts on investment concerns	I am not sure. But it should be good to do
What type (if any) project would be suitable	Jatropha, or any crop that is better than Tobacco, Cash crops
What type of committee structure would be suitable	Cooperative and leaders
How and where do you market your crops	Locally, nearest town, use hired transport, Lusaka
Food concerns, reasons	On occasion
Education	Good for boys and girls. Must do grade 10
Energy	
Types of energy used	Wood for cooking, Electricity for lights
Accessibility/ Availability	Wood within 300 metres
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

10. LOCAL INTERVIEWS – Thematic Analysis (SZ11)	
Observation	
Crops	Maize(M), sunflower, sorghum
Maize Yields/Reasons	7 Tonne
Soils	Loamy sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Conservation Tillage
Fertilisers	Manure
Chemicals	No
Erosion	None
Ecology Degradation	All cleared
	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	5 Hectares
Land requirements	1 Hectares
Finance availability	None
Limitations	Access to inputs and transport
Corruption	Heard there is
Water accessibility	Well 1km
Thoughts on investment concerns	Want investment in conservation tillage. I want to grow much more maize like this. (zero tillage and manure)
What type (if any) project would be suitable	Maize
What type of committee structure would be suitable	Locals and investor
How and where do you market your crops	Local miller
Food concerns, reasons	No
Education	Yes as much as finances will allow
Energy	
Types of energy used	Wood for cooking, paraffin, candles
Accessibility/ Availability	Wood within 1.2 km
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

11. LOCAL INTERVIEWS – Thematic Analysis (SZ12)			
Observation			
Crops	Jatropha Growth	Maize(M), Jatropha, GN, SP	V. Poor
Maize Yields/Reasons		2 Tonne	
Soils		Sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Hoe	
Fertilisers		None	
Chemicals		No	
Erosion		Gully	
Ecology Degradation		All cleared	
		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		3 Hectares	
Land requirements		0.5 Hectares	
Finance availability		None	
Limitations		Access to inputs	
Corruption		Yes in areas	
Water accessibility		Stream and well 300m	
Thoughts on investment concerns		Want investment, I need much help to grow better crops	
What type (if any) project would be suitable		Any	
What type of committee structure would be suitable		Government, locals and chief	
How and where do you market your crops		Locally, nearest town,	
Food concerns, reasons		Dec to Mar	
Education		Good but finances are short kids leave after standard 7	
Energy			
Types of energy used		Wood for cooking, paraffin	
Accessibility/ Availability		Wood within 600 metres	
Cost of soap , cooking fuel and lights		15 000 Kwacha per month	

12. LOCAL INTERVIEWS – Thematic Analysis (SZ13)	
Observation	
Crops	Maize(M), GN, pumpkins, Sunflower
Maize Yields/Reasons	3 Tonne
Soils	Loamy sand
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN
Chemicals	No
Erosion	None
Ecology	5% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure poor
Would change for better options be considered	Yes
Land availability	3 Hectares
Land requirements	1 Hectares
Finance availability	None
Limitations	Access to inputs, help and extension services
Corruption	Heard there is plenty
Water accessibility	River 200m
Thoughts on investment concerns	Yes investment is good. We have no one trying to help us and it is difficult to make a good living with our crops
What type (if any) project would be suitable	Any but perennial would be good so we can also work
What type of committee structure would be suitable	Government, locals and local chief
How and where do you market your crops	Locally, nearest town,
Food concerns, reasons	At times
Education	Yes for boys but not girls but jobs are short
Energy	
Types of energy used	Wood for cooking, candles, paraffin
Accessibility/ Availability	Wood within 500 metres
Cost of soap , cooking fuel and lights	20 000 Kwacha per month

13. LOCAL INTERVIEWS – Thematic Analysis (SZ14)			
Observation			
Crops	Jatropha Growth	Maize(M), Jatropha, Cattle, goats, Turkeys, pumpkins and Sweet Potato	V. Poor
Maize Yields/Reasons		1 Tonne	
Soils		Clay sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha Compound, 50 kg of AN, manure	
Chemicals		No	
Erosion		Sheet	
Ecology Degradation		15% natural, remainder cleared	
		Most animals and birds have been hunted, soil structure poor	
Would change for better options be considered		Yes	
Land availability		12 Hectares	
Land requirements		1 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs, sickness	
Corruption		Certain amount	
Water accessibility		Well 50m	
Thoughts on investment concerns		I want a job. I grew some Jatropha but the company has never come back. The Jatropha did not grow well and most has now died. I am not sure about it.	
What type (if any) project would be suitable		Any but must be fair for all, advantages for locals	
What type of committee structure would be suitable		Government, locals and investor openness	
How and where do you market your crops		Locally, nearest town,	
Food concerns, reasons		No unless poor weather	
Education		Good for boys and girls , jobs are short	
Energy			
Types of energy used		Wood for cooking, candles for lights	
Accessibility/ Availability		Wood within 300 metres	
Cost of soap , cooking fuel and lights		40 000 Kwacha per month	

14. LOCAL INTERVIEWS – Thematic Analysis (SZ15)	
Observation	
Crops	Maize(M), Munemo Beans, Vegetables, GN, Goats chickens
Maize Yields/Reasons	5 Tonne
Soils	Loams
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Conservation tillage
Fertilisers	Manure
Chemicals	No
Erosion	Gully
Ecology	20% natural, remainder cleared
Degradation	Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	4 Hectares
Land requirements	1 Hectares
Finance availability	None
Limitations	Access to Manure and prices
Corruption	Yes
Water accessibility	Well 100m
Thoughts on investment concerns	Want investment, trusting is a problem and so is the marketing. I need a loan and training to grow the right crops put on the right inputs. We also need machinery to plough but I want to try conservation farming.
What type (if any) project would be suitable	Any but a cash crop is good,
What type of committee structure would be suitable	Locals, open meetings with all concerned
How and where do you market your crops	Locally, nearest town, not sure of best prices, want cash, will negotiate
Food concerns, reasons	No
Education	Yes for boys but not girls, jobs are short
Energy	
Types of energy used	Wood for cooking, candles, batteries
Accessibility/ Availability	Wood within 100 metres
Cost of soap , cooking fuel and lights	30 000 Kwacha per month

15. LOCAL INTERVIEWS – Thematic Analysis (SZ16)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, Jatropha, Goats, Pigs	V. Poor
Maize Yields/Reasons		0.5 Tonne	
Soils		Loamy sands	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Hoe	
Fertilisers		Manure, anthill	
Chemicals		No	
Erosion		Gully	
Ecology Degradation		25% natural, remainder cleared	
		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		8 Hectares	
Land requirements		1 Hectares	
Finance availability		None	
Limitations		Access to inputs	
Corruption		Yes, to get inputs	
Water accessibility		Stream with pools 250m away	
Thoughts on investment concerns		Yes would like investment	
What type (if any) project would be suitable		Food or cash crops. We need help to produce better crops.	
What type of committee structure would be suitable		Locals, chief, councillors and investor	
How and where do you market your crops		No crops for sale	
Food concerns, reasons		During rains before harvest.	
Education		Yes, until grade 7 then must work	
Energy			
Types of energy used		Charcoal for cooking, candles, paraffin for lights	
Accessibility/ Availability		Wood within 800 metres	
Cost of soap , cooking fuel and lights		10 000 Kwacha per month	

16. LOCAL INTERVIEWS – Thematic Analysis (SZ17)	
Observation	
Crops	Maize(M), SP, Cotton, chickens
Maize Yields/Reasons	1 Tonne
Soils	Clay sand
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 50 kg ha Compound, 50 kg of AN
Chemicals	No
Erosion	No
Ecology Degradation	10% natural, remainder cleared Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	4 Hectares
Land requirements	1 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Access to inputs and transport, help, training
Corruption	Yes
Water accessibility	Well 1km
Thoughts on investment concerns	Want investment, with good understanding and training
What type (if any) project would be suitable	Any kind but prices must be good
What type of committee structure would be suitable	Locals, headman, councillors
How and where do you market your crops	will negotiate for cash locally
Food concerns, reasons	When weather is poor
Education	Only to grade 7 but with more money to grade 10 or university
Energy	
Types of energy used	Wood or charcoal for cooking, paraffin or candles
Accessibility/ Availability	Wood within 300 metres
Cost of soap , cooking fuel and lights	20 000 Kwacha per month

17. LOCAL INTERVIEWS – Thematic Analysis (SZ18)			
Observation			
Crops	Jatropha Growth	Maize(M), munemo beans, goats, chickens, cattle, jatropha, vegetables	V. Poor
Maize Yields/Reasons		2 Tonne	
Soils		Loams	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough and conservation tillage	
Fertilisers		Average 100 kg ha Compound, 100 kg of AN	
Chemicals		On vegetables and jatropha	
Erosion		Slight sheet	
Ecology		15% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		2.5 Hectares	
Land requirements		1.5 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs and help, roads, transport	
Corruption		Seems to be much	
Water accessibility		Borehole. 200m	
Thoughts on investment concerns		Want investment to help locals with cash. Education on how to farm the new crop is important. We also need equipment. (Cultivation)	
What type (if any) project would be suitable		Food, cash crops with clear understanding	
What type of committee structure would be suitable		Government, locals and investor	
How and where do you market your crops		Locally, nearest town, self-delivery	
Food concerns, reasons		Years when the weather is not good.	
Education		Yes to university but money and teachers are short	
Energy			
Types of energy used		Wood for cooking, candles	
Accessibility/ Availability		Wood within 200m	
Cost of soap , cooking fuel and lights		30 000 Kwacha per month	

18. LOCAL INTERVIEWS – Thematic Analysis (SZ19)	
Observation	
Crops	Maize(M), Chickens, Veges, GN, Pigs, Sorghum, (Charcoal production)
Maize Yields/Reasons	1.5 Tonne
Soils	Loamy sands
Vegetation	Hyparrhenia Grasses, Woodlands
Tillage techniques	Plough
Fertilisers	Average 100 kg ha Compound, 100 kg of AN, Manure
Chemicals	No
Erosion	Sheet
Ecology Degradation	5% natural, remainder cleared Most animals and birds have been hunted, soil structure average
Would change for better options be considered	Yes
Land availability	3 Hectares
Land requirements	1 Hectares
Finance availability	Government offers subsidised fertiliser for cooperatives
Limitations	Access to inputs, money and training
Corruption	Yes
Water accessibility	River 50m
Thoughts on investment concerns	Want investment, with open communications and discussed with the chief and government. We must be protected because we do not understand many things about investments with companies
What type (if any) project would be suitable	Any kind
What type of committee structure would be suitable	Locals and leaders (Government and Chief representatives)
How and where do you market your crops	Town,
Food concerns, reasons	A times when weather is not good.
Education	Improving, good for boys but not girls, jobs are short
Energy	
Types of energy used	Wood for cooking, paraffin and candles
Accessibility/ Availability	Wood within 150 metres
Cost of soap , cooking fuel and lights	25 000 Kwacha per month

19. LOCAL INTERVIEWS – Thematic Analysis (SZ20)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, sunflowers, chickens, vegetables, Jatropha	V. Poor
Maize Yields/Reasons		2.5 Tonne	
Soils		Sandy loam	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 50 kg ha Compound, 50 kg of AN	
Chemicals		No	
Erosion		No	
Ecology		10% natural, remainder cleared	
Degradation		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		7 Hectares	
Land requirements		1 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs and distances	
Corruption		No there is no corruption	
Water accessibility		Stream and well 75 m	
Thoughts on investment concerns		Investment that benefits locals Many people make promises but nothing happens	
What type (if any) project would be suitable		Something that grows well in this area and has better prices than we already receive	
What type of committee structure would be suitable		Locals and representatives and investor	
How and where do you market your crops		Locally, nearest town mill, use hired transport,	
Food concerns, reasons		None	
Education		Boys to university and girls to grade 10 but finances are a problem	
Energy			
Types of energy used		Wood for cooking, paraffin and candles	
Accessibility/ Availability		Wood within 1.5km	
Cost of soap , cooking fuel and lights		50 000 Kwacha per month	

20. LOCAL INTERVIEWS – Thematic Analysis (SZ21)			
Observation			
Crops	Jatropha Growth	Maize(M), GN, SP, cotton, sunflowers, sorghum, watermelon, pumpkins, turkeys, chickens, goats	V. Poor
Maize Yields/Reasons		0.5 Tonne	
Soils		Clay loam	
Vegetation		Hyparrhenia Grasses, Woodlands	
Tillage techniques		Plough	
Fertilisers		Average 10 kg ha Compound, 10 kg of AN, manure	
Chemicals		No	
Erosion		Small gully	
Ecology Degradation		20% natural, remainder cleared	
		Most animals and birds have been hunted, soil structure average	
Would change for better options be considered		Yes	
Land availability		4 Hectares	
Land requirements		2 Hectares	
Finance availability		Government offers subsidised fertiliser for cooperatives	
Limitations		Access to inputs training	
Corruption		Certain amount	
Water accessibility		Well 50m, 3km to borehole, river100m	
Thoughts on investment concerns		Want investment,	
What type (if any) project would be suitable		Any crops but only if everyone is clear on the outcome	
What type of committee structure would be suitable		Government, locals and investor, chief, head of village	
How and where do you market your crops		Locally, nearest town, self-transport and hired transport	
Food concerns, reasons		If rain is short	
Education		Yes for boys but girls are married at 14 and have children, jobs are short	
Energy			
Types of energy used		Wood for cooking, paraffin, candles, batteries	
Accessibility/ Availability		Wood within 800 metres	
Cost of soap , cooking fuel and lights		35 000 Kwacha per month	

Appendix C Local Small-Holder Questions and Interview Responses: Zimbabwe

Interview Schedule of Local Inhabitants Affected by Biofuel Projects in Zimbabwe (A section of the semi-structured interviews conducted)

1. Is there concern for the security of land tenure?
2. Is there participation from all affected stakeholders? If yes, how is each group represented?
3. What is your water accessibility and quality?
4. What type of energy do you use? What is the availability?
5. Are agreements efficiently implemented?
6. What is the status of the soil and biodiversity?
7. Are livelihoods improving (e.g. health, education, food security and access to energy)? If yes, how? If no, why? a. Health. b. Education c. Food security d. Access to Energy
8. What impact is the project having on food security?
9. What types of jobs are available? Is training offered?
10. What are the local livelihood norms? What is your career preference?
11. How does the project affect gender issues?
12. What type of project and risk and reward would you consider fair to all parties?
13. What is your food situation? Why and how can food security be improved?
14. What crops do you grow and reasons for growing them?
15. What are your agronomic techniques?
16. What are your concerns for investors coming into your district?
17. What type of participation and communications would you consider most suitable for local populations?
18. Do you feel fairly represented by local officials and extension workers?
19. What are the roads and transport like?

MV – Masvingo Zimbabwe

MC – Manicaland Zimbabwe

<table>
<tr><th colspan="11">1. LOCAL INTERVIEWS – Thematic Analysis (MV 1)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, Soya, sorghum, cattle</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.1 tonnes/ha, weeds, nutrients, timing, stand</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough</td></tr>
<tr><td>Fertilisers</td><td colspan="10">25 Kg/ha compound, 25 AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">10 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">15 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, overgrazing, deforestation and erosion</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Borehole, 150 metres</td></tr>
<tr><td>Food Security</td><td colspan="10">It is poor and some years we have no food. We have received aid this year.</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, equal benefits.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">In Chiredzi</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Chief, locals, government representatives</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: The project does not affect me directly. I have had work on the plant but not with the irrigation and sugar cane. We have been promised work later when the project expands. If the pay is good I will find work there. We only hear what is happening. We are not sure who makes decisions. I believe I will be affected in future years. We will see if what they promise us is what they deliver. I have not had time to go to meetings.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Paraffin and wood for cooking and lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Immediate</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Muteyo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 770m, Rain 675mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sandy, 2% slope, eroded</td></tr>
</table>

<table>
<tr><th colspan="11">2. LOCAL INTERVIEWS – Thematic Analysis (MV 2)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, sunflowers, rapoko, cattle, goats, turkeys</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.5 tonnes/ha, weeds, nutrients, timing, stand</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">5 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">7 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, soil degradation and deforestation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Borehole, 100m</td></tr>
<tr><td>Food Security</td><td colspan="10">Good</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">With crops and irrigation, to help us</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Chief, locals, Agritex, headman</td></tr>
<tr><td>History</td><td colspan="10">Communal land</td></tr>
<tr><td colspan="11">Comments: I am hoping to find plenty of work but the irrigation does not benefit us. I have no husband and my children want to leave here. So I am not sure about the project. I will wait and see. We have heard through others what is happening with the project. I have not been to any meetings.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 200m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Muteyo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 770m, Rain 675mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sands, 2% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">3. LOCAL INTERVIEWS – Thematic Analysis (MV 3)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, sunflowers, cotton, cattle, goats,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.5 tonnes/ha, weeds, nutrients, timing, stand</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet,</td></tr>
<tr><td>Land Requirements</td><td colspan="10">5 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">10 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, erosion</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well, 200m</td></tr>
<tr><td>Food Security</td><td colspan="10">Given aid</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Irrigation, training and markets</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Chiredzi</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Locals, agritex, government, investor</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: My husband is in South Africa working. I have not seen him for two years. So we just try to survive. I will be unable to work on the plantation because I have many other duties. It does not affect us here. I only hear through others about the project.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Electricity sometimes. Wood for cooking, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 200m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chiredzi, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 440m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Clay loam, 2% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">4. LOCAL INTERVIEWS – Thematic Analysis (MV 4)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Sorghum, sunflowers, cotton, goats, chickens</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0 tonnes/ha, weeds, nutrients, timing, stand, drought</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough with oxen</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">12 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">River ,400m</td></tr>
<tr><td>Food Security</td><td colspan="10">We have no food. Given aid.</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, any kind with a good understanding and transparency. I am not involved in the project but many people have found work. I will get work if I can. I have been ill and unable to tend my fields properly</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Chiredzi</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Locals, agritex, investor, chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: The lack of income options forces young people to poach animals and cut wood for sale to locals and in the towns. To flush out animals they burn the grass in drier months. I am not affected but hope to find work with the ethanol company. I have not been to any meeting but have spoken to some who have. It seems to be a good project and the government says it will be good for the area. We are not sure but some have been given irrigation already and the schools and hospitals are operating again more efficiently.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Electricity sometimes. Wood for cooking, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 200m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chiredzi, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 440m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Clay loam, 2% slope, fair structure</td></tr>
</table>

<table>
<tr><th colspan="11">5. LOCAL INTERVIEWS – Thematic Analysis (MV 5)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, cotton, goats, GN, SP, sheep</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.25 tonnes/ha, nutrients, stand, drought</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">None</td></tr>
<tr><td>Land Requirements</td><td colspan="10">4Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">8 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, overgrazing, erosion</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Borehole 200m. It is not working so we travel 1 km to a river.</td></tr>
<tr><td>Food Security</td><td colspan="10">Given donations</td></tr>
<tr><td>Corruption</td><td colspan="10">Plenty Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, we need to be helped, we need inputs and a markets. We hope this will work this time. The irrigation is being fixed and if they do what is promised it will be good for us all.(jobs, education)</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Chisumbanje</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Government , chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Communal land</td></tr>
<tr><td colspan="11">Comments: Yes I have found work, and I will carry on again once the project begins again. The Chisumbanje sugar cane is now growing and there will be many more jobs needed there in the future. We need the money but it is still not enough but it helps. We do hope to gain skills. Yes, the schools are being operated and the clinic is improving. I have not lost land, but I have heard others will lose theirs and I am not sure what compensation has been promised. The government wants this operation to go ahead so there is nothing we can do.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, batteries and paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 800m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Muteyo, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Black Clay, 2% slope, good structure</td></tr>
</table>

6. LOCAL INTERVIEWS – Thematic Analysis (MV6)										
Observation										
Crops	Maize, cotton, goats, water melon, cattle, sorghum, vegetables									
Yields/Reasons	1 tonnes/ha, nutrients, stand, drought, timing									
Tillage techniques	Plough									
Fertilisers	25kg of compound, 25 AN, manure									
Erosion	Sheet									
Land Requirements	8Ha									
Land Availability	8Ha									
Environmental Concerns	Roads, deforestation, overgrazing, erosion									
Water accessibility	River 500m									
Food Security	December to April									
Corruption	Yes Ag. workers									
Thoughts on investment concerns/ what type	Yes, very good, irrigation									
How and where do you market your crops	Chisumbanje									
What type of committee structure would be suitable	Chief, committee made up of investors and local leaders, and Government									
History	Communal land									
Comments: I have been ill so I am not sure what is happening with the cane for ethanol. I believe the production is close to starting and many people have jobs on the construction of the machinery. The people close to the operation have been promised irrigation, which will help them, but we will not really benefit here. I have been to two meetings. One in the beginning and another late but we are outside the project.										
Types of energy used	Wood for cooking, candles and paraffin for lights									
Accessibility/ Availability	Wood 400m									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓		✓	✓	✓	✓		✓	✓	
Local Information										
Locality	Rupanggwana, Masvingo									
Regional climate	Alt. 405m, Rain 485mm.									
Soils	Clay sands, 5% slope, fair structure									

<table>
<tr><th colspan="11">7. LOCAL INTERVIEWS – Thematic Analysis (MV 7)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, round nuts, sorghum, goats</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">M = 0.3 tonnes/ha</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Shallow plough, hand level</td></tr>
<tr><td>Fertilisers</td><td colspan="10">50kg/ha Compound, 50kg AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Soil structure degradation</td></tr>
<tr><td>Land Requirements/observe,</td><td colspan="10">7 Hectares (Ha)</td></tr>
<tr><td>Land Availability/Observation</td><td colspan="10">7 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, bridges, erosion, soil degradation, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">River and village tank 150metres</td></tr>
<tr><td>Food Security</td><td colspan="10">Very little food in winter and early summer – look for jobs in cities, collect mushrooms in summer and bush fruit</td></tr>
<tr><td>Corruption</td><td colspan="10">Not much (Relevant to the country)</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Only want local help to expand themselves, need inputs</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Village headman, chief, and locals</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally</td></tr>
<tr><td>History</td><td colspan="10">Communal Land</td></tr>
<tr><td colspan="11">Comments: The rain has been very poor this year and our crops have failed again. This happens most years and even our livestock has no grass for grazing. The goats and cattle are eating the leaves in the trees. We need aid to feed our families because our harvest will not last for six months. I have been to one meeting with the company and government and chiefs and in about three years we will lose our land. It belongs to ARDA but we have used it for a number of years. They say they will provide us irrigated land when the company expands to this area.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, and candles and paraffin for lights</td></tr>
<tr><td>Accessibility/Availability</td><td colspan="10">I find it where I can. It is not easy to find in this area.</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information (Observation)</th></tr>
<tr><td>Locality</td><td colspan="10">Rupangwana, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Clay loam, 5% slope, poor nutrients,</td></tr>
</table>

<table>
<tr><th colspan="11">8. LOCAL INTERVIEWS – Thematic Analysis (MV 8)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, groundnuts, round beans, tomatoes, sunflowers, goats</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.1 tonnes/ha, weeds, nutrients, late planting</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Shallow plough, hand level</td></tr>
<tr><td>Fertilisers</td><td colspan="10">10 kg/ha Compound and 10 kg AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Gully,</td></tr>
<tr><td>Land Requirements</td><td colspan="10">10 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">5 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, bridges, deforestation, livestock over grazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">75m to river</td></tr>
<tr><td>Food Security</td><td colspan="10">Very bad most the year</td></tr>
<tr><td>Corruption</td><td colspan="10">Average</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Only want local help for inputs and marketing. No Jatropha some have hedges but most have nothing</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Chiredzi</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Headman, locals, government and chief</td></tr>
<tr><td>History</td><td colspan="10">Communal Land</td></tr>
<tr><td colspan="11">Comments: This local area has little bush left so we are struggling to find other food. If our crops fail we have nothing. I would be happy to find a good job. This new project may help us with that. My land is not affected so I do not receive irrigation. Those whose land is affected get the chance of jobs first. I have come home to harvest the crops and then I will go back to look for work in other areas.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles and paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 100 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Nandi, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Red, clay sand, 5% slope, poor nutrients.</td></tr>
</table>

<table>
<tr><th colspan="11">9. LOCAL INTERVIEWS – Thematic Analysis (MV 9)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, Groundnuts, sorghum</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.2 tonnes/ha, weeds, nutrients, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Hoe</td></tr>
<tr><td>Fertilisers</td><td colspan="10">None</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet</td></tr>
<tr><td>Land Requirements</td><td colspan="10">1Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">1 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, bridges, deforestation, land degradation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">250m to well</td></tr>
<tr><td>Food Security</td><td colspan="10">Survive on AID</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes for fertiliser and other inputs, or any project. We need jobs.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">None for sale</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Headman, locals, government</td></tr>
<tr><td>History</td><td colspan="10">Commercial Farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: I have received irrigation on half an hectare. We knew it was always ARDA’s land. We were warned many years ago that we could not live there, only use the land. The half hectare is on land outside ARDA area where I owned 7 hectares. It is very harsh here, so we think sugar cane is better for the conditions.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 100 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Sand, 2% slope, poor nutrients and structure</td></tr>
</table>

<table>
<tr><th colspan="11">10. LOCAL INTERVIEWS – Thematic Analysis (MV 13)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, Groundnuts,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.1 tonnes/ha, weeds, nutrients, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Hoe</td></tr>
<tr><td>Fertilisers</td><td colspan="10">20 kg/ha Compound and 20kg AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Nil</td></tr>
<tr><td>Land Requirements</td><td colspan="10">9Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">1 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Poaching, overgrazing and deforestation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">100m to well</td></tr>
<tr><td>Food Security</td><td colspan="10">Survive on Aid</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Need development of any type .Would like jobs and education help. I cannot make a living on the land I have. The soil is too hard to work and needs much rainfall .</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">None</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Headman, chief, local committee, government</td></tr>
<tr><td>History</td><td colspan="10">Commercial Farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: I have lost land. I had about nine hectares with my brothers but I am down to one hectare. I have received irrigation of half an hectare. We are hoping to see good crops from this. We have also been promised good jobs because we are one of the first affected by the project. They came and spoke to us and we went to meeting held by the company, extension officers, chiefs and government. This land does belong to ARDA and they are taken it back for this operation. We hope for the best as it has been very difficult here for many years without any irrigation. The pumps have been broken. They came and fixed them but no one knows how to maintain them so they when they break down they stay that way and we all suffer with poor crops.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, electricity for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo.</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Black Clay, 2% slope, poor nutrients and structure</td></tr>
</table>

<table>
<tr><th colspan="11">11. LOCAL INTERVIEWS – Thematic Analysis (MV 14)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">1 tonnes/ha, weeds, nutrients</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Shallow plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">75 kg/ha Compound and 75 AN</td></tr>
<tr><td>Erosion</td><td colspan="10">None</td></tr>
<tr><td>Land Requirements</td><td colspan="10">8Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">2Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, bridges, deforestation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">150m to a well. But it sometimes dries up.</td></tr>
<tr><td>Food Security</td><td colspan="10">OK, but not every year. Some years we need aid.</td></tr>
<tr><td>Corruption</td><td colspan="10">Average</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, even if it is to lease the land off us. We need work and inputs. So development will be good.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">People pick up for cash, unsure of market price</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Extension officer, locals, government</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , resettlement</td></tr>
<tr><td colspan="11">Comments: I have lost land but we did not live on our fields because it was not ours. Our house is in the communal lands. That land belongs to ARDA. The government spoke to us and they told us there is this operation and we would gain. We have irrigation of about half a hectare next to Arda land. It is good to see the schools are renovated and the health facilities improved. That is a good start. Many have to travel a long way for water but they</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo.</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Red clay , 2% slope, fair structure</td></tr>
</table>

12. LOCAL INTERVIEWS – Thematic Analysis (MV 15)

Observation	
Crops	Maize, Soya, GN,
Yields/Reasons	0.2 tonnes/ha, weeds, nutrients, poor stand
Tillage techniques	Plough,
Fertilisers	25 kg/ha Compound and 25 AN
Erosion	None
Land Requirements	7Ha
Land Availability	1Ha
Environmental Concerns	Roads, bridges, overgrazing, deforestation
Water accessibility	400m to river
Food Security	Shortage of food for 4months, Yields are very low
Corruption	Very Bad Ag. workers
Thoughts on investment concerns/ what type	Any type, open to negotiation but only if completely fair. Yes i heard about the company that wanted us to grow but have not seen them
How and where do you market your crops	Barter and cash
What type of committee structure would be suitable	Committee, locals, government
History	Commercial land , Resettlement
Comments: Yes I have been given half a hectare for irrigation. It has not started but they will be planting in about two months. This may help us because our other crops have failed. Sometimes other people's cattle get into our crops and we lose out. This year I have very little food and will have to rely on aid.	
Types of energy used	Wood for cooking, candles, paraffin for lights
Accessibility/ Availability	Wood within 300 metres

Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
		✓		✓	✓	✓	✓	✓	✓	✓

Local Information	
Locality	Chisumbanje, Masvingo.
Regional climate	Alt. 405m, Rain 485mm., Rain 485mm.
Soils	Black Caly, 2% slope, good structure

<table>
<tr><th colspan="11">13. LOCAL INTERVIEWS – Thematic Analysis (MV 16)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Sorghum, GN, chickens, goats, sunflower, rapoko</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.3 tonnes/ha, plough, weeds, nutrients, plant population</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">25 kg/ha Compound and 25 AN, manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">5Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">7 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, poaching</td></tr>
<tr><td>Water accessibility</td><td colspan="10">30m to well</td></tr>
<tr><td>Food Security</td><td colspan="10">January to April</td></tr>
<tr><td>Corruption</td><td colspan="10">No</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, need plenty, insinuated only to benefit locals and not the investor. Had heard of jatropha being grown for a big company but had not witnessed it</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Barter and cash, GMB</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Committee, locals, government representatives, chief</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: I have not had land taken but I believe they are coming to take it and give us irrigation on a smaller area in exchange. It may help us. They say it will. I will wait and see when it happens.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo.</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Black clay, 2% to 5% slope, good structure</td></tr>
</table>

<table>
<tr><th colspan="11">14. LOCAL INTERVIEWS – Thematic Analysis (MV 17)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, sorghum, cow peas cotton</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.4 tonnes/ha, weeds, nutrients</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">75 kg/ha Compound and 75 AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Gully, sheet</td></tr>
<tr><td>Land Requirements</td><td colspan="10">7Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">7 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, overgrazing and erosion</td></tr>
<tr><td>Water accessibility</td><td colspan="10">100m to river</td></tr>
<tr><td>Food Security</td><td colspan="10">We need aid as some months of the year (January to March) we have little or no food.</td></tr>
<tr><td>Corruption</td><td colspan="10">A little</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, with fair negotiations and opportunity to better herself</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Grain Market Board (GMB)</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">committee, locals, government officials, chief</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: I do not follow the discussions much but the rain was very poor this year. Many of the young men hunt and some sell timber in the towns for food. We have had theft problems. We have been given food aid which keeps us going. I am going to see what the future holds for this new project. I have been to one meeting in the beginning, and heard what they had to say.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 300 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo.</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Loamy sand, 2% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">15. LOCAL INTERVIEWS – Thematic Analysis (MV 18)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, Soya, GN, Tobacco, Goats, cattle, chickens</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.7 tonnes/ha, weeds, nutrients</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">50 kg/ha Compound and 50 AN, Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">sheet</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">5 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, bridges, erosion, overgrazing and deforestation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">200 m to well</td></tr>
<tr><td>Food Security</td><td colspan="10">Not on most years</td></tr>
<tr><td>Corruption</td><td colspan="10">Very bad. Inputs are only for party supporters (ZanuPF). The big chefs take it all (money and aid) for themselves. Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">No</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Barter and cash, GMB</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Chief, headman, committee, locals, government</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: Politics is involved in all decision making. Discussions are one thing but acting on it is not normal practice.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Masvingo.</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm.</td></tr>
<tr><td>Soils</td><td colspan="10">Clay sand, 5% slope, Fair structure, no nutrients</td></tr>
</table>

16. LOCAL INTERVIEWS – Thematic Analysis (MV 19)										
Observation										
Crops	Maize, Sorghum, round nuts, sugar beans, sweet potato									
Yields/Reasons	0.5 tonnes/ha, weeds, nutrients									
Tillage techniques	Plough,									
Fertilisers	None									
Erosion	Gully									
Land Requirements	3Ha									
Land Availability	7 Ha									
Environmental Concerns	Roads, overgrazing and deforestation									
Water accessibility	100m to well									
Food Security	We have enough food.									
Corruption	Very Bad Ag. workers									
Thoughts on investment concerns/ what type	Any type if infrastructure is sorted out and gives jobs. This farming is too difficult and I do not have machinery or inputs and my soils are too sandy.									
How and where do you market your crops	Barter and cash									
What type of committee structure would be suitable	Everyone involved									
History	Commercial land , Resettlement									
Comments: I would like to see irrigation. At a meeting I went to with government and company representatives, I asked if I will get some and have been told when the sugar cane programme reaches here in two years' time I will. It is much better for us because the rain in this area is very poor and only rains for 1 or 2 months.										
Types of energy used	Wood for cooking, candles for lights									
Accessibility/ Availability	Wood within 50 metres									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local Information										
Locality	Chisumbanje, Masvingo.									
Regional climate	Alt. 405m, Rain 485mm.									
Soils	Black Clay, 2% slope, good structure									

<table>
<tr><th colspan="11">17. LOCAL INTERVIEWS – Thematic Analysis (MC 1)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, GN, vegetables, goats,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">3 tonnes/ha, nutrients, stand, drought, weeds</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">75kg of compound, 75 AN,</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, Gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">4 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, river erosion (gold panning)</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well 200m</td></tr>
<tr><td>Food Security</td><td colspan="10">Shortage before harvest,Feb to March. We sell too much because we need the money for education and health and then run short later</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, if it helps improve situation. I have not seen the development in Middle Save, but people are going from here to work. Their wives stay behind and look after their crops and they come home most days.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Mutare</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Locals, investor, chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: We receive better rain here than in Chisumbanje. The project will not affect, but I am hoping to sell my produce to people working in Middle Save as it is much closer than Mutare. They come to collect people to work on the sugar cane which helps those without land or money for inputs. Fertiliser is expensive and hard to come by.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles and paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 100m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Birchenough bridge, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 470m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Loam, 5% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">18. LOCAL INTERVIEWS – Thematic Analysis (MC 2)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, beans, sorghum, chickens, vegetables</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">2 tonnes/ha, nutrients, stand, drought, weeds</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure , 50kg of compound, 50 AN,</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">5 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, river erosion, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well 100m and River 1000m</td></tr>
<tr><td>Food Security</td><td colspan="10">No shortages</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, any investment with transparency, jobs are already available and there will be more money available for business in the area.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Mutare</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Government, locals, investor, chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Communal Land</td></tr>
<tr><td colspan="11">Comments: I do not know much about the project except there will be many jobs, but I am not sure if they will decent jobs or if we will all find jobs. The meetings are near the project so we do not travel to them.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 100m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td><td></td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Nyanyadzi, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 600m, Rain 700 mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Pink loam, +5% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">19. LOCAL INTERVIEWS – Thematic Analysis (MC3)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, GN, vegetables, sorghum, chickens,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">1 tonnes/ha, nutrients, stand, drought, weeds</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">50kg of compound, 25 AN,</td></tr>
<tr><td>Erosion</td><td colspan="10">Gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">5 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, river erosion</td></tr>
<tr><td>Water accessibility</td><td colspan="10">River 100m</td></tr>
<tr><td>Food Security</td><td colspan="10">No shortages</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, any with transparency. We need jobs and we need infrastructure, machinery to cultivate, better schools, health and jobs for children</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Mutare, Chiredzi</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Government, locals, investor, chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Communal Land</td></tr>
<tr><td colspan="11">Comments: The project may help everyone in the area. We will see in the future. I have been to a meeting and we were promised training and good jobs. I have not been given a job as I am not yet affected by the project.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles and paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 100m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chibuwe, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 470m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Loam, 5% slope, poor structure</td></tr>
</table>

20. LOCAL INTERVIEWS – Thematic Analysis (MC 4)										
Observation										
Crops	Maize, GN, goats, chickens, sunflowers, vegetable									
Yields/Reasons	0.4 tonnes/ha, nutrients, plant population, drought, weeds									
Tillage techniques	Plough,									
Fertilisers	50kg of compound, 50 AN,									
Erosion	Gully, sheet									
Land Requirements	2 Ha									
Land Availability	10 Ha									
Environmental Concerns	Roads, deforestation, river erosion									
Water accessibility	Well 50m									
Food Security	At times if there is illness and drought									
Corruption	Yes Ag. workers									
Thoughts on investment concerns/ what type	Yes, any but must suit the locals and be equally administrated. Jobs are very important so children have opportunities									
How and where do you market your crops	Locally									
What type of committee structure would be suitable	Government, locals, chief,									
History	Commercial farmland, resettlement									
Comments: Maize and Sorghum in the area has failed except for some farmers who planted early, but I do not think their food will last until next year's harvest. Even though we try and plant more, we have no money for inputs and the rainfall is less than previous years										
Types of energy used	Wood for cooking, candles, paraffin for lights									
Accessibility/ Availability	Wood 200m									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓		✓	✓	✓	✓		✓	✓
Local Information										
Locality	Chibuwe, Manicaland									
Regional climate	Alt. 470m, Rain 485mm,									
Soils	Loam, 5% slope, poor structure									

<table>
<tr><th colspan="11">21. LOCAL INTERVIEWS – Thematic Analysis (MC 5)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, GN, sunflowers, vegetable, cattle,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.25 tonnes/ha, nutrients, stand, weeds, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Hoe</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">1 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">8 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, river erosion, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well and river 50m</td></tr>
<tr><td>Food Security</td><td colspan="10">At times if there is illness and drought</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. Workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, to get jobs and training. I have no job with the company at Middle Sabi but hope to when they expand cultivation. Any job will do.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Chipinge</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Government, locals, chief,</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: I believe we will get electricity again. This is good for the area but we do not have lines working. They have been stolen and we are not sure if they will be replaced. We have been using land taken from commercial farmers but now they want to take it for the project. The government promises one thing and now they are changing their minds. We have many meeting s and are waiting to see what happens. We are still negotiating. It depends what the chief decides and we will follow.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 100m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Rupisi, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 470m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sandy Loam, 5% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">22. LOCAL INTERVIEWS – Thematic Analysis (MC 6)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, round beans, goats, chickens, sunflowers, rapoka</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.1 tonnes/ha, nutrients, stand, weeds, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough, Hoe</td></tr>
<tr><td>Fertilisers</td><td colspan="10">10kg/ha compound, 10kg AN, manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">1 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">10 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, river erosion, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well and river 50m</td></tr>
<tr><td>Food Security</td><td colspan="10">Sometimes have food but if inputs are late have a problem</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, better inputs and training and jobs. I have not had a job at Middle Sabi but there are some who catch a bus there to work</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Mutare and locally</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Government, locals, chief, committee, headman</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: We are pleased to have irrigation again as we should produce better crops. Green Fuel also provides free transport for workers to work and return from up to 80 km away on a daily basis. They collect the people on the road beyond Birchenough bridge. Many people are in trouble with law because of corruption in the law. Also, we have to find animals in the forests and sell food, like mushrooms and honey to survive. Our crops then suffer, but what can we do with no rain. The crops fail nearly every year.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, paraffin, candles lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 100m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Rupisi, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 470m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sandy Loam, 2% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">23. LOCAL INTERVIEWS – Thematic Analysis (MC 7)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, sorghum, cotton, vegetables, chickens, rapoka</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.25 tonnes/ha, weeds, nutrients, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">ploughing</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Nil</td></tr>
<tr><td>Land Requirements</td><td colspan="10">4Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">7Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation and overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">300m to river, well 50m</td></tr>
<tr><td>Food Security</td><td colspan="10">Shortage in January to February</td></tr>
<tr><td>Corruption</td><td colspan="10">Some places</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, We have been promised good futures if we accept this project. We are not sure but things are very bad , we have poor health, schooling and jobs and the crops do not provide much</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">GMB and locally</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">committee, government representatives</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: I have land which will gain irrigation sometime in the future. The project has not reached us yet. I do find food in the bush and am always looking for bush meet to sell. The forests have nearly all disappeared so we rely on aid.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin, electricity for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 100 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Black clay , good structure</td></tr>
</table>

<table>
<tr><th colspan="11">24. LOCAL INTERVIEWS – Thematic Analysis (MC 8)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, cotton, cattle, goats, chickens</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.25 tonnes/ha, weeds, nutrients, timing</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Hoeing,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet, gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">10 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">20 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, river erosion, deforestation and overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well 200m</td></tr>
<tr><td>Food Security</td><td colspan="10">At times food is short</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes, leaders and others in the right party (ZanuPF) They are not sharing the benefits(aid , inputs)</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, We have poor rains here and it is overgrazed. We are happy for the new opportunity for jobs. We have been promised better schooling and hospitals. I will not receive irrigation but I hope to benefit with the job I have (construction labourer at the processing plant).</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Local barter</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Chief, committee, government representatives</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: No further comments</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin,</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sand, less than 2% slope, poor structure</td></tr>
</table>

<table>
<tr><th colspan="11">25. LOCAL INTERVIEWS – Thematic Analysis (MC 9)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, cotton, goats,</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.25 tonnes/ha, weeds, nutrients, timing, stand, drought</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Manure , 10kg of compound</td></tr>
<tr><td>Erosion</td><td colspan="10">gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">2Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">7 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, erosion, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">River 400m</td></tr>
<tr><td>Food Security</td><td colspan="10">Most years</td></tr>
<tr><td>Corruption</td><td colspan="10">Plenty Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, with equal benefits , I have a job and hope the company expands. I will be getting irrigation in exchange for land. It may help us with electricity, let's hope so.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Chisumbanje, it will give us jobs and income we need.</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Locals, chief, village committee</td></tr>
<tr><td>History</td><td colspan="10">Communal land</td></tr>
<tr><td colspan="11">Comments: I just would like electricity in my house. We have been told it will happen in the future. Things are very bad for us here with no transport, no health facilities and the few teachers at the school. The company has promised to create a community centre where all these will be provided.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, paraffin for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 200m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Chisumbanje, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 405m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Clay Loam, 2% slope, fair structure</td></tr>
</table>

26. LOCAL INTERVIEWS – Thematic Analysis (MC 10)										
Observation										
Crops	Maize, Soya, GN, cotton									
Yields/Reasons	1 tonnes/ha, weeds, nutrients, sickness (he was sick for a while during growing season)									
Tillage techniques	Plough,									
Fertilisers	25 kg/ha Compound and 25 AN									
Erosion	Slightly sheet									
Land Requirements	1Ha									
Land Availability	10 Ha									
Environmental Concerns	Roads, bridges, deforestation and overgrazing									
Water accessibility	200m to river									
Food Security	Not often, if weather is poor									
Corruption	Yes in all areas Ag. workers									
Thoughts on investment concerns/ what type	Any type, for jobs, water and markets. No I have not had any experience of bad investments and have not seen Jatropha grown									
How and where do you market your crops	Barter and cash									
What type of committee structure would be suitable	Headman, area chief, committee, locals, government									
History	Commercial land , Resettlement									
Comments: If the project provides better jobs and gives the youth an opportunity it will help with the crime. People live from hunting wild animals and finding food in the bush. Yes, sometime they poach and many cut the timber to sell in the towns.										
Types of energy used	Wood for cooking, candles, paraffin, electricity for lights									
Accessibility/ Availability	Wood within 250 metres									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓		✓	✓	✓	✓			✓	✓
Local Information										
Locality	Nyanyadzi, Manicaland									
Regional climate	Alt. 600m, Rain 700 mm									
Soils	Red, clay sand, 2% slope, fair structure									

<table>
<tr><th colspan="11">27. LOCAL INTERVIEWS – Thematic Analysis (MC 11)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, Soya, GN, sorghum, cattle</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">1 tonnes/ha, weeds, nutrients, timing (Late planting)</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">hoeing,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">25 kg/ha Compound and 25 AN</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet</td></tr>
<tr><td>Land Requirements</td><td colspan="10">1Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">5 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, overgrazing</td></tr>
<tr><td>Water accessibility</td><td colspan="10">100m to river, well 100m</td></tr>
<tr><td>Food Security</td><td colspan="10">Not often, if weather is poor</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, for jobs, and expertise help. I have not grown or seen anyone grow Jatropha except around their houses</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Barter and cash</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Headman, area chief, committee, locals, government</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: There is much crime in the area and our produce is often stolen. We need help with inputs, but even then the rain does not come like it used to in the past.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin,</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 200 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td></td><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Nyanyadzi, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 600m, Rain 700 mm</td></tr>
<tr><td>Soils</td><td colspan="10">Red, clay sand, 2% slope, fair structure</td></tr>
</table>

28. LOCAL INTERVIEWS – Thematic Analysis (MC 12)	
Observation	
Crops	Maize, GN, goats
Yields/Reasons	0 tonnes/ha, weeds, timing, stand
Tillage techniques	Hoeing,
Fertilisers	5kg/ha Compound and 5AN. Manure
Erosion	Gully, sheet
Land Requirements	3Ha
Land Availability	5 Ha
Environmental Concerns	Roads, deforestation, overgrazing and ersionn
Water accessibility	200m to river, well 500m
Food Security	Most years from August to March
Corruption	Yes Ag. workers
Thoughts on investment concerns/ what type	Any type, We want any kind of job, there is no work and my children do not want to farm. They want education to find work.
How and where do you market your crops	Barter locally
What type of committee structure would be suitable	Headman, area chief, committee, locals, government
History	Commercial land , Resettlement
Comments: We have had no crops this year. I planted late because we had no seed and I was ill. We are living on aid handouts and are worried for the future. If I get irrigation it will help us with food and education.	
Types of energy used	Wood for cooking, candles, paraffin for lights
Accessibility/ Availability	Wood within 200 metres

Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓		✓	✓	✓	✓	✓	✓	✓

Local Information	
Locality	Rupisi, Manicaland
Regional climate	Alt. 470m, Rain 485mm,
Soils	Sandy loam, 2% slope, poor structure

29. LOCAL INTERVIEWS – Thematic Analysis (MC 13)	
Observation	
Crops	Maize, Soya, GN, sorghum, goats
Yields/Reasons	0.5 tonnes/ha, weeds, nutrients, timing
Tillage techniques	hoeing,
Fertilisers	150 kg/ha Compound and 100 AN
Erosion	Gully, sheet
Land Requirements	5 Ha
Land Availability	10 Ha
Environmental Concerns	Roads, river erosion, overgrazing, deforestation and erosion
Water accessibility	300m to river, well 20m
Food Security	No
Corruption	Some places
Thoughts on investment concerns/ what type	Any type, equal benefits , We are hoping that good jobs will be provided by the company at Middle Save
How and where do you market your crops	Locally
What type of committee structure would be suitable	Committee, government representatives
History	Commercial land , Resettlement
Comments: If they give us irrigation, even on a small piece it will help us. I have very little food for the year.	
Types of energy used	Wood for cooking, candles, paraffin, electricity for lights
Accessibility/ Availability	Wood within 100 metres

Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓	✓	✓	✓		✓	✓	✓	✓

Local Information	
Locality	Rupisi, Manicaland
Regional climate	Alt. 470m, Rain 485mm,
Soils	Pink, clay sand, 2% slope, fair structure

<table>
<tr><th colspan="11">30. LOCAL INTERVIEWS – Thematic Analysis (MC 14)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, sorghum goats, sweet potato</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">0.2 tonnes/ha, weeds, nutrients, timing, stand</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">hoeing,</td></tr>
<tr><td>Fertilisers</td><td colspan="10">Anthill, manure</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet</td></tr>
<tr><td>Land Requirements</td><td colspan="10">1 Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">1 Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, river erosion from mining, deforestation</td></tr>
<tr><td>Water accessibility</td><td colspan="10">100m to river,</td></tr>
<tr><td>Food Security</td><td colspan="10">No</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Any type, We need jobs and help with our farming.</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Barter locally</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">committee, government representatives,</td></tr>
<tr><td>History</td><td colspan="10">Commercial land , Resettlement</td></tr>
<tr><td colspan="11">Comments: I have a job and two of my friends and we hope to get training. I work on irrigation as a team leader. Our land will not be affected. We hope the electricity that is promised will take place one day.</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, candles, paraffin,</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood within 50 metres</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Birchenough Bridge, Manicalnad</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 470m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Sandy 5% slope, poor structure</td></tr>
</table>

31. LOCAL INTERVIEWS – Thematic Analysis (MC 15)										
Observation										
Crops	Maize, Soya, game meat, cotton, cattle									
Yields/Reasons	0.25 tonnes/ha, weeds, nutrients, timing									
Tillage techniques	hoeing,									
Fertilisers	Manure									
Erosion	Gully, sheet									
Land Requirements	1Ha									
Land Availability	10 Ha									
Environmental Concerns	Roads, river erosion from mining, deforestation and overgrazing									
Water accessibility	100m to river,									
Food Security	No									
Corruption	Yes Ag. workers									
Thoughts on investment concerns/ what type	Any type, We need jobs and opportunity to work with people who know how to farm. We need to learn. My children need to find jobs one day.									
How and where do you market your crops	None									
What type of committee structure would be suitable	committee, government representatives									
History	Commercial land , Resettlement									
Comments: I have been given irrigation. They are coming to plant sugar cane. I am not planting maize, which is a concern because I need food for my family. I chose sugar cane because the inputs are provided and it will be irrigated for us. If the price is good, we will do better than other years. I am pleased with this opportunity. I am told we will do much better with sugar cane and we will be able to afford food.										
Types of energy used	Wood for cooking, candles, paraffin,									
Accessibility/ Availability	Wood within 100 metres									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local Information										
Locality	Rupisi, Manicaland									
Regional climate	Alt. 470m, Rain 485mm,									
Soils	Loam sand, 2% slope, poor structure									

<table>
<tr><th colspan="11">32. LOCAL INTERVIEWS – Thematic Analysis (MC 10)</th></tr>
<tr><th colspan="11">Observation</th></tr>
<tr><td>Crops</td><td colspan="10">Maize, goats, GN, sunflowers, sorghum, cattle</td></tr>
<tr><td>Yields/Reasons</td><td colspan="10">02 tonnes/ha, nutrients, stand, drought, weeds</td></tr>
<tr><td>Tillage techniques</td><td colspan="10">Plough, hoe</td></tr>
<tr><td>Fertilisers</td><td colspan="10">25kg of compound, 25 AN,</td></tr>
<tr><td>Erosion</td><td colspan="10">Sheet , gully</td></tr>
<tr><td>Land Requirements</td><td colspan="10">6Ha</td></tr>
<tr><td>Land Availability</td><td colspan="10">20Ha</td></tr>
<tr><td>Environmental Concerns</td><td colspan="10">Roads, deforestation, overgrazing, erosion, river erosion (gold panning)</td></tr>
<tr><td>Water accessibility</td><td colspan="10">Well 100m</td></tr>
<tr><td>Food Security</td><td colspan="10">Shortage on most years, we receive aid.</td></tr>
<tr><td>Corruption</td><td colspan="10">Yes Ag. workers</td></tr>
<tr><td>Thoughts on investment concerns/ what type</td><td colspan="10">Yes, with equal benefit. We receive little rain and would like a job to look after my family as our crops are very poor</td></tr>
<tr><td>How and where do you market your crops</td><td colspan="10">Locally, Chisumbanje.</td></tr>
<tr><td>What type of committee structure would be suitable</td><td colspan="10">Locals, investor, chief, headman, village committee and Government</td></tr>
<tr><td>History</td><td colspan="10">Commercial farmland, resettlement</td></tr>
<tr><td colspan="11">Comments: Our soils and rainfall are very poor and it is difficult to produce enough food or cash crops to survive. This area is very short of money and we have no job opportunities to buy soap and medicines. We would prefer employment to farming in this area. The new biofuel project may help with jobs but we are not yet sure of the problems it will cause, or whether many locals will be given jobs</td></tr>
<tr><td>Types of energy used</td><td colspan="10">Wood for cooking, batteries and candles for lights</td></tr>
<tr><td>Accessibility/ Availability</td><td colspan="10">Wood 300m</td></tr>
<tr><td>Livelihood Concerns</td><td>Climat</td><td>Crops</td><td>Degra.</td><td>Transp</td><td>Health</td><td>Corrup</td><td>Tenure</td><td>Jobs</td><td>Energy</td><td>Educ</td></tr>
<tr><td></td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><th colspan="11">Local Information</th></tr>
<tr><td>Locality</td><td colspan="10">Rupisi, Manicaland</td></tr>
<tr><td>Regional climate</td><td colspan="10">Alt. 440m, Rain 485mm,</td></tr>
<tr><td>Soils</td><td colspan="10">Loamy sands, 5% slope, poor structure</td></tr>
</table>

33. LOCAL INTERVIEWS – Thematic Analysis (MC 11)										
Observation										
Crops	Maize, goats, vegetables, chickens, round nuts									
Yields/Reasons	0.5 tonnes/ha, nutrients, stand, drought, timing, weeds									
Tillage techniques	Plough									
Fertilisers	25kg of compound, 25 AN, (Manure on the vegetables)									
Erosion	Sheet									
Land Requirements	2Ha									
Land Availability	6Ha									
Environmental Concerns	Roads, deforestation, overgrazing, erosion									
Water accessibility	River 200m									
Food Security	December to April									
Corruption	Yes, Ag. workers									
Thoughts on investment concerns/ what type	Yes, I now have a job working on the irrigation at Middle Sabi. It provides for my family. My wife looks after the crops.									
How and where do you market your crops	Locally,									
What type of committee structure would be suitable	Locals, investor, chief, village committee and government									
History	Commercial farm land, resettlement									
Comments: The job is not perfect but it helps for the moment. I would prefer a better job but there is not much work in the cities.										
Types of energy used	Wood for cooking, electricity for lights									
Accessibility/ Availability	Wood 200m									
Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓	✓	✓	✓	✓		✓	✓	✓
Local Information										
Locality	Rupisi, Manicaland									
Regional climate	Alt. 460m, Rain 485mm,									
Soils	Loamy sands, 2% slope, poor structure									

34. LOCAL INTERVIEWS – Thematic Analysis (MC 12)	
Observation	
Crops	Maize, vegetables
Yields/Reasons	0.5 tonnes/ha, nutrients, stand, drought, timing, weeds
Tillage techniques	Plough
Fertilisers	20kg of compound, 30 AN,
Erosion	Sheet
Land Requirements	5Ha
Land Availability	5Ha
Environmental Concerns	Roads, deforestation, overgrazing and erosion
Water accessibility	River 100m, borehole 50m
Food Security	We run short most years
Corruption	It is noticeable
Thoughts on investment concerns/ what type	Yes, any project that can help us. We have no inputs
How and where do you market your crops	Locally, Grain Marketing Board (GMB)
What type of committee structure would be suitable	Locals, investor, chief, and committee with agritex, local government, investor and local representatives.
History	Commercial farm land, resettlement
Comments: I am not affected by the project. I will get a job if there are jobs available, but I have not yet applied.	
Types of energy used	Wood for cooking, batteries and paffin for lights
Accessibility/ Availability	Wood 900m

Livelihood Concerns	Climat	Crops	Degra.	Transp	Health	Corrup	Tenure	Jobs	Energy	Educ
	✓	✓	✓	✓	✓		✓	✓	✓	✓

Local Information	
Locality	Rupisi, Manicaland
Regional climate	Alt. 460m, Rain 485mm,
Soils	Loamy sands, 2% slope, fair structure

Discussion with:

Local policeman – crime has been reduced by 95%. We are able to spend more time helping the community rather than fighting crime. It had become very bad as there is no opportunity in the area, such as jobs. The rainfall has been very bad and some of the crops have died in the field from drought. Discussion with Policeman at Rupisi (2011).

Small scale farmer Middle-Save – I have been unable to irrigate my lands for six years. I received a resettlement farm of 50 ha but have produced only a few crops because we share the irrigation scheme with many resettled farmers and nobody was doing the maintenance. The motors had broken so we were unable to do any irrigated farming. The weeds are too many to control. My land is now irrigated and I will receive earnings from the sugar cane. I do not need to get involved in the production. They are the experts and they have the money. I will be paid my share at the sugar prices (world) less costs. I am still learning how to farm with irrigation. It is not easy, there are many difficulties with insects, fertiliser and weeds.

Appendix D Acceptance Letter and Final Proof Amendments: Paper 1 (Chapter 2), African Journal of Economic and Sustainable Development

Re: FW: Submission of Article
aida.sy1776 [aida.sy1776@gmail.com]
Sent: Tuesday, 11 December 2012 8:51

Dear Author,

The reviewers have recommended I accept your paper "Understanding sustainable biofuel development: a sub-Saharan Africa perspective" for publication in AJESD. Please inform your co-authors. I will process it with the Publishers and you will deal with the copyright as soon as possible.

Sincerely,
Aida

Amendments to Proof

Journal: African Journal of Economic and Sustainable Development (Inderscience Publishers)
Authors Name: Ian Duvenage
Paper Title: Understanding sustainable biofuel development: a sub-Saharan Africa perspective

Page No.	Section	Para-graph	Line No.	Delete	Add/amend
4	*1.1 Sustainability policy and principles*	2	1 and 3	Line 1: Hawkins (2011) Line 3: Hawkins (2011)	Line 1: Hawken (2007) Line 3: Hawken (2007)
22	References			Coleman, J. (1988) 'Organizations and institutions: sociological and economic approaches to the analysis of social structure', *The American Journal of Sociology*, Vol. 94, pp.95–120.	Coleman, J. (1988) 'Social Capital in the Creation of Human Capital', *The American Journal of Sociology*, Vol. 94, No. Supplement, pp.95–120.
23	References			Lozano, R. (2009) 'Envisioning sustainability three-dimensionally', *Journal of Cleaner Production*, Vol. 16, pp.1838–1846.	Lozano, R. (2009) 'Envisioning sustainability three-dimensionally', *Journal of Cleaner Production*, vol. 16, no. 17, pp.1838–1846.
24	References			Hawkins, P. (2011) 'Natural capitalism', Presentation, 2 November, Bond University, Gold Coast.	Hawken, P. (2007), *Blessed Unrest,* Viking Press, New York.
26	References			Stiglitz, J. (2011) 'Rethinking development economics', *The World Bank Research Observer*, 19 July, Vol. 26, pp.230–236.	Stiglitz, J. (2011) 'Rethinking development economics', *The World Bank Research Observer*, Vol. 26, No. 2, pp.230–236.

Appendix E Reviewer Comments and Responses: Paper 2 (Chapter 3), Journal of Environment, Development and Sustainability.

Reviewer #1 Comments	Responses
1. Reviewer 1 said political ecology is identified as the theoretical lens but it is only superficially mentioned at the beginning and end. It is not clear how it has shaped the research design or added insight to the analysis. If political ecology is to be kept as a theoretical reference point, greater effort should be made to show how it has been applied in other relevant studies (beyond the Ariza-Montobbio et al. paper) as well as how its insights have advanced and/or been advanced by this research. Another option would be to simply state that a political ecology perspective could be applied to go deeper into some of the equity issues raised in the survey without claiming that this paper does so.	To address this we have opted for latter approach suggested by the reviewer. However, in addition we have strengthened the mention of political ecology throughout the paper (given pages and lines). Although, we do not claim to have advanced political ecology, it is considered a useful lens to through which to view biofuels sustainability. p.6, line 30 to p.7, line 3. Sustainability achievement capacities can be examined through institutional understandings of informal institutions (i.e. codes of conduct, conventions and behavioural norms) (North 1990); especially in cases with countries that display weak governance. The term, 'weak governance', is usually referred to as issues impeding social and environmental and economic development, including inequality, insecure property rights, corruption and bureaucratic delays (World Bank 1999). p.3, lines 27-30. Enquiry grounded in political ecology, seeking to understand the uneven power relationships, and the hierarchal impacts on costs and benefits, which often lead to economic, social and environmental inequalities (Bryant and Bailey 2007; Hall et al. 2009), can be usefully applied to this field of research. p.18, lines 11-13. Understanding the political ecology concerns of an unjust allocation of risks and insecurities (Ariza-Montobbio et al. 2010), through uneven power scales (political, knowledge and economic) (Blaickie 1985), ... p.18, lines 15-20. Many respondents suggested that this can only be attained if stakeholders' representatives are suitably educated in sustainable development and project design. Effective education and active participation throughout a project's lifecycle can help recognise political ecology beliefs that projects can be implemented less coercively, less

	manipulatively and more sustainably (Peets and Watts 1996; Robbins 2004). p.18, lines 21-28. Drawing on the social capital understanding that cooperative behaviour generates fairer outcomes (Putman et al. 1993), political ecology explanations can help account for the concerns of surveyed experts that education and knowledge should not be considered a one way process that solely informs local stakeholders about project developments (cf, Vermeulen and Cotula 2010) but rather a two way communication process. Through a political ecology approach – i.e taking into account development economics and understanding of reasons for poverty standing alongside affluence (Bass 2011), and institutional economic studies of informal institutions (North 1990). p.19, lines 6-14. Drawing on key ethical principles examined from the perspective of knowledge frameworks may provide the base from which a mediating/advisory body could operate to gain the confidence of all stakeholder groups. Arguably, the mediating/advisory body could function effectively by drawing on: the understandings of uneven power relations in political ecology (Peet and Watts 1996; Elgahali, 2007); development economics and its study of effective use of scarce resources (Bass 2011); the explanations of social capital in promoting quality networking, and trust and social norms within informal institutions (Putman et al. 1993); and institutional economics arguments that informal institutions can facilitate efficiency and fairness until capacities are reached to form formal institutions (Jutting 2003).
2. Reviewer 1 said, for the literature review to provide enough context for the empirical work that follows, I think it is important for it to briefly summarize a few additional topics: a. The nature and extent of current biofuel initiatives in Africa, whether in terms of land area, amount of investment or even number of countries involved (I realize there's no complete inventory of these, but some sense of scale can still be given. This would help explain why Africa deserves the particular interest given to it in this study as well as some of the unique challenges	To address topic a. we provided a context of biofuel initiatives in Africa on p.5, lines 9-20. While many reports about biofuel development in Africa are largely anecdotal, some reports document land appropriations for commercialisation (Mortimer 2011; Nhantumbo and Salomão 2010). The numerous requests for land to the Mozambique Government to produce sugarcane and *Jatropha curcas L.* to produce biofuel feedstock had by 2009 exceeded 20 million hectares. Although not all requests are granted, 15 ongoing projects seek to grow 500 000 hectares for biofuel feedstock (Arndt 2011).

facing biofuel development in Africa) b. The diversity of approaches of current biofuel production activities in Africas (i.e. introduce and explain the industrial, central / outgrower and community models that are mentioned later) c. Describe what currently exists (or doesn't exist) with respect to sustainability frameworks / bodies / certification schemes for biofuels (this would help with the interpretation of the survey results.)	According to some reports an estimated 50 companies have established at least 100 agrofuel projects in sub-Saharan Africa, although figures are likely to be higher, given the lack of accurate data (Carrington and Valentino 2011). In some cases vast quantities of land requested are granted, such as the surrender of 2.8 million hectares of land to China by the Democratic Republic of Congo (Paul et al. 2009). In another case, Mali, Senegal and Guinea have between them relinquished 900 000 hectares to Crest Global Green Energy, a British bioenergy company (Carrington and Valentino 2011). To address topic b. we have provided an explanation of the various approaches on p.2, lines 14-20. Three biofuel project types, common to sub-Saharan Africa (Vermeulen and Cotula 2010a), are focused on: 1) Agro-industrial projects which include projects that acquire vast tracks of land to produce, process and distribute feedstock. The local community involvement is often only menial employment opportunities. 2) Centrally-operated projects which involve an investor owning a central processing operation that is supplied by feedstock produced by contracted out-growers. 3) Community-produced feedstock for a community owned processing operation. To address topic c. we have discussed the sustainability assessment/certification sources through a footnote on page 1. Biofuel assessment frameworks discussed within this article refers to 17 internationally recognised regulatory frameworks, voluntary frameworks, scorecards and analytical frameworks BEFSCI (2011) and GBEP Task Force on Sustainability (2011).
3. Reviewer 1 said, sustainability is the central concept of the paper but it is not defined. This is particularly important because nearly every survey question asked respondents how biofuels could be produced more "sustainably." Did the survey provide a definition of sustainability for respondents to consider when answering the survey, or were they left to apply their own interpretations of this very flexible term? The literature review could also more clearly link the concerns with biofuel production detailed on	In response to this we edited the paper and explained the concept of sustainability on p.2, lines 22-26. Sustainability is a contested term, so rather than be prescriptive respondents were left to apply their own interpretation. For the purposes of this paper, biofuel development is considered sustainable if across the three pillars of sustainability (environmental, social and economic), the strengths of one (or two) pillar/s does not undermine the other/s (Binder et al. 2010).

pages 2-5 with sustainability criteria as applied in the rest of the paper.	
4. Reviewer 1 said, more detail about the respondents is needed to inform the interpretation of findings, e.g. how many were drawn from governments, the private sector, NGOs and researchers, and how many were based inside vs. outside Africa. This is important to know when considering what strategies they recommended for improving the biofuel industry (e.g. private sector actors could be expected to have an interest in promoting voluntary guidelines).	To address this, an explanation is provided on p.8, lines 2-8. Although respondents were selected internationally for their diverse fields of expertise with regard to sustainability and biofuel production, owing to the relatively small participant sample, care was taken not to select respondents affiliated to the private sector. This was in an effort to minimise bias through self-promoting responses. The survey requested names and institutional affiliations on a voluntary basis. As some of the respondents chose to remain anonymous, findings by respondents' institutional affiliations, or whether from within or outside Africa are not presented here.
5. Reviewer 1 said, I find the presentation of survey results too concise. Including more of the respondents' qualitative comments would add richness, while further interpretation would enhance the reader's understanding of the results. For example, under Q5, "equality," "framework" and "transparency" are very broad terms used in passing and it is not immediately clear what respondents meant by them	To address this, a number of qualitative responses from respondents were added to various survey questions on given pages: Q3 on p.11, lines 15-17 Respondent 5 offered the opinion that "sanctions would be near impossible to enforce because of the huge investment in monitoring, reporting and verification that would be needed". Q5 on p.16, line 17 to p.17, line 4 Concerns were raised about a lack of transparency and unequal stakeholder participation, often stemming from poor communication, and leading to confusion and inequality. These concerns are explained by respondents 15 and 21: "I think the multiple benefits claimed for biofuels (fuel security, trade growth, jobs increase, environmental gains, infrastructure development) leads to confusion about what exactly they are for. This confusion is not only apparent within local communities, but also government and to some extent industry" (Respondent 15). "The processes are designed to profit the companies at the expense of the people who own the land. They are based on misinformation to the communities" (Respondent 21). Q6 on p.15, line 21 to p.16, line 12. Respondent 5 suggested that: "Capacity building at the local level is vital, as well as moves by funders and those responsible for project delivery to look more holistically not only right across the 3 pillars of sustainable

	development, but also to make long-term time horizon considerations central to projects" (Respondent 5). Respondent 31 reinforces the need for impartiality, open communication and education: "This must start before project approval. Local stakeholders need to be given impartial information over a number of meetings. They need the opportunity to get informed and impartial advice on plans. Only then can they be expected to give free and informed consent (or rejection). Formalised partnerships need to be entered into with the community where they have substantive and real equity in the project (remember, it is in effect their land that they are brining to the party). There is a need for unbiased facilitation and sound record keeping of meetings and agreements. Land rights need to be protected (Respondent 31)."
6. Reviewer 1 said, likewise, the conclusions are presented in too general a manner. For example, the statement that sustainability objectives "may be best served by projects displaying efficiency?" (p. 17 line 1) invites the question of what kind of efficiency, since an economic interpretation of efficiency could be linked to the same kind of "develop at all costs" motive that is critiqued in the next paragraph.	To address this, efficiency has been defined on p.19, line 27-28. Timely execution of agreed commitments and efficient use of scarce resources, ...
7. Reviewer 1 said, the recommendation that a mediating body be established could be further clarified. For example, what form could this body take? Who could fill this role and achieve legitimacy in the eyes of all stakeholders? How could it gain trust from all parties involved, particularly if it were funded by (and seen to be answerable to) investors as the paper suggests? Even if answering such questions is beyond the scope of the paper, at least raising some of these issues would add important nuance to the discussion.	To address this we provided clarification on the administration of a mediating body on given pages: p.19, lines 15-22. Stakeholder representatives principally agreeing on an internal and external communication framework within which to operate, (i.e. similar to the belief of Coleman (1988) that building rapport within unions by constantly sharing information) may assist the mediating panel to achieve legitimacy in the eyes of all stakeholders. An effective understanding, by the mediating panel, on marginalisation issues and upholding community integrity (i.e. self-reliance, security, equality, health and education) (Amazega et al. 2010; von Maltitz and Stafford 2011), would assist in smoother project implementation for all stakeholders – and is likely to infer trust from local stakeholders. P.23, lines 15-18. Choosing the members and

	monitoring the work of a mediating panel (on a project specific basis) is not without complications, but applying a political ecology perspective, which also reviews the key understandings of development economics, social capital and institutional economics, may improve decisions.
8. Reviewer 1 said, the introduction mixes general and biofuel-specific insights, for example on stakeholder participation. The distinction between these bodies of literature should be clarified.	To address this we reworded p.2, lines 8-11 to read: As sustainability planning, implementation and monitoring become more participatory, all concessions and compromises ideally need to be explicitly justified and openly discussed, with the most desirable options selected (Gibson 2006).
9. Reviewer 1 said, throughout, greater clarity on whose interests and perspectives are being presented would be helpful. For example, p.3 lines 10-13 states that particular countries "may profit appreciably from the development of biofuels," but a political ecology approach challenges us to uncover who profits in what ways, and to probe the unevenness of those benefits (see for example Hall et al. 2009 on Brazil's biofuel policies and social exclusion).	To address this we have edited the paper to clarify the interests and perspective been presented, including: p.3, lines 27-30. Enquiry grounded in political ecology, seeking to understand the uneven power relationships, and the hierarchal impacts on costs and benefits, which often lead to economic, social and environmental inequalities (Bryant and Bailey 2007; Hall et al. 2009), can be usefully applied to this field of research.
10. Reviewer 1 said, under Q1 it is important to show separately how many respondents chose "all of the above". For example, did 21% of respondents choose the large-scale industrial model as their single preferred option? How many of them chose "all of the above" which then added a vote to industrial?	To address this we have provided and explanation on p.9, lines 10-16. For the purposes of tabulation, the cases for which respondents recommended option 4 (Any Project) (13% of total responses) saw each of the three optional project types being awarded with an additional response. In other words, for option 4, three responses (options 1, 2, and 3) were added to the total for calculating the percentage below. Respondent 8 is an example for choosing option 4 with the comment, “if you are taking a national view of biofuel production, I think a mixture of approaches is needed to offer maximum benefits (within a sustainability framework of course!)”.
11. Reviewer 1 said more accuracy would be appreciated in the interpretation of findings. For example, pg. 9 line 21: "Respondents felt strongly?" is followed by a quotation from a single respondent. How many respondents expressed similar views? Even giving a general indication such as "a majority of respondents" would help.	To address this we have edited the paper to accurately portray the results, including revising p.10, line 1. “respondents felt strongly” to “three respondents felt strongly”.
12. Q2: Reviewer 1 said "weak governance" is not defined in the paper. Was it defined in the	To address this we have added citations and edited the paper to provide clarification on weak

survey? Also, citations would help support the point that countries with weak governance fail to attract foreign investment. Others have published the opposite view (see for example James Ferguson's Global Shadows, and, though not new, this map overlaying mineral extraction sites with areas of political instability in Africa: http://maps.grida.no/go/graphic/sub-saharan-africa-mineral-resources-and-political-instability)	governance issues, including: p.7, lines 1-3. The term, 'weak governance', is usually referred to as issues impeding social and environmental and economic development, including inequality, insecure property rights, corruption and bureaucratic delays (World Bank 1999).
13. Q4: Reviewer 1 said; please elaborate further on what is meant by the four options A-D.	To address this we have elaborated further on p.12, lines 17-19. Responses to the choices, A, B, C and D, indicated the respondents' understandings as to which choice, or combination of choices, efforts could be directed to realise sustainable biofuel production.
14. Q5, Q6: Reviewer 1 said, clarify whether the answers were provided (multiple choice) or written in response to an open-ended question and then grouped into categories by the authors.	To address this we have provided clarification on p.8, lines 13-17. The questionnaire consisted of three questions (questions 1, 3 and 4) with modified Likert Scale response options, and optional qualitative comments. The remaining six questions (questions 2 and 5 - 9) were open-ended. Responses have been grouped in categories determined during analysis of the findings.
15. Q5: Reviewer 1 said, the quotation on p. 13, lines 38-41 suggests that greed, corruption, unethical business and poor communication all reflect a single concern called "equality." This bundle of issues could be examined in more detail.	To address this we have examined equality in more detail on p. 10, lines 9-12 and p.14, line 16 to p.15, line 4. Concerns were raised about a lack of transparency and unequal stakeholder participation, often stemming from poor communication, and leading to confusion and inequality. These concerns are explained by respondents 15 and 21: "I think the multiple benefits claimed for biofuels (fuel security, trade growth, jobs increase, environmental gains, infrastructure development) leads to confusion about what exactly they are for. This confusion is not only apparent within local communities, but also government and to some extent industry" (Respondent 15). "The processes are designed to profit the companies at the expense of the people who own the land. They are based on misinformation to the communities" (Respondent 21).
Reviewer #2 Comments	
Reviewer 2 said, I think this is useful information, although I believe it should be rewritten to be	To address this we edited the paper to shorten the paper (Particularly in the introduction and

more concise and easy to understand. Since this is all opinion, there is no scientific merit to judge, but the issue of bioenergy development in Africa is an important one and this paper outlines how it might be done in a more sustainable, humane way. But I found the paper to be quite long and not particularly easy to read. I think if the authors could condense and sharpen the paper, it would be much more impactful. Some figures or more attractive tables might help.	biofuel background section) and improve its readability.
Reviewer #3 Comments	
Reviewer 3 said, this is a straightforward, relatively a theoretical paper that sets the results of a modest-sized expert questionnaire survey within a decent review of the biofuel sustainability literature as it relates to developing countries. Although the paper could be strengthened (I have made some suggestions below), it could also be accepted with relatively modest modifications, as follows. Reviewer 3 gave four suggestions: Firstly, the paper tells us nothing about how the results split by source, i.e. by respondent affiliation. Were there any patterns in this regard, for any of the questions? Even if not, this should be commented on.	To address this we provided an explanation on p.8, lines 30-31. With regards to the respondents' affiliations, an analysis of the survey responses did not uncover any evident patterns in relation to them.
Secondly the self-selectivity of the respondents should be noted. Always the case, but of more importance in small samples.	To address this we provided an explanation with regard to the selectivity of respondents on p.8, lines 2-8. Although respondents were selected internationally for their diverse fields of expertise with regard to sustainability and biofuel production, owing to the relatively small participant sample, care was taken not to select respondents affiliated to the private sector. This was in an effort to minimise bias through self-promoting responses. The survey requested names and institutional affiliations on a voluntary basis. As some of the respondents chose to remain anonymous, findings by respondents' institutional affiliations, or whether from within or outside Africa are not presented here.
Thirdly, the recommendation of an intermediary panel is made far too uncritically. It would be useful to know how, given all the contra-indicating factors (to good governance) listed in the literature review, that the author envisages such panels would be established, monitored and	To address this we have described the complexities involved in selecting a mediating body on the given pages: p.19, lines 15-22. Stakeholder representatives principally agreeing on an internal and external communication framework within which to operate, (i.e. similar

so on. These need not be a detailed account, but the at present the recommendation needs at least some recognition that the process would likely not be uncomplicated. Are we talking about thousands of such panels per country? One in every village? under whose auspices and with what checks and balances? Whatever you have in mind, you need to give us a bit more than you have!	to the belief of Coleman (1988) that building rapport within unions by constantly sharing information) may assist the mediating panel to achieve legitimacy in the eyes of all stakeholders. An effective understanding, by the mediating panel, on marginalisation issues and upholding community integrity (i.e. self-reliance, security, equality, health and education) (Amazega et al. 2010; von Maltitz and Stafford 2011), would assist in smoother project implementation for all stakeholders – and is likely to infer trust from local stakeholders. p.21, lines 15-18. Choosing the members and monitoring the work of a mediating panel (on a project specific basis) is not without complications, but applying a political ecology perspective, which also reviews the key understandings of development economics, social capital and institutional economics, may improve decisions.
Fourthly, you call for a political ecology approach but you barely explore the results in these terms. The paper would be a lot stronger if you did - this is where, in 500 words or so (shorten the lit review if you need space), you could lift the paper substantially. My understanding is that theoretical development need not be demanded in this particular journal, so I won't require it as a reviewer. Nonetheless, the opportunity is there to discuss more deeply the implications of your results and to contribute to the PE literature. If I were you I would probably focus on the panels that you recommend, as this does need attention anyway. There is likely some governance and institutions literature that you could bring to bear in the discussion section and also perhaps some post-colonial literature.	To address this we edited the paper and strengthened it by exploring political ecology further on the given pages: p.6, line 30 to p.7, line 3. Sustainability achievement capacities can be examined through institutional understandings of informal institutions (i.e. codes of conduct, conventions and behavioural norms) (North 1990); especially in cases with countries that display weak governance. The term, 'weak governance', is usually referred to as issues impeding social and environmental and economic development, including inequality, insecure property rights, corruption and bureaucratic delays (World Bank 1999). p.3, lines 27-30. Enquiry grounded in political ecology, seeking to understand the uneven power relationships, and the hierarchal impacts on costs and benefits, which often lead to economic, social and environmental inequalities (Bryant and Bailey 2007; Hall et al. 2009), can be usefully applied to this field of research. p.18, lines 11-13. Understanding the political ecology concerns of an unjust allocation of risks and insecurities (Ariza-Montobbio et al. 2010), through uneven power scales (political, knowledge and economic) (Blaickie 1985), ... p.18, lines 15-20. Many respondents suggested that this can only be attained if stakeholders'

	representatives are suitably educated in sustainable development and project design. Effective education and active participation throughout a project's lifecycle can help recognise political ecology beliefs that projects can be implemented less coercively, less manipulatively and more sustainably (Peets and Watts 1996; Robbins 2004). p.18, lines 21-28. Drawing on the social capital understanding that cooperative behaviour generates fairer outcomes (Putman et al. 1993), political ecology explanations can help account for the concerns of surveyed experts that education and knowledge should not be considered a one way process that solely informs local stakeholders about project developments (cf, Vermeulen and Cotula 2010) but rather a two way communication process. Through a political ecology approach – i.e taking into account development economics and understanding of reasons for poverty standing alongside affluence (Bass 2011), and institutional economic studies of informal institutions (North 1990). p.19, lines 6-14. Drawing on key ethical principles examined from the perspective of knowledge frameworks may provide the base from which a mediating/advisory body could operate to gain the confidence of all stakeholder groups. Arguably, the mediating/advisory body could function effectively by drawing on: the understandings of uneven power relations in political ecology (Peet and Watts 1996; Elgahali, 2007); development economics and its study of effective use of scarce resources (Bass 2011); the explanations of social capital in promoting quality networking, and trust and social norms within informal institutions (Putman et al. 1993); and institutional economics arguments that informal institutions can facilitate efficiency and fairness until capacities are reached to form formal institutions (Jutting 2003).
Reviewer 3 suggested some other things... a. There are several typos and misspellings that copy editors will likely pick up. b. The first figure seems unnecessary. c. Qu 5: what is this framework? We need some definition/description. Is it legally enforceable, for example? Did the respondents interpret this	a. To address this we have thoroughly edited the paper to correct spelling and typos. b. To address this we removed Figure 1 and relaced the percentage of respondents from specific fields in the text on p.7, lines 27-31.

in any way that they wanted? ideally you should append the questionnaire so we can see what was asked exactly.	• Environmental Biodiversity (19 % of respondents), • Social Capacity Building in Developing Nations (21%), • Economics (13%), • Agro-production (21%)and • Sustainable Energy Development (26%). c. To address this we have provided an explanation of the various types of frameworks in a footnote on page 1. Biofuel assessment frameworks discussed within this article refers to 17 internationally recognised regulatory frameworks, voluntary frameworks, scorecards and analytical frameworks BEFSCI (2011) and GBEP Task Force on Sustainability (2011).

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Appendix F Reviewer Comments and Responses: Paper 3 (Chapter 4), Natural Resources Forum

Reviewer #1

1) The reviewer said, in the abstract can you not be more specific than "social and political" factors being the cause of the problems observed? You could at least refer to the imbalances in knowledge and access to finance.
To address this we used the following rewording: The findings suggest that the uneven distribution of costs and benefits are brought about by imbalances in knowledge, access to resources and the allocation of social and political influence....

2) The reviewer said, Ross and De Klerk etc: I'm doubtful about the use of identifiable interviewee names – is there a reason for this and are the interviewees happy with it?
To address this we have edited the paper and removed the names of interviewees.

3) The reviewer said, p.12 local growers are 'coerced': this is quite a loaded term – would it be more accurate to say encouraged, persuaded or pressurized? (The latter two suggestions are entries relating to 'coerce' in Microsoft Word's thesaurus). I'd leave this to you to decide, though.
To address this we have replaced "coerced" with "encouraged" (p.14).

4) The reviewer said, p.12 27 minutes – presumably an average?
To address this we added "...an average of 27 minutes..." (p.13).

5) The reviewer said, p.13 invests 'in' (not on), I think
To address this we have thoroughly edited the paper and replaced the inappropriate wording.

6) The reviewer said, p.16 'Although both case study projects had not' – change to 'Although neither case study project'
To address this we editing the sentence with "Although neither case study project...." (p.15).

7) The reviewer said, in the conclusion: 'would assist advance' – change to 'would assist in advancing'
To address this we edited the sentence with "would assist in advancing" (p.16).

8) The reviewer said, in the conclusion: 'exploiting uneven knowledge scales through the transferral of flawed perceptions': I think I know what you mean but this is pretty obscure and could do with rephrasing or a subsequent explanatory sentence.
To address this we rephrased the sentence This research suggests that the lack of local understanding and uneven knowledge scales are largely responsible for project failures in Zambia. Local stakeholders

enter into contracts with conviction based on information recommend by developers. Project failure can be attributed largely to a lack of understanding of local conditions in relation to the chosen crop, poor species suitability, and incomplete knowledge communicated by developers (p.17).

9) The reviewer said, Table 4: please add a note beneath the table reminding us whether 4 is good or bad performance

Good and bad performance is mentioned immediately above the table.

10) The reviewer said, Table 5, land availability row: there is a typo: 'cropped 4ly'

To address this we edited Table 5 and replaced "4ly" with "poorly" (p.24).

Reviewer #2

Concerning the introduction the reviewer said:

1) China is also developing policies and targets for biofuel agriculture.

To address this we added "China" as developing policies and targets into the introduction (p.1).

2) Please, define the term 'political ecology'

To address this we added an additional sentence to define political ecology: Political ecology seeks to explain how power structures, ecological committees and local-level culture are part of broader economic and political structures (Peet and Watts 1996) that have national and international relationship links (Neumann 2009) (p.4).

3) The objectives should be presented more clearly and specific.

To address this we have explained the objectives more clearly and specifically: The research presented in this paper accordingly examines power imbalances, and how the ensuing ineffective implementation of biofuel projects linked to these imbalances, can affect environmental and social sustainability within site-specific cases in Zambia. The study unpacks the reasons for biofuel project implementation disappointments and the impact on local populations. In addition, opportunities are examined for rural energy production to assist local livelihoods and reduce the impacts that natural timber harvesting has on deforestation (p.2).

Concerning the Zambia Background the reviewer said:

4) You present Zambia as one of the landlocked countries in Africa, but you do not analyse the consequences for a specific energy policy.

To address this we have edited the paper and added the following sentences: This landlocked status raises the importance for Zambia of access to locally produced energy. The expense and complexities of negotiating commodity imports and exports through neighbouring countries increases both fuel insecurity and volatility of oil prices (p.5).

5) I would like to see some benchmarking with other sub-Saharan countries.

To address this we added the paragraph: In the case of Tanzania, receiving advice to suspend biofuel development pending a suitable legal framework to govern lending decisions (Kitundu 2011), the Government formed the National Biofuels Task Force (NBTF) to navigate a process for development of biofuel project guidelines to help regulate the haphazard nature of biofuel production in Tanzania and formulate national policy (Kitundu 2011) (p.1).

6) This section is quite descriptive!
To address this we have edited the Zambia Background section.

Concerning the Material & Methods the reviewer said:
7) It seems that the local interviews are not based on an ad-random selection of interviewees. I get the impression that the response of farmers may be confounded with the opinions of village leaders.
We thank the reviewer for the comment. We only interviewed Jatropha growers using the snowball sampling method and purposely averted the influence of village leaders.

8) The number of interviews is quite limited (14 and 10 Jatropha growers in resp. the Eastern and Southern Province).
We thank the reviewer for the comment. The research strived to gather data from as many varying villages as practically as possible within this research's capacity, to gain a widespread perspective, rather than many local viewpoints from few villages.

9) The reviewer said, no information is presented on the statistical analysis!
We thank the reviewer for the comment. The coded qualitative information gathered from interviewees was analysed and used to support arguments.

Concerning the Results the reviewer said:
10) The first part on the analysis of the data should be moved to the M&M section.
To address this we move the following sentence to the methods section: The criteria and indicators in these five sustainability assessment frameworks were adopted for the purpose of this research (p.7).

11) The presentation of results is mainly qualitative and only to a very limited extent quantitatively.
Noted – the research methods are mainly qualitative. Future research of a quantitative nature on this topic is recommended in the conclusions.

Concerning the Discussion the reviewer said:
12) The strengths and weaknesses of the political ecology approach are not discussed! At the same time quite strong conclusions are drawn based on this methodology.
To address this we added: Political ecology seeks to explain how power structures, local committees and local level culture are part of broader economic and political structures (Peet and Watts 1996), which affect the local environment that have national and international relationship linkages (Neumann 2009). This paper recognises that "political ecology is divided and ambivalent in its attitude towards and engagement with environmental and social policy" (Walker 2006 p.382) (p.3).

Concerning the Conclusions and Recommendations the reviewer said
13) Some more crop-based recommendations are interesting, but are not based on the information derived from the interviews.

To address this we added the following sentence: A study of the literature provided the researchers with an insight into crop species (both food and energy) that may offer preferable options in meeting social, environmental and economic sustainability goals (e.g. maize and sweet sorghum (Diaz-Chavez 2010)). (p.7).

Reviewer #3

1) The reviewer said, I somehow feel that many of the conclusions are a bit "given" or obvious (for ex. involving local stakeholders will increase ownership and improve, or, use other crops (that grow better) or decentralize processing systems to reduce costs as means to increase financial viability).

To address this we thoroughly edited the paper.

2) The reviewer said, I think you're missing two important points in your assessment of Jatropha seed pricing. Firstly, yes, farmers are carrying an unfair investment risk but not due to the low price of the seed but because they don't have enough knowledge in how to maximize yields (actually insufficient knowledge on how to grow it at all). Secondly, to compare Jatropha income (USD1000/ha) with 7t/ha maize return is misleading. How many small holders in Zambia achieves 7t/ha? It would have been very interesting to assess how much they are currently earning from their plantations (what are their yields, the price they get for the produce in their local market - prices vary a lot inbetween regions - , etc) and compare that to the Jatropha earnings. This is not to say that I support them growing Jatropha rather than maize but to say I think you missed an important elaboration and analysis of the importance and implication of pricing and crop displacement.

To address this we clarified the point by firstly adding: Due to the lack of knowledge, local growers are persuaded to carry investment risks by cultivating a crop of unknown qualities, and often without the knowledge on how to cultivate the crop. (p.12).

Secondly, we have analysed and accordingly adjusted the returns per hectare for the different crops at lower yields, following the advice of the reviewer (p.11).

3) The reviewer said, one of the conclusions of the research is that "exploiting uneven knowledge scales through the transferral of flawed perceptions is largely responsible for project failures in Zambia". I would disagree. I fully agree that project proponents came in and used their knowledge to persuade farmers to grow this new crop. I also agree that is not a good way to design development projects nor sustainable business models for agriculture activities in Africa (or elsewhere). However, the projects didn't fail because of this power imbalance - they failed because the crop wasn't suitable for all conditions it was planted in and there was inadequate information on how to care for the crop. The power imbalance reduced local ownership and probably made the projects a lot less long term sustainable, but the foremost problem was that Jatropha can't be grown everywhere with no attention to pest management, etc.

To address this we edited the paragraph along the lines recommended by the reviewer: Local stakeholders enter into contracts with conviction based on information recommended by developers. Project failure can be attributed largely to a lack of understanding of local circumstances in relation to the growing conditions for chosen crops, poor species suitability and incomplete knowledge communicated by developers (p.17).

4) It would have been very interesting to look further at the deforestation potential of Jatropha. How much would it impact if most small holder farmers in Zambia would switch its present wood fences to Jatropha fences? How much biomass would be saved by not having to cut new trees every 4-5 years? How much CO2 emission savings? I realise this is part of future studies but just wanted to put the thought out there.
We appreciate the comments of the reviewer and agree with the observation that it would be useful future research.

5) Are you intentionally using "energy accessibility" as an indicator for deforestation on page 1 row 56, and then "environment" as an indicator for deforestation on page 2 row 53? Perhaps an explanation or modification could be helpful?
We thank the reviewer for bringing this ambiguity to our attention,
To address this we edited the paper by removing deforestation in both cases (p.1 and p.2).

Reviewer #4

The reviewer said, I have two major criticisms of your paper:
1)The first is that you assume knowledge that your reader may not have. The second is the structure, particularly your results and discussion section. I recommend that you read back over your manuscript with fresh eyes – how do you know that your reader knows what jatropha is? Why is the crop being promoted in arid environments? What are its strengths and weaknesses? Who is D1 biofuels? Who is Southern Biopower? Somewhere in your manuscript you need an introduction to your two case study projects – beyond the summary in table 3 – to ground your subsequent discussions, perhaps early on in the results section.
To address the comment regarding an introduction to the case study countries, we added an introduction on in Table 3. D1 Oils operates as an alternative energy crop company based in London, United Kingdom. The public company engages in low-cost, sustainable, fuel-crops, and operates in Europe, Asia Pacific, Africa and India.

2) In terms of the structure, it doesn't always flow and in many instances you assume prior knowledge. The weakest part of your paper is the results and discussion sections, where I think you frequently confuse the two. At times you present your results and make a half-hearted attempt to explain why you think that may have been the case. Please either combine these two sections or provide more detailed explanations to support your suppositions and conclusions. You also need to make a greater distinction between the results of the two projects, you switch between the two and it is confusing for the reader.

We thank the reviewer for the comments. To address this we have thoroughly edited the paper to assist the paper's readability.

3) You also use terminology and phrases that seem not to fit with the rest of the article, for example on p.16, lines 28-30 you write "...cognisance of interchanging economic and environmental values pertaining to multiple scale power relationships" – what does this mean? You would benefit from using more simple language and explaining some of the terminology that you use. A more thorough analysis of the political ecology literature would help with this. For example how have other studies, perhaps in other fields, used 'chains of explanation' to frame their research?
To address this we thoroughly edited the article, including the sentence (p.16).

4) The reviewer said, this paper is less about bioenergy than biofuels; I would change the title from bioenergy to biofuels to reflect that focus.
To address this we have replaced the word "bioenergy" with "biofuels" within the title.

5) The reviewer said, p.2, lines 34-35: You state that the "implementation of [sustainability] frameworks is often considered to be the limiting factor to sustainable production". Do you have any other references for this statement, indeed does your research own support this conclusion?
To address this we added an additional references to strengthen the argument of this statement (Harrison et al. 2009; Vermeulen and Cotula 2010). (p.1)

6) The reviewer said, p.2, lines 55-56: What do you mean by energy accessibility (deforestation)? Are you saying that deforestation is an indicator of energy accessibility or that accessibility drives deforestation? Needs more explanation.
To address this we have edited the sentence to read "energy accessibility" (p.2).

7) The reviewer said, p. 3, lines 29-38: It is here that you first mention jatropha. This section needs expanding to provide a better introduction to the crop – why is this relevant to your paper?
To address this we added the sentence: One such biofuel crop that is receiving increasing attention globally is *Jatropha curcas L. Jatropha* is a bush that grows up to six metres tall, with oil bearing qualities. It is a deciduous woody plant belonging to Euphorbiaceae family, and has a life span of about 50 years (de Jong 2010). *Jatropha* grows naturally in many semi-arid environments, and is acclaimed for its ability to be produced under marginal conditions (i.e. arid soils and poor rainfall), high oil content, non-browsable qualities and little need for agronomic management (Kant and Wu 2011) (p.3).

8) The reviewer said, p.3, lines 42-44: You need an explanation as to why unequal power relations would be 'largely responsible' for deforestation as its not immediately obvious why this would be the case – what type of deforestation are you referring to, on what scale, for what use? Is this applicable to deforestation on a global scale? Is this the case across Africa or in Zambia specifically?
To address this we have rephrased the sentence to read more clearly. The marginalisation of communities (Dauvergne and Neville 2010), their inability to access alternative means of affordable

domestic energy supply rather than wood (Hunt et al. 2010), associated with poor governance, contribute to deforestation in developing countries (p.3).

9) The reviewer said, p.3, lines 53-54: Are you using deforestation (see above) as a proxy for environmental impacts? If so, you need to explain that this is the case. Also refer back to this in your results/discussion section – did you find any evidence to support this assumption?
To address this we edited the wording of deforestation to dispel confusion.

10) The reviewer said, p.4, lines 3-5: Here is an example of where I find the language confusing – what do you mean by this, needs more explanation.
To address this we edited the sentence: This research acknowledges that different groups of people relate to the value of ecology and resources differently under varying circumstances (p.3).

11) The reviewer said, p.4, lines 19-20: What do you mean by this and in particular by 'meagre social welfare'?
To address this we changed the wording of 'meagre social welfare' to "inadequate social welfare" (p.3).

12) The reviewer said, p.3, lines 37-40: I do not find your explanation of Pilcher's research convincing, please find a different way to express this.
To address this we have removed the sentence of Pilcher's research from the article, as it was considered the sentence did not add to the article (p.4).

13) The reviewer said, p.4, lines 12-16: Whose confidence has been affected – investors, local communities, government?
To address this we have edited the sentence to read "...sub-Saharan African governments' and local citizens' confidence..." (p.4).

14) The reviewer said, p.5, lines 24-27: Are likely to draw attention or already have – as your paper demonstrates.
To address this we have changed "...targets are likely to draw the attention..." to read "...targets have drawn the attention..." (p.5).

15) The reviewer said, p.7, lines 50-57: The latter half of this sentence makes no sense, please rewrite.
To address this we edited the sentence to read "...and had experienced the effects of uneven..." (p.8).

16) The reviewer said, p.8, lines 18-21: What do you mean by the questions were 'purposefully undemanding'? Please rewrite.
To address this we changed "...purposely undemanding..." to read "...understandable to local citizens..." (p.8).

17) The reviewer said, p.8, lines 43-55: Did you ask the participants themselves to rank each aspect of the project, or is this something the authors have come up with. If the latter, could you provide more

detail about the information that you had access to regarding the case studies, for example the risk assessments.
To address this we added the sentence to provide additional explanatory information: Results were derived through interviews with local villagers and case project representatives (p.9).

18) The reviewer said, p.9, lines 46-49: How were these farmers assessed?
To address this we added the sentence: Through discussions and observations of small-scale farmers' land and management situations, D1 Oils assessed farmers' capabilities and potential for involvement in Jatropha cultivation (Senior administrators of D1 Oils, interview on 13 May 2011) (p.10).

19) The reviewer said, p.9, lines 51-54: Please provide examples of 'previous exploitative and costly biofuel developments', such a statement needs more evidence/ referencing.
To address this we added text and references as examples of exploitive and costly biofuel developments: the German based Flora EcoPower biofuel company's controversial biofuels project in Fedise, Ethiopia, which was abandoned and left many disgruntled employees without remuneration (Sisay 2010); and the case of BioShape, Netherlands, which payed villager's in the Kilwa district, Tanzania, exploitive prices of between USD 5.8 and USD 6.67 per hectare for land and trees (Ndosi et. al. 2008); and (Senior agronomist for Oval, interview in Lusaka 13th May 2011) (p.10).

20) The reviewer said, p.10, lines 32-36: This sentence is confusing – do you mean that, unlike most food crops, jatropha is harvested throughout the year and therefore provides a more constant source of income? Please clarify.
To address this we have clarified by adding: Jatropha is usually harvested in January and February every year and the harvesting of food crops usually begins in April (p.11).

21) The reviewer said, p.12, lines 10-11: What do you mean by 'model' of the chosen project. Nowhere have you mentioned that jatropha can be cultivated under different models, needs more information.
To address this we edited the sentence to read "...of the importance for the viability of Jatropha feedstock cultivation being the model adopted for the chosen project (e.g. agro-industry, small-scale or hedgerow planting)" (p12).

22) The reviewer said, p.13, lines 15-20: How was it 'evident'? What did the administrators say that led the authors to this conclusion? 'Coerced' is a strong statement and needs a more thorough explanation than what is given in the bracket – how would 'power imbalances framed by uneven knowledge' have led to them being 'coerced' – this is important and needs more explanation.
To address this we edited the sentence to read "Past administrators of Oval (Oval administrator, interview 15th April 2011; Oval agronomist, interview 13th May 2011) "...divulged that projects were poorly implemented..." (p.13).
and "...coerced..." was changed to read "...encouraged..." (p.14).

23) The reviewer said, p.13, lines 38-47: According to who have the discussion groups improved social

governance, does your interview data support this? Why would these groups help to mitigate ‘uncertain futures’? needs more information.
To address this we added the interviewees who confirmed the statement: (Senior administrator of D1 Oils, interview 7 May 2011; 8 local participants; interviews between 10 to 12 May 2011).
We also edited “help to mitigate uncertain futures” to read “may help mitigate uncertain futures” (p.14).

24) The reviewer said, p.13, lines 32-35: Again you use the expression ‘political and knowledge power imbalances’ without explaining what you mean by this. This is important so needs more explanation. It is in these sections when you confuse presenting the results with the discussion. Your findings are very interesting, but some of the attempts to explain why that might be the case are too brief and rely too heavily on unexplained jargon. Please revise both the results and discussion to check for statements such as these.
To address this we have thoroughly edited the article in an effort to improve the comprehensibility of the article.

26) The reviewer said, p.14, lines 40-42: How can a crop be ‘idyllic’?
To address this we changed “idyllic” to read “favourable” (p. 15).

27) The reviewer said, p.14, line 46: Again, here is where your failure to provide an adequate introduction to the crop means it is confusing for the reader – what does it mean to plant jatropha ‘correctly’? According to whom?.
To address this we have provided references: (Ariza-Montobbio et al. 2010; de Jong 2010) (p. 15).

28) The reviewer said, p.15, line 42 (and elsewhere): How is it possible to have a ‘physical observation’?
To address this we edited “physical observation” throughout the article to read “field observation”.

29) The reviewer said, p.16, lines 1-6: How ‘young’ is the biofuel industry given that ethanol has been produced on an industrial scale in Brazil since the 1970s. Jatropha is certainly ‘new’ as a biofuel crop (although has been used as a fence for centuries), and many countries and companies may be new participants in the industry, but is it really young?
To address this we edited the phrase “is a young enterprise” to read “is an enterprise” (p. 16).

30) The reviewer said, p.16, lines 12-13: This is the first time you mention sorghum, please explain why it might be more suitable.
To address this we added a comment and reference with regards to sweet sorghum: A study of the literature provided the researchers with an insight into crop species (both food and energy) that may offer better options for social, environmental and economic sustainability options (e.g. maize and sweet sorghum [Diaz-Chavez 2010]) (p. 7).

Reviewer #5.

1) Line 13: The reviewer said, the article says sustainable Jatropha cultivation can effectively assist….deforestation. However, it does not certainly tell how it does this. Is this because of income generation say that communities will be able to buy other sources of electricity such as gas (natural gas and or electricity) or just because jatropha will be used to generate electricity local electricity.
To address this we added the phrase: "...to offer alternative local biomass energy options to wood, through domestic processing or communal energy generation." (p.3).

2) Page 11; Line 14-31, The reviewer said, the article compares harvests of other crops and jatropha. However, it does not give how many times people might harvest jatropha compared to other crops such as beans which might be harvested two times a year in areas that receives rains two times a year or when irrigation schemes are applied. So, with the analysis that the article provides, at the current price jatropha
can hardly compete with other crops in the country.
To address this we added the sentences: In addition, other crops (i.e. beans) that can offer more than one harvest per annum under certain growing conditions, are likely to provide more viable land use options. Nevertheless, comparisons with other cropping options need to be carried out in site-specific settings owing to the variability of water and energy requirements.

3) Page 12; line16. The reviewer said, would Jatropha in the hedges be economically viable? I think more data is required to say that jatropha from the hedges can supply any biodiesel even for the rural electricity. Author may want to see check with other models such as inter-cropping as practiced in Mali etc.
To address this we added the sentence: Although, hedgerow cropping may be more economically viable, it is unlikely that enough Jatropha seed can be produced to assist communities to generate their own electricity from this source (p.13).

4) Page 12; line 28. Discusses the importance of jatropha to help with deforestation as the result of fencing practices. Also, page 13; line 7…the article mentions that increasing yield of maize and allocation of the small amount of land to energy crops will reduce deforestation. However, there is no real analysis of how much timber is used and if the establishment of jatropha may not touch forested areas.
We thank the reviewer for the comment. Unfortunately, these interesting issues raised are outside the scope of this research, and would add an interesting dimension with further examination.

5) Page 15, Line 17, The reviewer said, the article talks about the risks that farmers face, however, it does not clearly explain what has caused the real failure of the companies that initiated jatropha projects in Zambia.
At this point authors might want to re-check with other studies that have identified the global failure of jatropha. For this I find this article useful "Kant, P and Wu, S. (2011) The Extraordinary Collapse of Jatropha as a Global Biofuel, Environment Science and Technology, Viewpoint."
To address this we added the sentences: Kant and Wu (2011) relate that to meet transportation energy

needs ambitious biofuel planting programs in India (in 2003) and China (in 2006) encouraged millions of small-scale farmers to plant Jatropha. They report discontinuance by 85% of the Jatropha farmers by 2011. When due diligence processes are ignored, even projects adopted in good faith can be in danger of becoming obsolete (Kant and Wu 2011) (p.1).

6) Page 16; Line 1. The reviewer said, if the authors agree that jatropha is a young enterprise, how did they come to the conclusion that it has many sustainable qualities amid the revelation that thefirst generation jatropha has less output to produce viable biodiseal as identified in the study above?

To address this we have edited the phrase “young enterprise” to read “is an enterprise” (p.16).

Appendix G Reviewer Comments and Responses: Paper 4 (Chapter 5), Journal of Cleaner Production

Reviewer #1

Overall:

This is an interesting paper that is clearly of relevance to the Journal of Cleaner Production. However, I am not sure the ideas are clearly presented. The paper could have a much stronger impact with some reformatting and additional explanation.

1. The Reviewer said, I am also worried about some of the claims made by the paper. For example, on Page 3 the authors state the paper "reports an empirical case study and analyses surrounding social and environmental impacts in Zimbabwe". While a case study is presented, it is unclear how the study analyses impacts across Zimbabwe?
To address this we edited the sentence and clarified that we are assessing the local social and environmental impacts in relation to the biofuel project.

2. The Reviewer said, furthermore the study appears to focus on social impacts while the environmental impacts are not fully reviewed. There is only a small paragraph about the environment on page 16 and some mention of dams.
To address this we thoroughly edited the article and expanded the environmental concerns with regards to biofuel production.

3. The Reviewer said, one of the main weaknesses is that two case studies use different methods and reply predominately on interviews collected over a short period of time, whose questions were not standardized nor recorded in the paper. Without longitudinal data, can the authors really claim to analyze social or environmental impact of the biofuel production?
To address this we thoroughly edited the paper. We have removed one of the case studies and have reframed the focus to look at the current social and environmental impact of biofuel production and whether these can create an enabling environment for future sustainability.

Nevertheless this is an interesting topic and given the challenges of working in Zimbabwe, the authors were probably limited in the data that could be collected.

Title:

4. The reviewer said, I am not sure the title accurately describes the content of the paper. The paper focuses on Zimbabwe, while the title indicates that this paper will describe biofuels across sub-Saharan Africa as a whole. Either the title should be narrowed or the paper should include more facts and discussion to prove this case study is relevant to sub-Saharan Africa.
To address this we changed the words sub-Saharan Africa to Zimbabwe. The title now reads:

Grappling with biofuels in Zimbabwe: depriving or sustaining societal and environmental integrity?

Keywords:

5. The Reviewer said, perhaps add the term "biofuel"?

To address this we added the word “biofuel” to keywords.

Introduction:

* The clarity of the introduction could be improved.
* A few specific points:

6. The reviewer said, Paragraph 1 - you may want to mention that there are a variety of biofuels, beyond sugarcane and Jatropha. Or perhaps add a definition of biofuels?

To address this we added, “Biofuels can be defined as processed fuels derived from biomass for purposes of electricity, transport and heating (Vermeulen and Cotula 2010). Feedstock options include biodiesel crops such as palm oil, *Jatropha*, soya beans, and bioethanol crops including maize, sweet sorghum, rapeseed and sugarcane (Dauvergne and Neville 2010).

7. The reviewer said, Pg. 2 line 27 from "moreover" to "2010" - line is misplaced as the paragraph discusses scarcity of information

To address this we removed the sentence “moreover, sugarcane is promoted as one of the best options for biofuel production for areas with ample sunshine (Richardson 2010)”.

8. The reviewer said,Pg2 line 34 - 38. This topic sentence doesn't fit with the paragraph. The paragraph discusses positives of biofuels, while the topic sentence mentioned exploitation of farmers. Move this sentence to section 3 of the intro.

We agreed with the reviewers comments and in the process of editing we removed the sentence from the article.

9. The reviewer said, Pg 3 line 53 - 55. The authors indicate that they will analyze multiple scales of power and evidence. It doesn't appear that they have done this. They have simply conducted interviews. Does this count as multiple forms of evidence?

To address this we changed the sentence to read “Through interviews and observation this paper seeks to identify “less coercive, less exploitive and more sustainable way of doing things” (Robbins 2004 p.12)”.

10. The reviewer said, Pg 5, Section 5, Line 31 - change " into become" to "into becoming" or to "To become"

To address this we changed "…into become…" to read “…into becoming…”.

11. The reviewer said, Pg 5 Section 6. Relevance of landlocked countries to biofuels is unclear. Uganda for example is landlocked but has now discovered oil and may not suffer from fuel insecurity. Remove statistic.

To address this we changed “These countries are…” to read “Many of these countries are”. While we agree with the comment, there are other landlocked countries (e.g. Swaziland, Lesotho) which have not discovered oil.

Methods:

12. The reviewer said, Why were different methods used for each of the case studies? E.g. Only 3

representatives of NBFPPZ were contacted but 6 from Green Fuel were contacted. Also the interviewers used a random sample frame to interview 240 farmers from NBFPPZ but used purposive sampling and a snowball sampling method to interview people affected by Green Fuel. Furthermore only 34 villagers were interviewed for the Green Fuel case study. Why is there a difference?
To address this, and in response to other reviewer comments, we have removed the NBFPPZ case study from the article.

Results:
13. The reviewer said, Even though more people were interviewed for NBFPPZ, most of the results focus on Green Fuel. Greater discussion and analysis of the failures of NBFPPZ is needed. Alternatively, remove NBFPPZ case study.
To address this we removed the NBFPPZ case study from the article to concentrate on improving the depth of reporting on the Green Fuel case study.

14. The reviewer said, Can the authors offer any quantitative statistics? For example, on page 16, section 8.9 the authors claim most people interviewed diversify their income streams with other forms of enterprise including bee keeping, etc. However no data or further information is given. How important is the natural resource base?
To address this we added the data where possible. The section now read: "Owing to illegal forest derived income activities, statistics in Zimbabwe were difficult to come by, however it was stated by a law enforcement officer (personal communication, 29 April 2011) and local interviewees that most young men in the area seek alternate forms of income to farming, and this includes illegal timber and bush-meat harvesting in neighbouring conservancies. Interviewee Mv4 (interview 1 May 2011) divulged that "the lack of income options forces young people to poach animals and cut timber for sale to locals and in the towns. To flush out animals they burn the grass in drier months". By producing and supplying local electricity and providing alternate income generating options, Green Fuel expects deforestation rates and unsustainable bush food harvesting techniques…"

Discussion
15. The reviewer said, Pg 17. Line 52 - 57. I am not sure this claim is sufficiently substantiated by the evidence provided in the article. Does transport for workers really reduce environmental issues cause my labor migration? How?
To address this we added an explanation on page 13, first paragraph, (e.g. increased pressures on water sources and natural resources owing to the need for doubling accommodation needs, including infrastructure, energy and bush foods).

16. The reviewer said, how do the findings relate to previous research on biofuel projects in Zimbabwe or Africa? The work should be placed in context of previous literature.
To address this we edited the article and placed the article in the context of the Zimbabwean literature (see e.g. page 15, where we reference Makadho, 1996, and Amigun and Musango, 2011)

Conclusion
17. The reviewer said, Pg 18. The authors claim the paper shows "that agro-industrial biofuel projects, developed within a framework ..can improve community integrity and advance sustainable

livelihood options". I am not sure they do this. Greater discussion about community integrity and sustainable livelihood opportunities is needed. These terms should be defined previously and discussed in the results. What other livelihood opportunities are there? How is biofuels production better than these opportunities?

To address this we thoroughly edited the article and discussed the terms community integrity and livelihood options in greater detail. For example on page 4: "Community integrity is understood to include gender equality, survival in healthy homes, work places and ecosystems, gendered environmental rights, conflicts over natural resource issues, and family fragmentation from pressures of work commitments (Eden 2010)".

References:

18. The reviewer said, Pg 21. Line 22. Can the authors provide further information on this reference? E.g. a Title? Where it will be published?

To address this we added the reference Duvenage, I., Taplin, R. and Stringer, L.C. 2012, "Bioenergy project appraisal in sub-Saharan Africa: Sustainability barriers and opportunities in Zambia", *Natural Resources Forum,* [Online], vol. 36, pp. 20 September-167-180. Available from:http://onlinelibrary.wiley.com/doi/10.1111/j.1477-8947.2012.01453.x/pdf. However this reference has since been removed from the article.

Reviewer #2

Reviewer comments

The paper tackles topical and interesting issue in Africa. However, major changes need to be addressed in order for the paper to be acceptable for publication.

1. The reviewer said, the paper need to be re-organized as it does not flow well. There is a mix-up of discussion around Africa and Sub-Saharan Africa, yet, the case used is Zimbabwe, which is only one of the countries in Africa / sub-Saharan Africa.

To address this we have thoroughly edited the paper, being much more specific in when we are referring to sub-Saharan Africa and when we are referring to Zimbabwe.

2. The reviewer said, also see page 16 line 59 - it is incorrect to indicate that 'this section discusses multiple perspectives pertaining to biofuel implementation in sub-Saharan Africa' yet the discussion is based on two case studies in Zimbabwe!

To address this we changed the sentence from "This section discusses the multiple perspectives pertaining to biofuel implementation in sub-Saharan Africa and the key project implementation opportunities and impediments linked to social and environmental integrity".

to read "This section discusses the multiple perspectives pertaining to biofuel implementation links to social and environmental integrity". By multiple perspectives, we refer to the multiple stakeholders engaged in the research.

3. The reviewer said, the titles the paper sections do not reflect the information that is discussed. For instance:

* The title for the paper 'Grappling with biofuels in sub-Saharan Africa"; the expectation was that this covers several examples and cases in sub-Saharan Africa.
We agree. To address this we changed “sub-Saharan Africa” to read “Zimbabwe” in the title.

* The reviewer said, the title for section 2 is 'Political ecology of biofuels in sub-Saharan Africa', which does not even provide discussion on the situation in the region.
To address this we changed the heading “Political Ecology of Biofuels in Sub-Saharan Africa” to read “Political Ecology of Biofuels” as the material is not specific to sub-Saharan Africa.

* The reviewer said, the same case applies to section 3 and 4.
To address this we thoroughly edited the article . For example, in section 3 we changed “…Africa…” to read “…sub-Saharan Africa (including Zimbabwe)…”.

4. The reviewer said, the background of the case studies in 6.2 and 6.3 is also not in full. These sections give the impression that the plants are operating well. To my knowledge, these two plants have failed and one of them is considered as 'white elephant'. In addition, some of the background information of the case studies discussed in the results section could be moved to 6.2 and 6.3 respectively.
We removed the case study NBTFFP, which as reported, had failed. This also addressed one of the other reviewer comments. We have moved some of the material as suggested.

5. The reviewer said, in the methods section, the authors indicate that the 'research involved gathering evidence to identify impacts of the two case studies, taking into account of the three pillars of social, environment and economic sustainability'. What indicators were used to account the three pillars of sustainable development? What criteria were utilized to choose the indicators? Was only onsite observations and interview able to identify this?
We have now clarified the framework we used, which was based on four certification frameworks that cover the 3 pillars. We added the following text: “From the following four sustainability certification frameworks, common sustainability criteria and indicators themes were integrated to frame the core questions for the interviews.
1. Bioenergy Environmental Impact Analysis (BIAS): Analytical Framework (Food and Agricultural Organisation, (FAO) 2010).
2. Global Bioenergy Partnership (GBEP) (Voluntary) (GBEP Task Force on Sustainability, 2011b)
3. RSB Principles & Criteria for Sustainable Biofuel Production (Voluntary) (Round Table on Sustainable Biofuels, 2011)
4. IDB Biofuels Sustainability Scorecard (Scorecards), Version Two, Based on the Round Table on Sustainable”

What kind of information was sought for?, that is, what were the questions that were asked during the interviews? The authors need to discuss of the weaknesses of the approach they utilized.
To address this we added the questions to section 7.3 : “Integrity relating to investment projects was addressed in depth; with particular attention paid to: 1) project developmental concerns – participation, understanding, marketing, communications; 2) access to energy – type of energy used, 3) extent of deforestation; 4) security of land tenure and who is it controlled by; 5) preferred system for decision-making, type of representation, structure of meetings and discussions; 6) if investment

is favoured what are the views on given opportunities 7) land use and land availability; 8) food security and crop yields". (Duvenage et al. 2012)

6. The reviewer said, it will be advisable to tabulate the results as it is hard to follow the discussion. For instance, line 45 on page 10 '. while many of the 240 small-scale.." what is 'many' in this case? 90%, 95% etc. Also, while it is indicated that 240 small-scale were interviewed for the NBFTPPZ, little results from them is provided. Seems that the most of the information gathered were from the investors and the question is how this truly captures all the stakeholders involved?
To address this we removed the NBFPPZ case study.

7. The reviewer said, page 17 line 25 'important to the future success of Green Fuel Project ...' I am not convinced that Zimbabwe is a suitable location for large scale biofuel plants! The sustainability analysis accounting for social (including political), economic and environmental criteria need to be well presented to convince a reader that the plant could at any time be successful. Amigun & Musango (2011) found that Zimbabwe is not suitable for large scale biofuels (with specific focus on biodiesel) plant in Southern Africa. See the reference: Amigun B and Musango JK (2011). An analysis of potential feedstock and location for biodiesel production in Southern Africa. International Journal of Sustainable Energy, 30: S35-S58
To address this we have removed the biodiesel case study and have discussed the conditions under which biofuels may be suitable in Zimbabwe.

8. The reviewer said, in the conclusions section line 52-55; the authors argue that the paper was developed within a framework with sustainability implementation approaches! Again, this was not clear nor is it visible to the readers and hence, the earlier question on which indicators and criteria used in choosing those indicators!
By addressing the reviewer's comments no. 3 we have addressed the issue of criteria and indicators. See response to comment 3.

9. The reviewer said, it is unclear about the basis of some arguments in the conclusions section e.g. page 19 line 1 and 2. 'Integrating local farmers into Jatropha outgrower projects has a potential to provide many local benefits in the form of replacing wood and charcoal with alternative energy options, crop diversification ..." How is it possible if the Jatropha plants have not been growing well in the first place? Secondly, the farmers will only be useful in terms of providing feedstock for biodiesel production and not necessarily transitioning to alternative energy themselves! They are not the ones who will be using biodiesel!
We agree this was unclear, Following the removal of the NBFPPZ case study, this comment no longer applies.

Reviewer #3

General comment:
Analyzing currently established biofuel projects based on field work in order to draw lessons from the success and failure is very relevant. However, the manuscript fails to present the research in a structured and scientific way.
Specific comments:

1. The reviewer said: **Title:** The step from two case studies in Zimbabwe does not allow answering questions for sub-Sahara Africa. Please explicitly refer to Zimbabwe in the title.

To address this we changed "sub-Saharan Africa" to read "Zimbabwe" in the title.

2. The reviewer said: **Structure/logic:** The manuscript is hard to read, since a clear structure is missing. For example, the aim/objectives of the study are described more than once in the article (page 3, line 12ff and chapter 5).

To address this we thoroughly edited the article and integrated the aims into the end of the introduction.

3. The reviewer said: In addition, the chapter 3-4 can be shortened and integrated into the introduction/methodology chapter. Further, the results and the discussion are mixed, even though two separate chapters are chosen. In addition, the readability sometimes suffers from repetitions in arguments and unfocused descriptions (not concise).

To address this we thoroughly edited the article and condensed chapters 3, 4 and integrated them into the introduction and methods chapters.

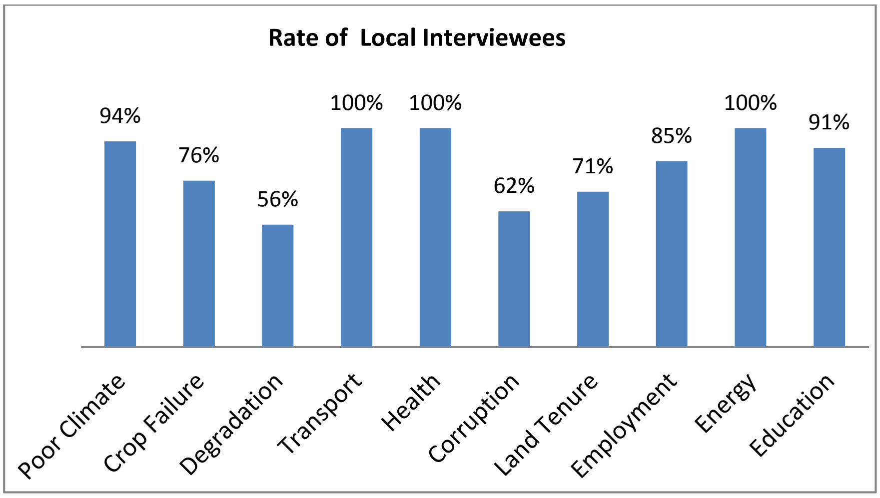
4. The reviewer said: **Length of article:** The manuscript (> 9000 words) is well above the journal guideline for standard research papers (6000-8000 words in length). One option is to avoid repeating same issues (just one example: chapter 6 first two sentences provide the same information as on page 6, 2nd line: "*The country's…*").

To address this we thoroughly edited the paper and removed any repetition.

5. The reviewer said: **Illustrations:** Figure 2 is obsolete, since there it is just poorly linked to the article. The same goes with Table 1, which provides to detailed information about a very specific aspect. On the other hand, some illustrations and tables about the methodology (sampling) or results might indeed by appropriate to improve the readability.

To address this we removed Table 1 and Figure 2 and the text referring to it. We added the figure to assist readability. Please see next comment for action taken on the methodology section.

Figure 2. Key Livelihood Concerns of Local Small-Scale Farmers



6. The reviewer said: **Methodology:** Even though some concept/theories are acknowledged, the conceptual and methodological approach is poorly described. The explicit definition of the analyzed system and the "sustainability" assessment is missing:

To address this we added, "Based on four internationally recognised sustainability certification frameworks (chosen for their comprehensiveness) (BEFSCI 2010): 1. Bioenergy Environmental Impact Analysis (BIAS): Analytical Framework (FAO 2010); 2. Global Bioenergy Partnership (GBEP) (GBEP 2011);

3. RSB Principles & Criteria for Sustainable Biofuel Production (RSB 2011); and 4. IDB Biofuels Sustainability Scorecard, Version Two, Based on the Round Table on Sustainable Biofuel Production, (IDB 2011), common sustainability criteria and indicators themes (see Table 1) were integrated to frame the core questions for the interviews. Selecting the four frameworks makes an effort to harmonise some of the many international sustainability initiatives linked to bioenergy (Janssen and Rutz 2011; Scarlat and Dallemand 2011). The interview questions and observations were designed to better understand the limitations and opportunities of biofuel project planning and implementation for sustainability criteria (see Table 1). Examples of the interview questions are provided in Table 2".

Table 1. Sustainability Criteria Derived Through the Integration of Sustainability Initiatives.

Criteria			
Social	**Environment**	**Economics**	**Ethics**
Cultural Respect	Environmental Integrity	Species Suitability	Efficiency
Food Security	Migration Impacts	Resource Utility	Accountability
Health	Water Management	Viability	Transparency
Education/Skills	Soil Management	Technology	Comprehensibility
Livelihood Quality	Waste Management	Management	Communications
Social Disturbance	Chemical Use	Best Practice	
Equality/Power Relations	Land Degradation	International Relations	**Policy**
Equal Costs & Benefits	Sustainable Agriculture	Marketing	Optimal Utility
Energy security			Compliancy
Participation			Land Rights
Rural Development			Enforcement Capacity
Marginalisation			

Table 2. Examples of interview questions to both local inhabitants and investor representatives to understand the effects on criteria presented in Table 1.

Is there concern for the security of land tenure?
Is there participation from all affected stakeholders? If yes, how is each group represented?
How is the water accessibility and quality?
What type of energy do you use? What is the availability?
Are agreements efficiently implemented?
What is the status of the soil and biodiversity?
Are livelihoods improving (e.g. health, education, food security and access to energy)? If yes, how?
What impact is the project having on food security?
What types of jobs are available? Is training offered?
What are the local livelihood norms? What is your career preference?
How does the project affect gender issues?

7. The reviewer said: **System boundaries:** The system boundaries are not clearly set. In chapter 5 (line 10) refers to biofuel cultivation, while also processing facilities are subject of the study. Further, there are also other stakeholders effected by the biofuel projects, which are currently neglected (e.g. retailers and end users of biofuels, down-stream villages, etc.). The scope has to be clearly defined at the beginning of the article and not considered effects have to be taken up in the discussion of the results (see limitations).

To address this we thoroughly edited the article to define the scope of the research

8. The reviewer said: **Temporal scope:** The study indicates that "all past, present and future aspects of the case studies were discussed …." (page 8, chapter 7.1, line 39ff), without indicating what "future" means.

To address this we changed the sentence in section 7.1 "All past, present and future aspects of the case studies were discussed with particular reference towards social and environmental sustainability" to read "Past and present aspects of the case studies were discussed with particular reference towards social and environmental sustainability. An understanding of future concerns, such as, equal benefits for local stakeholders as the project matures, eutrophication from agriculture run-off and water accessibility were also sought".

9. The reviewer said: **Sustainability concept:** The terms "sustainability" and "social/environmental impacts" are used without providing a definition of what is meant. For instance, the only result about the environmental impacts provided is the statement that deforestation can be avoided. However, other environmental impacts, e.g. ecotoxicity (due to the increased application of pesticides in the case of sugarcane cultivation) are neglected. Further, also the dams constructed for irrigation most likely will have impact on the aquatic ecosystem (positive and negative). Of course it is not possible to evaluate all aspects of suitability, however, at least the considered aspects have to be properly introduced and the results have to be discussed in the context of the aspects not analyzed (limitations of the study).

To address this we edited the article and expanded upon the environmental issues. For example on page 14, section 4.7 "Agro-production Environmental Policies"; page 15, "The case project's promotion of efficient irrigation techniques reduces environmental impacts through energy and water savings and reduces the risks of eutrophication, salinisation and nitrogen and pesticide toxicity (Diaz-Chavez et al. 2011)"; and page 14/15, "As the research was conducted at a single point in time it is difficult to draw concrete conclusions on the future sustainability of the project. Since sustainability is a conceptual process (Strange and Bayley 2008) with principles across space and time and an end goal with sub-objectives focussed on bettering conditions (e.g. health, social exclusion and livelihoods) and avoiding the depletion of resources (Hawken 2007), ongoing monitoring and assessment is needed to determine the environmental and social sustainability of Green Fuel's operations. As the project matures and expands, analysing sustainability becomes more important as impacts are likely to magnify. This is especially important for external and indirect environmental and socio-economic impacts not encompassed in this research (e.g. downstream water users, riverine habitats, local impacts from dam construction, movement of labour away from other livelihoods and timber harvesting)".

10. The reviewer said: **Actor selection:** Not all stakeholders affected by the biofuel projects were interviewed (national policy makers, biofuel users, down-stream villages, etc.) and

external factors were hardly considered. Again, not everything can be and has to be considered, but some justification/discussion is required.

To address this we thoroughly edited the paper and pointed out the weaknesses of the paper. The boundaries of our focus and what is inside and outside of the boundaries has been clarified.

11. The reviewer said: **Results:** The results are focused very much on one study site. I'd have expected that the same set of indicators/criteria has been used to evaluate both projects and that results are provided for both cases. That would allow a systematic comparison, which is currently missing. Further, in some occasions the cause-effect relationship is hardly visible or simplified. For example the link between producing electricity and avoiding deforestation (chapter 8.9, page 16). It might well be that this hypothesis does not crystallize (e.g. since neighboring villages will be attracted to use the forests or forest land) and generally the statements should be discussed more critically.

To address this we thoroughly edited the paper and removed the NBFPPZ case study to allow more depth to be placed on The Green Fuel case study. We also discussed the need for further research to identify the affects the case study may have on land degradation, including, deforestation, soil erosion water accessibility and riverine habitats.

12. The reviewer said: **Limitations:** Like any other research study there are some limitations to your findings (conditions under which they are valid, aspects neglected, uncertainties, etc.). At the moment the results are provided without any critical discussion about limitations.

To address this we edited the article and added limitations, including, "…ongoing monitoring and assessment is needed to determine the environmental and social sustainability of a project such as Green Fuel. As the project matures and expands analysing sustainability becomes more important as impacts are likely to magnify. This is especially important for external and indirect environmental and socio-economic impacts not encompassed in this research (e.g. downstream water users, riverine habitats, local impacts from dam construction, movement of labour away from other livelihoods and timber harvesting)".

13. The reviewer said: **Abbreviations:** Please double check the abbreviations, since some are introduced more than once (e.g. ARDA, chapter 6.3, page 8,line 9 / chapter 8.2, page 11, line 12 / chapter 9, page 17, line 27)

To address this we edited abbreviations and removed all unnecessary introductions.

14. The reviewer said: **References:** Not all the references are provided in the reference list (e.g. Dauvergne and Neville 2010).

To address this we thoroughly edited the paper and added "Dauvergne, P. and Neville, K. 2010, "Forests, food, and fuel in the tropics: the uneven social and ecological consequences of the emerging political economy of biofuel", *Journal of Peasant Studies,* vol. 37, no. 4, pp. 631-660".

Appendix H Zimbabwe and Zambia Interview Transcriptions

Please refer to the Compact Disc attached to the inside back cover of this thesis.