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An assessment of the impact of land acquisitions for biofuels on local livelihoods in Zambia

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Abstract

Biofuels are considered a mitigation tool, as an energy alternative to the global conventional oil reliance. Moreover, biofuels are seen as aiding rural development priorities for developing countries by increasing agricultural investment through foreign direct investment. Driven by international blending mandates, large agricultural investments for biofuels have been made in sub-Saharan Africa. This study examined the biofuels industry in Zambia using the Sustainable Livelihoods theoretical framework in order to investigate economic, social and environmental indicators of resilience and vulnerability for local people in the face of such agri-investments. A desktop study, case studies and interviews were used to assess the impacts. The study found that a lack of strong policy governance and appropriate support for the industry in Zambia is a challenge facing the development of a successful biofuels sector. For rural communities who are dependent on land held under community tenure, the conversion of communal land to commercial agro-fuel crops through land transfers to investors has led to loss of access to land necessary for subsistence and increased competition over natural resources. Biofuel investments based on employing local people through outgrower schemes have had no real economic benefits. When land was directly transferred, it decreased the land available to landholders and had implications for food security, livelihood diversification and welfare. In negotiations over land between investors and local elites, local landholders were excluded from voicing their needs, and impacts related to benefit sharing, conflict and gender disparity were felt. Land demarcation led to loss of access to marginal lands, important for the cultivation of crops by women, and forests - crucial for supplementing livelihoods with forest products such as *ifishimu*.

Keywords:

biodiversity, biofuels, land acquisitions, livelihoods, sustainable, Zambia

Table of Contents

List of Tables

List of Figures

List of Acronyms

AR4	IPCC Fourth Assessment Report
CH_4	Methane
CO_2	Carbon dioxide
CSBF	Civil Society Biofuels Forum
DoE	Department of Energy
EIA	Environmental impact assessment
EU	European Union
FAO	United Nations Food and Agricultural Organisation
FBD	Farm block development
FDI	Foreign direct investment
GDP	Gross Domestic Product
GHG	Greenhouse gases
ha	Hectares
HDI	Human Development Index
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
IIED	International Institute for Environment and Development
IPCC	International Panel on Climate Change
LSLC	Large-scale land conversions
LUC	Land-use change
MFEZ	Multi-facility economic zones
MoU	Memorandum of Understanding
Mtoe	Million tons of oil equivalent
N_2O	Nitrous oxide
NGO	Non-governmental organisation
NRCF	Natural Resource Consultative Forum
OECD	Organisation for Economic and Co-operative Development
PRSP	Poverty Reduction Strategy Papers
PSDRP	Private Sector Development Reform Programme
RDS	Rural Development Strategy
SADC	Southern African Development Community
tCO_2e	tons CO_2 equivalent
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
WEO	World Energy Outlook
WWF	Worldwide Fund for Nature
ZCCN	Zambia Climate Change Network

ZDA	Zambia Development Agency
ZIEM	Zambia Institute of Environmental Management
ZK	Zambian Kwacha

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1 Introduction

This Chapter provides a brief background statement, aims and objectives, and central research questions, as well as the research approach of the study and the scope and limitations of the research process. The focus of the thesis was determined by the literature that was reviewed, as presented in Chapter Two.

In sub-Saharan Africa (SSA) the importance of land cannot be overstated. Land is particularly important as an asset that contributes to people's livelihoods options – through farming, livestock rearing or ownership. Access to land therefore offers opportunities for local people to augment livelihood strategies through resource management or use, and can improve their resilience to external shocks or vulnerabilities (e.g. to climatic events). Land plays a crucial role in the theory of sustainable livelihoods – or how people can preserve or enhance their long-term livelihood security. In SSA, the increased investor interest in biofuel projects has implications for the sustainable livelihoods of (specifically) subsistence farmers.

Biofuels have been heralded as a solution to the world's dependence on oil. In the 2011 edition of the World Energy Outlook (WEO), the International Energy Agency (IEA) warned that the world has, at a push, only six years to shift to a low-carbon energy pathway or face irreversible and catastrophic climate change (Pearce, 2012). Possible mitigation options across all sectors need to be considered to deal with the expected scope of climate change impacts. Globally, the transport-sector contributes 23% to CO_2 emissions and 15% of overall GHG emissions (OECD/ITF, 2010). Given the large contribution of GHGs from the use of fossil fuels in the transportation industry, biofuel targets have been incorporated into renewable energy policies in order to assist in climate change mitigation (Campbell & Doswald, 2009). This is because agro-fuel crops sequester CO_2 during their growth and, when harvested, can be replanted. Thus, CO_2 that is released in the combustion of the final product is believed to be offset by the carbon sequestered during the plant growth (Koh & Ghazoul, 2008). Because biofuel crops produce an oil-alternative fuel at the same time, such projects are considered an investment tool whereby credits from these schemes can be bought and sold on global agriculture-based carbon offset markets (Overbeek, 2011; Bond & Sharife, 2012). Some claims argue that replacing petroleum and diesel with bioethanol and biodiesel can significantly reduce GHG emissions in the transport sector (Demirbas, 2008). Thus, biofuels lessen the global energy reliance on fossil fuels, making biofuels an important mitigation tool against anthropogenic GHGs. Under both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, international treaties on climate change, biofuels are considered to be carbon-neutral when they are used to substitute fossil fuel (Danielsen, 2008).

While the abatement of greenhouse gas emissions (GHGs) is the most frequently quoted argument (Peters & Thielman, 2008), the diversification of the energy mix for greater energy security and a reduced reliance on crude oil imports - particularly in light of geopolitical uncertainties, and foreign exchange savings are other factors that are driving the burgeoning biofuels industry worldwide (Koh & Ghazoul, 2008; Escobar, 2009; Amigun, et al., 2011; Hanff et al., 2011; Jumbe & Mkondiwa, 2013). Alongside tightening oil supplies and fluctuating prices, many countries have been incentivised to diversify their energy portfolio (Koh & Ghazoul, 2008). Such political-economic considerations take into account the growing demand for transport fuel, as well as the risk inherent in relying on oil-rich, dictatorial Gulf states or politically unstable, petrolist states (e.g. Angola/Iran/Nigeria) for oil imports (Friedman, 2008). As well as this, biodiesel and bio-ethanol are considered by many to be the only relevant and feasible substitutes of fossil fuels in transportation (Peters & Thielmann, 2008), and can be easily integrated into the current logistic and modern engine systems already in place (Koh & Ghazoul, 2008; Escobar, 2009). This results in an immediate reduction in dependency on oil imports (Zhou & Thomson, 2009) - an important factor for developing governments to consider in regard to national foreign exchange savings.

Importantly, biofuels are also seen as a means for rural development strategies through investment in the agricultural sector, and production technologies, and an opportunity to generate employment for rural communities (Amigun, et al., 2011; Escobar, 2009; Ewing & Msangi, 2009). Biofuels are recognised as having the potential to contribute to rural incomes by being grown on land unsuited to food crop production (Jumbe, et al., 2009). Prospects to increase incomes and expand agricultural production are seen to improve purchasing power and decrease vulnerability of rural populations (Ewing & Msangi, 2009). Advocates of the biofuels industry in Africa believe that investment in agro-crops will advance agricultural reforms, add value to local markets, and enhance socio-economic goals like water and energy access, health, and infrastructure services in rural areas (Kitabu, 2011). Economically speaking, biofuels grown in isolated areas create advantages for rural communities through plantation employment opportunities (German, et al., 2011a), contract or outgrower schemes (Ewing & Msangi, 2009) and improving production capacity (Hanff, et al., 2011). Bio-ethanol and biodiesel can provide a solution for an alternate fuel for cooking and meet off-grid electricity needs, such as lighting, water pumping, food processing and powering machinery. In addition, the use of biofuels as a household fuel can decrease indoor smoke pollution and related illness, which can specifically improve both the health and productive time use of women and children (Ewing & Msangi, 2009).

For industrialised countries, scarce land resources, high costs and unfavourable climatic conditions (Jumbe & Mkondiwa, 2013) have driven investors to turn to Africa for growing energy crops. SSA, in particular, is seen as a region with promising potential for biofuels production due to its large land surface, much of it uncultivated, and favourable climate

(Escobar, et al., 2009; Amigun, et al., 2011; Jumbe & Mkondiwa, 2013). Owing to the amount of land needed to grow biofuel crops such as *Jatropha curcas* (Jatropha), sugarcane and oil palm, the promising biofuels market has given rise to swift investment in the world's farmland by public and private-sector investors (Cotula & Buxton, 2010).

Ample land is crucial for the production of first generation biofuels and an essential factor for attracting investment (Habib-Mintz, 2010). The continent alone accounts for 56.2 million hectares of publically reported land deals (Deiniger & Byerlee, 2010; Anseeuw, et al., 2012b). This constitutes almost half of all authenticated deals. Land acquisitions in Africa verified and cross-checked by the Land Matrix, an international collaboration of organisations committed to ensuring transparency in land transfers, are dominated by the biofuels market, with over half (66%) of land being bought for the production of biofuels (Anseeuw, et al., 2012a).

African governments see foreign direct investment (FDI) in land as a means to stimulate the economy and advance developmental goals, particularly in rural areas. The investment in agriculture is considered crucial for boosting rural economies, increasing opportunities for job creation and modernising farming methods. As such, the introduction of biofuel projects in developing countries may improve livelihood prospects by providing welfare gains and decreasing socio-economic vulnerability, in addition to providing a possible alternative source of energy for household use (Ewing & Msangi, 2009). Despite this development potential, socio-economic and environmental challenges remain associated with the biofuels industry.

One of the serious challenges relates to land use and ownership. Across Africa, only a small percent of land is formally registered. Much of what is left is nominally under state control. As per Pearce (2012), an estimated 700 million Africans live and work on land that is under community tenure – that is, owned by the state but customarily held by local communities or individuals under statutory law. The failure to formalize land claims in many African countries undermines tenure security (German, et al., 2011a). The lack of formal title deeds or regulatory frameworks relating to land has been found to encourage the investment action of private firms (Jumbe & Mkondiwa, 2013) and facilitates negotiation over the land with governments, who often see the land as unused, marginal or devoid of habitation (Levidow & Paul, 2010). Such a classification of land has the potential to devalue subsistence practices that make use of this common resource (Burgess, 2012) for farming, hunting, pastoralist or other livelihood activities, notwithstanding the strong cultural and ancestral ties to land in Africa. This has important implications for the concept of sustainable livelihoods and the ability of local people to maintain or enhance their livelihood prospects. Often, large tracts of land have been sold or rented to multinationals despite the ramifications for those who inhabit or make use of the land for food security or income generating purposes.

In spite of the associated downsides of large-scale land acquisitions for biofuels, communities are often open to investment schemes on or near their land, particularly when expectations are created around the development of infrastructure (roads, irrigation, power supply, schools,

clinics etc.) and other much-needed amenities. Other benefits may include formal employment through contract work or outgrower schemes. However, as Habib-Mintz (2010) points out, local people may not be able to resist foreign persuasions, particularly when the community is entrenched in poverty and under threat from environmental or socio-political externalities. Furthermore, benefits are often not guaranteed or included in contracts. Business-orientated biofuels production tends towards commercial exploitation of land and in turn can threaten rural livelihoods (Jumbe, et al., 2009) as opposed to providing benefits for local communities. Furthermore, while formal employment opportunities are recognised as making a positive difference to income levels, such gains may not outweigh the indirect cost of land loss for affected households (German, et al., 2011a). Combined with inadequate land governance systems, biofuel deals have the potential to marginalise smallholders whose interests are not protected nor even recognised (Anseeuw, et al., 2012a). Vulnerable groups of people such as women, the aged, children and pastoralists often face cultural discrimination and may be excluded from consultations over land (Odhiambo, 2011; Anseeuw, et al., 2012a). This lack of recognition for the challenges they face in access to land and natural resources precludes them and their needs from being represented in negotiations for land transfers.

In addition to the challenges mentioned above, the conversion of arable and irrigated land to a non-food crop is associated with environmental costs and food security issues (Levidow & Paul, 2010; Anseeuw, et al., 2012a). Should the agro-fuel crop fail or have low yields, or climatic conditions affect the harvest of food crops, food security is threatened. Where plantations restrict access to forest products or ecosystem services, local people could lose access to important household resources. Industrial-scale plantations could furthermore degrade soil quality and pollute water via chemical inputs of fertiliser, pesticides etc. (Nhantumbo & Salomão, 2010).

It is important to understand the trade-offs in the burgeoning biofuels industry in SSA, and under what circumstances biofuels production will be socio-economically and environmentally sustainable, particularly through the industry's interaction with local people and their livelihoods. This thesis attempts to examine specific elements of livelihood impacts from biofuel plantation in the context of Zambia, as one of the favoured countries to have been targeted by land investors for biofuels, integrated with the sustainable livelihoods theory by using three broad indicators – economic, social and environmental – to assess such impacts. The research will attempt to highlight impacts on livelihoods in Zambia through the use of in-depth interviews with industry stakeholders, but will rely on drawing parallels to case studies in other SSA countries to determine the full extent of these impacts.

1.1 Country context- Zambia

Particular challenges exist for the dry, sub-Saharan regions already affected by high levels of poverty, rural subsistence and variable weather events. In conjunction with the problems already faced, higher global temperatures due to climate change are expected to have hugely damaging consequences on fragile livelihoods and ecosystems in this region, due to loss of arable land and water resources. Projected climate damage may push agricultural production over critical thresholds (Beddington, et al., 2011) – leading to ever worsening erosion and desertification rates, higher levels of hunger and malnutrition, severe shortages of water, and expected mass migration to already overpopulated urban centres. Staple crops already under pressure from the predicted growth in global population of nine to ten billion by 2050 (Thornton, 2012) will be further challenged by the changing climate. Such impacts have severe implications for the sustainability of livelihoods and development objectives.

Zambia itself is one of the African countries seen to offer abundant areas of near-natural and underdeveloped land necessary for the development of biofuels. This research needs to be understood in the context of the relevant country policies and economic status. Zambia, as a developing nation in SSA, is expected to suffer negative impacts from the changing climate. Indeed, it is expected that it will be amongst the 20 countries worst affected by predicted climatic change impacts (Wheeler, 2011).

It is understandable then that the Zambian government is actively pursuing foreign direct investment in order to create economic stimulus towards employment, education, income, increased production in agriculture, mining and other sectors, improved access to global markets and technology transfers. All these aspects of economic advancement can act as buffers against poverty-related issues and improve the adaptive capacity of Zambia in terms of expected climate fallout.

As can be seen from **Table 1.1**, Zambia has a high rural population, a significant proportion of which is poverty stricken. These basic indicators underscore the challenges related to poverty and development that Zambia faces. Furthermore, it has a low Human Development Index (HDI), falling into the lowest percentile of ranked countries. HDI is a measure of life expectancy, literacy, education and gross domestic product (GDP) per capita (Prasad, 2011). It is understood to be a relevant indicator, beyond those of economic importance, of development within a country.

Table 1.1 Basic country statistics for Zambia [Source: FIAN, 2010; OECD AfDB, 2010; UNDP Zambia HDI, 2011; UNDP stats online, 2011; ZDA, 2011; World Bank data, 2012]

DATA	ZAMBIA
Country Size (thousands km^2)	753
Population (million)	12.9
Population density (pop/km^2)	17
GDP per capita (PPP valuation US$)	1,516
Human development index	0.430 (164 of 187 countries ranked)
Poverty index (% poor living on less than US$1 a day)	60% (2010)
Rural poor	67% (2006)
Rural population	64%
Agriculture contribution to GDP	20% (2011)

1.2 Problem Statement

In some developing African countries, state objectives for economic progress, energy security and agricultural reform are encouraging investments into land-based agricultural projects, such as those for biofuels. The status of biofuel projects are not always publically accessible, the reasons for success or failure not always known, and the full range of impacts on livelihoods not well understood. By the use of economic, social and environmental indicators in the context of the Sustainable Livelihoods approach, this thesis examines the impact of biofuels grown in Zambia through an analysis of policy, literature, desk top study and information provided by industry stakeholders.

1.3 Central research question

The central research question is to assess the impact of the production of biofuels on local livelihoods in Zambia through the use of economic, social and environmental indicators, that act as asset classes employed in the theory of sustainable livelihoods. In general, biofuel projects are internationally recognised as valuable carbon offset solutions, yet there are important issues to consider when implementing a new industry such as this in a developing country.

An understanding of the policy background is crucial in order to investigate what the government administration predicted for the local industry. It is important to learn how biofuel projects were implemented, how the biofuel projects influence the environment and/or land use, and how these land impacts are directly related to economic, social and environmental indicators that can be used to assess the sustainability of local livelihoods. The impacts of implementation are examined through these specific indicators in order to determine the socio-economic factors that might benefit or disadvantage local communities. As such, the overarching research question can be broken into the following specific questions that require an answer:

- What is the policy background to the biofuels industry in Zambia?
- What are the impacts of the biofuels industry that can be related to economic impacts on livelihoods in Zambia?
- What are the impacts of the biofuels industry that can be related to social impacts on livelihoods in Zambia?
- What are the impacts of the biofuel industry that can be related to environmental impacts on livelihoods in Zambia?

An extensive review of literature was undertaken in order to determine research gaps and help formulate and guide the research process, and answer the research question. A thorough desk-top study of relevant case studies will form the foundation for the research findings; however, only those relevant to the case in Zambia will be drawn from. Case study findings will be followed by findings from a qualitative data-gathering process in Zambia, whereby individuals from civil society organisations, local authorities and academic stakeholders were consulted to define the breadth of these impacts according to their involvement in and knowledge of the local biofuels industry.

1.4 Aim and objectives of the study

The aim of this research is to assess the impacts of land acquisition on local livelihoods in Zambia. The study examines how biofuel projects are linked to land and rural development in Zambia, and the economic, social and environmental impact such projects have on the welfare of local livelihoods.

Objectives of this research are to:

i. Understand the policy and legislative instruments relevant to the development of the biofuel industry in Zambia
ii. Identify the impacts of land acquisition for the biofuel industry on local livelihoods.

1.5 Scope

The purpose of this research is to examine the impact of the domestic biofuels industry in Zambia on local livelihoods using economic, social and environmental indicators that underpin the sustainable livelihoods approach. The scope of this study thus covers the policy background and impacts of investments for biofuels local livelihoods in Zambia, using case studies, narrative from industry respondents and literature. The research attempts to highlight the policy context, the consultative and investment processes for biofuels in Zambia, the high reliance on land for rural communities in these countries, and what the outcomes of the biofuels industry on livelihoods have been thus far for local people in economic, social and environmental terms.

While many of the studies cited in the overview of literature are extensive, detailed, informative and well executed, there are not many studies that have been conducted in Africa specifically examining the impacts on sustainable determinants of livelihoods from biofuel monoculture plantations, within the particular context of one country (Zambia).

1.6 Limitations

This thesis is limited to the design of objectives mentioned above. Limitations pertain directly to the findings, where little empirical research exists on the topic. Case studies were selected according to their relevance to socio-economic impacts of the biofuels industry in Zambia according to the asset classes of economic, social and environmental indicators that are used in the theory of sustainable livelihoods. By no means were all aspects of biofuel impacts or all empirical cases reviewed. This thesis hopes to examine the impacts thus far of the biofuels industry (in general) on local livelihoods in Zambia (in particular) by using case studies and in-depth interviews, and determining the implications for sustainable livelihoods.

The desk top study was based on secondary data - well-recognised and researched case studies that make use of qualitative and/or quantitative data collection. This was followed by primary data research gathered on the ground in Zambia by conducting in-depth interviews and through stakeholder engagement. One week was spent in Lusaka, Zambia in order to conduct important face-to-face interviews with relevant stakeholders that were organised prior to travel. All findings used are based on literature and/or stakeholder knowledge.

A limitation to the study is that of resources. Financial constraints curtailed the time and opportunities for data collection *in situ*.

1.7 Layout of thesis

A literature review relating to the various drivers and aspects of the biofuels industry in SSA is presented in Chapter Two, which ends with a gap analysis and the rationale for this study. The

research methodology is detailed in Chapter Three. In Chapter Four, the findings of the research are presented. An introductory analysis of the policy background for investments into the biofuels industry is given for Zambia. The findings are presented through an in-depth analysis of case studies in SSA countries viz. the impacts on economic, social and environmental factors, in the context of sustainable livelihoods, alongside a discussion. Conclusions and recommendations follow these results and are presented in Chapter Five.

2 Literature Review

The aim of this research was to assess the impacts of land acquisition on local livelihoods in Zambia. In this regard, two objectives were set out as outlined in Chapter 1 – i) Understand the policy and legislative instruments relevant to the development of the biofuel industry in Zambia, and ii) Identify the impacts of land acquisition for the biofuel industry on local livelihoods. This chapter, firstly, contextualizes the Sustainable Livelihoods theoretical framework and why it was chosen for this study. It then examines the drivers of the biofuels industry, why biofuels are considered important, and how these aspects have encouraged land acquisitions for biofuels development in Africa. The chapter ends with a discussion of related concerns raised in the literature reviewed.

2.1 Theory of sustainable livelihood

A livelihood is a means of making a living, and encompasses people, their capabilities and their mode of subsistence, whether through food, income or ownership of assets (Chambers & Conway, 1991). The sustainability of a livelihood refers to the maintenance, if not enhancement, of resource productivity in the long-term for the purpose of gaining livelihood security. According to the definitive paper on sustainable livelihoods by Chambers and Conway (1991), a livelihood is sustainable if *"…(it) can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term*" (Chambers & Conway, 1991).

The sustainable livelihoods (SL) approach emphasizes the rural poor in the context of several interrelated factors which may affect how they are able to enhance and create meaningful livelihoods, recognizing that this range of factors can affect the choices they are able to make for themselves (DfID, 2000b). As best defined by Chambers and Conway (1991), a livelihood '*comprises the capabilities, assets (including both material and social resources) and activities required for a means of living'.* In the context of this research, local livelihoods primarily refers to the means through which rural people are able to create or supplement their income and existence, whether via farming, livestock rearing, the harvesting or selling of products available to them, employment etc. The most widely adopted SL framework was composed by the UK Department for International Development (DfID) and best articulated the choices and trade-offs underlying livelihood strategies in the context of internal and external drivers (Upham, et al., 2012). A central aspect of the SL approach is how the use of assets and capabilities can be used in order to cope with risks and external shocks and reduce vulnerability (Chambers & Conway, 1991). Indeed, the focal feature of the sustainable livelihoods framework are the assets relating to

livelihoods – classed as Natural (Environmental), Physical, Social, Human and Financial (Economic) capital – where each asset class is key to livelihood strategies that may enable a particular outcome (Vista, et al., 2012). By examining the original asset base of a particular group of people in the context of how these assets have changed, what caused the change and how the change might drive impacts on, or affect livelihoods (Upham, et al., 2012), greater understanding of how a community might experience differing risk factors and their ability to exercise livelihood strategies in order to cope can be achieved. The rationale of the SL approach thus begins with an analysis of strengths as opposed to needs of a community (Upham, et al., 2012).

For example, access to resources, such as land or forest products, can improve people's Natural or environmental asset base and help them cope with externalities. In a rural context, access to land is a key determinant of livelihood security, while the use of it can be examined in order to understand whether such use or access translates into sustainable livelihood outcomes (Vista, et al., 2012). Thus, where new agricultural endeavors or reforms are introduced, there is a need to examine how such land investment processes can or should result in benefits being transferred to the local population. Attention must also be paid to social relations, and how hierarchy (cultural power relations, gender etc.) might structure rural livelihoods and govern the distribution of benefits, income or property (Scoones, 2009). Furthermore, the SL approach highlights the political and institutional context which might delineate the livelihood options available and drive varying livelihood outcomes (Upham, et al., 2012) through financial or economic impacts. The SL approach stresses the significance of social, economic, environmental and governance perspectives within a particular context. Thus, a sustainable livelihood is not simply one that is based on access to resources, or asset ownership, or remuneration for the foreseeable future, but any number of inter-related dependencies and socio-economic linkages that reduce vulnerability.

2.1.1 The SL Framework

It is well recognised that poverty is not simply a function of a lack of financial income, but also a lack of access to assets or capabilities that can help improve the vulnerability of livelihoods (Scoones, 1998). The SL approach seeks to determine the different assets at hand to a particular group of people in a specific context. The five capitals of sustainable livelihoods are:

- **Environmental or Natural assets:** Natural resource stocks (land, soil, water, air etc) and ecosystem services and provisioning
- **Social assets:** Social resources (networks, social relations, affiliations)
- **Human assets**: Skills, health, labour, knowledge
- **Physical assets:** Infrastructure (e.g. roads), equipment and technology
- **Economic or Financial assets:** Capital base (e.g. cash, savings, income) (Morse, McNamara, 2013)

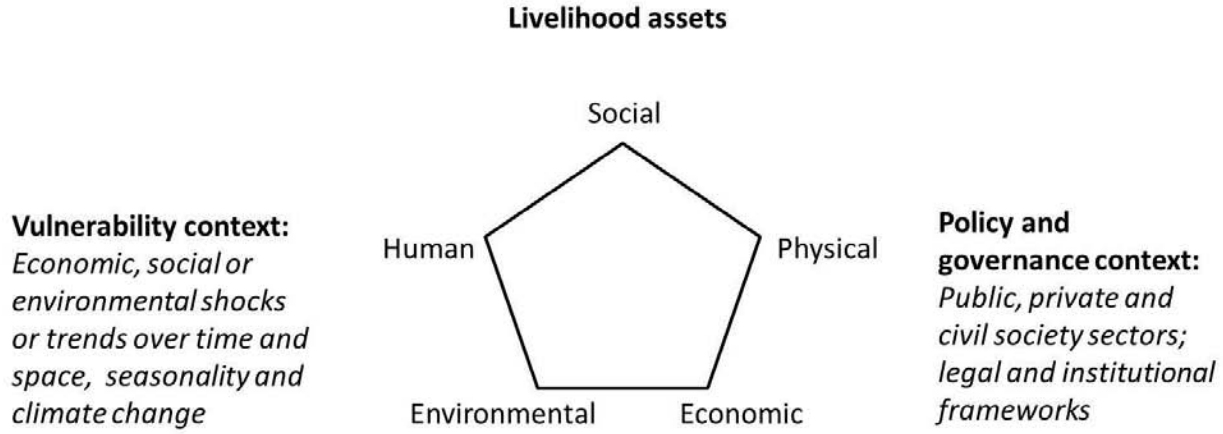


Figure 2.1The DfID sustainable rural livelihoods framework [adapted from source: Morse, McNamara, 2013]

Diagrammatically, this is often shown as **Figure 2.1**, where the assets or capitals are represented at the core and assessed according to the policy context in which they are found, as well as their vulnerability to external shocks or risks. The purpose for this is to then develop recommend interventions for the particular context in order to improve the sustainability of livelihoods (Morse, McNamara, 2013).

Examining the impact of the biofuels industry in Zambia from a livelihoods perspective can broaden the understanding of policy implementation and enable further exploration of the issues that rural households may face in attempting to partake in new markets. This research is an attempt to explore the impacts of biofuels investment on local livelihoods in Zambia, in particular, and as a mode of agricultural investment that is expected to enhance sustainable livelihoods, in general. The research assesses the impacts of biofuels investment in relation to three of the five asset classes, or themes, of the SL framework - economic, social and environmental. These asset classes encompass a number of livelihood indicators available to local people in Zambia.

2.1.2 Indicators

The selection of indicators chosen for this research is based on a review of the literature which indicate the common risks and benefits of the biofuels industry and the economic, social and environmental impacts associated with biofuels production. A number of indicators are used to specify impacts on the asset base of local landholders in the context of the biofuels industry set-up in Zambia. It is necessary to frame the objectives of this thesis in the context of these indicators. The policy context of each asset base is also important to consider – the relevant land laws, institutional framework, investment policies and customary rights play an important role in determining how assets are ultimately used. It must be pointed out that land is the main

economic and natural asset available for rural landholders, and plays a strategic role in livelihood support.

a) **Economic indicators:** As an economic asset to local people, financial provision from the biofuels industry through income generating activities, access to markets and possible by-product markets, employment and returns to labour are crucial indicators to consider. Food security is also an economic indicator, used to measure not only people's ability to feed themselves, but also as a means to generate supplementary income.
b) **Social indicators:** In considering the social asset base of rural people, it is important to consider participation and representation of local people, within the context of possible cultural hierarchies. Legal rights of landholders play an important role in the implementation of biofuels projects. Similarly, it is necessary to consider equity in the distribution of both land and deliverable benefits, particularly related to gender.
c) **Environmental indicators:** The manner in which land is used indicates related impacts on the natural asset base. Indicators relevant to land, as the most crucial component of the natural asset base for rural people and that of biofuels development, include land use – i.e. the type of land used for biofuels production (e.g. marginal); land use change (LUC) and the cultivation practices used in a particular setting; forest-based activities i.e. the collection of forest products (e.g. timber, charcoal); and the competition for natural resources such as water and fertile soil.

The application of a theory such as that of SL is a relevant lens through which to examine the context and impacts, risks and benefits, of the biofuels industry in Zambia. The SL approach is particularly relevant for this research as it recognises how a variety of assets, such as land ownership, and/or vulnerabilities, such as poverty levels, interact with a broader macro-economic context, such as national policies, in determining how and whether livelihoods are sustainable in a particular setting.

2.3 The global to local context of biofuels

Bioenergy is a source of alternative fuel that uses raw natural materials (biomass) to produce energy, through thermo-chemical conversion, and can be used as an alternative to petroleum fuel (Demirbas, 2009). Inputs include wet biomass, sugar, starch or oils (Letete, 2011). The term 'biofuel' for the purpose of this thesis will apply exclusively to liquid biofuels, and not biogas or traditional forms of biomass such as fuelwood, crop residues, dung etc.

There are two types of liquid biofuels: first-generation biofuels, generally produced from sugar, starch and animal fat; and second-generation biofuels, produced from cellulose or lignin – that are not yet based on mature technology (Timilsina & Shrestha, 2011). First-generation biofuels

are typically sugarcane or starch-based ethanol, biodiesel from crops such as corn or soy, or animal fats which may consist of food residue (OECD FAO, 2011). Second-generation biofuels still require research and development, and are generally produced from the 'non-edible' or ligno-cellulosic parts of forestry or agricultural residues and waste (Koh & Ghazoul, 2008; Letete, 2011; Jumbe & Mkondiwa, 2013).

The most common types of liquid biofuels are bioethanol and biodiesel. Bioethanol is produced from feedstock such as grains (maize and wheat), roots (cassava, sugar beet and potatoes) and grasses (sugarcane and sweet sorghum). Biodiesel is produced from oil-producing crops such as Jatropha, corn, soybean, sunflower, rapeseed or palm; from animal fats or waste cooking oil (Demirbas, 2009; Hanff, et al., 2011; Burgess, 2012). Bioethanol has only 66% the heating value of petrol but can be blended with petrol in existing vehicle engines, or used unblended in modified engines. Biodiesel, however, has almost 90% the heating value of diesel, and be used blended or unblended (Letete, 2011). By-products from some biofuels include animal feed, or glycerol products such as soap and shampoo, and can be used in household or commercial applications (Kumar & Sharma, 2008; Ewing & Msangi, 2009).

2.3.1 The role of government in the biofuels industry

Biofuels are considered to be a relevant renewable technology, particularly important as a substitute for oil in the transport sector, and have been integrated into energy plans for industrialised and developing countries alike (Demirbas, 2008). The reasoning for biofuels includes climate change mitigation measures, energy security and diversification, and socio-economic gains for rural development purposes (Campbell & Doswald, 2009; Hanff, et al., 2011).

In 2008, world food prices skyrocketed due to increased costs of staple grains and edible oils – reaching price levels unseen since the 1970s (Kugelman, 2009) and creating ripple effects across commodity prices. In addition to the food crisis, in 2008 crude oil prices reached over US$100 a barrel, leading to international energy security concerns (Meinzen-Dick & Markelova, 2009). Primarily initiated by this food and energy price crisis, the renewed interest in land as an investment tool has driven the acquisition of undeveloped land across the globe (Cotula & Buxton, 2010), particularly for biofuels. Biofuels are, however, not cost competitive with fossil fuels without considerable government support (Peters & Thielmann, 2008). Direct payments and government mandates are used in order to encourage the take-up of renewables such as biofuels, thereby accelerating the speed and scale of deployment and decreasing unit costs through economies of scale. In 2010 it was estimated that global renewable-energy subsidies totalled US$66 billion, of which US$44 billion was allocated to renewables-based electricity and US$22 billion in subsidies was allocated to biofuels alone (IEA WEO, 2011). Such energy strategies include subsidies and tax breaks, incentivising the private sector and guaranteeing a

profitable market for agro-fuels (Meinzen-Dick & Markelova, 2009).Renewable energy subsidies are thus intended to underpin a sustainable and secure energy future and compete with oil, gas and coal in the current energy marketplace, making them a viable alternative.

Globally, bio-ethanol production grew at an annual rate of 20% between 2004 and 2009, while the average annual growth rate of biodiesel production was 50% between the same years (Timilsina & Shrestha, 2011). Biofuel production has recently been the greatest source of new demand for land and feedstock in agricultural markets (OECD FAO, 2011). The recent surge of investment in the biofuels market is due to industrialised countries government mandates that specify blending targets for the transportation and fuel industry (Jumbe, et al., 2009), further supported by the heavy governmental subsidisation and research funding in scientific development for second-generation biofuels. Driven by transportation mandates, supportive subsidies and continued high oil prices, investment in agro-fuels is expected to continue growing (Timilsina & Shrestha, 2011). It is anticipated that energy demand in transportation will increase by 43% by 2035, while oil demand in the road transport sector alone will increase by 32%. Augmented by an estimated US$1.4 trillion in subsidies, biofuels supply is expected to reach more than 4 million barrels per day by 2035, an annual growth rate of 5% (IEA WEO, 2011).

2.3.2 Growing interest for biofuels in Africa

The concern for both energy security and diversification by industrialised countries is validated by data from the Land Matrix (see **Figure 2.1**), an international collaboration of scientists, researchers and NGOs who are working together to corroborate information on reported large-scale land acquisitions. Of the total number of verified global land deals (71 million hectares) where the commodity is known, 78% are for agricultural production. Of these agricultural land acquisitions, almost 60% are for biofuels (Anseeuw, et al., 2012a).

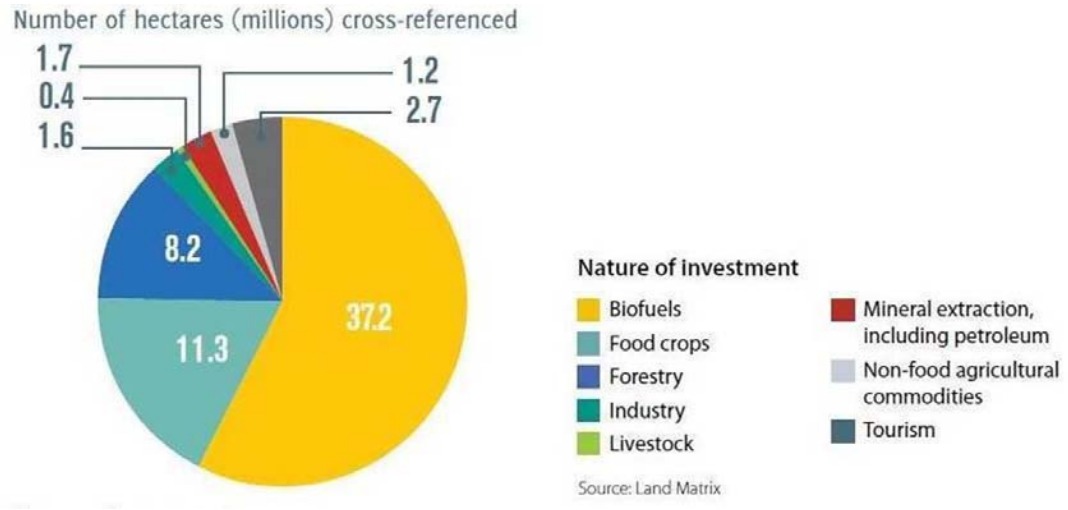


Figure 2.2 Global land acquisitions by sector according to cross-referenced hectares (millions) [Source: Anseeuw, et al., 2012a]

The International Food Policy Research Institute (IFPRI) previously estimated that 15–20 million hectares (ha) of the world's farmland has been targeted in recent land transactions (Kugelman, 2009). Some reports claim that more than 750 land deals have been identified on the continent (some unverified), covering 56.2 million hectares (Deiniger & Byerlee, 2010; Anseeuw, et al., 2012b), an area equivalent to the size of Kenya (Provost, 2012).

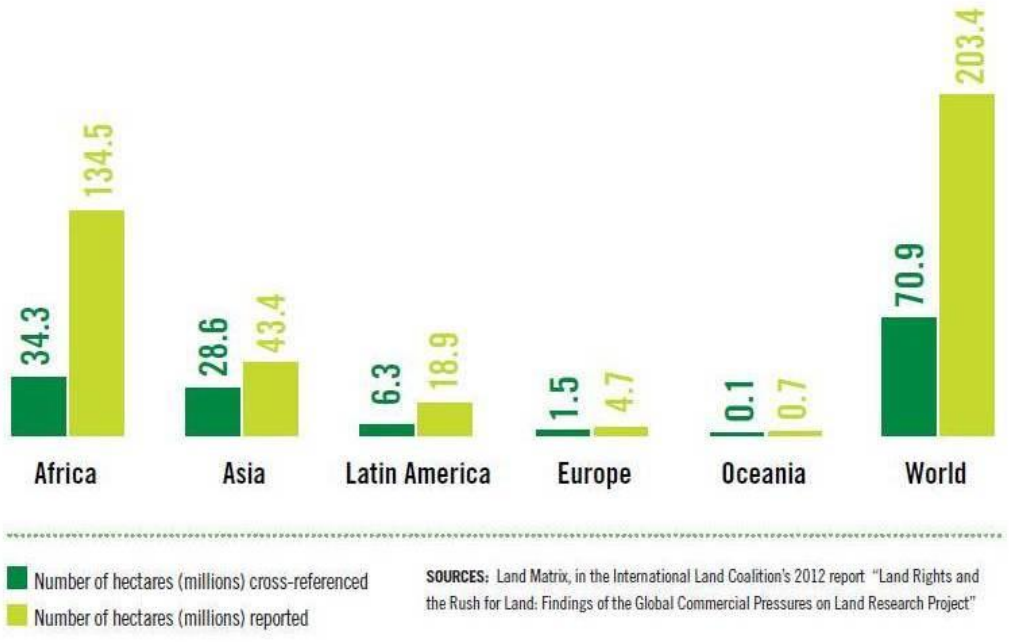


Figure 2.3 Regional focus of land acquisitions [Source: Pearce, 2012]

However, the Land Matrix (Anseeuw, et al., 2012b) has cross-referenced 37.2 million ha of land deals for biofuels alone – globally, the sector accounting for the largest investment in recent land acquisitions. Countries with favourable tropical conditions, low labour costs and vast land resources have a comparative advantage in the cultivation of biofuels (Timilsina & Shrestha, 2011). Indeed, thus far Africa accounts for 34 million hectares of cross-referenced deals (or a total of 948 publicly reported deals) of a possible 134 million hectares reported (Anseeuw, et al., 2012a) – or 48% of verified global land acquisitions, as **Figure 2.3** illustrates. SSA is increasingly recognised as a region that meets the large landmass, water and biomass productivity requirements for the farming of biofuels (Kugelman, 2009; Mulugetta, 2009).

In SSA, there are more than 300 million poor rural people which rely largely on subsistence farming and ecosystem services to meet their food and energy needs. Between 40% and 70% of rural households in the region meet more than three-quarters of their income from on-farm production (IFAD, 2010), and thus access to land is a crucial element for sustaining livelihoods.

However, estimates are that only 200 million hectares of land in Africa is under cultivation, of a potential 800 million hectares of arable land (Odhiambo, 2011). Moreover, 42 African nations are net oil importers – making these countries vulnerable to volatile oil prices and increasing their dependence on foreign exchange to fulfill domestic energy demands (Amigun, et al., 2011). The rapid development of the renewables sector is seen as an important solution for addressing power provision in the region and meeting the demand for modern energy services for the poor (Karekezi, 2002), at the same time as stimulating the rural economy and improving food security.

A national biofuels industry could provide a solution for energy security and increase foreign exchange savings by lessening oil import dependency, while creating socio-economic benefits for the rural poor (van Eijck & Romijn, 2008). Benefits of such investment projects frequently include promises or terms by the investors that include the upgrade of infrastructure, improved services and construction of facilities (Meinzen-Dick & Markelova, 2009; Burgess, 2012) that are often non-existent in rural areas where the majority of land deals take place.

Already, industrialised countries have invested heavily into the biofuels industry in SSA to take advantage of the available land and low production costs – as well as the lack of formal regulatory biofuels policies that control the development of the agro-fuels sector (Jumbe & Mkondiwa, 2013).

In Africa, the verified land acquisitions are dominated by the biofuels market, with over half (66%) of the land bought in Africa being for the purpose of producing biofuels, as **Figure 2.4** illustrates. Thousands of hectares of agro-fuel crops have already been planted, with many millions more in the planning phase (von Maltitz & Setzkom, 2013).

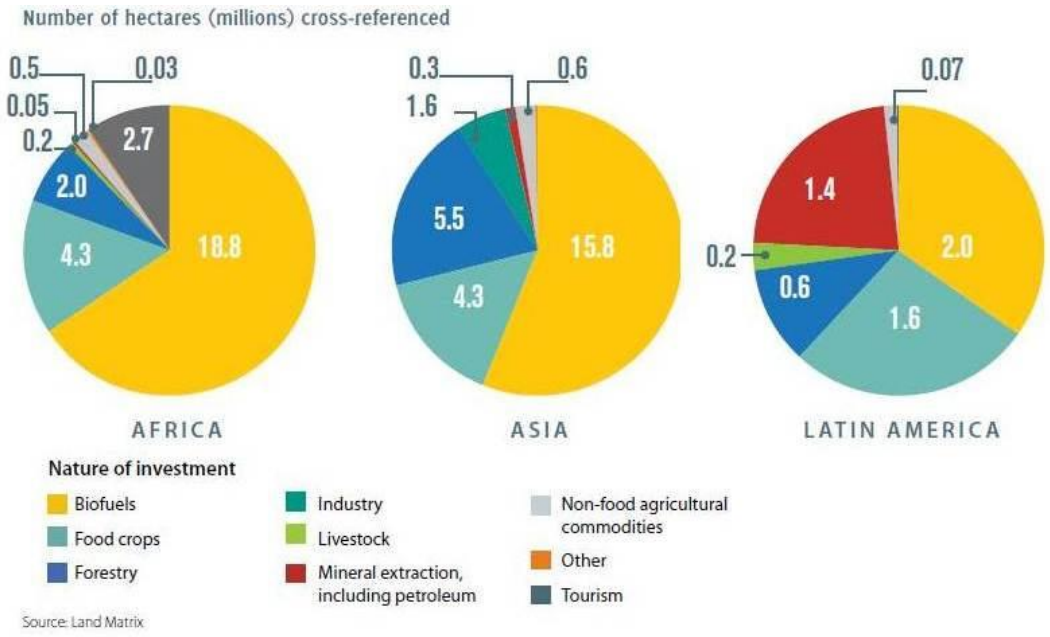


Figure 2.4 Regional land acquisitions by sector [Source: Anseeuw, et al., 2012a]

2.3.3 Policies, principles and private investment

The fundamental driver of land acquisitions specifically for biofuels in sub-Saharan Africa is the export market. In particular, biofuel directives in the United States (US) and the European Union (EU) that stipulate blending mandates have created a demand for land in Africa for the production of agro-fuel crops (Jumbe, et al., 2009; Hanff, et al., 2011).

As Table 2.1 illustrates, global blending mandates, particularly those already mandatory, guarantee an ongoing demand for biofuels. The EU alone introduced an ambitious and binding target of 10% share of biofuels in the transport sector by 2020 (Hallström, et al. 2011), which has subsequently been decreased to 5% (Dunmore, 2012).

Table 2.1 Regional/country-specific biofuel blending targets [Source: Hallström et al., 2011, amended from Fischer, et al., 2009]

Country/region	Mandatory, voluntary or indicative targets
European Union	10 % by 2020
Japan	A goal to reduce fossil duel dependence of transport sector from 98% to 80& by 2030
New Zealand	3,4% target for both gasoline and diesel by 2012
United States	20,5 billion gallons by 2015, 35 billion gallons by 2022
China	10 Mtonnes ethanol by 2020, 2 Mtonnes biodiesel by 2020
India	20% ethanol blending in gasoline by 2017, 20 % biodiesel blending by 2017
Indonesia	3% biofuels in energy mix by 2015, and 5% 2020
Thailand	10% ethanol blend by 2012, 10% biodiesel blend by 2012
South Africa	2% of biofuels by 2013

Typically, biofuels development is a crucial step for national energy security and independence, for both developing and developed countries. However, as per Singh (2006), fluctuating crude oil prices introduce uncertainty in the value of fuel ethanol as a replacement, and create a risk for commercial enterprises. Currently, under a cost comparison, bioenergy is still relatively expensive and less competitive than crude oil (Mangoyana, 2009), with some claims that the cost of biofuels production is three times higher than that of petroleum based fuels (Demirbas, 2009). The cost of biofuel production depends on a number of factors, including production technology, geographic region, the domestic cost of oil, and most importantly, the cost of the base feedstock (Thomas & Kwong, 2001; Demirbas, 2008). Mulugetta (2009) specifies that the cost of feedstock accounts for more than 75% of the total production cost.

Hence, biofuels production requires financial subsidies from host governments in order to compete under a low crude oil price scenario (Singh, 2006). Particularly in developing countries, where the biofuels sector is in the early stages of development, there is need for governments to play an integral role in supporting the growth of the industry.

Secure, reliable and affordable energy provision is fundamental to economic stability and growth (Prasad, 2011), and crucial for national energy security and sustainable development. Therefore, energy policies contribute towards and shape an important constituent of overall regulatory frameworks and are crucial for the integration of the private sector into the market (Demirbas, 2008) alongside increased investment in technology and infrastructure (Jumbe & Mkondiwa, 2013). The establishment of policies is crucial for the smooth introduction of a new industry, while government support and coordination is needed for the development of the right regulatory tools necessary to monitor and evaluate a fledgling sector such as that of biofuels. Indeed, the highly successful commercial bio-ethanol industry in Brazil is cited as a prime example of how

government support in the infancy of the industry, in the form of price guarantees, subsidies, public loans and state guaranteed private bank loans, allowed the substantial growth and development of the sector (Jumbe & Mkondiwa, 2013). All government support has subsequently been withdrawn, making Brazilian ethanol production the only cost-competitive replacement for petroleum (Timilsina & Shrestha, 2011).

With the exception of a few countries, there are few national supportive mechanisms in place across SSA that promote the growth and development of a viable biofuels industry (Amigun, et al., 2011), with most SSA nations relying on general statements on biofuels development included in overall energy policies (Jumbe & Mkondiwa, 2013), without a distinct strategy for implementation (Jumbe, et al., 2009). In Nigeria and Uganda the role of government has importantly been identified in national energy policies – encouraging private sector investment and facilitating control over the biofuels sector. In South Africa, Tanzania, Malawi and Zambia, responsibility has fallen on the private sector to stimulate the development of the biofuels industry and train farmers to grow appropriate feedstock for biofuels production (Jumbe, et al., 2009). In their 2009 study, Jumbe et al. examined the major policy frameworks specifically related to Poverty Reduction Strategy Papers (PRSPs) of 17 SSA countries to determine whether the policies would enable the development of a feasible biofuels industry. It was found that despite the increasing importance of the biofuels sector for economic development, almost none of the PRSPs contained specific institutional frameworks or detailed strategies for implementation of the sector (Jumbe, et al., 2009). In some cases, biofuel projects were initiated without any policy set-up and very few have been ratified by parliament (Amigun, et al., 2011). In fact, much of the policy formulation process has been guided and developed by global commercial interests rather than domestic governments, resulting in divergent frameworks (Amigun, et al., 2011). Most countries in SSA have no regulatory policies or framework regarding the biofuels sector – this lack of monitoring has encouraged foreign investors and private entities to enter the market, acquiring land for the purposes of biofuels production (Jumbe & Mkondiwa, 2013). Furthermore, with the exception of South Africa's biofuel policy, most were prepared without a full analysis of the potential impacts of the biofuels sector on food security, employment and the environment (Jumbe, et al., 2009). In light of promised agricultural reforms and expected improvements in rural economies, governments welcome land investments as transactions of 'trade rather than aid' (Odhiambo, 2011).

Unfortunately, only a few African countries have initiated clear regulatory frameworks necessary for the development of a viable biofuels industry (Amigun, et al., 2011). Unsurprisingly, the development of the industry thus far has taken place in a relatively impromptu manner, with stakeholders having to learn from experience and adapt to changing policy regimes and external pressures such as the 2008/2009 global recession (von Maltitz & Setzkom, 2013). However, it is the role of government to provide linkages between farming communities and private actors, regulate and monitor the industry as well as investments, sustain and offer support for small-

scale operations that benefit rural areas, and provide incentives or employment schemes for local people to contribute to the burgeoning industry (Jumbe & Mkondiwa, 2013). One such manner of employment in implementing an agro-crop industry like that of biofuels is the introduction of contract farming, or outgrower schemes. An outgrower scheme is a system whereby independent farmers supply a contractor (agro-processors or traders) with their harvest, generally in return for some form of service or inputs (e.g. technical advice, fertiliser etc.). The farmer is seen to carry the risk of production, while the contractor takes on the risk associated with marketing and taking the product to market. The allocation of the risk is typically specified in the terms of a contract agreement, either through production levels, or price and buy-back guarantees etc. (Baumann, 2010). The establishment of such regulatory policies is crucial for the smooth introduction of a new industry.

The basic need for clear, detailed policy formulation and strategic framework for the implementation of national biofuel initiatives is obvious. With the expectation that the private sector can act as a key benefactor for revitalising rural economies in the South, many governments have committed to improving institutional regulations in order to attract and protect FDI in agriculture and extractive industries (Anseeuw, et al., 2012a), using incentives such as outgrower schemes to improve the longevity and smooth the entry of industry players, alongside governmental objectives.Without institutional guidelines that cover possible impacts and pre-empt potential repercussions it will be very difficult for the biofuels industry to be managed and evaluated in terms of costs and benefits across domestic activities. A growing biofuels industry without any form of government control or input could affect a number of aspects related to local livelihoods and have implications for land, the environment and biodiversity, poverty levels and vulnerable groups of people.

2.3.4 Investment flows

Almost all biofuel projects in SSA are initiated by foreign investors (Jumbe & Mkondiwa, 2013). It is mainly states, sovereign funds or government-backed investors (Meinzen-Dick & Markelova, 2009; BondGraham, 2011) who are leading agri-investments into biofuels.

In 2010, the largest country investors in terms of outward FDI flows were the US, Canada, China, Japan, Italy, Norway, Korea, Germany, Denmark, and the United Kingdom (UK) (FIAN, 2010).

However, while FDI in land generally originates from wealthier, developed nations, as the list implies, investment flows do not simply follow a ‘North-South’ pattern (Spieldoch & Murphy, 2009). Much of this FDI is intra-regional (Anseeuw, et al., 2012a) with developing nations investing heavily in their own regions or in other lower-income areas that have abundant land resources. China is buying farmland in Africa, India has plantations in South America, and much

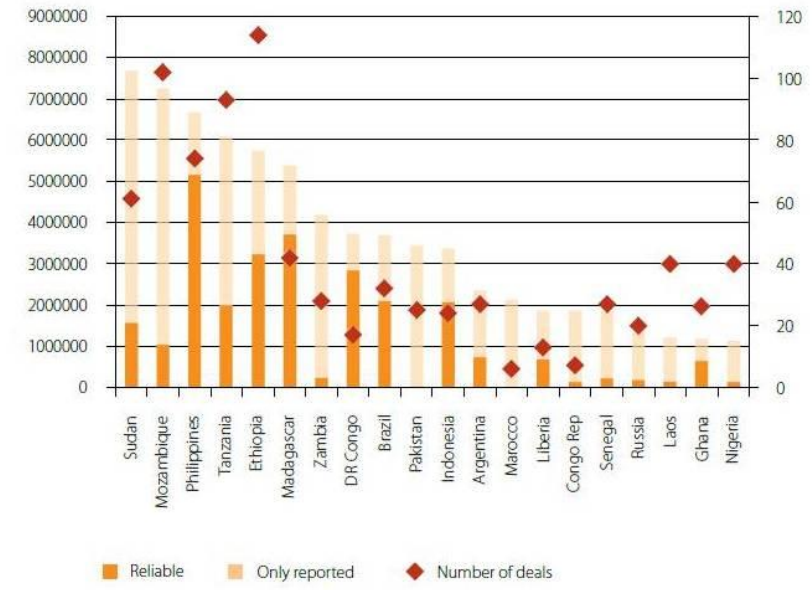
of the buy-in of the biofuels market in Africa comes from wealthier African countries like Egypt and South Africa (Schoneveld, 2011; Anseeuw, et al., 2012a).

In terms of actual demand, the USA, Brazil, China, Germany, Italy, India, France, the UK, Pakistan and South Africa account for the top ten consumers of bio-ethanol, while for biodiesel, the countries that contribute the highest consumption levels are Malaysia, the USA, France, China, Brazil, Italy, Germany, Spain, the UK and Indonesia (Gerbens-Leenes, et al., 2012).

2.4 Land acquisitions for biofuels in SSA

2.4.1 Targeted land in SSA

In its 2012 analytical report, the Land Matrix revealed that, of 84 countries targeted for large-scale land acquisitions, 11 are responsible for 70% of the reported land deals (**Figure 2.5**). Of these, seven are in Africa – Ethiopia, Democratic Republic of Congo, Madagascar, Mozambique, Sudan, Tanzania and Zambia (Anseeuw, et al., 2012b).



Source: Authors' calculations based on Land Matrix data.

Figure 2.5 Most targeted countries according to the total size of reported acquisitions [Source: Anseeuw, et al., 2012b]

While the actual figures on acquired land differs between reports (see **Table 2.2**), research has revealed numbers of hectares (ha) for some of the most targeted countries in Africa. These numbers differ according to what can be assumed in comparative timelines, level of verification, and the level of implementation (planned/operational). Due to a lack of transparency in many

land deals, it is difficult to verify reports on all land acquisitions, but what can be acknowledged is the sheer scale of land acquisitions in Africa. In **Table 2.2**, the data sourced by the Overseas Development Institute (ODI) in 2013 is obtained from GRAIN (2013) and CIFOR's Bioenergy Information Tool (2011) and reflects only reported deals related to biofuels. It is important to note the large proportion of land in these countries dedicated to biofuels alone, in comparison to overall reported land deals.

Table 2.2. Comparative list of reported hectares (ha) of land acquired across targeted countries [Source: amended from sources listed]

Source	DRC	Ethiopia	Mozambique	Sudan	Tanzania	Zambia
World Bank, 2010		1 190 000	2 670 000	3 965 000		
Schoneveld, 2011	292 500	2 029 170	1 609 740		7 534 200	1 861 860
CIFOR Global Bioenergy Information Tool (up to 2011)*		173 990	590 162		225 122	676 483
Land Matrix, 2012	2 800 000	3 200 000	1 000 000	1 500 000	2 000 000	250 000
Provost, 2012			1 983 127			2 273 413
GRAIN, 2013*		710 715	469 332		652 835	273 715

Key	
	2004-2009 data
	Amended from Schoneveld, 2011 - in hectares calculated by the author as a percentage of total available land – may not be exact
	according to reliable data only – may not be exact
	sourced from Land Matrix data
*	Biofuel related deals only. Sourced from ODI, 2013

The differences between land acquisitions in these countries, as per **Table 2.2**, may relate to the difference in years when data was collected, the reliability of the data, or whether the land is allocated to biofuels or land acquisitions in general. According to Schoneveld (2011), 188 of the 329 projects in SSA that detailed their objectives acquired land with the aim ultimately to produce biofuel feedstocks. The land area acquired (11 220 334 ha) for these projects accounts for 63% of the total land involved in acquisitions in SSA, a figure that closely matches that of Anseeuw et al (2011a). While some of these projects target both the food and biofuel industries, 158 of the 188 projects – with a combined land area of 7 647 859 ha – have the sole goal of servicing the biofuels sector. Of these, 89 projects across 5 376 075 ha are focused on cultivating Jatropha only – accounting for 48% of all land acquired in biofuel-related land deals.

Thus, nearly two-thirds of the total land area involved in land acquisitions across sub-Saharan Africa is dedicated to biofuel plantations and related projects (Schoneveld, 2011).

2.4.2 Identifying land in SSA for biofuels

The World Bank reported in 2010 that there was approximately 445 million ha (Mha) of unused, non-forested, non-protected land available for cultivation, of which almost half (201 Mha) is in SSA (Deiniger & Byerlee, 2010). Such figures indicate huge potential for agricultural investments in SSA, such as those for biofuels production. Much of the way in which the data that has been gathered on land use makes use of statistical databases and satellite imagery (Cotula, 2011b). In the literature, estimates on land requirements necessary to meet biofuels blending targets vary significantly. Campbell and Doswald (2009) suggest that the wide variance in estimates imply a possible deficit between land requirements necessary to meet biofuel production projections and the actual availability of land.

This may be because satellite imagery does not accurately identify land used for shifting cultivation, pastoralism, hunting, gathering and other small-scale activities. Some forms of land identification and zoning are performed at a scale that does not take into consideration smallholder activities and customary land. For example, in Niassa province, Mozambique, agro-industrial zoning took place through mapping at a scale of 1:1 000 000 (Nhantumbo & Salomão, 2010) – a scale that precludes even the identification of communities or communal lands (German, et al., 2011c). Such a top-down approach of identifying unused or marginal land might be inaccurate and cause land under community tenure to be classified as ‘idle’ – and encourage investment despite the manifold functions this land may perform for local people (Levidow & Paul, 2010; Burgess, 2012).

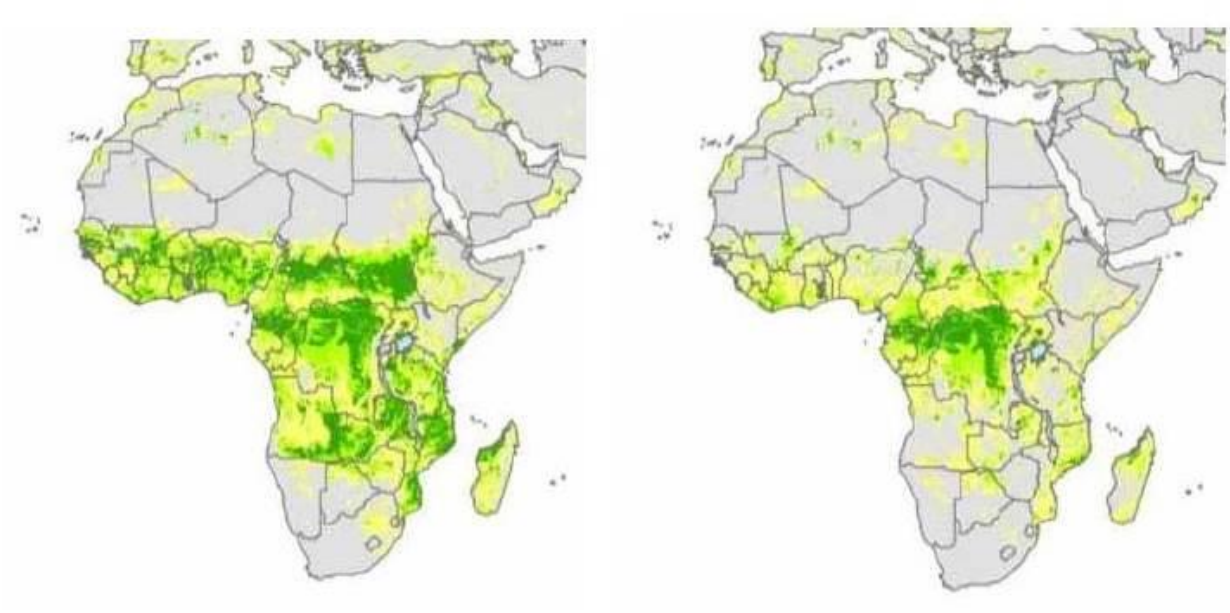


Figure 2.6 Oil crop suitability under rainfed conditions in SSA (left), and sugar-based crop suitability under rainfed conditions in SSA (right) [Source: von Maltitz, 2013]

Maps such as **Figure 2.6** show the vast crop suitability of both oil and sugar based crops under rainfed conditions in sub-Saharan Africa – further emphasizing the attractiveness of growing biofuels in this region. However, such maps do not automatically translate into justification for large-scale investments into either oil or sugar-based biofuel crops, particularly where the land may be in use for other means.

2.4.3 The importance of land tenure in SSA

In Africa, only 2–10% of land is held under official tenure (Deininger, 2003; Cotula, 2011a), meaning that the majority of land is vested in the state. Such distribution of formal title gives governments the authority to allocate land as they see fit. This creates particular implications for any project that utilises or targets land in Africa deemed as a prospective economic investment by governments - land is an obvious and central component of any form of agricultural investment (Amigun, et al., 2011). If the demand for biofuels continues as predicted, particularly at the magnitude necessary to meet biofuel blending mandates in industrialised countries, there will be substantial repercussions for land use and availability (Timilsina & Shrestha, 2011).

Indeed, legal security is offered on the basis of 'visible productive use' of land. Many forms of land use, such as pastoralism, hunting and smallholder crop rotation, might not obviously qualify under this requirement in spite of the significance to local livelihoods, tradition and resource management (Cotula, 2011a). Other ways in which land might be of value to landholders is in

religious importance, such as sacred or burial sites, or land reserves being held for future generations (Cotula, 2012).

Because land is a central issue to biofuels development in SSA, land tenure plays a large role in determining the type of farming scheme employed, the security of landowners in terms of land and how investors acquire land for biofuel production. Much of SSA's land is under customary tenure predominantly farmed by small-scale or subsistence farmers, who contribute the majority to the agricultural sector (von Maltitz & Setzkom, 2013). While customary rights to land are arguably relatively secure and legally recognised in most SSA countries, when pressures heighten competition for land resources the failure to formalise such claims can undermine security of tenure (German, et al., 2011a). With poor regulatory mechanisms and the inadequate land tenure afforded to rural populations, commercial interests in biofuels development could increase the pressure on communal land, pushing rural dwellers off their land (Jumbe, et al., 2009). Some findings claim that investors take advantage of the weak system at the expense of economically vulnerable communities (Habib-Mintz, 2010; Amigun, et al., 2011).

A related issue is that much of the land allocated to biofuel projects is not unused or idle (von Maltitz & Setzkom, 2013), in spite of the drive to convert marginal or degraded land to energy crops. Indeed findings by the Land Matrix (Anseeuw, et al., 2012b) were that the third largest land targets (28% of land deals and 17% of targeted surface area) are represented by shrub- and grassland. While such ground could arguably be brought into production to contribute towards economic benefit, it is commonly used as grazing areas or corridors for pastoralists, or occurs naturally in areas of high biodiversity – making it irreplaceable in terms of socio-environmental value. This evidence indicates that such land acquisitions correspond to significant trade-offs with ecosystem and environmental services, such as timber, food, biodiversity and CO_2 sequestration, which may have severe ramifications for local populations who may rely on or manage these services for their livelihoods (Anseeuw et al., 2012b). Whether such land is used as a communal resource or for informal, low productivity activities for livelihood purposes, biofuel investment can potentially cause a reduction of access to common property resources such as forests, pastoralist routes or water through private control - either directly or indirectly resulting in the removal of both the current land use and users (Burgess, 2012; von Maltitz & Setzkom, 2013). The reduced access to land for livelihood enhancing activities can have serious consequences for rural populations, and particular implications for food security.

Food security is a primary issue in the implementation of new agricultural sectors, such as that of agro-fuels. This is because biofuel projects are recognised as competing with food crops for land, labour, capital inputs and entrepreneurial skills (Mangoyana, 2009), and may result in a trade-off between land used for food production versus that required for growing a biofuel cash crop (von Maltitz & Setzkom, 2013). In many cases investors rely on local farmers and labourers to grow energy crops in exchange for cash, which can result in a diversion from household subsistence food production to agro-crops (Burgess, 2012) as an attractive form of income generation.

Moreover, many recent studies on biofuels have advocated the planting of biofuel crops such as Jatropha on marginal lands – suggesting that this could achieve carbon savings (Timilsina & Shrestha, 2011), reclaim degraded land and improve soil quality (Wood, 2005; Lal, 2006), prevent erosion (Lal, 2006; Kumar & Sharma, 2008; van Eijck & Romijn, 2008) and reduce biodiversity impacts (Fargione, et al., 2008).

However, the classification of certain land as 'idle' or 'marginal' can have unforeseen repercussions. Firstly, it may result in the commodification of lands held under community tenure, used as a common resource for local people (Burgess, 2012), as the state may see fit to reallocate this land for investment purposes. Secondly, in many SSA countries it has been found that marginal lands are often apportioned to women to grow traditional crops for household or medicinal use, and thus the conversion of marginal lands to energy crops may threaten women's agricultural activities and ability to provide for the home (Amigun, et al., 2011). Finally, the understanding of 'degraded' land can be mistaken to imply 'low carbon' land, justifying the conversion of natural habitats to monoculture crops with severe implications for biodiversity (Campbell & Doswald, 2009).

Further, it is important to note that degraded lands are 'ill-suited for agriculture by definition' (Timilsina & Shrestha, 2011) and 'economically inferior' to fertile, high quality agricultural land (Campbell & Doswald, 2009). This implies that it is unlikely that such marginal land will be seen as viable, attractive land for agro-fuels by investors, who generally wish to produce high yields for maximum profit.

Indeed, according to information from the Land Matrix (Anseeuw, et al., 2012b), of the 246 global land deals that include specific information on detail, 43% involve cropland and comprise 22% of reported land acquisition surface area. This not only implies that irrigated areas are being targeted, but further analysis revealed that different cropping mosaics (across global land datasets), which usually indicate smallholder or peasant farming, are the most affected. Such local-level, or micro, analysis of land deals indicates that almost half of all land deals target areas with continual cropping and smallholder farming activities – challenging the oft-argued case that land deals target 'available', underutilised or marginal land. What is more, 24% of land acquisitions target forestland, representing 31% of total surface. This has further implications for rural populations who are often reliant on ecosystem services and forest products, as well as biodiversity and natural habitats.

Due to the high reliance on subsistence farming in African countries and the interpreted nature of land deals to target cropland and forested areas, as well as the high poverty levels, low national GDP and low global human development indicators of these specific countries, it can be assumed that targeted land deals in these African countries will have repercussions on smallholder farming, ecosystem services and the overall well-being of citizens. It can also be assumed, based on Schoneveld (2011) and Anseeuw, et al.'s (2012b) data that most of the land targeted in these land acquisitions is for biofuel projects. It is important to note that, of these

seven countries, four (Ethiopia, Madagascar, Mozambique and Zambia) are also among the list of countries expected to be the worst affected by climate change (Wheeler, 2011). Several concerns have already been raised in the literature.

Given the fragile socio-economic conditions, and the climatic challenges that the SSA region faces, an in-depth, detailed and cautious approach is necessary for the introduction of bioenergy programmes (Mangoyana, 2009) that may compete with agricultural land needed for food production and income-generating activities.

2.4.4 Implications for livelihoods

Under conditions of climate impacts, the most vulnerable are the impoverished – the landless, isolated and unemployed. They suffer under weak terms of trade, poor infrastructure, lack of access to amenities, electricity, information and education, and the possibility of armed conflict afflicts them, and disables them to cope effectively with the consequences of climate change (UNFCCC, 2001).

Using data from the World Bank and other sources, it is possible using an interactive modelling program (Gapminder) to depict the HDI and income per capita in 2011 for the seven African countries that account for the majority of land deals in Africa, as portrayed in **Figure 2.7**.

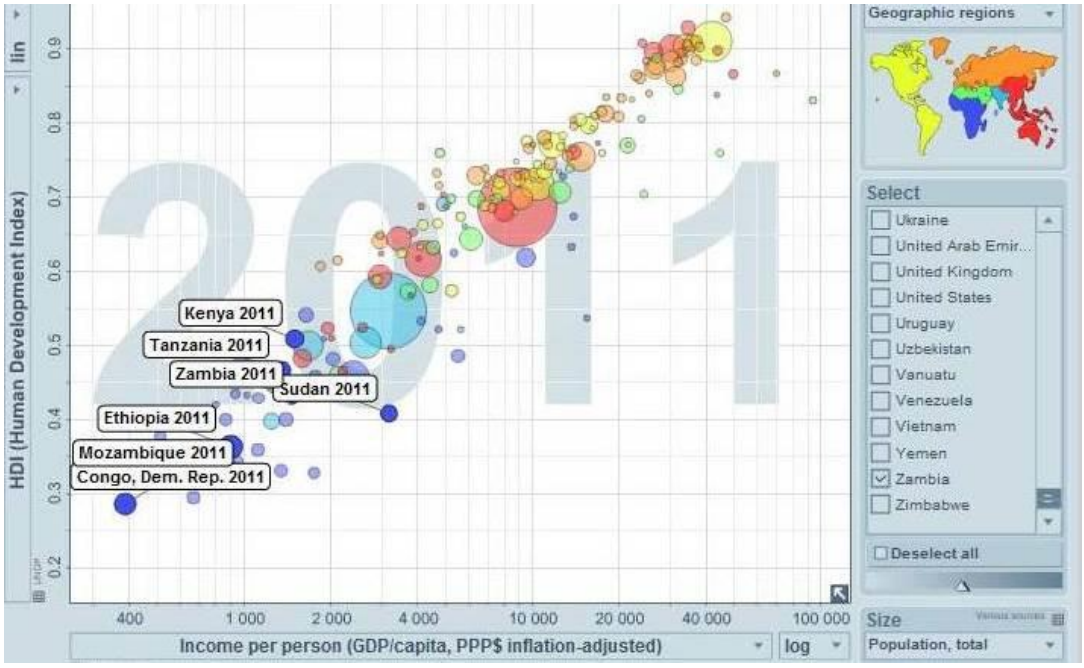


Figure 2.7: HDI and income per capita measurement for most targeted African countries in terms of land acquisitions [Source: author's own, using Gapminder data]

Here it is easy to see by their positions on the graph that these seven sub-Saharan countries all have low human development indices, as well as low national levels of average income per capita (inflation-adjusted for purchasing power parity in US dollars). In comparison to other countries, as well as geographic regions, these African countries have amongst the lowest HDI levels relative to income per capita. It can be understood that the domestic governments of these countries are interested in FDI flows that support government objectives for rural (and economic) development.

While some projects may focus on satisfying local energy needs (von Maltitz & Setzkom, 2013), and thus be more altruistic in nature, large-scale biofuels projects create business opportunities for the private sector, specifically for domestic and international export markets, and are thus driven by a profit motive (Jumbe & Mkondiwa, 2013). Often, the large-scale biofuel plantations have the sole purpose of growing and processing biofuel feedstock and are based on a monoculture plantation farming structure, where the farmer views the biofuel as a cash crop (von Maltitz & Setzkom, 2013). Even where plantations may be linked to outgrower schemes, and thus incorporate small-scale rural farmers, profiteering objectives by investors seem to outweigh poverty reduction goals (Burgess, 2012).

One of the greatest assurances of biofuels development is that of high levels of employment. Industry stakeholders claim that the creation of nurseries, planting and preservation of crops, and the harvesting and processing of feedstock will generate employment opportunities for local people (Wood, 2005), with research corroborating the promises of hundreds and thousands of potential jobs by biofuel projects investigated (Habib-Mintz, 2010; Nhantumbo & Salomão, 2010; Schut, et al., 2010; Norfolk & Hanlon, 2012). According to von Maltitz and Setzkom (2013) activities linked to feedstock production will create the largest number of employment opportunities – in the order of magnitude of two to three times difference.

However, the total employment effect is not always clear, as simply counting the number of workers does not take into indirect effects such as crowding out in other industries, or budget effects where consumers' financial resources for other products are diminished by an increased price and promotion of biofuels (Peters & Thielmann, 2008). Nor do employment levels necessarily guarantee improved or even stable returns to labour – the income gained relative to time and effort spent on labour. Other observations are that although there might be an influx of investment in biofuels initially when market prices are high, investors might leave the industry rapidly should the commodity face a downturn (Habib-Mintz, 2010). In spite of these risks, communities are often open to investment schemes on or near their land, particularly when expectations are created around the development of infrastructure (roads, irrigation, power supply, schools, clinics etc.) and other much-needed amenities.

Sadly, even where compensation has been included in the terms of land deals and contracts have been negotiated, the pace and scale of many land deals does not allow for sufficient time to establish concrete governance principles – and thus monitoring of investor compliance remains

complicated (Meinzen-Dick & Markelova, 2009). Where such consultation is a requirement, the terms of agreement rarely impose binding commitments on the investor (Deiniger & Byerlee, 2010), ensuring an almost inevitable failure on the investors' part to meet community expectations. As well as this, when consultation takes place with local communities it is often the case that the contracts are negotiated under a limited time period and unequal negotiating power (Cotula, 2011). Negotiations usually take place between a local government administrator and the investment company (FIAN, 2010; German, et al., 2011c) where the national and local administrators typically act as the mediators of land deals with outside parties. In his work on contracts, Cotula (2011b) found that the deals can include associated 'kick-backs' for the arbitrator's involvement. Such benefits promote the interests of a few at the expense of many and, in addition to their already insecure position in terms of land rights, there is typically no legal specification to achieve free, prior and informed consent of local land users on the negotiated deals before land acquisitions take place (Cotula, 2011b). Combined with inadequate land governance systems, the result is often the political marginalisation of rural smallholders whose interests are not protected nor even recognised (Anseeuw, et al., 2012a). This may be particularly the case for vulnerable groups of people, such as women or pastoralists.

It is estimated that women produce 80% of subsistence food for families and households in southern Africa, but hold only1% of the total land in terms of formal legal rights (Matavel, et al., 2011). Owing to their situation, women are often sidelined in decision-making processes, even though they are often the caretakers and heads of households. Likewise, hunters, gatherers and pastoralists face similar challenges in the transfer of land. Their nomadic existence translates into very little recognition of their land use and dependency, and they are often excluded from decision-making processes due to the impermanence of their residency in a particular area. Where transhumance passages are obstructed, or areas of natural vegetation cleared for large agriculture projects, these groups of people lose access to resources that are a critical aspect of their traditional livelihoods and ability to survive (Odhiambo, 2011).A related problem is that of restricted access, where the investment entity actually takes control of natural resources available to local human and animal populations. Ecosystem services can be defined as 'the benefits people derive from ecosystems' (MAWEB, 2005). These benefits include provisioning services (e.g. food, raw materials, products), regulating services (e.g. carbon sequestration and storage, air quality), habitat supporting services (e.g. habitat provision for species), or cultural services (e.g. tourism, spiritual sense of place) (TEEB, 2014). For the purposes of this research, ecosystem services will refer to the direct benefits that forests and forests products provide, as natural assets, to local livelihoods.

Further, a related issue is that the private sector has been reluctant to invest in rural areas, due to these areas often being far from roads or basic infrastructure and the risk thus inherent in recovering profits (Martin, et al., 2009). For example, in their 2010 study, Schut et al. discovered that biofuel developments in Mozambique were implemented in areas near roads and ports, where skilled labour was available, and access to processing and storage facilities decreased

costs of transport and distribution. While the number of jobs proposed were lower than that expected in the National Biofuels Policy Strategy (NBPS), these projects did still contribute to socio-economic development in the areas in which they were based (Schut,et al., 2010).

However, whether and how biofuels projects contribute significantly enough to justify rural development and poverty reduction goals as drivers of the sector is yet to be seen. Poverty alleviation is crucial for economic growth and, if governed well, the biofuels sector can contribute towards enhancing rural livelihoods through increasing income earning potential, employment opportunities and welfare improvements. Other factors that require discussion include the process of biofuel projects implementation and the consequent participation in contracts and decision making by local communities, and whether the general improvement of socio-economic welfare is measurable, particularly in relation to the importance of land and the agriculture sector to local livelihoods.

2.4.5 The case of Zambia

2.4.5.1 Geography and Environment

Zambia occupies a nearly central position on the African continent, and is located near the tropics. It is a landlocked country, surrounded by eight neighbours (Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe). The equatorial climate is tempered by Zambia's high altitude - most of the western and central regions of the country are situated on the great plateau that runs through central Africa. Hotter weather is experienced in the valley regions of the country, and the favourable weather allows for a range of crops to be grown. The most predominant vegetation category of Zambia is the savanna woodlands, or 'Miombo' forests, that cover 64% of the country (Diaz-Chaves, et al., 2010). This translates into approximately 50 million hectares or forest (UN-REDD+, 2014). Grasslands cover approximately 27% of the country's surface, ranging from drier grasses in the South, to those associated with wetland areas, and open plains along the higher escarpments (Diaz-Chavez, et al., 2010). Deforestation in Zambia is occurring at an alarming rate of between 250,000 and 300,000 ha a year (UN REDD+, 2014), and alongside overgrazing, has contributed to acute soil degradation and poor soil fertility (Diaz-Chavez, et al., 2010).

2.4.5.2 Agricultural context

Although only 1.5 million ha of the land in Zambia is under production, agriculture contributes significantly to GDP at 20% (ZDA, 2011). Some estimates are that only 7% of arable land is being used productively (Sinkala, 2011), translating into even greater potential towards GDP contribution. In 2005, poverty in Zambia was estimated at 70% (Ministry of Finance & National Planning, FBD, 2005), while more recent estimates are that, of this, 67% are rural poor (UNDP Zambia, 2011). The majority of these rural households are involved in smallholder agriculture,

with high estimates of between 85% (Siegel & Alwang, 2005), 90% (Aregheore, 2009) and 97% (Mucavele, 2009). This means that for the majority of rural people, livelihoods and incomes depend on small-scale farming. The Northern Province of Zambia is reliant on cassava as the staple crop, while in the Central, Lusaka, Southern and Eastern ('the maize basket') provinces, maize and livestock production is more widespread (Aregheore, 2009). Smallholders are responsible for producing approximately 60% of maize, 90% of sorghum, 85% of groundnuts and almost all the cassava for national consumption, while cash crops such as tobacco, cotton and paprika are also grown (Siegel & Alwang, 2005). Thus, not only are livelihoods directly bound to land and land use for a large proportion of the population, but the country's economic performance is closely linked to the agriculture sector, and as such, is crucially dependent on climate and weather conditions (Chapman & Walmsley, 2003). It is important to note that 65% of the rural population is female (SIDA, 2004), however, only 19% of smallholder farms are female-headed (Rep. of Zambia, GIDD, 2005). In spite of female-headed households being in the minority, SIDA (2004) estimates are that women are responsible for 95% of the country's millet and cotton, 85% of sorghum, 75% of groundnuts, 65% of maize and 55% of sunflower crops, as well as a substantial proportion of cash crops. Therefore, the importance of women's role in agriculture cannot be understated.

According to the FAO (2005), farming in Zambia is classified according to four categories:

- Smallholders or subsistence farmers – who make up the largest proportion of the agricultural sector of Zambia as producers of staple crops on farms ranging in size from 0.5 to 9 ha, and contribute 51% of agricultural GDP. Generally, smallholders lack mechanization or formal organisation.
- Emergent farmers – make up 20% of the agricultural sector, and produce food and cash crops on farms that range between 9 and 20 ha.
- Medium-scale – approximately 4% of farmers in Zambia produce food and cash crops on farms that range from 20 to 60 ha. Together, emergent and medium-scale farmers supply 25% of GDP attributable to agriculture
- Large-scale – large-scale farmers comprise less than 1% (fewer than 800 individuals or companies) of Zambia's farmers. These farmers are classed as commercial, produce cash crops on farms greater than 60 ha, are characterized by high mechanization, and are well organized, facilitating input and extension flows (Diaz-Chavez, et al., 2010).

Zambia has suffered from persistent food insecurity for a number of years, unrelated to the availability of land and water. Nutrition is a serious concern, and 44% of the population is considered undernourished (FAO BEFS, 2013). Forest products and a high reliance on ecosystem services ameliorate rural livelihoods, and edible caterpillars (*ifishimu*) harvested from the Miombo woodlands specifically play an important role in rural diets and income generation (Diaz-Chavez, et al., 2010). The 2002-2004 PSRP of Zambia was prepared in order to support

government strategies for growth and diversification in agricultural production, improve the delivery of services, and implement relevant policies related to gender, health and the environment (FAO BEFS, 2013) – important considerations to improve the sustainability of livelihoods and increase the levels of domestic food security. Similarly, the biofuels industry was introduced as a means to uphold this agricultural strategy.

3 Methodology

Chapter Three provides an overview of the methodology undertaken for this study in order to gauge the impacts of land acquisitions for biofuels on the sustainability of local livelihoods in Zambia.

3.1 Desktop study

This research is based on a 'rapid' method of conducting livelihoods analysis, using secondary data through a desktop study, review of case studies and information garnered from key informant interviews (DfID, 2000a). The research findings are based on case studies uncovered and investigated in the literature review.

Zambia was chosen as a basis for this research not only for its highly targeted land mass for biofuel projects, but is also expected to be one of the countries' worst affected by climate change impacts. It is furthermore an interesting country to use as a case study due to government involvement in the set-up of the biofuels industry. Zambia suffers from high levels of poverty, unemployment and poor energy access, low HDI, a large constituent of GDP attributable to the rural economy; food security remains a concern, and the government is challenged by developmental priorities. Thus, this research aims to contribute towards the literature on specific impacts of the biofuels industry on local livelihoods in developing countries that may face some or all of the same developmental challenges.

While case studies examine varied aspects of biofuels-based projects specific to Zambia, this research attempts to bring together all generalised socio-economic aspects of the case studies in order to relate impacts to the explicit effect of biofuel projects on local livelihoods in Zambia through the lens of the SL theory. While additional studies have been published since the completion of the literature review and subsequent revisions, this paper includes assessments that were available at that time.

Literature that encompassed both the use of the SL approach, or aspects thereof, and those that related specifically to biofuels was carefully sought out. For example, Upham et al's 2012 study used the theory of sustainable livelihoods to investigate 'Sustainable livelihoods and cultivation of *Jatropha curcas* for biodiesel in India'. Their study was based on site visits and key informant interviews. Vista et al (2012) studied the impact of agrarian reform on livelihood in the Phillipines. They used a case study, site visits and interviews with farmers in order to determine the impacts felt by the beneficiaries of agrarian reform. Ladefoged, et al. (2009) studied the possible impacts of Jatropha cultivation through the Sustainable Livelihoods approach, applying the theory to the specific production and utilisation of Jatropha as a biofuel feedstock. The

research used the case study of Marli Investments in Zambia, as well as the case of MFC Nyetaa in Garalo Bagani Yelen, Mali as a supporting example.

The main objective of this investigation was to assess the impacts of land acquisition for the biofuels industry in the context of sustainable livelihoods in Zambia. In view of this, the sustainable livelihoods theoretical framework was found to be appropriate.

Further information was gathered from industry stakeholders in June and July 2012, as well as from an extensive literature review. An overview of the policies that surround such land deals in Zambia is followed by a presentation of case studies from other research papers which analyse specific aspects of livelihood impacts from the burgeoning biofuels industry. Findings considering the economic, social and environmental impacts as guided by the SL approach follow. The case studies are supplemented with direct information from civil society groups, academics, environmentalists and, where possible, government authorities and other relevant stakeholders involved in the biofuels sector in Zambia.

3.2 Data collection

The detailed case studies were supplemented by qualitative data gathering in Zambia in July 2012. The data collection constituted of visits to locations where key informants were based in Lusaka, Zambia. This was done with the objective of acquiring current, localised knowledge on the development of the biofuels industry in the country as well as the context from relevant industry stakeholders. The key informants chosen were from a diverse background and were selected based on their involvement in the biofuels industry and their views relating to livelihood issues. Semi-structured interviews were conducted with nine industry stakeholders in Lusaka (Zambia).The analysis of information gathered is based on policies, case studies and impacts of biofuel projects that were known and understood by the respective industry stakeholders in the relevant country. The collected data was meant to provide insights on economic, social and environmental impacts, and add to insights on impacts presented under the case studies by D1 Oils Plc, German, Schoneveld, Nutakor (2011a), German, Schoneveld, Gumbo (2011b) and Milimo, et al. (2011).

The sectors included were:

- NGOs/Civil society – civil society groups and NGOs were contacted in order to gain an understanding of the reported impacts of the biofuels industry felt by local communities on their livelihoods
- Government – government officials were approached in order to obtain general insight on policies and the status of pilot biofuels projects in the relevant area

- Research institutions – academic and technical advisors were interviewed in order to gauge the updated outcomes of biofuel projects at a grassroots levels and to evaluate the sector according to expert and academic opinion.

Private sector information was sought out where possible in order to supplement the information provided by the sectors. While some case studies presented by respondents may have ceased operations prior or subsequent to the research process, acknowledgement is made of the impacts as land rarely reverts back to its original ownership status and therefore has implications for the sustainability of affected livelihoods

A semi-structured questionnaire was prepared in order to conduct the in-depth interviews (Appendix A); however, the data-gathering process was led by the respondent, with the researcher asking probing questions in line with the questionnaire in order to guide the information captured. These questions were often aligned to the scope of the respondent's work and knowledge of the industry, such that answers given provided crucial insights that might not have been possible were the questionnaire strictly followed.

4 Research findings and discussion

The aim of this study was to assess the impacts land acquisition for the development of the biofuels industry in Zambia. Consequently, it is necessary to know about sustainable livelihoods, drivers of the biofuels market and importance of biofuels. The relevant work on these aspects was reviewed in Chapter 2. The methodology used to achieve the objectives of this study has been reported in Chapter 3. Research findings and a detailed discussion of these findings is presented in this chapter. The chapter begins with an analysis of the policy context of Zambia in order to understand the relevant legislative background for the biofuels development in the country. This is followed by a presentation of relevant case studies, and the findings thereof in terms of economic, social and environmental impacts. What follows are the findings from in-depth interviews with industry stakeholders in Zambia according to the SL framework.

4.1 Policy analysis: Zambia

4.1.1 Macroeconomic and Land policy analysis

Zambia is recognised as one of the African economies most open to foreign equity ownership, through its 2004 Private Sector Development Reform Programme (PSDRP) and long-term development visions articulated in the Sixth National Development Plan (SNDP). These reforms aim to improve foreign investment and boost the private sector in the country, and include regulatory changes consistent with a liberalised market environment (OECD/Zambia, 2011). Between 1999 and 2009 Zambia's average rate of growth for GDP was 4.8%, driven primarily by output in the agriculture, mining and construction sectors. However, limits on this growth continue to be imposed by energy bottlenecks, civil service constraints and, critically, rural infrastructure needs (OECD AfDB, 2010).

Through a Presidential directive (2002), the Zambian government identified agriculture as a crucial vehicle to drive economic development and diversify its traditional economic reliance on mining and natural resource extraction, specifically copper (Siegel & Alwang, 2005; Ministry of Finance & National Planning, FBD, 2005). The potential growth of the agricultural sector is seen to be significant due to the country's abundant, underutilised land and water resources and rural labour force (Siegel & Alwang, 2005).

In order to promote Zambia's commercial agricultural potential, the Farm Block Development Programme (FBD) was created along the guiding principles of integrating horizontal and vertical linkages in the sector through geographic positioning of farms. Through voluntary transactions, the government acquired 892 000 ha across the nine provinces, divided into 'blocks' of between 45 000 – 147 750 ha each. These blocks are then partitioned into one 'anchor' estate (of around

10 000 ha), a few 'commercial' estates (2000 – 4000 ha each) and hundreds of 'satellite' farms (20 – 100 ha) (Schoneveld, 2011). The core venture is supposed to focus on export crops in order to enable accelerated growth and market access, while the smaller-scale operations based on outgrower arrangements should focus on food crops (Ministry of Finance & National Planning, FBD, 2005; OECD/Zambia, 2011). The location and size of the designated farm blocks are listed in **Table 4.1**.

Table 4.1: The designated farm blocks, size and location [Source: OECD/Zambia, 2011]

Farm block	Province	District	Size of land (ha)
Nansanga	Central	Serenje	155 000
Musakashi	Copperbelt	Mufulira	100 000
Mwase Mphangwe	Eastern	Lundazi	100 000
Luena	Luapula	Kawambwa	100 000
Muku	Lusaka	Kafue	100 000
Manshya	Northern	Mpika	147 000
Mikelenge/Luma	North- Western	Solwezi	100 000
Simango	Southern	Livingstone	100 000
Kalumwange	Western	Kaoma	100 000
Total area			1 002 000

Past efforts at attempting to develop the agricultural sector in Zambia have failed to attract investment due to a lack of rural infrastructure. The FBDs are envisaged as large areas of agricultural potential or use, for which basic infrastructure and services are provided in order to facilitate commercial production and economies of scale for food and export crops. The objectives of revamping the agricultural sector through farm blocks include, importantly, the improvement of food security and the opening up of rural areas for economic development (Ministry of Finance & National Planning, FBD, 2005). **Figure 4.1** shows the location of the FBDs relative to agro-ecological zones in Zambia.

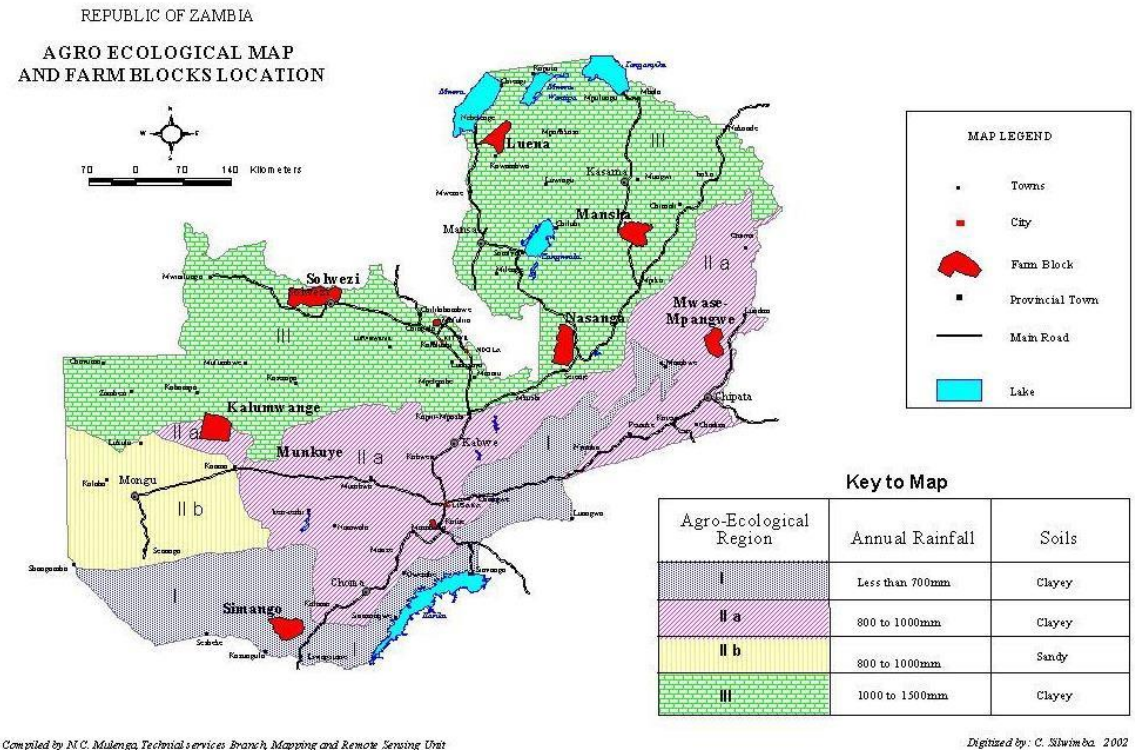


Figure 4.1 Location of farm block developments relative to agro-ecological zones in Zambia [Source: Zambia, Ministry of Finance and Planning, FBD, 2005]

In Zambia, land is held by the state and local people access the land through a customary tenure system governed by traditional rulers (Aregheore, 2009). Legislation from the colonial era placed limitations on customary land conversion to Crown land – 94% of land was held as Reserves and Trust Land (Diaz-Chavez, et al., 2010). However, the controversial Land Act of 1995 facilitated the permanent conversion of land under community tenure to leasehold land held by the state (German, et al., 2011c) – Reserves and Trust Land was converted to Customary Lands (Diaz-Chavez, et al., 2010). All traditional land is managed by chiefs in areas of cultural, historical or traditional import to their chieftaincy, who allocate land and activities to their constituencies as they see fit. Under this particular form of traditional land ownership, there are no formal land titles and ultimately land is formally 'vested' in the state. The majority of the rural population is reliant on the land they use under this tenure system for subsistence farming and ecosystem services for income and survival.

Figure 4.2 illustrates the large amount of land in Zambia that is classed as 'trustland' – or land held under community tenure.

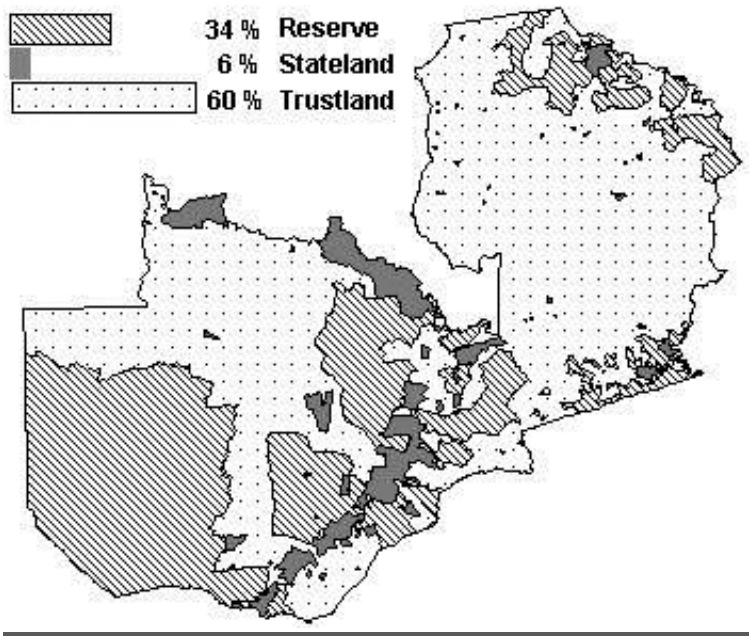


Figure 4.2: Dispersion of different types of land tenure in Zambia [Source: Gumbo, *year unknown*]

In its recent country-specific report (2011), the Organisation for Economic Co-operation and Development (OECD) corroborated the high levels of land held under community tenure in Zambia, putting the figure at 85%. The difference in percentage allocated to community tenure between this number and Gumbo (**Figure 4.2**) can possibly be attributed to land that falls under community tenure within reserve areas, as well as the possibly different time period when mapping took place.

The Land Act essentially encouraged outside investment and enabled non-Zambians to purchase or rent land from the state (German, et al., 2011c). Exact land regulation parameters for Zambia are outlined in Appendix B. Acquisition of land by foreigners and conversion to state land requires negotiation with the traditional chiefs who, while possibly being eager to see development in the area under their rule, are expected to account for the needs of their subjects (OECD/Zambia, 2011). As custodian of the land, the chief of an area would need to be approached and consulted in the process of land allocation for biofuels or other large agricultural projects.

A worrying addition to the Land Act is the fact that Zambia has no foreign exchange controls and international investors are able to repatriate 100% of profit and capital after local balances have been paid (OECD/Zambia, 2011), meaning that there is little incentive for investors to reinvest funds and disperse income for national or local benefit. A related issue preventing small- to medium-scale domestic investment is the high threshold requirement on investment proposals (US$500 000 – US$10 million) of the Zambian Development Agency (ZDA). Beyond the reach of most local enterprises, this prevents joint ventures with international partners and emphasises

the perception that the land investment regime favours foreign investment at the cost of domestic investors (OECD/Zambia, 2011).

While efforts are being made to streamline land investment, there are still severe challenges that investors must face. Zambia remains a signatory to the World Bank's Multilateral Investment Guarantee Agreement and the African Trade Insurance Agency which both protect against political risks in investing. However, high levels of corruption at the authority level as well as the lack of rural infrastructure and provision of basic services hinders investment in rural areas (OECD/Zambia, 2011), while conflict over land with local land users is a deterrent to investors wishing to invest responsibly.

Other issues faced in land investment in Zambia have previously included the fact that most of the land has not been surveyed or mapped, or where such mapping has taken place the records are outdated. Additionally, the Ministry of Lands is based in Lusaka (the capital city), far away from where the deals are taking place, and land records are kept in an antiquated system that makes retrieving the files difficult. Poor record keeping and slow processing of title deeds, as well as limited funding, further hampers the system. However, recent updates to the system, including computerisation, budget allocation for mapping purposes and offices opening in other provinces, have enabled the Ministry of Lands to become more transparent and decentralised in dealings with land investment. Collaboration with local chiefs and the rooting out of corruption, alongside these processing-system improvements, should ultimately ensure the lands registration procedure becomes more efficient. However, issues related to conflict over the actual ownership of land remain (OECD/Zambia, 2011).

4.1.2 Energy policy analysis

Zambia is landlocked and highly dependent on oil imports – as such, the biofuels industry is not only seen as an important tool for attracting foreign investment, but it is also as a solution to domestic energy security (German, et al., 2011b). As has been indicated, the potential for biofuels within SSA in terms of arable land and environmental and climatic suitability is large. Over the past few years, many foreign entities have acquired extensive tracts of land for agribusiness purposes, in particular for oil-seed bearing *Jatropha Curcas* (Jatropha) for the cultivation of biofuel feedstocks (Amigun, et al., 2008; Schut, et al., 2010).

Hailed as a solution to greenhouse gases in the transport sector, rural poverty and food insecurity due to it being a non-food crop, and thus not competing with other edible oil crops such as cassava, Jatropha seems the obvious choice for start-up biofuels markets in developing countries. Based on claims that Jatropha can be planted on marginal land or poor soils and still produce high yields, requires low water use, is resistant to diseases and pests, and is a promising development opportunity, the Zambian government has been promoting investment into this 'wonder crop' (Muleba, 2009; Amisi & Sharife, 2012).

The business model that has been pursued in Zambia for biofuels development is that of smallholder production – through outgrower or contract schemes, or the like (German, et al., 2011b). Such models are seen to be a solution to the problems (outlined previously) associated with the scale of land acquisitions typically seen in SSA (von Braun & Meinzen-Dick, 2009).

Published by the Ministry of Energy and Water Development in 2008, the National Energy Policy of Zambia was a revision of the 1994 National Energy Policy's objectives to promote optimal supply and utilisation of indigenous forms of energy for socio-economic development. The revised Energy Policy is aimed at improving the sector's potential to drive economic growth and reduce poverty, including energy poverty, and considers the cross-cutting issues of energy provision (Nat. Energy Policy, 2008).

According to figures from the Biofuels Association of Zambia, the required biofuels standards are ZSE100 for bioethanol and ZSB100 for biodiesel. Non-mandatory Blending Ratios released by the government in 2011 were 5% for biodiesel (approximately 21 million litres) and 10% for bioethanol for petrol (approximately 18 million litres) (Sinkala, 2011).

The 2008 Energy Policy considers the utilisation of biofuels as a viable option to meet some of Zambia's energy requirements, specifically in order to reduce reliance on imported petroleum and ensure security of supply. Zambia imports all its petroleum, of which the transport industry is the largest consumer (53%), followed by the mining industry (27%) (Zambia, Nat. Energy Policy, 2008).

Nationally, 60.9% of the population relies on firewood for cooking, 24.3% use charcoal and only 13.8% use electricity. In rural Zambia, 87% of households use wood for cooking, 9.5% use charcoal, and only 1.5% have access to electricity (Nat. Energy Policy, 2008) – despite the huge hydropower generation potential of the country. According to the Policy, the diversification of the energy mix to include biofuels will also facilitate the provision of modern energy services to the local population, specifically stating that 'to improve the standard of living there is need to switch from low quality energy sources to better quality energy sources such as electricity, petroleum products, biofuels and biogas which can be used as household fuels' (Zambia, Nat. Energy Policy, 2008).

Interestingly, the policy measures (*Chapter 5.2.2.2*) in the National Energy Policy of Zambia makes mention of the manner in which biofuels will be used as a source of modern energy provision for the population through expansion of biofuels in the transport industry. However, the policy document does not make mention of policy measures used to integrate biofuels into household use or as an alternative fuel source, as stated in the Policy Objectives. Furthermore, the Energy Policy lays out the reasoning for the support of growing of energy crops, including the participation of Zambians in the biofuels industry and support of farmers wishing to grow energy crops, and discusses the policy and legal framework necessary in order to build capacity and support the industry in an environmentally friendly way. However, the legal provisions

mentioned previously include the full repatriation of capital by investors and the high ceilings on investment proposals - essentially preventing small-to-medium scale local enterprises from entering the market.

What follows is an assessment of the impact of land deals for biofuels investment on the ability of local people in Zambia to maintain sustainable livelihoods. Selected in-depth, peer reviewed case studies have been used, particular to Zambia where possible, and where not, parallels have been drawn to case studies from other SSA countries. The case studies are then followed by findings that add depth and breadth to the circumstances surrounding biofuels investment in Zambia, based on key informant interviews conducted in Lusaka, Zambia.

4.2 Case studies

After a brief introduction to the situation and any relevant terms of contract, case studies were examined through the themes of economic, social and environmental impacts.

4.2.1 ZAMBIA - Mungwi/Chinsali, Northern Province (Marli Investments)

In 2011, German, Schoneveld and Gumbo investigated Zambia's largest outgrower scheme for biofuels, Marli Investments Zambia Ltd (Marli), employing an estimated 25 000 contracted farmers to grow Jatropha feedstock. Research consisted of key informant interviews with government agencies, civil society and representatives of Marli in Lusaka, followed by field research in the selected districts, which were chosen based on the existing clusters of Marli outgrowers. The field research consisted of key informant interviews, once again with relevant employees and local government, as well as focus group discussions with local village members associated with the company. The summary that follows is based on the work undertaken by German, Schoneveld and Gumbo in May-June 2011.

A joint venture between South African, Indian and Zambian investors, Marli began operations in 2004 and by 2009 had operations in all nine Zambian provinces. The extensive operations, including seedling distribution, were made possible by 96 field officers and over 180 coordinators. By 2009, Marli had in excess of 12,000 ha in Jatropha plantations and roughly 6,500 ha in seedling stage (Desai, 2009). The high cost of labour, as well as other justifications related to logistics, land and governance issues, is cited as the reasons for Marli's adoption of the outgrower business model for its operations. The seasonal labour needs and inability to mechanise the harvesting of feedstock are considered to be the crucial deterrents for investment in large-scale plantations, in terms of costs. Contracts formed with farmers were incentive-based in return for the exclusive sale of feedstock to Marli, at a price determined by Marli at the time of sale (based on the then-current world price of crude oil), and were for a period of 30 years.

Contracts included an upfront once-off payment term (of USD $60) and a supplementary payment of USD $15 per month until maturity to the outgrower farmers able to plant 5 ha of trees or more. This was subsequently decreased to 1 ha due to the fact that none of the farmers were able to dedicate that amount of land to growing Jatropha. This commitment was, however, not included in signed contracts, in spite of the verbal report made by field officers in translation. The contracts (written in English, which most of the farmers could not read) further stipulated the provision of support and services by Marli, under a loan agreement and to be recovered through crop proceeds. Further, according to contracts, while 5% of profits were specified to be used in community-based projects, confusion surrounding the signing of the contract by farmers and field officers meant Marli was under no legal obligation to fulfill the conditions of the contracts, and remained unsigned from the company's side.

In the field work in two areas (Mungwi and Chinsali), German et al. discovered that unrealistically high expectations had been created around the introduction of the Jatropha scheme, with farmers believing they would be able to produce a diverse range of products (e.g. soap, candles) for sale from the feedstock oil, high access to loans and inputs by becoming an outgrower, as well as a significant income from the sale of seeds and the receipt of annual payments until tree maturity. Importantly, all farmers also expected that Marli would provide a secure and stable market for contracted growers, and protect farmers from price fluctuations – as promised in company material (Desai, 2009). Many of these expectations were based on Marli's own representatives and promotional material, as well as a set of guidelines that declared advantages of production of Jatropha (e.g. limited labour involvement, limited capital investment, easily overcome pests and diseases etc.).

a) Economic

To date, the main benefit received by farmers was that of training and seed supply, as well as limited income from sales. Interestingly, in Chinsali, income from the sale of feedstock was not considered the primary motivation for being involved as an outgrower by farmers. Presumably, secondary benefits (such as access to loans) were considered as attractive incentives as much as income from the sale of Jatropha seeds, if not more.

At the time of publishing (2011), Marli representatives had not been seen on-site in either district since 2008. All payments to field officers had ceased in 2008, and, as a result, field officers had stopped visiting farmers (although it must be noted that field officers continued to work without pay for up to a year after payments ceased). Despite two years' worth of crop yield on some farms, no respondent indicated that Marli had purchased feedstock from contracted growers in this time.

The majority of farmers interviewed (73.3%) specified that Jatropha cultivation was not meeting their expectations – namely due to the lack of a market, the lack of any solid benefits accrued in cultivation, or the poor yields of the trees. Even so, the vast majority of these dissatisfied farmers expected future returns, and had continued to tend their Jatropha crops. Those who claimed their

expectations had been met justified their response based on the expectation of future returns, the fact that they had managed to sell seed, or had seen other farmers selling seed. Overall, 74% of farmers continued to weed their crops, in spite of Marli's disappearance.

A Dutch NGO, SNV, stepped in to support business development skills for those farmers left with a growing Jatropha crop but no market. Farmers are trained in Jatropha production and marketing, and are further assisted by the establishment (by SNV) of local biofuels associations which represent the interests of the smallholders. SNV has further provided local agro-enterprises with value addition skills, specifically for the processing of Jatropha oil into soap, shampoo and other by-products, and has provided linkages to service providers and farmer organizations. One of the most established enterprises, Mulondolwa Jatropha Industry, began producing soap in 2008 in Mungwi. While only a few farmers had sold feedstock to enterprise at the time of research (69 in 2009, 57 in 2010), the association claims the selling price is too high to be sustained, at US$ 0.20 per kilo. However, the enterprise ostensibly has the capacity to purchase all the seed in the district – leading farmers to expand the area for Jatropha cultivation in response to this possibly secure market and expectation of future price increases. The increase in investment and improved management of the crops in Mungwi has resulted in better yields and superior survival rates in comparison to their counterparts in Chinsali (94% and 67% survival rates respectively).

Household interviews signified that 90% of respondents would plant Jatropha in fields, as opposed to the common method of using Jatropha as a hedge or fence. On average, 0.71 ha were dedicated to fields, while 54% of households intercropped Jatropha with food crops such as maize, groundnuts, beans, sweet potato, cassava and soybean. Cassava and Jatropha share common plant disease types, and based on Marli's advice, households initially avoided intercropping the two crops. However, when Marli failed to return, farmers began to practice different intercropping between the plant types. Through intercropping, observed impacts on improved soil fertility had the effect of increasing the yields of groundnuts, while the leaves were incorporated into the soil in prepping for planting.

Early impacts on livelihoods through observable outcomes on food security and returns to labour were measured. Interestingly, the average area of land dedicated to food crops increased following the integration of Jatropha into farming. It is plausible that this is due to the fact that new land was opened up for food crops, while some food crops were intercropped with Jatropha – either in the original area of land used for farming or in the new area. When questioned about the increase in land dedicated to food crops, respondents indicated that this was partly to compensate for food crop displacement by Jatropha, but also because due to independent decisions taken on growing new crops. A decrease in food production was only measured in a small proportion of respondents. Nonetheless, respondents in Mungwi (one third) and Chinsali (one fifth) alike stated that due to a focus on Jatropha, they had less time to tend food crops. This issue was reinforced in responses regarding pressure due to limited labour experienced during harvest.

Some respondents reported an improvement in food crop yields, explained by the fact that higher quality land such as fallow or cleared 'new' land was used to grow displaced food crops, while many households chose to plant Jatropha in degraded land. As stated by the report, "*Although this trend is encouraging news for food security, it may compromise the viability of Jatropha that, under Zambian conditions, seems to require ideal growing conditions to produce reasonable yields*" (German, et al., 2011b).

An important consideration for households investing in Jatropha is that of returns to labour – in terms of time, effort and advantages of investment in the fuel crop. Dedicated time was needed in the upfront cultivation of Jatropha, specifically for watering, land preparation, clearing and planting, but also for the continued maintenance of the crops in weeding, pruning, harvesting and processing. Due to there being an existing market in place for Mungwi farmers, average returns to labour were calculated (at less than US$ 0.06 per day) based on the 2011 average income thus far received for Jatropha feedstock, with the maximum received by any farmer calculated at double this (approximately US$ 0.12 per day). Both low yields (from 0 to 400kg per year) and low market prices are responsible for such poor returns.

In spite of low returns, the perceptions amongst 35% of respondents were that the investment in Jatropha had increased income and ability to purchase basic goods, provided a viable by-product (specifically soap) market, as well as a source of organic fertiliser, and the ongoing yield of a perennial crop associated with future returns.

b) Social

In spite of the hope and expectation of future returns, many farmers are angry with the field officers for their breach of contractual duties – in spite of the field officers repeated efforts to contact Marli. Relations between the two, employed in different capacities by Marli, have broken down. Non-payment by Marli is an issue faced by both groups. Field officers and farmers thus bear the risk and brunt of failed investment in both costs to relations and income earning potentials.

Some gender disparity is seen in the case study of Marli. In Mungwi, where better yields and superior survival rates were experienced due to greater investment in the crops, nearly half of all respondents (39%) claim Jatropha is a 'man's crop' as opposed to only 10% in Chinsali. Interestingly, the viability of Jatropha as a cash crop seems directly related to whether it is perceived as a 'man' or 'woman's' crop.

Importantly, children contributed significantly to the majority of on-farm Jatropha maintenance and management activities required by Marli. Communal labour was engaged, with a case of the employment of an elderly woman and school children also reported. In-kind payment, mostly through food as opposed to cash, was the common method of payment for such employment.

c) Environment

In the Northern Province where the research took place, the agricultural system of '*chitemene*' is practiced by many local farmers. The *chitemene* system makes use of organic matter (branches, leaves etc.) collected from a large 'outfield' area. This matter is then piled on the ground in a smaller 'infield' area and burnt in order to release nutrients through the breakdown of the matter into ash. Seeds are then sown in the burnt area in order to maximise yields. Respondents indicated that Jatropha was more likely to be planted in permanent fields rather that in areas where *chitemene* took place due to the amount of time spent in land preparation.

As a result of the introduction of Jatropha crops into smallholder farming, both direct and indirect land use change (LUC) was observed in the two case study areas. Direct land use change occurred as a result of the integration of Jatropha with food crops, by intercropping or displacement, the conversion of fallow land or the opening of mature forest land for the specific purpose of planting Jatropha. Indirect land use occurred where food crops were displaced, requiring the opening of new crops areas in forest or fallow land. While no respondents in Chinsali spoke of observable environmental impacts from Jatropha expansion, 56% of respondents in Mungwi mentioned observable environmental effects. Deforestation and the decrease in availability of forest products were the observable negative environmental impacts. Based on figures presented in the report, an estimated 438 ha of mature forest and 267 ha of fallow land would be cleared for every 1 000 ha of Jatropha planted in the two case study areas.

Interestingly, while there is no major push for farming in the Northern Province due to a high-reliance on forest products, like caterpillars, mushrooms, fruits, charcoal etc, only 21% of those who had cleared mature forest or fallow land for Jatropha indicated they had been collecting forest products from the area. The reported change in availability of these products was minimal, likely due to the area of remaining forest considered to be significant. Importantly, information based on respondent's recall is that 44% of Jatropha expansion occurs at the expense of Miombo woodlands, while 27% occurs at the expense of fallow land.

4.2.2 ZAMBIA - Macha mission land, Choma (Brethren of Christ Church)

In 2011, John Milimo (Team Leader, Zambian Open University), Henry Machina (Executive Director, Zambia Land Alliance), et al., alongside the International Land Coalition (ILC) and CIRAD investigated the impacts of land commercialization by the Macha mission in Choma district, Zambia. The research incorporated literature, but was reliant on key informant interviews, focus group discussions, and direct observations in the field over three days. This synopsis is based on the work Milimo et al. conducted.

Founded by the Brethren of Christ (BIC) Church in 1906, the Macha Mission was granted land title deeds to 3,003 ha of land by the then British colonial authority. By 2009, a large market and four villages had been established around the Mission's hub – comprising a church, a hospital,

two schools and homes for its employees. In total, 222 families – mostly farmers growing crops (maize, beans and groundnuts) and rearing livestock - were living on Mission land. In 2005 the Church made the decision to put its land to productive use for developmental purposes, which included the introduction of foreign investment in the form of a Jatropha project. In total, 200 ha of land were leased to a private entity, PrivaServe, for a period of 35 years, and commercialization of the area begun. An airstrip, internet café, radio station, restaurant, guesthouse and a private school were built, with the positive benefit of the provision of employment to approximately 113 local people. A number of services previously not available were introduced, and infrastructure was improved as a result of the commercialization. The radio was especially appreciated by local people. However, the development of the land meant that the families based on Church land were seen as 'squatters' and evicted at the start of the 2009/2010 farming season, as per the Lands Act (1995) that gives the title deed holder the right to evict illegal land settlers. None of those evicted possessed title deeds to the land they occupied, and thus the landowner (BIC in this case) was not obliged to compensate any illegal inhabitant of land. Some families lost their homes or the land they used for subsistence and to graze their livestock, while many lost both their home and land used for livelihood purposes. Furthermore, the evicted families were unable to harvest their crops for the season.

Many of the villagers were unaware that the land they occupied belonged to the Mission, as most were given permission to settle there by the local chiefs. The affected households formed a committee and raised money to hire a lawyer to contest the eviction in the High Court. A representative from the committee was selected, and given the monies raised to travel to Lusaka to represent the affected households in the High Court. On his way, the representative met with the local chief, who informed him that he was going to Lusaka to see to the matter himself with the (then) President of Zambia. The representative abandoned his trip, giving over the money to the chief, and returned home. The President advised the chief to allow the families that had proof of receiving land from the Church to stay on the land until the matter was resolved. However, the chief did not attend the meeting on the matter in the High Court, and the Court ruled in favour of the mission and PrivaServe. The ruling meant that the 222 affected households were to move from the land, and police reinforcements were put on stand-by to forcibly evict them if need be. In spite of the contestation, most of the families left peacefully and moved to nearby villages outside the area of dispute where they were granted land in new areas by village elders. The eviction ultimately included people who had been given land from the Church itself (and had it in writing), as well as households who lived outside the mission land, but used the land for farming activities.

a) Economic

In spite of the provision of employment to 113 people and the services introduced, there were severe negative impacts felt by the families evicted that threatened their livelihoods. An investigation into the Macha mission by Milimo, et al. (2011) found that the loss of land was the largest negative impact felt by the evicted families. Much of the new land granted to these

families was smaller, resulting in smaller crop yields and the inability of the farmers to keep all their livestock. Many households also traded produce from their homes and owned part-time grocery stores. The loss of land and homes had a direct impact on these small businesses and the ability for these households to generate income.

From interviews with key individuals, a comparison of crops and yield (**Table 4.2**) was drawn up in order to compare the farm sizes, quantities of crops, and livestock before and after their loss of homesteads and/or land for a proportion of respondents.

Table 4.2 Farm sizes and quantities of crops grown before and after land commercialization [Sample from Milimo, et al., 2011]

	Before		**After**	
Interviewee	Size of land	Quantity of crops	Size of land	Quantity of crops
1	6 ha	230 x 90kg bags of maize	2ha (moved to non-Mission land)	6 x 90kg bags of maize
2	4ha	80 x 90kg bags of maize	No land	None
3	Not indicated	30 x 90kg bags of maize	No land	None
4	Not indicated	200 x 90kg bags of maize 10 x 90kg bags of groundnuts 10 bales of cotton Lots of vegetables	No land	None
5	Not indicated	20 x 90kg bags of maize	No land	None
6	4ha	80 x 90kg bags of maize	No land	None
7	Not indicated	24 x 90kg bags of maize	No land	None
8	Not indicated	300 bags of maize 24 bags of groundnuts 16-24 bags of cotton	Not indicated (moved to non-Mission land)	24 bags of maize 18 bags of groundnuts

In all cases, the impact on the evictees was a decrease in crop production and yield due to the loss of land for farming. These households now need to buy the food they were previously able

to produce themselves. Food insecurity increased, and many respondents reported that hunger was now a condition they had become familiar with. Further, as the majority of homes owned significant numbers of livestock, information was collected on the numbers of livestock held before and after the loss of land **(Table 4.3**).

Table 4.3 Number and type of livestock owned before and after land commercialization [Sample from Milimo, et al., 2011]

Interviewee	Before	After
A	15 cattle 38 goats 30 chickens	6 cattle 20 goats, in three different locations
B	16 goats 8 pigs	None
C	48 goats	8 goats
D	6 cattle 8 goats 8 pigs	4 cattle, in four different locations
E	300 chickens 30 cattle 20 goats 4 turkeys 10 ducks	60 chickens 11 goats 3 turkeys
F	4 cattle 18 goats 100 chickens 8 pigs	6 goats 4 chickens 1 pig
G	96 chickens 21 goats 4 pigs	All livestock was sold due to unavailability of grazing land
H	15 cattle 16 goats 8 pigs	6 cattle

In all cases, the ownership of livestock has decreased. Even those interviewees who owned a sufficiency of livestock, and thus might have had more of a 'buffer' against eviction, have had to sell their animals or disperse the animals with relatives or friends due to a lack of land availability – mostly due to it being rededicated to the Jatropha crop.

b) Social

Through its commercialization efforts, the BIC lost popularity and local people suspected an ulterior motive behind the development by the investor. Residents blame the BIC for their dilemma.

Social conflicts were found to have arisen between community members, as local people and their livestock compete for limited grazing land. Tension was also found to have arisen between friends and relatives, as the animals relocated suffered from poor health and in some cases, died, leading the resettled farmers to question why their friends and relatives animals did not. Livestock farmers have also suffered a reduced social status, as status is directly dependent on the number of animals owned.

The Jatropha field was seen by respondents to be responsible for the majority of evictions. Not only this, but the field restricted community members access. Paths and roads that were previously used by local people on the land now occupied by the Jatropha field have been closed, resulting in longer journeys for those wishing to use the services provided by the Mission (e.g. hospital, schools).

c) Environment

Where livestock was given over to friends or relatives due to a lack of space needed for grazing, overgrazing of communal areas in areas of resettlement has occurred. Respondents indicated that they saw no value in the Jatropha field - the research uncovered that the Jatropha field which displaced the original land tenants appeared to be untended and weeds were rife. As well as this, the Jatropha feedstock had not been harvested at the time of research due to the long-lead time required for harvesting. Under these circumstances, it is unsurprising that very little value has been derived from the investment into Jatropha in Macha.

In support of these findings, one respondent said:

"My family and I left the house and we are now living in another village where we do not have a single field on which to grow crops…I used to keep 15 head of cattle but now I have only six. We had 16 goats but now we have none at all. We had eight pigs; now we have none. We used to produce about two hundred 50kg bags of maize per year, but now we produce nothing. We used also to produce about ten to fifteen 50kg bags of groundnuts, nineteen 90kg bags of cotton, and one or two bags of beans. Now we have to buy all these commodities. We do not have enough land to graze our animals. The land was very fertile. Now it is being used to grow Jatropha." (Milimo et al. 2011)

In essence, the benefits of the land commercialization project are drastically outweighed by the loss of land for grazing and farming, homes, and income generating economic activities related to sustaining livelihoods.

4.2.3 ZAMBIA – Eastern Province (D1 Oils Plc)

The following case study relates to D1's agro-industrial Jatropha investment in Zambia, which began operations in 2005. The case study is based on a 2011 D1 report by Sally Ross, in her capacity as Outgrower Manager of D1's Zambian operations. The report focuses on the learnings from widespread planting and formal trials with outgrowers, and substantial research and development (R&D) investment into Jatropha by D1. This report has ultimately resulted in significant intellectual property around the breeding and agronomy of this biofuels crop in Zambia, and alongside the reference to such knowledge in other literature (see Desai, 2009; Andreasson and Richard, 2011), justifies the use of it as a relevant case study.

D1 Oils begun operations in Zambia in 2005, with formal trials of Jatropha in Lusaka, and by 2009 had decided to focus all efforts on five training farms and 70 farmer-managed demonstrations in the Eastern Province, based on the strategic plan of 'quality not quantity' for the cultivation of Jatropha. Like many other biofuel companies, D1's investment was premised on the advantages of Jatropha as a robust, drought resistant perennial crop, with low input requirements and high production potential. D1's growth strategy was linked to governmental goals of rural development, through the generation of revenue for farmers through outgrower schemes, and thus diversification of risk for livelihoods, the potential of carbon trading and the reduced reliance on imported fossil fuel through the improvement of balance of payments at the national level. Other goals of D1's investment centred on secure market supply through home production (i.e. on-farm cultivation), improved food security due to an additional form of income for rural farmers and rural electrification through Jatropha's substitutability with diesel as an energy source.

While certain aspects of D1's strategy remained promising, such as the use of Jatropha seedcake as an organic fertiliser in the cultivation of maize or as animal feed, the company acknowledged that its heavy investment and subsequent learnings from cultivation of Jatropha also afforded it the '*dubious priviledge of dispelling many of the myths associated with jatropha'*.

a) Economic

Through its outgrower planting programme, Jatropha was grown effectively. D1 found that keys to success were to maximise grower density while minimising the size of the area used, the effective transfer of skills and training to extension teams and farmers alike (alongside a careful selection of outgrowers and field areas), managed cultivation practices, and demonstration plots. Importantly, D1 stimulated the market in conjunction with planting and production promotion activities.

It is important to note that D1 itself recognised that the reality of Jatropha as a biofuel crop did not meet the '*unrealistically high expectations*' of several market entrants, such as ETC Bioenergy, Oval Biofuels or Marli Investments. This was primarily due to huge initial investment costs in large-scale plantations that delivered poor yields and led to substantial investor losses.

At the time of the report, D1 Oils was the only biofuels company actively expanding Jatropha cultivation in Zambia, based on the known agronomy and research conducted by D1. The report critically notes that Jatropha is a long-term investment, with a lead time of eight years before profitability. Through its focus on quality and R&D, D1 was able to streamline its processes and produce high yields, an important consideration for profitability and the benefits of the project to be passed to outgrowers.

b) Social

D1 acknowledges in its report that for Jatropha to be grown successfully and have optimum yields, the crops needs to be integrated with local farming systems, have minimal distance to market and be sustainable from an economic, social and environmental perspective. The success of Jatropha as a biofuel crop could thus be said to be tied directly to the manner in which it is cultivated and tended to by local farmers. Crucially, D1 maintained strong linkages with its outgrowers and developed strong networks through year-round extension presence on the ground, fair and transparent pricing and good communication with the outgrowers. However, an issue the report notes regarding the outgrower scheme is that side-selling and variable quality in fuel substitution at final use was a significant challenge. Thus, in spite of the good relationship maintained with employees, D1 continued to struggle with issues along the value chain of production.

c) Environment

Of the underlying reasons to exploit Jatropha, the expectation that it can survive and produce high yields if planted on marginal land is possibly one of the largest factors contributing to its propagation as a viable biofuel crop. However, through their trials, D1 Oils found that, if planted on marginal land, Jatropha will have only marginal yields. Furthermore, maximum productivity varied and was dependent on certain climatological factors, such as precipitation, and well-drained soils. For the maximum yield to be achieved, it was found that Jatropha required as many water and chemical inputs as the next agricultural crop.

In its research process, D1 discovered that Jatropha is not particularly hardy, pest or disease free. Indeed, the crop was found to suffer from pests such as Golden flea beetles (*Altcidae* spp, *Apthona dilutipes*), termites (*Macrotermes*), leaf miner disease (*Stomphosistis thaurastica*) and powdery mildew (*Oidium*) under the Zambian climate, which require chemical control agents. Furthermore, in fertiliser trials it was found that the application of manure at planting and annually thereafter was '*critical*' in order to maximize production, and that Jatropha required a balanced input of nutrients like any other agro-crop.

D1 importantly notes that the burden placed on the private sector was found to be a fundamental challenge to the development of the industry in Zambia, with investors responsible for the majority of activities along the value chain – from breeding, processing, extension services, market development, quality standards establishment, regulation and monitoring, and information dissemination. The report points out that the regulatory and fiscal environment remained unclear, and policy makers expectations were just as unrealistic as that of producers and investors.

4.3 Findings from interviews

4.3.1 Economic Impacts

4.3.1.1 Land and land access

It is important to note that while Zambia is seen to have a large amount of underutilised land it has a large, sparsely distributed rural population that is primarily reliant on land for livelihoods. In addition, poor land mapping in the past has led to problems of classifying land as available, when it might be in use by the rural population for subsistence purposes under a customary tenure land-use system.

Land is the most easily accessible asset available to local citizens in Zambia, especially considering the large rural population, land availability and low population density. It is seen as natural and physical capital, and contributes directly to livelihoods. Individuals or communities are able to utilise land for production and self-fulfilling functions according to their needs, and ultimately control the consumption of land systems and services. In essence, local landholders manage the sustainability of the land under their tenure. This ability for self-determination comes under threat where land investment takes over control of this resource for locals.

Respondents from the Zambian Climate Change Network (ZCCN) explained that the government's desire to seek out industry that creates employment and revenue opportunity facilitates the potential of FDI to flow into the country through sectoral improvements. Schemes that meet the standard of economic possibility and create an export product that is capable of being sold onto a global market will be willingly approved by the Zambian government. The influence of multinationals (such as the World Bank) on the state through FDI flows is significant, and can affect the state's assessment of 'available' land. Due to the promises of economic benefits and opportunities, it is widely acknowledged that the Zambian government is eager for investments that complement their agricultural reform ambitions, and quickly approve the conversion of traditionally communal land to state land. The result is that, with the sudden interest of commercial industry, much customary land has been converted through local chiefs' consent.

Often, investors were given long-lease contracts up front as seen in the case of Marli (30 years), Macha (35 years), and Brong Ahafo (50 years), and had to pay little if anything at all in rental fees. Experts from the Zambian Institute for Environmental Affairs (ZIEM) similarly stated said that in Zambia there have been many cases where land – easily convertible from food to biofuel crops – has changed use quickly due to investment interest and the support of multinational agencies.

Once land has been converted from communal to commercial ownership under sale or lease agreements, it is seen as a strategic and economic loss to the local land users. When land is converted to state ownership or, more importantly, given over to a private entity, it deprives local people of the opportunity to make use of the land resource for their livelihoods. A respondent from the Worldwide Fund for Nature (WWF Zambia) used the example of grazing, where land is needed for the crossing of livestock to reach a common resource such as a river. Lack of access to these 'corridors' or available land results in '*all sorts of problems related to socio-ecological issues of equity, ownership, land rights and tenure*'. In the case of Macha, the loss of access to the natural and physical capital of land had repercussions on households' ability to generate a livelihood through the ownership of other assets (food crops and livestock) – which were also affected. Such a loss severely compromised the resilience of the affected households, due to their inability to restore or replace the land, their loss of harvest and loss of livestock. In Ghana, the loss of access to products gathered from forests, due to a reduction in land, resulted in a decrease in the provision of forestry activities towards livelihoods.

Another example mentioned by respondents is that of an expansive sugarcane plantation in the Kafue Flats region of Zambia. The Flats is a pristine wetlands environment, used by local communities for fishing and as an important water source. Due to the rate of expansion of the sugarcane project into the Flats, there is increasing resentment towards the project from local land users. The land used for the projects was converted to state land, thus the government is enjoying the benefits of royalties and taxes paid under the 99-year lease given to the investor. The issue of land succession once the lease has expired will be a future problem, but for now, the current situation excludes the local communities from any benefits of the project and leaves them frustrated by the impacts of the plantation on their livelihoods. The traditional landholders are not the ones benefiting from dispensation of benefits from the sugarcane plantation revenue, and the plantation has diminished their access to the Flats and traditional water source. This is land-use change on an industrial scale, and bound to have far-reaching socio-economic and ecological impacts, due to the transfer of benefits out of the community's control. The Kafue Flats case illustrates how current tenure policies, in which customary land is to be developed by private entities, results not only in loss of land or tenure, but also loss of access rights, and the rights to products, resources and benefits.

This is because where there are issues of displacement, there is very little recourse for local people, legal or otherwise. Historically, much of the land held under formal title in Zambia was owned by (colonial era) settlers who recognised the value of fertile land and bought large tracts

of land for farming or investment purposes. Traditionally, leaders and chiefs move their communities from place to place, following seasons or pastoralist patterns, and establish settlements in promising areas over periods of time. Poor mapping of land by the Ministry of Lands has meant that there is often not a distinction between formally owned land and that under community tenure. In some cases, this means that even where families or communities had been settled on a particular piece of land for generations, the title deeds might still be in the name of a foreign entity. Such is the well-known situation of locals in Macha, as the case study illustrated.

In many cases, local people have been promised benefits by the biofuel investors, such as employment (as in the case of Marli in Northern Province of Zambia, or the Ghanian case study,), infrastructure (roads, pipes etc), facilities (clinics or schools) or services, which do not materialise timeously. As is obvious, however, most large multinationals undertake large-scale land acquisitions for their own profit in order to meet global market demands for biofuels. There have been very few cases in Zambia where investors considered community level development above their own corporate profit. D1 Oils would be a case in point, however, even where biofuels projects have aim to provide developmental assistance to locals, it is not their ultimate responsibility to deliver economic reform to poor or rural communities.

4.3.1.2 Markets and access

The push for a biofuels industry in Zambia started in 2005–2007, in order to support the upcoming revised Energy Policy of 2008 in which biofuels were being introduced as a source of alternative fuel and a viable option towards meeting some of the country's energy requirements. Government earmarked land for commercial crops through its creation of the FBD. The crops to be grown in the core venture are predominantly for export, such as biofuels crops like Jatropha, so as to support economy growth. However, the FBD's objectives crucially included those related to food crops; grown on satellite farms, they were also to receive strong support. Respondents confirmed that, '*Small-scale farmers on these smaller satellite farms can grow biofuels through an outgrower scheme, as long as they grow food crops too'*.

According to information provided by the Civil Society Biofuels Forum (CSBF), application of feedstock for both biodiesel (palm oil, soybeans, *Jatropha curcas*) and bioethanol (sugarcane, sweet sorghum) was considered for Zambia's biofuels industry. Zambia performed a preliminary assessment on biofuels, and classified biofuels in terms of those coming from edible or non-edible crops (e.g. sugarcane vs. Jatropha) and dual or single use. Baseline studies undertaken by the CSBF have indicated that there is a strong drive to promote Jatropha as the main feedstock for biodiesel (CSBF, 2012). As a non-food crop, the theory that supports the use of this crop is that small-scale farmers will increase incomes by growing Jatropha and selling the feedstock or oil to the market, without threatening food security.

As part of the organisation's objectives, the CSBF is responsible for understanding the market forces of the domestic biofuels industry. Besides the intention to supply the domestic market, the biggest market for export of biofuels is expected to be South Africa and China – the 'first' or

primary markets. As a SADC country, South Africa has historical trade routes and good relations with Zambia, as well as it being the only country in the region with advanced biofuels technology. China is prominently investing in Zambia – building roads, infrastructure and entering joint ventures with the government to create Multi-Facility Economic Zones (MFEZs) in several provinces. These zones are designated areas of activity for local and foreign industrial investment, complete with infrastructure, electricity, water and facilities conducive to business demands (OECD/Zambia, 2012).

In contrast to these primary markets, while EU blending mandates are driving the biofuels rush, the European market is not easily accessible due to restricted trade in EU arrangement. Furthermore, African countries struggle to meet the costs and to adhere to the strict criteria and high standards demanded.

This issue is further exacerbated by the fact that Zambian farmers are often scattered, and operate individually in a rural environment, without any cooperative or unionised schemes. Thus, while it is important to encourage small-scale farmers to trade with other importers directly, it is not always logistically and financially practical. This is part of the problem with the integration of the biofuels industry being dependent on outgrower schemes. A recent market example was used to illustrate this point, where Canada wanted to meet domestic demand of honey by importing 30 metric tons of honey from bee farmers in Zambia. However, the trade fell apart due to the required standards being too high for small-scale farmers, as well as the level of organisation of local farmers needed to meet the high demand. The expectation is that demand for biofuels would face similar logistical failure without a cooperative or unionised effort by small-scale farmers. Hence, while the business model of the outgrower scheme was hailed as a possible solution to the development of a biofuels industry, it did not necessarily have the relevant policy support to facilitate commercial production of biofuels. It would seem that in Zambia the overseas demand for biofuels via blending mandates could only be met by larger, private entities that have access to the markets and are able to meet the required standards through organisational efficiencies. Such market forces are further influenced by Zambia's Land Policy that allows full repatriation of profits from agri-ventures, as well as the high capital requirements dictated by the ZDA.

Thus, while the biofuels industry in Zambia attempted to include smallholders as a means to drive the industry through outgrower schemes, the implementation was done in such a way as to favour larger entities – in spite of the fact that commercial farmers comprise less than 1% of Zambia's farmers. The result was that, while small-scale farmers were expected to be mostly responsible for biofuel production in Zambia, many larger biofuel investments attempted to take advantage of the fledgling industry and gain the initial lead on a potentially profitable market, such as Marli Investments. Even where medium sized entities had initiated biofuel projects, they were operating at the mercy of market forces based on biased policies.

Such apparent profitability of the Zambian biofuels industry is what attracted many large corporates and multinationals to the market initially. Respondents emphasised how the industry sprang up quickly and stakeholders entered the market having only seen it as an opportunity to make money, without taking full cognisance of the lack of policy surrounding deals in Zambia. Full implications of (what would mostly be) rural operations or impacts on surrounding communities were not wholly considered by many investors. The scale of the biofuels industry, in the context of other developmental targets, and the implementation thereof, was never fully integrated within the National Energy Policy. Without the right policy framework, investors were not fully aware of the consequences of their operations.

The case in Zambia was that many of the investors pulled out of their 'contracts', ceased operations, abandoned the project and left the land. Reasons for failure include the economic downturn of 2008–2009 – for example, Marli may have pulled out of its operations due to the global downturn and inability to secure outside investment needed for the maintenance and expansion of operations (German, et al., 2011b). Other reasons for failure include a lack of rural infrastructure necessary to take the product to market, the initial cost of capital required in the set-up of the project and possible controversy surrounding projects, particularly in light of failed crops, land conflicts and impacts on surrounding communities.

Often closure of a project was done without any explanation and it fell to civil society groups, such as the ZCCN or the CSBF, to uncover the reasons for failure. What such groups discovered was that investors were not always able to honour their side of the agreement and very little was done to support local farmers in the provision of seed, skills and training. An issue that has been highlighted in instances where this was the case was that many of the rural farmers were still growing Jatropha crops in the hope that the investor would return when the feedstock was ready and the market would be resurrected, giving them a buyer and a means to still make an income. Such a hope highlights the poor information dissemination surrounding the outgrower arrangement and the possible danger that farmers would continue to tend to non-food crops at the cost of food crops. Marli is a prime example of the high expectations created upfront in the implementation of a project, and a lack of description of the risks or possibilities of failure surrounding the project. As described by Ladefoged et al. (2009), the pricing structure proposed by Marli was below average and offered low returns (ZK 400 per kg seeds), and did not meet the expectations created. In the case of Marli, in spite of disappointing returns, farmers continued to have hopeful expectations for future returns and continued to tend their Jatropha fields, despite Marli's disappearance. Civil society representatives claim that the initial approach to the outgrower scheme is at fault through weak policy guidance. '*There was no community sensitisation, no communication on risks of the model or information on benefits and how to achieve these*.'

An example of pricing structures related to price comparison between feedstock types, noted by the DoE respondent, was that whereby ETC Bioenergy had 400 ha of Jatropha planted in Mpika District but were bought out in 2008 by Zambeef. According to the respondent, they were the

only company to have devoted such a large piece of land to growing energy crops. With an extensive global market, oil palm is considered far more profitable, as one litre of oil from Jatropha can be sold at US$1.00, but 750ml of palm oil can be sold at US$2.00 (July 2012 prices). Zambeef promptly uprooted the Jatropha cultivation on this land, which was originally a coffee plantation, and planted over 1 million hectares of oil palm. Such scenarios portray the influence that pricing and demand has on the direction of an industry, dictating to the investor which crops should be grown in order to maximise profitability.

Another issue raised is that refining capacity is limited in Zambia. A pilot project in Longacres, Lusaka, was set up in order to test the functionality of biofuel oil as well as the receptiveness of the market to the alternative fuel. Due to the project not having access to the machinery needed to squeeze oil from Jatropha seeds, sunflower oil was used instead. As a test project, no EIA was necessary. A small market sprang up around this demo project and when last visited, six vehicles were regularly relying on this oil as a blend with diesel. This small pilot project would seem to work based on its contained scale and internal efficiencies in using waste oil. Other projects mentioned by respondents were not as successful. Representatives from both large agricultural entities (MRI-Agro) and a local consultancy (ZIEM) spoke of the well-known venture of D1 Oils as indicated in the case studies, in which British Petroleum (BP) bought into D1 Oils in order to establish a test biofuels project in Lusaka. The establishment cost of the facility was very high, and required the clearing of large trees on a 1 ha piece of land, which added to the expense. Thereafter, D1 had a change in their global strategy, and is yet to have commercial success. All reports seem to indicate that BP has subsequently withdrawn from the project and D1 has been closed down, subsequent to their promising 2011 report. Oval Biofuels, a biofuels company that went into an agreement with surrounding farmers, also failed. Similar to Marli's outgrower scheme, the farmers were to grow seeds to sell to Oval. However, in contrast to Marli's value chain, Oval was to then process the feedstock and provide the farmers with oil, either for their own use or for sale. Unfortunately, the farmers did not meet their feedstock target. The problem here was that even though a market existed, supply became an issue because the farmers themselves were operating by trial and error in growing feedstock. Respondents maintained that it could be the case that farmers who are operating now may have more experience compared to previous farming efforts where farmers perhaps did not have any planting or energy crop knowledge.

Not all biofuel projects have been a total failure, and some have even supplied contract work to smallholders. A few small projects have had limited success, being suppliers to able buyers. In an interview with CSBF, Tapera Industries was used as an example. Based in Lusaka, it is a small pilot biofuels project which is successfully selling feedstock to USAID. Southern BioPower, an entity mentioned by the respondent from MRI-Agro, is harvesting, replanting and buying Jatropha seeds from small-scale farmers, and running its plant and vehicles on the oil produced. The feedstock is bought at ZK 500 per kilogram (2012 price), providing the small-scale farmers with a sizeable stream of alternative income. The respondents validated that

Jatropha is often planted as a hedge around their crops – performing a double function for the farmers, whose food crops are protected from animals while they receive remuneration through this outgrower arrangement.

Besides the functional success of these small pilot projects, no biofuel crop or production facility has had complete success in terms of either commercial operations or profit. Only at Zambia Sugar's Mazabuko facility, mentioned in an interview with ZIEM representatives, has there been limited industrial success using bio-energy for operations. The power supplied to their plant is produced using sugarcane waste and molasses from their own crops and production, and is thus a closed cycle that makes economic sense for the entity. Interestingly, latest reports indicate that Zambia Sugar, the operating entity at Mazabuko, has signed a Memorandum of Understanding (MoU) with the Zambian government to produce ethanol for large-scale production by 2016 in order to meet petrol blending mandates. Refineries and blending facilities in Ndola and Lusaka are also expected to be set-up by the end of 2014 (Kunda, 2014; Mulikelela, 2014).

The only benefit that has emerged from the few pilot projects that have had success is the introduction of an additional income stream for those who are directly employed and earning a wage through an alliance with the production facility. However, in practice, these farmers' overall income security does not improve much due to the discretionary basis they operate on. Typically, employment is not long-term even where it is present and does not present an obvious change in improving livelihoods.

The biofuels market situation is best surmised by the CSBF –

'*Driven by private sector interests, the Zambian biofuel industry experienced strong growth in the mid-2000s, much of it speculative and based on feedstock and production systems yet to be proven in Zambia. This character contributed to the failure of many early initiatives during the global economic downturn, causing some investors to pack their bags and leave Zambia and others to go into hibernation. Other investors have scaled back and taken a more cautious, knowledge-based approach in which future expansion will draw on lessons learned from early failures and from systematic research into the agronomics and organizational arrangements for contracting and supporting smallholders. Thus, the sector is still in its infancy, characterized by experimentation in feedstocks and production models' (CSBF 2009; German, et al., 2011b).*

The result was that, although the Zambian government introduced biofuels in its 2008 Energy Policy, the lack of policy measure and assistance resulted in no real domestic market even years later when the market may or could have progressed naturally.

4.3.1.3 By-products

Respondents commented on a crucial development that arose from the shortfall in the biofuels market. Farmers took matters into their own hands, and developed a market harvesting and using Jatropha oil to produce marginal products such as soap, mosquito repellant, lamp oil, candles and

organic fertiliser. The market for by-products proved to be more lucrative than the sale of feedstock to biofuel companies.

'*In the Northern Province of Zambia, entire communities now no longer want investment in biofuels, because of the huge potential the new market created for income*,' (CSBF representative).

Reports are that where feedstock can be sold for ZK 1,500, the equivalent oil from feedstock can produce a soap bar that sells for ZK 5,000. The lucrative by-product market has resulted in Jatropha being seen in a mostly positive light by many farmers who initially attempted to join the biofuels market. It is crucial to note that the success of the by-product market in the Northern Province can be attributed partly to a local NGO. As seen in the case of Marli Investments in Zambia, when outgrowers were left with harvested seeds SNV stepped in to support the development of an alternative market for Jatropha oil. SNV trained local farmers, helped establish local biofuel associations to support the interests of the farmers (German, et al., 2011b) and, most importantly, helped link the products to market.

However, many farmers who have grown Jatropha have not discovered the use of its oil as a means to produce by-products, as respondents from ZCCN clarified. Many farmers did not have the skills or knowledge to undertake the planting and growing of biofuel crops such as Jatropha. Other farmers will not enter the jatropha-based biofuels market due to the long growth period. Importantly, a respondent from the Department of Energy (DoE) emphasized this point: '*Skills and knowledge of the process are necessary for the growing and refining of biofuels to the point of blending. Jatropha takes four years to grow, resulting in a delayed market, and therefore it takes time for farmers to realise their returns*.' Farmers are not often informed about this delay or the impact on returns. In addition, the access to markets is difficult because it is disorganised – buyers may exist and be willing, but may not know where the producers are or who they are. Other issues include the labour cost for Jatropha production being too high, and problems with getting Jatropha seeds to the market, as has been previously mentioned.

For these reasons it is important for the Zambian government to develop the biofuels market sufficiently before pursuing and promoting the use of agro-fuel crops. The government has halted further development of the sector to continue work on the policy surrounding biofuels in order to understand the risks and issues associated with these crops, some of which are unclear. For example, representatives from ZIEM pointed out that due to poor information dissemination and knowledge gaps, some small-scale farmers have not wanted to plant Jatropha alongside their cereal or other food crops, believing it to be a non-native species which will cross-pollinate with their crops. While a common misconception, no full assessment on this crop has been performed. In the study undertaken on Marli Investments, company representatives had rightly warned farmers in the outgrower scheme to avoid intercropping Jatropha with cassava, in order to avoid the spread of diseases common to both crops (German, et al., 2011b). However, it was found that intercropping Jatropha with groundnuts increased the yields of groundnuts – a positive result due

to improved soil fertility. In the study, farmers spoke of how the Jatropha leaves, which reportedly shed frequently, were used in preparing the soil for planting. It is a concern that information on such secondary benefits is not passed to farmers who are growing Jatropha for the purposes of the potential biofuels or by-product market, and who could use this information to increase the yields on other food crops in the meantime.

Most individuals grow Jatropha as any other tree, without knowing of its use or potential as a biofuel or for by-products. This highlights the poor way Jatropha entered the market and the lack of information about this crop, a problem which hampered the ability of farmers to take advantage of potential alternative sources of income.

A problem related to this lack of information highlights the oft-quoted recommendation to plant Jatropha as a hedge. With the slowdown in the biofuels industry in Zambia, it is now recommended that Jatropha is planted as a hedge around food crops or as a living fence around homesteads. Due to the durable nature of the plant, its height, and the ease with which it can be replanted, Jatropha offers good protection against animals foraging for vegetables or plants. A representative from the Kasisi Agricultural Training Centre explained that farmers can plant Jatropha to prevent goats, sheep, cattle and elephants from wandering onto farmed land, eating the crops and destroying potential sources of income or food. The hedges provide protection against soil erosion as well and help to filter ground water.

At the Kasisi centre, a farming community about 15 minutes south of Lusaka, about 20 Jatropha trees have been planted to demonstrate this. The author was shown the Jatropha plants set out along the edges of some homesteads. One can easily see how these sturdy trees can function as a living hedge, as **Figure 4.3** shows. However, owing to the slow market, it is not a priority to harvest the seed from these hedges or encourage farmers in the area, '*who see it as a dead-end crop'*, to plant more Jatropha. A further concern of the value chain analysis of this introductory market, as per feedback from the ZCCN, is that even though a viable by-products market has been created, the original intention (and as per the Energy Policy) to produce biofuels has not been realised. Thus, while many farmers continue to tend to their Jatropha hedges, there is no harvesting of seeds or processing of by-products from the trees, and they therefore continue to miss out on the dual functionality of owning Jatropha plants.

Figure 4.3 Jatropha hedge at Kasisi Agricultural Training Centre [Image source: author's own]

4.3.1.4 Food security

At a national level, approximately 70% of small farmers contribute to the national food basket of Zambia. Biofuel production is expected to follow the same pattern as food farming in terms of measurable success in Zambia, and according to objectives of the FBD. Advocates of the biofuels market expect that small-scale subsistence farmers would be able to grow both food and biofuels crops through schemes such as an outgrower arrangement. Multinationals would support the planting and growth of the crop with technical advice for subsistence farmers, working in alignment with government initiatives to bring reformation to rural agriculture and meeting the terms of their contract.

Hence, outgrower schemes implemented via the FBD became a feasible solution to integrating the new market for biofuels into a rural setting. If it were to work, it would mean that rural farmers would have food security at the same time as being able to grow biofuel feedstock for sale as an additional form of income, ultimately reducing personal poverty levels.

Those advocating against the biofuels industry in Zambia argue that this type of reasoning is flawed due to the allure of additional income. Small-scale farmers are reliant on profit, and

because export markets have more value, it is tempting for them to convert all their food crops to cash crops (such as jatropha) where there is a willing buyer and a market. This was a particular concern for the Zambian market for biofuels, which opened up so quickly there were few policy measures or safeguards in place to prevent such issues further down the line. While the emphasis was on outgrower arrangements, that protected food security, the undefined policy meant there were no real specific requirements for implementation of biofuels projects, and small-scale farmers became mostly responsible for producing biofuel for the domestic market without the relevant supporting legislation. This could have resulted in immediate consequences for food security. However, as was seen in the case of Marli, respondents did not indicate that food security had been compromised. The farmers themselves had adapted to changing conditions, and had actually transferred food crops displaced by Jatropha to land of higher quality.

What is more concerning is the long-term impact regarding the loss of land and access to forest products, which would seem to be an insidious issue wherein the full ramifications might not be felt or understood until increasing competition for scarce resources leads to compromised food security or an inability to supplement livelihoods. In cases like Macha, where land previously used for communal farming is transferred to the investor for biofuel crops such as Jatropha, the impacts on food security are far more immediate. In spite of attempts to justify the investment by the provision of employment or development brought to the area, the circumstances under which the project proceeded had severely negative impacts on local people's food security. It is instances such as these that continue to be a concern in examining the ramifications of the biofuels industry on food security in developing countries, in spite of governmental attempts to prevent such impacts through policy measures or specific means of implementation (e.g. outgrower schemes).

Zambian policy does not allow for biofuels to be produced from staple food crops such as maize. As an example of how this is implemented in the industry, ethanol should be produced from molasses as a by-product of sugar, such that there is no conflict with food production. In the interview with the Senior Energy Officer from the DoE, she cautioned, '*The problem is that conflict with food crops can escalate should the demand for biofuels increase*'. This is a concern for the Ministry of Energy, which encourages a balance between food and energy crops. However, there is a limit to the Ministry's power, as farmers act in their individual capacity and use their own discretion when planting crops either for survival or profit.

Across the different provinces of Zambia, different crops are grown according to the climate and soil quality. Consequently, the dietary pattern of locals follows the harvest –staples of cassava crops are relied on in the Northern Province and maize and groundnuts in the Southern and Eastern provinces. What is critical to note is that all these crops can be used as both a subsistence and cash crop in Zambia, and thus could play a role in biofuels production. Exported goods have more value to small-scale farmers who are reliant on income. Thus, if the demand for biofuels increases, the result might be that many small-scale farmers could turn from food crops and start producing cash crops in order to earn an income, with devastating potential repercussions on

food security in the country, considering the high contribution of smallholders to food production.

Such a dire possible outcome might be partly attributable to departmental responsibilities within ministries. Because of a lack of communication between departments or authorities, farmers are not always given the full spectrum of information, as seen in the underutilised by-products market. Local administrators might be hoping for regional investment for a number of financial reasons, and might promote the idea of biofuels without relaying the full costs, benefits and risks involved. Farmers in the area are liable to hear only about the advantages, and thus perceive agro-fuel crops as cash crops, without understanding the market, production timelines, and issues related to profitability. This was clearly seen in the case of Marli, with farmer's high expectations of future returns. While the case may be that thus far there have been few repercussions on food security, the Head of Commercial Agriculture from MRI-Agro pointed out a problem with market linkages of Jatropha demand to production levels. Jatropha seeds produce only 17% oil, whereas sunflower and groundnuts produce around 40% oil. This has potential repercussions on food security should the market become more competitive, with farmers moving away from non-food crops, such as Jatropha, towards food crops in order to meet oil or feedstock targets for fuels.

Even though proponents of Jatropha claim that it can be grown successfully in marginal or waste land, it has often been the case that farmers convert the land used for staple food crops in order to make space for Jatropha. Whether because of poor information dissemination or a lack of support a common attitude is that '*it won't matter if Jatropha is planted experimentally*.' However, the fact remains that Jatropha can have huge impacts on food security if it is unnecessarily planted on arable land. Representatives from ZCCN confirmed that very few Jatropha crops in the country had thus far been planted on already used land. Most of the crops were planted using new land. While this undermines claims that Jatropha has been successfully grown on marginal land, it also verifies that there is no competition with food crops – yet. It further indicates the possibility that it is mainly foreign actors who have been planting this crop on new areas of land, as unavailable land is likely already in use by small-scale farmers using it for their own crops.

As with any investment, there is always an opportunity cost involved - agro-fuel crop farming can also have indirect impacts on food systems and security. In Zambia, the traditional *chitemene* system is ecologically sound in rural areas with plentiful land and trees and a sparse population. However, in a modern system of crop rotation between staple food crops and monoculture crops that drain the soil of nutrients and demand high inputs of fertilisers, it is not sustainable. Most local landholders need to produce their own food crops for subsistence, but where the land has been converted to a monoculture cash crop, the natural nutrient level and quality of the soil may be depleted. Should a cash crop such as Jatropha fail, over and above the possible damage done to soil quality, farmers might not be able to revert to the *chitemene* system – which they know and understand. Such an opportunity cost related to the carrying capacity of the land can have

dire consequences for the livelihoods of small-scale farmers and their ability to feed themselves and their families. Whether this is a measurable cost that can be determined prior to a biofuels project remains to be seen.

Similar repercussions can occur if farmers have converted all their fields to monoculture crops and the bottom falls out of a specific market. As noted, many biofuels investors in Zambia shut down their operations due to the economic crisis. Farmers who had already converted their land to provide inputs to such companies were left with a crop ready for harvest but no buyers, possible soil-quality loss, and the spectre of food insecurity. So, for example, in the Eastern Province, D1's project closed, with only the demonstration plant remaining. This too has ramifications for food security and the ability of rural people to have self-determining livelihoods.

A recent case that occurred recently in the Eastern Province, Zambia was used as an example by representatives from ZCCN. Here, farmers were persuaded to grow cotton, a cash crop. Investors were to pay the local farmers per kg. When the crop was harvested, however, they lowered the price. The farmers were left with a poor price for their produce, on top of soil depletion, with the result that subsequent (food) crops might not fare very well. This is yet another danger in promoting cash crops such as Jatropha, where the long-term impacts of local farmers converting land used for staple food crops to cash crops is not fully understood.

4.3.2 Social Impacts

4.3.2.1 Benefits sharing of land investment

Industry outcomes are often based on a number of important determinants that have been pointed out – the nature of the feedstock crop, land tenure, access and availability, the ability of farmers to diversify livelihood generating activities, and the localised awareness of investment procedures, via previous experiences (German, et al., 2011b). From a social viewpoint, it is important to understand how these elements interact – and what the differences may be amongst social groupings in terms of access to assets, power over assets (e.g. land), and how the social 'organisation' or local hierarchy affects livelihoods – and if these effects are equitable.

As can be understood from German, et al.'s research (2011b), the negotiation over land in Zambia essentially translates into a situation where foreign investors can persuade chiefs and government authorities to allow investment by convincing them of the ability to generate economic revenue and increase the productivity of the agricultural sector through such investments. In fact, findings from stakeholder engagement indicated that although the land in Zambia is generally vested with the chief (*Nduna*) of an area, the people surrounding the chief are those who traditionally hold the power. Where investors are awarded land titles by the state for commercially viable projects and investors are presented with land titles, the land deal, in

essence, reduces the amount of land available to a particular chieftaincy or community. This means that should the chief make a decision the constituencies are not happy with, such as decreasing the land available to the community, they have the power to remove him from his position. For this reason, chiefs may be reluctant to decrease the size of the area allocated to his people or relocate them in order for the investment to make use of their land. Local chiefs have been becoming more cautious of land concessions for investment purposes due to the historic disadvantages communities have faced in contracts with foreign investment, as well as a lack of delivery of promises and the many failings of the biofuel industry as a whole.

The interesting example of Chieftainess Nkomeshya Mukamambo II of Chongwe (Zambia) is a case in point. She allows investors to use the land vested in her chieftaincy, but will not allow conversion to state land in order to maintain her tenure over it, understanding that if the land is converted to state land and title deeds are given to the investment company, then it will no longer be available for use to the community under her governance and she may lose favour with her constituents.

However, such a stance by a local leader is seen to be the exception, not the norm. Media reports and research papers highlight the fact that chiefs and local elites are often susceptible to bribes, 'kick-backs' and privileges afforded to them by investors by virtue of their favourable position of power in land negotiations. Chiefs may also wish to re-establish their authority over land, particularly to generate higher economic value for their area or avert land disputes with adjacent traditional leaders (Boamah, 2012). Because of this, many chiefs have not been entirely opposed to negotiations on their land – particularly where they believe real value could be created for them and their communities. Respondents from ZIEM confirmed that this is often the situation in Zambia: '*Biofuels investors present their proposal for land development to the head man in a village, including him in the negotiations and giving him the responsibility of feedback to the villagers,'* but they warned of a worrying addition to these negotiations –*'...this larger community is excluded from negotiations and have no voice in the matter*.' This was exactly the circumstance surrounding the biofuel project in Macha. Such exclusion of local people can result in very limited favourable outcomes for them according to terms of the contract, and has the potential to benefit only a few at the expense of many.

If the consultation produces a contract, these 'contracts' are often not passed onto local people for review in areas where land has been allocated for biofuels to be grown. Or in the case of Marli, farmers signed their side of the agreement (in spite of a language barrier) but the company did not – leaving the agreement skewed and the farmers at risk should Marli not comply with the conditions, as was the case.

A lack of public information has furthermore had the result that the biofuels sector in Zambia is seen to be shrouded in secrecy by industry stakeholders. Even though the 2008 Energy Policy explicitly details the policy measures to promote the industry, and the finance minister mentioned biofuels in the last budget speech, further information is not forthcoming. According

to the CSBF, this secrecy does no good. It would be far more advantageous if both the potentials and the pitfalls of the industry were discussed openly with all stakeholders, including local landholders, in order to avoid specific issues that such opaque negotiations beget. Instead, authorities are seen to encourage local farmers without full details of the project being supplied. A recent newspaper article highlighted the vague optimism that surrounds the biofuels industry in Zambia (Appendix C), without any information on advantages and disadvantages of the industry being passed to local landholders. The article relates to a 78 000 ha biofuels processing plant in Muchinga being set up by a Chinese organisation, worth an estimated $450 million. The article reported on the public meeting held with the local chiefs and quoted the Presidentially-elected overseer, Edith Nawakwi, as saying: '*I hope you are not waiting to be employed by these people (the Chinese); be prepared to produce as many (biofuel) crops as possible so that you can be selling these products to the company*'. While the chiefs were reported as being eager to see development in their districts, believing the area to be lagging in terms of economic activity, it would seem that the encouragement to plant '*as many crops as possible*' belies the real issues that have been associated with large-scale agro-fuel crops in the country and highlights the inadequate information dissemination on potential pitfalls of the industry –which seemingly extend further into levels of authority than expected.

4.3.2.2 Conflict as a result of land acquisitions

The issue of corruption is introduced where limited negotiations occur and relevant information is not passed on to affected communities. This is becoming more common as contracts are kept confidential in order to maintain support for the incumbent chieftaincy due to their impacts on land ownership. Respondents pointed out that while some projects, such as North Western BioPower in Solwezi (North Western Province, Zambia) have tried to avoid this, the power hierarchies and social order within communities nonetheless often impede transparency. A consultant from the Natural Resources Consultative Forum (NRCF) in Lusaka confirmed that the secrecy surrounding the contracts and the subsequent marginalisation of land under communal tenure is essentially a form of so-called '*land grab*', as the local people have no voice in consultation, yet it is their communal land that they are deprived of. Whereas investors take occupancy of land and have legal recourse through the allocation of title deeds, the locals have no form of land entitlement. Even where leasehold titles for previously commercial farms are purchased for land transfers, which technically should minimise land conflicts, lands are rarely devoid of occupants (German, et al., 2011c) and the potential for conflict is high.

In addition to the issues surrounding land tenure disagreements, corruption and weak governance in Zambia, as discussed, it is rare for investors to deliver on promises to create employment and build infrastructure, causing strife between communities and the company. With FDI and foreign nationals entering Zambia for development purposes and economic opportunities, respondents indicated that local people are often seen as a cheap labour force in dire need of alternative forms of income, particularly in rural areas. This perspective has the potential to backfire when local workers are seen to be desperate for any form of income and are paid too little by employers.

The CSBF asserted that reactions are changing; where workers believe they have been taken advantage of, the consequences for investors can be dire. Where the produce or benefits are not seen as their own, workers are reported to have burnt fields ready for harvest when employers have defaulted on payment to the labour force.

It is crucial in such cases that civil society organisations are cognisant of what is occurring and take the relevant steps to inform both the appropriate public and government agencies. A case in the Northern Province in which a Chinese entity was looking at developing a potential 700 000 ha for biofuels confirms the importance of civil society groups. The land development would have spread over five different districts (Nakonde, Isoka, Chinsali, Mporokoso and Luwingu), and had serious repercussions on local land use and caused possible conflict. Fortunately, the Northern biofuels association raised the alarm in time and the development was halted. This highlights the importance and need for civil society organisations that hold industry players accountable.

In the case studies of Marli, and Macha, tensions arose between various segments of the local population due to the local biofuels development and the manner in which these projects were implemented. Another example mentioned by respondents from ZCCN is regarding a development in Mpula (Central Province, Zambia), where another potential conflict between local land users and a biofuels company is brewing. The local people have been growing oil palm as a traditional crop, and utilising the flesh for domestic cooking use. Investors have taken an interest in the land, as well as studying the possibility of using the wasted seeds and nuts of the fruit to produce biofuel. The concern is that, should production prove to be viable, the investors will displace the local people and use the available oil palm crops for their own use. This would have the result that local people would lose access to an important alternative source of food and lose out on the potential market that could be created from this crop in terms of the seed oil.

There are large negative repercussions in Zambia where these land users are relocated or not compensated for their loss of land or access to natural resources. The majority of these land users are impoverished, small-scale rural farmers with no knowledge or recourse to fight the land deal. The weak land tenure system offers such land users virtually no protection in this situation. This breeds tensions and conflict. Local people, dispossessed and disempowered, are left with little land or access to resources. This has significant effects on the sustainability of livelihoods and, potentially, their ability to survive. Where there is no compensation offered, or benefits are not extended in order for local people to maintain a comparable level of living, they are bound to fight the system that has trapped them. Indeed, civil society representatives argue that citizens were hoping for change in the processing of land acquisitions when the new Zambian government came into power (2011). However, no obvious amendments have been made to the regime and governance issues, and this has led to an unsettled population with legitimate complaints about the systems in place. Thus, in spite of local communities often being open to biofuels development, and the high expectations created around these projects, subsequent

failings of the investment and local market can breed tensions and create conflict, between local landholders and investment entities (as seen in Macha), between different cultural groups, and between different types of employees (as seen in the case of Marli with outgrowers and field officers), as well as between chiefs and their constituencies.

4.3.2.3 Gender disparity in land acquisitions

Vulnerable groups of people are often disproportionately affected by commercial land acquisition. Women, the aged and children are most likely to feel the negative impacts of large-scale investment, whether by virtue of their social standing or physical vulnerabilities.

Due to many customary practices in sub-Saharan Africa, women are not held in as high esteem as men. These practices are further entrenched by state laws which do not offer equal and secure access to land to poor rural women (IFAD, 2010). Men are seen as the head of the household, regardless of how much or little work they contribute towards running the home. Indeed, men are often responsible for higher-end activities – such as employment, while women are responsible for much of the menial labour. In Zambia, as discussed, this is no different, and women are responsible for the majority production of Zambia's staple and cash crops. While cultural learnings are beyond the scope of this work, it is important to understand how the biofuels industry in Zambia might enable or disable benefit sharing in light of gender disparities.

Agriculture projects such as those producing biofuels often indirectly place a heavy burden on women and children. It is unclear if the biofuels sector in Zambia will distribute benefits impartially – whether women will receive the benefits of the industry in their area equal to the time they spent in the fields on subsistence crops and providing for their families. An additional problem associated with the biofuels industry is that such crops are seen as 'cash crops' – which the men are responsible for. In the study performed by German et al. (2011) on Marli Investments, nearly 40% of local farmers in Mungwi involved in the research indicated that Jatropha is a 'man's crop', thus precluding women's involvement and the potential benefits (such as income) that they could earn from it.

The case of North Western BioPower in Solwezi (Zambia) proved this gender disparity, if not that negative effects were felt unequally, as observed by consultants from ZIEM. In the North-Western province, this company began encouraging peasant farmers to grow Jatropha by providing inputs and seeds to them. In response, families divided responsibilities; men turned to farming Jatropha, seen as a cash crop, while women continued with cereals and food crops. Ultimately, the project failed for lack of a proper market system. Because the production of food crops had essentially been halved, food security became a localised issue, highlighting how gender bias can prove crippling to rural communities reliant on manual forms of subsistence. Should the Jatropha market have been successful, women would still have been excluded from it due to the fact that it was based on a man's cash crop.

Owing to their situation, women are often sidelined in decision-making processes, even though they are often the caretakers and heads of households. These are important issues that may be exacerbated in the transfer of land for biofuels development in Zambia. Underage children have to be excluded from the labour force and protected against being taken advantage of in manual activities where labour might be needed – as in the case of Marli where school children were involved in communal labour for the Jatropha crops. This is common practice, however, prevents children from attending school lessons, as a contributor points out (see Appendix D) – with implications for their learning and education. It is rare for these vulnerable groups of people to be included in negotiations on land transfers for investments such as biofuels, or to have a voice or choice in the matter. Gender discrimination alongside this exclusion from the consultative process may result in severe socio-economic impacts being felt by women, the aged and children.

4.3.2.4 Water and Energy

Another issue related to the social (and gender) element of livelihoods is the 'energy poverty' of rural areas. Typically it is the women who are responsible for collecting water, cooking, feeding and farming for rural families. In rural areas, very few people have access to vehicles – almost all deliveries, appointments or social visits are performed on foot. Other villages, markets where fresh produce can be sold or traded, and amenities such as schools and clinics are often many kilometres away from rural homesteads. The collection of water to meet daily water needs generally requires the filling of large drums or containers, as is seen in **Figure 4.4.** It can be back-breaking work, and it may in addition take long hours of travel for rural women to arrive at the nearest water source. This issue has huge repercussions on livelihoods. Where women and children spend long hours walking to collect water or to trade with other villages, the time for more productive activities is lost. Indeed, research indicates that the collection of fuel (charcoal, wood) and water prevents many young girls from attending school (REN21, 2005). The collection of water is a significant challenge that is specific to rural areas and social impacts in these areas. In many rural areas, water pumps have been put in place by NGOs or government agencies. However, there is still a deficiency of potable water and women often resort to digging deep holes (**Figure 4.5)** from underground aquifers in order to provide water for their cooking, washing and drinking needs.

Figure 4.4 The long road disappears into the distance as women and young children carry water and fresh produce to their homes in the rural Chiawa district, Zambia [Image source: author's own]

Figure 4.5 Many women resort to digging deep holes to collect water [Image source: author's own]

Respondents indicated that it is often the case that men or foreign individuals who do not know or understand the related costs to households are liable to overlook issues such as these. This is the result of women not having a voice or presence in consultations with investors. A lack of proper representation of local communities at consultation meetings undertaken with investors can have indirect impacts on the ability of women to add more productive hours to contribute towards household income. This concern fails to be an aspect for consideration in the supportive policies for biofuels in Zambia, but is guaranteed to add contention to an already controversial situation if not dealt with in the future. Were investors to provide infrastructure to meet household water or fuel needs, huge advances could be made with regard to income potential and prosperity of households related to the contribution that women could make.

A related issue is where land demarcated for investment purposes blocks access to water, trade, pastoralist, forest resources, facility or social routes. Water is a key factor in determining the location of agro-projects. Where states transfer land to outside investors it grants them priority access and entitlement to nearby water sources (Anseeuw, et al., 2012a). This is precisely what happened in the ProCana case of Mozambique, mentioned in literature (FIAN, 2010; Nhantumbo & Salomão, 2010; Burgess, 2012) and in discussions with respondents. The large sugarcane plantation required 407 million cubic metres of water for irrigation purposes. The district and national government of Mozambique committed a portion of water from the nearby Massingir dam to supply part of this need, alongside prior obligations to export hydroelectric power to South Africa. Had the project gone ahead, the water and irrigation needs of the local Massingir and Chokwe peasant communities would have remained unmet, due to their weak position in transboundary water management negotiations, where decisions are ultimately a function of power relations between countries (Chapman, et al., 2014).

In some case studies where land allocation prevented communities' access to resources, locals were cited as saying the time taken to travel to school, places of work or clinics was greatly increased, as well as the difficulty or danger of the new route. An example is Macha, where the relocation of many families essentially resulted in extended travel times, if not danger per se, to reach places of education or work. Displaced members of the community had to travel further to get to their place of work or education, increasing their socio-economic burden and vulnerability to wild animals and crime. Having to travel further impacts on productive time and increases the burden placed on vulnerable groups of people. Women and pastoralists especially suffer under such restricted access due to their reliance on the land, trees and water in communal areas for subsistence (Oxfam, 2011). In findings based on impacts of large-scale oil-palm plantations, it was found that women suffer from an increased workload due to the loss of access to water sources and wood fuel, as well as increased domestic violence as a result of socio-economic stresses associated with this loss (Anseeuw, 2012a).

4.3.3 Environmental Impacts

4.3.3.1 Environmental management

A weakness inherent in the Zambian policy surrounding biofuels investment is that of laws regarding EIAs performed prior to land clearing. EIAs are generally undertaken by the investor, who often lacks capacity, instruments and infrastructure to perform the assessment adequately in the domestic country. Findings have revealed that without legal monitoring, investors are inclined to cut corners in order to save time or finances. As a result of these shortcuts, as uncovered by the CSBF, foreign entities investing in biofuels have been found to use the same EIA across regions, and even countries. '*The location and date are changed on the EIA, but the same consultants are employed who frequently forgo site inspections and do not propose any outcomes which could possibly be construed as negative*.' Industry stakeholders and environmentalists bemoan the lack of capacity in the professional body. Training is often poor and leads to 'oversights' which enable industrial projects to be approved as feasible in spite of huge environmental costs. Civil society representatives confirmed this, stating that unless the entire process of obtaining land for investment purposes is improved, and correct procedure followed in the EIA process, no progress can be made. The level of compliance to an EIA should be adequately suited to specific areas of project implementation, tackling issues related to ecological or social fragility on the ground. If no changes or improvements are made, widespread environmental costs will continue to be ignored despite their significance to biodiversity and livelihoods.

The ZCCN added that no complete EIA study has been undertaken on Jatropha as a crop in Zambia. '*No full life-cycle assessment has been performed on whether this crop is harmful to food crops, the effects of cross-pollination, how it proliferates and which diseases are associated with it, and very little information has thus been given to communities where Jatropha is grown*,' respondents asserted.

The representative of MRI-Agro, with years of experience in commercial agriculture, pointed out that Jatropha plants are extremely susceptible to powdery mildew and leaf miner diseases in the Zambian climate, something that is not mentioned in the literature or in policy, but was, however, confirmed by D1's extensive agronomy research into Jatropha (section 4.2.3). These diseases cause the plant to lose its leaves, preventing the formation of seeds from which Jatropha oil is produced. Not only does this result in a failed 'crop', it also requires very expensive pesticides and fungicides to prevent and treat – in order to inhibit the spread of disease to other plant species such as cassava. Field officers from Marli were therefore not wrong in preventing the intercropping of Jatropha with cassava, however, the subsequent lack of follow-up and management of the outgrowers in this case may lead to farmers experimenting with intercropping food and Jatropha crops. This could have disastrous implications should disease spread amongst staple food crops, like cassava.

Due to the perceived advantages associated with by-products of Jatropha (e.g. soap) and the current favorable market for these products, subsistence farmers have continued with the crop in many areas. However, as a representative from the NRCCF remarked, '*As a prime choice in agro-fuel crop, Jatropha remains very controversial.*' The fact remains that further study is required to gauge the full environmental impacts of growing this crop. If unnecessarily planted on fertile cropland, Jatropha can have possible impacts on food security. However, if planted in areas of natural forests, Jatropha can have untold effects on natural systems and local ecology if its growth is not controlled.

4.3.3.2 Land and land use change (LUC)

In some areas of Zambia, environmentalists reported that Jatropha was planted but the fields were subsequently abandoned when the market was put on hold. Such was reportedly the case in Macha – where in spite of land being taken over by the BIC Church development for a Jatropha plantation, the field was left untended. A full surveillance of these areas has not been done since, and the impact of Jatropha left to grow without bounds or management is unknown. In contrast, other areas have been cleared for Jatropha crops at the expense of natural indigenous vegetation. A respondent from the WWF spoke of the Chisambo area, where mechanised clearing around the Lukanga swamps was done in order to facilitate the planting of a Jatropha plantation. All the native species of plant were removed, but as far as he was aware, no Jatropha had ever been planted. The removal of indigenous plants has the potential to cause immeasurable harm to natural biodiversity and soil erosion if performed on an industrial scale, with localised ecological impacts on insects, birdlife and animals.

In relation to these reported cleared areas, it is crucial that a full life-cycle evaluation is performed in order to understand the amount of land required to be cleared for agro-fuel plantations to be financially feasible. The respondent from MRI-Agro quoted a colleague involved in the biofuels industry as calculating that it requires approximately 40 000 ha of land to be converted in order to create a financially viable Jatropha project. This is mostly because of the fact that other crops are required to be planted in order to support a venture into biofuels due to their long lead time before harvest. Incredibly hopeful initial expectations, such as those of D1 Oils, were that a mature 5,000 ha Jatropha plantation would produce 15 million litres of biodiesel per annum (Wood, 2005). If this were the case, the industry might have had more success, but the disappointing yields and subsequent failure of many biofuel companies proves the opposite. This in itself should be a warning sign for investors and farmers alike, who need to be well-informed and to put in place the relevant buffers to protect their livelihoods. However, it is the scale of land clearing required to ensure such biofuel projects are commercially viable that is truly sobering. The cost to natural biodiversity is expected to be enormous, and thus the approval of EIAs performed for such plantations must be questioned.

Because land is so closely tied to livelihoods and the rural economy in Zambia, another concern is LUC for biofuel plantations. Deforestation and emissions from land-use change for

commercial plantations can contribute hugely to the carbon footprint of biofuels, undermining claims that it is less carbon intensive than fossil fuels. Of course, most biofuels projects in the country have made use of pilot crops, but should commercial or industrial-scale projects become more feasible, environmental impacts could be far-reaching. Land that is viewed as underutilised and targeted for biofuels is often undergoing a fallow cultivation cycle in order to regenerate soil and nutrient quality, and is unsuitable for intensive agriculture (Markelova & Meinzen-Dick, 2012).

Considering the government's push for job creation in the agricultural sector (such as outgrower or contract schemes) to go hand-in-hand with the development of a biofuels industry, it is important to understand the historical overview of traditional agricultural methods in Zambia. Of particular significance in agricultural practices is how the land is cleared and prepared, on what scale this is done, and how it is managed thereafter. The more 'sustainable' the farming methods are, the less damage there will be to the environment. Generally, in larger agricultural undertakings, more destructive methods are used.

LUC for farming reasons employs different methods of clearing in different areas and according to different purposes. For small-scale farming, topsoil turning using a plow and oxen is common in some areas, whereas in others 'slash-and-burn' agriculture, employing fire, cutting of dead organic waste, and methods such as *chitemene,* is used.

The Conservation Manager of the WWF Zambia stated that 'slash-and-burn' systems are in many ways a manifestation of a weak resource management regime that has prevailed in Zambia since pre-colonial days. It is weak due to the fact that it does not encourage security of tenure and has not promoted efficiency in the use of land as a resource. Such a lack of structure makes it both easy and desirable for people to engage in shifting cultivation – once a piece of land has been exhausted, locals simply move to the next piece of land. *Chitemene* is an element of this system of shifting cultivation, traditionally used for clearing land for small-scale or rural farming purposes.

In the area of Zambia where *chitemene* is primarily practised, there is good annual rainfall in excess of 1 000 mm, which prevents possible desertification and the soil is able to retain its quality. Therefore, with *chitemene* systems the area of land returns to fertility, while with large-scale land conversion (LSLC), trees, natural shrubs and grasses are uprooted, soil is overturned, and entire ecological systems can be disturbed depending on the extent of the plantation. Respondents emphasised the importance of demystifying the use of shifting cultivation systems such as *chitemene* in small-scale farming, where the burning of only dry or dead *flora*, waste or excess is used, no trees are uprooted and only the area needed for small-scale cultivation is cleared. Additionally, because branches and other tree parts are collected without felling the tree, and fields are only used for 3–4 years before declining crop yields force abandonment, the *chitemene* system allows rapid regeneration (Chidumayo, 1987; German, et al., 2011b). While such activities may have some environmental consequences, the *chitemene* system is essentially

cyclical due to the re-establishment of vegetation inherent in the process. Thus it is not comparable to LSLC where land is cleared through fire or deforestation for the specific purpose of long-term agricultural production, such as that employed in clearing land for oil palm plantations in Indonesia.

4.3.3.3 Wetland systems

Other issues related to the biodiversity impacts of biofuels include the fact that most agro-fuel crops are water thirsty and require large inputs to maintain their health until harvest. Often biofuels are planted on arable land that previously was used for a different commercial crop such as tobacco or cotton, and need a good water source. The huge water requirements of biofuel crops have been loudly criticised by media and environmentalists, specifically in light of claims related to crops like Jatropha, which supposedly require little water to grow. Other crops that can be used for biofuels, such as oil palm and sugarcane, are notoriously water-demanding. For these agro-crops, wetland areas are often targeted for plantations, with drastic impacts on the ecology, wildlife and natural life cycles of an area. Wetlands perform a range of crucial environmental services to wild creatures and humans alike.

Using the example of conversion of wetlands to palm oil crops in the Northern Province, an academic working at WWF Zambia emphasized that the loss in '*character*' of the area happens to the disadvantage of the specific, endemic functions of that particular region. Sugarcane monocultures have similar hard-hitting impacts on biodiversity. Sugarcane is commercially grown in the Bangweulu wetlands and Zambia Sugar (a subsidiary of Illovo) has a commercial plantation near Mazabuko in the Kafue Flats wetland area, as well as one of the sugar-milling factories. In Mpika, the majority of the area claimed by Zambeef for oil palm planting also fell in a wetland area.

An issue related to the impacts of large-scale biofuel projects on water or wetland systems is that of the run-off of chemical effluent from the plantation or processing facility. Industrial-scale agricultural production of biofuels entails the use of large amounts of agrochemicals and pesticides, with visible environmental issues related to run-off, pollution and pest-resistance. In the interview with the WWF representative, he spoke of how pollution that is flushed out from industrial-scale agricultural industries, such as fertilisers, increase the levels of nitrogen and phosphorus in nearby bodies of water, such as the Kafue Flats region. An important ecological and socio-economic area, the Kafue Flats supports rare and endemic species, as well as many local livelihoods that rely on the Flats for pastoralism purposes, fisheries and wetland-based agriculture (Schelle, Pittock, 2005). Due to the elevated levels of these additive nutrients in the water, an environment conducive to the growth of invasive plant species, such as water hyacinth, *Eichornia crassipes,* and *Mimosa pigra* is being created in nearby waterways and swamp areas. *M. pigra* is known to form impenetrable groves in wetland areas, stifling pastureland and preventing access to waterways. The changed ecological and water-flow regime from these plants in turn affects the growth of native plant species. For example, in the Kafue Flats region,

the WWF respondent spoke of how the *Acacia* plant has increased its expansion into other ecologically sensitive areas, such as grassland needed for grazing, due to the changed water regime of the Kafue River. This can result in a loss of important habitat for vulnerable species, such as the Wattled Crane, of which about 60% of the global population is found in the Kafue Flats region of Zambia. Hatching only one chick every season, these indigenous birds are dependent on wetland system and river floodplain cycles. Investigations into the loss of shallow open water, from a combination of expanding native and invasive plant species from the increased levels of agricultural pollution in the extensive water bodies nearby, has determined that their breeding grounds and feeding habits are being affected. The loss and degradation of the wetland systems has the potential to ultimately contribute to their demise as a species. Alongside the macro impacts of climate change in an ecologically sensitive area such as the Kafue Flats, the loss of wildlife and habitat in a local system can serve to trigger even larger impacts, such as the spread of disease and desertification in areas where animals might converge to seek out water and forage. This was reiterated by other respondents, one of whom stated '*As a case of non-food loss of ecosystem services, the loss of habitat in the Kafue region has implications for the survival of species, changes in availability of fuel wood, and impacts on water and food access for local people and animals*.'

Indeed, another complaint received by the respondent from local communities regarding the expanding *Acacia* growth is that of a lack of space for grazing animals. The Kafue region is a valuable area for pastoralists, but the reduction in grassland from *Acacia* trees is slowly affecting their ability to feed their livestock as well as their travelling patterns. The growth of *M. pigra* also blocks the access to fresh water systems for watering and household purposes. A concern for the pastoralists is where they will find new watering sources, grazing and roaming land for their cattle, sheep and goats should the chemical pollution of the Kafue region continue to stimulate the growth of these plants. Thus, the actual carrying capacity of the land is seen to be indirectly affected by pollutants. Such extensive ecological impacts are not measured in initial EIAs, and even case studies in relevant literature fail to mention the far-reaching impacts that chemical run-off from biofuel crops can have on the surrounding environment. Jatropha is no different, and studies, such as the extensive R&D undertaken by D1 Oils, have confirmed that it requires water and chemical inputs in order to improve yields. Even when planted in marginal or degraded land, fertilisation and pesticide use in Jatropha crops may infiltrate the water table and have longer-term impacts. There is a huge knowledge gap surrounding this issue, particularly regarding impacts in the medium- to long-term.

4.3.3.4 Ecosystem services

The state of development in Zambia exists in relation to the environment, in that there is a high degree of dependence on the ecosystem, particularly in rural areas. As mentioned before, the population has a low density, which means that the number of hectares or space available to every Zambian is relatively high per capita. Where land is converted to biofuel crops, it is often the case that local people may no longer have access to this land, nor the forest or plant products

that grow there. Access to water systems, natural resources or open land for grazing is restricted, and whole communities may need to relocate or adjust their livelihood systems. Products used for supplementary income generation such as charcoal, wood or, in certain areas, creatures that could be used for trade and sale, are no longer available to the local communities. These natural resources are of inestimable value but are not factored into the cost of conversion to agro-fuel crops. The reliance on ecosystem services or products that are thus taken away from local people can have ramifications for both the social and economic competence of these groups to survive. '*Almost every Zambian has a close connection to the environment, and the use of non-food resources is high even if they are not the ones who are directly harvesting products*,' said the respondent from the CSBF. Such estimations are supported by cases studies, such as that of Marli, where the high reliance on forest products contributes directly to livelihood support.

This situation is illustrated with the interesting case of an ecosystem service that is specific to Zambia, as indicated by respondents. In the Northern Province a certain caterpillar (*fikubata* – Nyanje or *ifishimu* – Bemba) is harvested as an alternative source of income and protein in times of drought, when the price of food increases, where there is a scarcity in staple food crops, or for generation of an alternative form of income. Several respondents, with unrelated professional mandates, described the impact of Jatropha crops in this region. When large-scale land conversion to a preferred crop took place in Mpika, certain trees were lost on which these caterpillars forage. As Jatropha takes four years to grow and areas previously used for communal spaces have been taken over by Jatropha crops, locals no longer had access to the forest system that provides them with *ifishimu*. A large proportion of people in the area were directly reliant on these worms and only had a seasonal opportunity to generate income from this ecological product. The complete loss of trees also meant the caterpillar population was not able to rejuvenate for the following year, resulting in this ecosystem product and income system for local people to come under threat.

Such severe impacts immediately demonstrate how detrimental land conversion can be, not only for specific ecosystem produce that works in a seasonal and sustainable system, but also on the ability of local people to enhance their capacity to survive under possibly unforeseen circumstances. Such services may be undervalued by local communities, but as competition increases for scarce natural resources, implications for food security and livelihood augmentation grow more obvious.

It is important to note that local people's ability to sustain their livelihoods is intricately related to traditional use of land to augment livelihoods. As such, the indigenous use of fire under forms of shifting cultivation, such as that of *chitemene*, determines both the degree of forest cover and the prevalence of ecosystem services (timber, bark used in beekeeping, charcoal, medication from roots) and species (edible fruit, caterpillars) that may be of significant socio-economic importance to rural livelihoods (Eriksen, 2007). On the other hand, the respondent from WWF went on to explain, where intensified fire is used to clear large tracts of land for industrial use, damage to ecological systems is significantly more extensive. Besides the loss of wood products,

other non-timber products can be destroyed, such as medicinal plants, vegetables, insects that might be eaten as a delicacy or that might be crucial in a particular ecosystem, tubers used for dietary or cultural purposes, thatch used for homesteads, and the total loss of habitat for certain wildlife species like birds and carnivores.

A related problem is that of restricted access, where the investment entity actually takes control of the resources. This is the concern where a crucial resource used by locals is potentially threatened. This yet again illustrates how the initial implementation of a biofuels project, whether by land-clearing or demarcation of property, has the potential to restrict access to crucial resources necessary for livelihoods of local people.

4.4 Discussion

The issue under examination is how the biofuels industry in Zambia has impacted on local livelihoods and whether the industry can be used to support sustainable livelihoods. Biofuels activity needs to be understood in the context of sustainable livelihoods indicators, if relevant conclusions and appropriate recommendations are to be made.

Case studies highlight issues related to contractual agreements, as well as impacts on economic, social and environmental assets that are likely to affect the sustainability of livelihoods. While the general perception remains positive due to farmer's often hopeful expectations of future returns and additional streams of income, risks and challenges of implementation fail to be adequately conveyed, with rural farmers bearing the brunt of possible industry or market failings. Moreover, inadequate and misrepresented environmental management fails to consider long-term impacts on ecological systems or increased competition over natural resources as biofuel crops compete for land and space, nor the high reliance of rural populations on natural assets.

4.4.1 Economic impacts

Respondents interviewed argued that biofuel-related activity in Zambia has already increased project activity and investment in rural areas, but the impacts have oft-times not been directly measurable. Moreover, some of these impacts and processes need to be studied over time in order to fill in any research gaps – such as the long-term impact of Jatropha cultivation (and the consequent chemical inputs) on water and soil quality. Where biofuels introduce benefits, which can be used by local people to improve livelihoods, projects are generally seen to aid developmental initiatives. Importantly respondents in the case studies pointed out the value of secondary benefits, such as loans, which provide an improvement in resilience and enable farmers to plan against external shocks. Economic development initiatives, such as those underpinning the biofuels industry in Zambia, are seen in a positive light by locals who are eager for an additional stream of income via economic incentives – either through employment on

plantations or outgrower-type arrangements that directly supplement their income levels. Strong market linkages, for example in the form of extension services and a guaranteed buy-back market, or a supported by-products market, can also create economic benefits for local livelihoods.

However, as seen in the case of Oval Biofuels, the success of a project is not always determined by a guaranteed market - even when there was a market, farmers could not meet the targets due to a lack of training and skills. Thus, as the case study on D1's report indicated (2011), market development needs to occur in conjunction with the delivery of training and skills. However, despite their heavy investment into transparency with and skills transfers to outgrowers, D1 suffered from poor end-use quality of the oil produced. It would seem that farmers employed in this manner are somehow incentivised to operate in their own interests and replace the Jatropha feedstock with some alternative oil, possibly of lower heating value.

Market linkages were not always guaranteed for outgrower schemes, but should, however, be a starting point for a project to be viable. In the case of Marli, the monthly retainer amount payable to outgrowers was not included in contracts, while the contracts remained unsigned from the company's side, meaning that Marli was under no obligation to deliver a portion of profit for community benefit. As well as this, the promised security of a market was not delivered. Farmers were unable to dedicate more than 1 ha of land to Jatropha cultivation. Yet when the NGO (SNV) stepped in to support farmers in Mungwi, they were able to expand the land dedicated to Jatropha cultivation because of the secure market provided by SNV. Interestingly, in Mungwi, the market provided by SNV resulted in better yields because of improved management of Jatropha crops (94% survival rate) in comparison to Chinsali (67% survival rate) where there were no secure market linkages.

It is also important to consider the support offered in the development of a by-products market and in training and marketing received from SNV in the case of farmers operating under the outgrower scheme with Marli. Whether the demand created by such market links is enough to sustain the large number of farmers employed in outgrower schemes (25 000 in this case) is yet to be seen, but this set-up is a crucial source of support and needs to be integrated into future considerations. This is an important consideration particularly because direct employment for biofuels plantation seems to be seasonal, as well as because the long lead-time before harvest (of Jatropha in these case studies) has led to disappointing returns to labour.

In fact, cases have been reported by respondents where initial employment has decreased over time as the investor company deals with unexpected challenges. These challenges can be anything from a lack of infrastructure or service delivery, to macro problems associated with the world economic climate, as was the case with Marli. In support of these findings, a case investigated in Brong Ahafo (Ghana) by German et al. (2011a) reveals a similar situation, whereby employment was offered and seen as a positive benefit. The initial promise by the investor was that 75% of the workforce would be made up of local people; however, at the time

of research only 16 people from the six affected villages had been gainfully employed at the plantation, while more than 73% of respondents (of which there were 63) indicated their standard of living had decreased due to the investment, their subsequent loss of land, and inability to diversify livelihood activities (German, et al., 2011a). Thus, whether or not the company considers the employment offered to local people to be sufficient, its' operations must be weighed against the high cost to households who were affected but unable to gain employment or a means to counter their loss of land and land-based livelihood activities.

High expectations created around the outgrower schemes are possibly responsible for farmer's commitments to such schemes, in spite of the length of contracts. In the case of Marli (30 years), this is of particular concern, considering that the economic downturn affected the company's ability to pay field officers, and were not seen or contactable for a critical amount of time in spite of two years' worth of Jatropha yields. Returns to labour remained low, based on low market prices and low yields. Likewise, in the plantation scheme investigated in Ghana, it was found that greater returns to labour were obtained from primary crop cultivation than from employment (110% per ha value of employment). However, on average, land holdings were decreased by more than half and some households (mostly those of settler farmers) become landless as a result of the plantation. In the case of Macha, the provision of labour to 113 local people through the investment was a positive benefit but did not offset the loss of land for the 222 households who were resettled. The direct loss of land in this example was the biggest impact on households; the quantity of crop yields decreased significantly and in some cases, no land compensation was indicated (see **Table 4.2**). Many of those evicted also had to close their shops where they sold produce, further disabling their ability to support their livelihoods. In all cases, ownership of livestock decreased (**Table 4.3**), leading to food insecurity, as well as associated social issues.

Without the right policy and governance support for regulatory purposes, it is difficult to monitor investor procedures or gainful employment, maintain market linkages, and, in the case of outgrower schemes, ensure that prices are guaranteed. It is particularly difficult to monitor whether investors are compliant with their contract terms, particularly in the long-term in order to support the sustainability of rural livelihoods. Under outgrower schemes, a set buy-back price is valuable in that it guarantees a certain level of income that can be predetermined by farmers. However, it is only beneficial if the harvested crop has a value that exceeds that of an alternative crop being cultivated and/or the associated income. It was found that where farmers were left with feedstock and no guaranteed market, they were able to generate more income from the sale of by-products. This can have interesting repercussions for the proposed biofuels industry set-up in the context of the promoted outgrower scheme in Zambia – would farmers still be satisfied selling feedstock to investors at a guaranteed price if they could earn more from the by-products market? Important questions around the biofuels by-product market need to be investigated and answered. Nonetheless, local enterprise and market development is crucial if outgrower schemes are to be seen as a viable, sustainable livelihood choice for farmers and support returns to labour.

In terms of food security, while in some cases Jatropha was dedicated to marginal land as per recommendations, and food crops were transferred to new 'opened' land, thus increasing yields, the indirect loss of access to land and forest products, and subsequent increased competition for dwindling natural resources, has not been incorporated into studies. People are losing access to natural assets and ecosystem services such as medicinal plants, fruits and edible products that would normally be used to supplement their livelihoods. The impact of such loss seems to be underestimated by local people themselves, while they consider the forest products 'abundant'. Nor do the case studies examined, or other literature, adequately measure or project the long-term effect such loss will have on livelihoods. In the case of Marli, deforestation and and a decrease in availability to forest products was directly observed by 56% of respondents in Mungwi. No respondent in Chinsali mentioned such observations, possibly due to there being less vested interest in Jatropha cultivation due to loss yields in this area – and thus less land conversion for Jatropha. In the Ghana case study, the loss of forest products due to Jatropha plantation expansion was considered to have had a significant impact on households, with a 90% decline in income generation, which affected 98% of households, reported. The high reliance in certain areas on forestry activities and forest products for food and income generation is bound to be affected by continued biofuel expansion. Furthermore, there are many 'worst case' examples reported, such as that of Macha, where loss of land affects people's immediate ability to supplement their food security and livelihoods by farming or livestock rearing. While in the case of Zambia efforts have been made in policy implementation to avoid such instances, it nonetheless is a possibility that where investment into biofuels has been irresponsibly managed there will be ramifications on food security for a local population.

D1 Oils, through their extensive R&D programme in Zambia, confirmed that, if planted on marginal land, Jatropha will only produce marginal yields, and that the crop requires as many inputs as a traditional agricultural crop. Indeed, as pointed out by respondents, the majority of Jatropha cultivation done by investors was on new land – that is generally more fertile and may lead to higher yields. This may have implications for future biofuel crop placement and competition with arable land required for food production. In the case of Marli, improved soil fertility was cited as a positive impact from Jatropha cultivation, due to higher yields of groundnuts when intercropped with Jatropha. This is likely due to the shedding of Jatropha leaves which is incorporated into soil during land preparation for planting. Without adequate information dissemination, farmers will not be able to access food production benefits such as these from intercropping techniques. These techniques need to be seen as adding to the skills base of farmers, and protecting food security and possible income. This is especially important in light of D1's findings that Jatropha seedcake can successfully be used to increase the yields of some staple food crops such as maize and groundnuts.

Ultimately, views are divided in Zambia over whether the biofuels industry will introduce food insecurity. The debate reflects differences of opinion as to whether the biofuels market can sustain vulnerable communities. Owing to the large contribution of small-scale farmers to the

national food basket, concerns regarding food insecurity have been raised and have contributed to governmental delay on biofuels policy. The price of food is a serious concern for local people, meaning they are often reliant on the produce of their own lands for nutritional needs. Any plan for biofuels requires a five-year buffer, regardless of droughts and floods, due to growth and production time periods, as well as relevant analysis on the impacts of such crops on annual food security. In the case of Macha, food security decreased significantly. This is in direct relation to the loss of land and livestock due to the acquisition of communal land by the BIC, and the affected households resettlement. However, in the case of Marli where farmers were in control of Jatropha crops through the outgrower scheme, food production was found to be astonishingly robust, and farmers were able to remain in control of their food production under a dynamic system. This can be said to be due to the new land opened for displaced food crops, where food crops were planted on high quality land, as well as the increased yields from some crops when intercropped with Jatropha. An important point here would be that where farmers are directly in control of their food crops and responsible for their own households' subsistence, they would not automatically convert land reserved for food crops to cash crops, such as Jatropha. They were also able to make informed decisions on intercropping where information was provided to them, and thus their groundnut yields were increased.

Investment will always have profit-driven goals at its core. Even where biofuels projects have lofty standards or aim to provide developmental assistance to locals, it is not their ultimate responsibility to deliver economic reform to poor or rural communities. However, when adequately supported by relevant policies, the biofuels market does have potential to eventually create jobs and socio-economic benefits, as originally envisioned by the Zambian government. A number of pertinent questions were emphasized by many respondents - '*how sustainable jobs will be and what type of jobs will they be; what will be the proportion of skilled, semi-skilled and unskilled labour in the biofuels market; will the jobs be seasonal, permanent or contract; and will they add to economic and poverty alleviation goals etc*.'

The potential positive spin-offs from the industry were reinforced by a respondent from the NRCF, who maintains that with a guaranteed market, well-laid-out processes and a strong legal framework, arrangements such as the outgrower scheme can potentially create many jobs and an income for small-scale farmers, as well as support the energy policy for sustainable development in Zambia. Despite low calculated returns to labour, it is interesting to note that the investment in Jatropha in the Marli case study (as well as in other substantive studies such as that undertaken by German, et al. (2011a) in Ghana) is perceived to have had an overall positive effect on livelihoods. It is especially important to note that secondary benefits (e.g. access to loans and secure monthly income) are considered to be of most benefit by respondents. This indicates a contribution of employment to improving resilience and reducing vulnerabilities to external shocks.

However, much uncertainty remains around the ability of the industry to create sustainable employment opportunities that meet governmental objectives of poverty alleviation and the

distribution of economic benefits. While the industry is on hold in Zambia, it is important for all involved to question the benefits and costs of biofuels, specifically in regard to the sustainability of rural livelihoods.

4.4.2 Social

Where there is little policy support for the biofuels industry in developing countries, impacts on social capital are possibly felt most acutely by those who have limited livelihood options. From a social aspect, cultural hierarchical systems play an important role, not only in industry investment, but also in how benefits are distributed - whether certain segments are adequately represented in investment negotiations and whether their needs are met. The national and local administrators typically act as the mediators of land deals with outside parties, and the deals can include associated 'kick-backs' for their involvement. For example, contracts under investigation in the investment scheme in Ghana specified a portion of profit (25%) to be shared directly with the traditional council (German, et al., 2011a). It can be understood that such a significant profit-sharing scheme will only benefit the council, and is seen as direct payment for their agreement and approval of the biofuels scheme. Such payments promote the interests of only a few at the cost of many. In addition to their already insecure position in terms of land rights, there is typically no legal specification to achieve free, prior and informed consent of local landholders before land acquisitions take place (Cotula, 2011). Investors do not face any consequences for cutting corners in the consultation process, and there seems to be no specification on community representation at the consultation in any case studies examined. In the context of the weak institutional background and lack of any form of biofuels policy, this might not be labelled as corruption; however, it certainly would not seem to be in line with domestic objectives for rural development and poverty alleviation, the reasoning that underpins the welcome flow of FDI into rural areas by government. Furthermore, where the contracts remain unsigned by the investor, there are no binding commitments on the investor, leading to an almost inevitable failure on the investors' part to meet any community expectations regarding the possible biofuels project, as was seen in the case of Marli.

Non-delivery or delays in delivering on promises may give rise to frustration on the part of the local community and ill-feeling towards the investors. Even higher levels of agitation are felt by local people when socio-economic impacts contained in the transfer of land, such as crop change, loss of land or relocation, result in a worse standard of living than prior to the investment, such as with the case study investigated in Macha. This happens frequently when, aside from 'guaranteed' infrastructure and employment benefits, there are also economic advantages and livelihoods at stake. As in Macha, a worse standard of living can include further distances to walk, decreased access to water and other natural resources, loss of land, crops and in some cases livelihood, and resettlement from traditional or ancestral land. All these impacts may lead to dispossession and increase socio-economic vulnerability. Another example is the case of Zambeef – one of Zambia's largest agri-businesses – that acquired approval for a leasehold title

for 20 101 ha of land for 99 years in Mpika province. Research into the situation revealed that 45 families were displaced; two villages nearby also claimed that their land had been encroached upon by the development. While the displaced families were compensated in cash, and a royalty agreement is in place for a Community Development Trust, other households that suffered impacts from the project were not compensated. Furthermore, reports indicate that the local chief and those close to him gained the lion's share of benefits in terms of the payout, with the chief receiving a monthly salary and a car, despite the fact that his village remains unaffected by the development (German, et al., 2011c).

As respondents and the case studies reveal, in the implementation of biofuels investments certain members of a community are left out of the consultation process entirely, limiting their voice or representation in the deal. This critically violates their right to prior, informed consensus, and it is likely none of their needs will be met should the trade take place. This may ultimately result in much conflict between the land users and company, as well as resentment towards any local authorities who may have had the means of preventing such obvious exclusion. Interestingly, in many cases, discontent is not alwaysy directed at the local chiefs as the purveyor of the biofuels plantation project, in spite of the limited benefits negotiated by chiefs on their constituencies' behalf. However, in the case of Macha, local people believed their chief could have done more to prevent land evictions. It is also of concern that the chief was given an amount of money by a local committee contesting the evictions, but no report of how that money was used was given by the chief, particularly worrying as the chief did not attend the High Court ruling as a representative for the evictees. Despite the chief being opposed to the evictions, his actions did not lead to positive outcomes for his constituencies. Where chiefs are responsible for the negotiations over land with investor, it is crucial that they represent their communities. It is of the utmost urgency and importance to improve the legal process of consultations to include communities, as well as to smooth the policy implementation of the transfer. It can be seen that communities are open to investment but not to being taken advantage of. Even where farmers are signatories to contract agreements, as in the case of Marli, it does not mean the agreement is automatically fair and equal to all parties. When promises are unmet and local needs are not understood, strife and conflict will follow – as in the cases mentioned by respondents where farmers burnt their fields.

A related issue discussed in interviews with respondents is that the value of monoculture crops such as Jatropha and sugarcane are often not discussed upfront with local communities, who are expecting a promising income from producing crops for a biofuels project. It is only once implementation is complete and operations have begun that local people might realise there is little benefit from growing and selling low-quality monocultures like Jatropha and sugarcane, and the price they are paid for them is very little or unguaranteed. This lack of transparency results in major tension between farmers and biofuels investment companies. It is often both the company and government who hold information back, and details are kept vague, leaving farmers who have converted their crops feeling frustrated and cheated out of income. While they

have limited powers to challenge the conditions of licensing once approved, this feeling of disempowerment can lead to ongoing conflict with the investor. Moreover, research has uncovered that other, indirect, social tensions and conflicts are likely to arise in the implementation of agro-industry like that of biofuels. In the case of Marli investments, farmers, disappointed by the lack of services, training and inputs provided by Marli, directed their frustration at the field officers. It is concerning that both farmers and field officers suffered as a result of non-payment from Marli, and carried the majority of risk, yet the resultant tension was targeted towards the field officers alone. Such tension can breed local conflict and create a break in relations that may not be repairable; even should the project be revived.

Further issues related to social capital is that of gender bias in the implementation of the biofuels industry. This is particularly associated with the use of marginal land for biofuel cultivation – and the impacts that the loss of these lands has on women, given the importance of marginal land in growing supplementary food and cash crops. This problem becomes more worrying where men are seen to then 'take-over' the cash crop (e.g. jatropha) – leaving women with less land and less potential for income-earning activities. As was the case of North Western Biopower, subsistence efforts were halved when men took over the cultivation of Jatropha, leading to a localised food problem when the bottom fell out of the market. Problems associated with gender bias could potentially lead to food insecurity impacts. The extent to which marginal land, often converted for growing agro-crops such as Jatropha, is of use to local livelihoods is a critical issue that deserves further attention. This is particularly the case for a country like Zambia, where women contribute to the majority of staple food crop production. It is of crucial importance that women are involved in community consultations with biofuels investors and have an opportunity to voice their needs.

Moreover, the significance of engaging in communal labour will manifest in greater livelihood impacts should markets improve and more time is invested in biofuel plantation management. A comparison can be made to the harvesting of forest products, such as caterpillars, for which school children are employed during harvest time (see Appendix D) – losing out on education during these periods. The use of communal labour may thus have further impacts on social aspects, not yet covered in any studies examined. A point to be made is that civil society groups are very important in the implementation of biofuel projects, in order to act as a voice for the communities affected and ensure industry players are held accountable, as well as to monitor investments and community perceptions.

4.4.3 Environment

In terms of environmental impacts, it was found that in Zambia the risks of the biofuels industry have thus far been borne, in the majority of cases, by smallholder farmers themselves. This is particularly the case where land has been lost, decreased in size or dedicated to non-food crops through land investment. Land is the main natural asset for use in livelihood support and generation of food supply and income in rural areas in Zambia, and the long-term impacts of the

loss of land have not been adequately measured. Both direct and indirect land use change were observed as a result of investment into Jatropha. In the case of outgrower schemes, direct land use was as a result of the integration of Jatropha into permanent fields, the clearing of mature forest, and the opening of fallow land, either for Jatropha or displaced food crops. In the case of Macha, the direct conversion of crop land to a Jatropha field resulted in direct land loss for households. The high association of Jatropha to the conversion of Miombo woodlands (44%) in the case of Marli is very concerning, particularly related to the perception that the loss of access to forest products is not significant. Zambia already suffers from high deforestation rates, and the continued expansion of biofuel crops into natural forestland is unsustainable. Such expansion, whether done on a small-scale and necessitated by farmers who need land for displaced or investment crops, or performed on a large-scale by commercial projects, will surely have severe repercussions on access to ecosystem services, forest products for food or income supplementation, biodiversity and ecological functions related to water and soil systems. When the natural resources are expropriated out of the hands of local communities and transferred to investors, it precludes them from generating alternative sources of income or supplementing their livelihoods, as is the case with *ifishimu*.

It would seem that the substitution of biodiversity and indigenous ecology with that of monoculture crops has far-reaching impacts that may not even be calculable were EIAs to be performed adequately – which they are not. This substitution reduces the natural resilience and may have serious implications for food chains, wildlife, plantlife and carrying capacity of a region. In Zambia, the impacts of land conversion are negligible for the majority of pilot studies, but had entire leased areas been converted as originally planned, the impacts on biodiversity and the ecology, including changes in water pH and availability, would have been incalculable.

The lack of understanding of the value of environmental services in relation to the biofuels industry in Zambia is as a direct result of poorly conducted EIAs. Institutional capacity to monitor the EIA process remains weak, and this extends into the monitoring of implementation on the ground. The level of compliance to an EIA should be adequately suited to specific areas of project implementation, tackling issues related to ecological or social fragility on the ground.

In the context of land use change, large-scale biofuel plantation often entails the use of fire for land clearing. Fires used to clear vast tracts of land for monocultures burn seeds and can kill sedentary or slow-moving creatures (Fitzherbert, et al., 2008), extending the damage to biodiversity. The complete loss of certain species of insects, birds or animals that belong to a specific biome can have devastating impacts on localised ecology, such as the possible loss of the Wattled Crane in the Kafue Flats region. There can be no confusion between systems such as *chitemene,* used in Zambia as mentioned in the Marli case study, and systems used for large-scale land conversion. Large-scale land acquisitions, seen in some cases in the biofuels industry and understood to be very likely in the future, are driven largely by commercial interest in response to global markets. The *chitemene* system, on the other hand, is anchored in communal land-ownership systems and is based on a very small scale. Although not a ‘sound’ practice in

environmental terms, it works due to the fact it is on a small scale, usually in heavily wooded areas, with very small populations or people per square metre. In Zambia, the use of *chitemene* is furthermore employed in areas of good rainfall, ensuring that the local environment is able to regenerate and local people are able to continue to make use of the natural resources available to them.

It was discovered that in some areas of Zambia, the use of LSLC to clear land for Jatropha plantations resulted in the loss of natural forests, and furthermore, the land was left barren and unused for the purpose of Jatropha cultivation. Such unjustified conversion of land, if continued on a large-scale and without adequate EIAs in place, will place a significant burden on ecosystem provisioning for local biodiversity and livelihoods. This issue needs to be considered in light of the fact that Zambia already suffers from high levels of deforestation and poor soil fertility. Furthermore, it was mentioned in several interviews that Jatropha, a non-indigenous plant, has brought about new pests and diseases to contend with alongside other developmental aspects of the biofuels industry within developing countries. These findings were reinforced in a statement by D1 Oils - '*Like any crop grown on a larger scale Jatropha is also confronted with region-specific pests and diseases'* (D1 Oils, 2011).

Other studies support findings on the far-reaching implications of biofuels projects on the access to forestry activities and ecosystem services. For example, in a study undertaken by Nhantumbo and Salomão (2010), it was found that in the case of Elaion, a biofuels project in Sofala Province (Mozambique), Jatropha crops were planted once the natural forest had been cleared. The timber products from the cleared forest were used to make charcoal, precluding the local community from accessing this income-earning activity for themselves (Nhantumbo & Salomão, 2010). Not only does this affect the availability of this important fuel source for rural people, but the commercialisation of the charcoal can link it to market forces of supply and demand which '*will determine who will have access to it*' (Wegerif & Tandon, 2013).

Other direct impacts of biofuel projects on natural assets is that of the use of fertilisers and other chemical inputs needed for agro-crop cultivation. Respondents reiterated the concerns regarding a lack of analysis of long-term impacts of large monoculture crops on biodiversity. Other research validates their concerns. In their study on the localised social and environmental impacts of biofuels across several countries, German, Schoneveld, Skutch et al. (2010) found that the heavy use of pesticides, discharge of chemical effluent and increase in erosion and siltation from commercially grown biofuels resulted in declining water quality for local residents at one of the sites investigated. Due to chemical run-off, biological degradation takes place from overgrowth of aquatic plantlife or imbalances in natural ecological systems and the common good will suffer as a result. Where aquaculture resources become threatened it can lead to increased food insecurity for local people and animals dependent on these systems. The sustainability of aquatic and wetland systems is based on the purity and health of those systems. The more polluted the system, the less likely it is to be available for future use by animals and humans alike and the more likely to encompass far-reaching damage to biodiversity.

It is not unimaginable that the findings in Zambia related to the Kafue region could be extrapolated to other countries that have priority setting for agri-investment. Countries like Mozambique, Kenya and Tanzania are reliant on large lakes and water systems that stem from other countries. In Matavel et al.'s work (2011) in Mozambique, a systemic study on access to clean water was undertaken. It was discovered that most communities and respondents made use of the closest rivers as a primary source of water. Many activities, including the collection of water for human consumption, relied on these water sources, subjecting the communities to the risks of using untreated or polluted water (Matavel, et al., 2011). It is important to note that the growth of invasive plant species as well as the pollutants in wetland or river systems due to increased use of fertilisers on commercial plantations can include serious repercussions for fisheries and aquatic resources for these countries, and have further, long-term implications for food chains where chemicals are ingested and cycled through entire ecosystems - impacting on the health and quality of water systems.

This is an important consideration for the Zambian government, due to the latest focus to build ethanol refineries and blending facilities to meet petrol blending mandates, as seen for Zambia Sugar's Mazabuko production plant situated in the Kafue Wetlands area. Where the biofuels strategy was previously focused on planting Jatropha on marginal lands, the MoU signed between the government and Zambia Sugar could possibly be seen as an economic indicator to investors and commercial farmers signaling a move away from outgrower-based Jatropha schemes to sugarcane expansion. The investment in such facilities could potentially lead to the encouragement of large-scale land use for sugarcane production in wetland areas, with severe ramifications for the health of local ecology and the sustainability of livelihoods of local populations who depend on fisheries and aquatic systems for food and income purposes.

5 Conclusion & Recommendations

Chapter Five presents the conclusion and recommendations as a prerogative in answering the objectives of this study (as presented in section 1.4) according to the SL theoretical framework and relevant indicators (economic, social and environmental), discussed in Chapter Two and through the methodology described in Chapter Three. The specific conclusions that can be drawn in answer to the primary objectives are followed by an overall conclusion, and the chapter is closed by recommending further academic work that can be taken in the context of this subject matter.

5.1 Local policy context of the biofuels industry in Zambia

Biofuels development in sub-Saharan Africa are pursued by governments wishing to achieve economic growth, agricultural improvements, food security, poverty alleviation and a number of socio-economic goals aligned with improved land production. Carefully constructed and managed biofuels projects can, in some cases, lead to employment, skills and livelihood opportunities for local land users who would otherwise not have an additional source of income. Thus, most governments in Africa have welcomed the flow of foreign investment via the introduction of land acquisitions for biofuels, believing it will lead to agricultural reform, poverty reduction and improve economic performance.

It was found that government objectives in Zambia were no different. The introduction of agricultural-based biofuels projects was intended to promote government targets of agricultural reformation and poverty alleviation and the potential of agricultural investment to enhance economic productivity. Hence, specific initiatives such as the FBDs and MFEZs in Zambia were developed in order to encourage the implementation of outgrower and other employment schemes in rural areas.

However, it was found that the biofuels industry has had very little success in despite the capital-intensive investment of some companies. Industry is profit-driven, and thus priority is given to financial targets and not state objectives for socio-economic upliftment. Considerable start-up costs, long lead times or time constraints, and infrastructure deficits have hindered investment potential, while macro issues such as the global downturn have resulted in the disinvestment and consequential failure of many biofuel projects. Poor policy support translated into investors being responsible for every activity along the biofuels value chain. A lack of technical support and skills, and poor information dissemination resulted in farmers employed in outgrower or contract schemes being unable to meet market targets, and uninformed about alternative uses for the feedstock in cases where the market failed.

Without the relevant government willpower and legislation, it would seem the biofuels industry in Zambia will continue to only have limited success on a very small-scale in cases where there is a guaranteed market and farmers have access to sufficient information and assistance. The latest drive by the Zambian government to set up ethanol blending facilities indicates a possible change in strategy to promote ethanol as a biofuel to address high fuel prices in the country. This change in strategy is an acknowledgement that facilities which have already achieved economies of scale in operations might be more economically feasible for the biofuels industry, such as sugarcane processing plants.

A lack of strong policy governance and appropriate support for the industry in Zambia is the largest challenge facing development of a successful biofuels sector. Where support was offered and relevant information passed on, in the form of civil society organisations and NGOs, local people were able to make choices that sustained their livelihoods and helped them adapt to their changing environment. Landholders remain open to investments but require the necessary market linkages in order to profit from biofuels industry investment through outgrower schemes or employment opportunities. Within the right policy context, local people can benefit from such livelihood opportunities, if investors are monitored and held accountable. Overall, however, the biofuels industry has yet to contribute towards government goals of poverty alleviation in Zambia.

5.2 Opportunities and risks of the biofuels industry on sustainable livelihood indicators in Zambia

Economic

Entrenched in the challenges the biofuels industry faces are those relating to weak land tenure systems and governance. It was found that where land has been converted from communal to commercial ownership under sale or lease agreements in Zambia, it was seen as a strategic and economic loss to the local land users who do not have formal tenure. When land is acquired by a private entity it deprives local people of the opportunity to make use of the reallocated land resource for their livelihoods. Access to natural resources, ecosystem services and products was constrained, such as that of *ifishimu* in the Northern Province of Zambia or charcoal production used as an alternative income generation for rural households. Communities were found to suffer from a subsequent reduction in welfare.

Employment benefits have been few. Little information was provided on the further use of the oil produced, thus excluding some smallholders from the profitable by-products market when the biofuels market was put on hold. Coupled with these issues, a lack of experience and technical know-how in growing agro-fuel crops resulted in many of the original biofuel crops failing, resulting in poor yields and disappointing returns for small-scale farmers.

Food security continues to be a concern, however, there is a level of uncertainty regarding the extent to which food security is affected. Market linkages may dictate to farmers what crops to plant in order to meet the market demands. Information on how intercropping can be used to increase yields of other (food) crops was not disseminated and thus many farmers continued to lose out on possible advantages of growing this crop.

Social

Under weak community land tenure, local communities have very little legal standing or recognition, nor do they fully understand their rights or capacity to claim compensation for loss of land or access to natural products and services.

Land acquisitions and investments for the development of agro-fuel crops has often been characterized by conflict or social tension. Very few positive outcomes for local people have been achieved. This is mostly due to inadequate consultations with local communities, while the implementation of projects and contract terms by investors has not been monitored or enforced. Contracts did not specify binding terms. Where compensation was offered, it was typically given over to only political elites due to corrupt processes, while the larger community suffered from a loss of land and tenure. Many land deals took place to the disadvantage of local land users, particularly for women – signaling significant gender impacts in the implementation of biofuel projects and a lack of understanding of the important role that women play in the agriculture sector in Zambia. It was found that where biofuel projects demarcated property, women lost access to marginal lands and forest products that are crucial to livelihoods.

Environmental

It was found that investors' environmental impact assessments were very poorly carried out and inadequate to a large extent. Many impacts of biofuel projects on the environment remained unquantified. The example of the Kafue Flats wetlands system in Zambia is a case in point.

Large-scale land use change or conversion for commercial biofuel plantations like Jatropha was responsible, in many cases, for the substitution of natural vegetation of high carbon stock value and biodiversity with a monoculture crop of little structural complexity and low sequestration potential. A loss of forest products and ecosystem services crucial to the provisioning of rural livelihoods was also found to be a major issue. Impacts of environmental degradation need to be seen not only in an apparent sense, but from a long-term, analytical perspective.

5.3 Overall conclusion

Without the full framework and structure of strong policy measures, successful implementation of a project has been left to the discretion of the investor. Where farmers have lost land to the plantation, the impact on livelihoods has been most severe – with implications for income and food security. It cannot be expected that small-scale, rural farmers can recover from such lost income or land use fully.

It was discovered that where projects have been implemented, local people or communities have carried the burden of various negative impacts on their livelihoods, without adequate compensation. Very little protection for local land users was offered and, while governmental objectives specified the trickle-down of investment benefits to local people, contradictory policy regulations allow the full repatriation of profits by investors. Despite these outcomes, local communities and leaders are often open to land investments, believing promises made by investors in initial consultations that infrastructure and services would be delivered and economic opportunities would follow.

Alternative energy agro-fuel crops such as Jatropha cultivation in Zambia has perpetuated poverty-related issues through the expropriation of natural assets used to sustain local livelihoods, such as land, water and forest products. The impacts of land acquisitions for biofuels has led to possible loss of land for local communities, deforestation, agrichemical usage and pollution, conflict and the loss of social cohesion in many cases. Results from biofuel investment in Zambia could be extrapolated to other sub-Saharan African countries. Results have found that the acquisition of land for biofuels cultivation – whether through outgrower schemes or plantations – introduces a new set of risks for local people to contend with.

The findings of this study show that thus far, the disadvantageous impacts of land acquisitions for biofuels in Zambia currently outweigh any real net benefits of the few small-scale projects where some success has been achieved through outgrower schemes that receive strong technical support. It is up to state authorities to monitor and ensure this delivery of benefits, however, even where smaller biofuel farms have had some success, indirect impacts on livelihoods have not been taken into account or examined in detail.

The impacts of biofuels investment on the sustainability of local livelihoods has been severe, regardless of the scale of projects. In Zambia, negative impacts are seen to initially stem from a lack of information and poor dissemination of the benefits, risks and shortfalls of the biofuels market, including the lead-time before harvest is possible for Jatropha, the primary crop promoted for the market.

In Zambia, it would seem that crops such as Jatropha grown through outgrower schemes have thus far not improved resilience, and that the market failings undermine the potential economic value that the cultivation of these crops could generate. This can be observed directly in the disappointing yields, failed market linkages and lowered buy-back prices, and indirectly in the form of low returns to labour and plantation employment levels as discussed in the case studies and reaffirmed by respondents.

The Zambian government has ostensibly put the industry on hold, acknowledging how underprepared it is. It would thus seem that biofuel agri-projects are not a solution for governmental goals of agricultural reform and poverty alleviation in rural areas in Zambia.

5.4 Recommendations

Through the research process, key issues were identified that remain central to the issue of livelihood sustainability under the introduction of biofuels project. While this research highlights the importance of participation and local representation in negotiations, investor accountability, knowledge sharing, market linkages, adequate EIAs and overall need for policy support in an introductory market such as that of biofuels, further work is needed.

It is recommended that future work should focus on:

5.4.1 Valuing ecosystem services in the context of biofuels development for rural areas

The misrepresentation and misunderstanding of the importance of ecosystem services for supplementing livelihoods is a major cause for concern, particularly related to the environmental impacts thus far observed in the biofuels industry in Zambia and the high reliance of livelihoods on these services. Although the industry has been put on hold, the new strategic direction towards ethanol from sugarcane has implications for local ecology, particularly that of wetland areas necessary for expansive sugarcane production. Long-term ramifications on livelihoods and biodiversity can be severe, as described in the case of access to water in the Kafue Flats region.

The value of marginal and forested land to local livelihoods, and specifically to women's income generation, as well as access to water systems was consistently found to be underestimated by investors and rural people themselves. It is recommended that a full valuation of ecosystem services (including provisioning services such as forest products and regulating services such as water filtering and soil fertility) is performed in a rural context in order to attempt to gauge the long-term measurable costs to livelihoods when these services are affected by land acquisitions for biofuels. While debates around the ‘monetising’ of ecosystem services abound, it is important that this discussion is introduced into a biofuels setting.

5.4.2 Long-term scenario planning for different biofuel models in SSA countries

It is recommended that an understanding of the *specific* value that different models of biofuels development can bring to local communities is adequately calculated across elements of livelihood indicators. While some methods of measurement (e.g. life cycle analysis, strategic niche management) have been conducted in terms of economic and (occasionally) environmental costs of biofuel plantations, there is inadequate information related to specific costs and benefits of other forms of biofuels development, such as outgrower schemes, faced in rural areas in SSA. The deliverable value of a biofuels project must be measurable and not only take direct economic factors such as returns to labour or salaried employment into account, but also the risk of long-term external changes such as market forces exerted on subsistence farming.

Livelihood benefits that are deliverable to a community need to be calculated as function of long-term planning in certain industry models, particularly important considering the lead-time for crops such as Jatropha. Benefits and risks of different biofuel crops, and an understanding of potential issues such as lead-time before maturity, cultivation techniques, capital inputs, scale of endeavours, and the economic allure of conversion to crops higher in oil content (including those of food crops) by small-scale farmers in order to meet feedstock targets should be adequately accounted and planned for. The by-products market was seen to be particularly lucrative in Zambia, yet it is not adequately understood how the attractive by-products market (and higher earnings potential from it) will affect employment schemes, such as that of the outgrower model, should both markets be a viable option for local farmers. It would important to measure or at the very least link a full costing to an issue such as this. This is because the by-products market was only introduced where biofuel production markets failed. Accuracy on production methods, types of biofuel crops, impacts on the asset base of local livelihoods, and the strengths and weaknesses of the industry need to be clarified in all circumstances, and a long-term scenario model could potentially aid the development of the industry in a SSA context.

Appendices

Appendix A: Research questions used in in-depth interviews

1. Biofuels in Zambia

1.1 How much land has been converted from other uses to biofuel plantations in recent years i.e. from sugarcane for sugar production to sugarcane to biofuel production (rough estimate)?

1.2 Of this land, how much of it was previously used for food production i.e. not tobacco or other non-food crops?

1.3 How have environmental impact assessments (EIAs) affected land use change or investment in Zambia, if at all?

1.4 Which plantations are actually in production in Zambia and are proving to be profitable?

1.5 If so, what are the main markets and who is profiting?

1.6 What is the refining capacity of Zambia?

1.7 Are there plans to increase refining capacity?

1.8 Are biofuel plantations creating jobs and other socio-economic benefits?

1.9 In terms of fuel use, how much energy do biofuels contribute to national energy use or purposes?

1.10 Which crops, if any, have proved successful as biofuels crops?

1.11 In areas where rural farmers have committed to growing biofuel crops (e.g. jatropha/sugarcane/cassava) on their own land have there been any measurable impacts on

i. Food availability

ii. Employment

iii. Increase in social welfare

1.12 Besides these, what are the observable impacts of biofuel plantations on surrounding environment/biodiversity and of immediate concern?

1.13 Is one able to separate the impacts of biofuel plantations out from those of

mining/tourism/forestry impacts in Zambia?

1.14 What are the environmental/social standards of land investment for biofuels in Zambia compared to the main export markets?

2. Ecosystem Service Impacts

2.1 Regarding land investment for biofuel plantations that you are familiar with, and in your opinion, what has been the extent of the land use change that has been undertaken i.e. clearing/burning/topsoil turning?

2.2 Besides the actual plantation, has there been a noticeable change in the types of plants that now grow naturally nearby (e.g. indigenous vs. exotic, invasive vs. non-invasive), due to a change in water or soil constituency?

2.3 Are there insects, weeds or other pests now prevalent that were perhaps not there before the land use change for biofuel investment?

2.4 Have residents or land users mentioned any change in their access to water or availability of water since the land use change for biofuels?

2.5 Have there been any changes to household livelihoods that could be attributed to soil changes or water availability?

2.6 If so, what have been the noticeable household level impacts on livelihoods e.g. staple diet/water-use/sanitation/self-determination?

2.7 What is the importance or significance of non-food ecosystem services to local livelihoods?

2.8 Are there any noticeable impacts on non-food ecosystem services after the land use change for biofuels, such as:

i. Forest products

ii. Charcoal production

iii. Timber for construction

iv. Fuel wood

2.9 Are there new forms of livelihood now available to local communities due to the land use change for biofuels?

2.10 How is this different to the possible variety of original livelihoods available prior to the land use change?

3. Policy & Governance in terms of land management/tenure

3.1 What is the policy objective of land investment in Zambia for biofuels?

3.2 How has this policy directed the areas which may be available for biofuel investment?

3.3 What has guided this policy most:

i. Geography/Topography

ii. Administrative capacity

iii. Availability of land

3.4 If land availability drives the policy making, what are the most crucial determinants of 'availability':

i. Soil composition & water availability

ii. No current land users in the area

iii. Land previously used for commercial farming (easily convertible)

3.5 How is the Government monitoring land investment for biofuels in Zambia?

3.6 How is the Government monitoring land use under community tenure?

3.7 How is the Government managing areas of potential conflict between local communities and land investors/farmers?

3.8 How involved are local administrative offices in negotiations for land investment?

3.9 What is the legal process that investors must go through to invest in biofuels in Zambia?

3.10 What is the consultation process with local communities who might be affected by the land use change for biofuels?

3.11 Are there intermediaries or neutral third parties (e.g. NGOs) involved in the negotiation process?

3.12 If so, what role do these intermediaries play?

3.13 Who draws up contracts for land investment or leases?

3.14 What level of representation do local communities who might be affected by the land use change have during negotiations?

3.15 What rights do the communities have during the consultation process?

3.16 Were these rights upheld during the consultation process?

3.17 What level of access do local communities have to the contracts once they have been drawn up?

3.18 What documents are given to the community from the consultation process, and are these (documents) in their language and understandable?

3.19 Is the contract signed and by whom?

3.20 After the consultation with local communities, are the contracts ever significantly changed?

3.21 Do contracts ever include compensation for communities who might lose their land or ownership rights through the land use change?

3.22 If so, how is this negotiated?

3.23 How are these benefits distributed to the community?

3.24 Did the community have free, informed (prior notice) in the consultation process?

3.25 Was there community-wide representation?

3.26 Were women represented during the consultation phase?

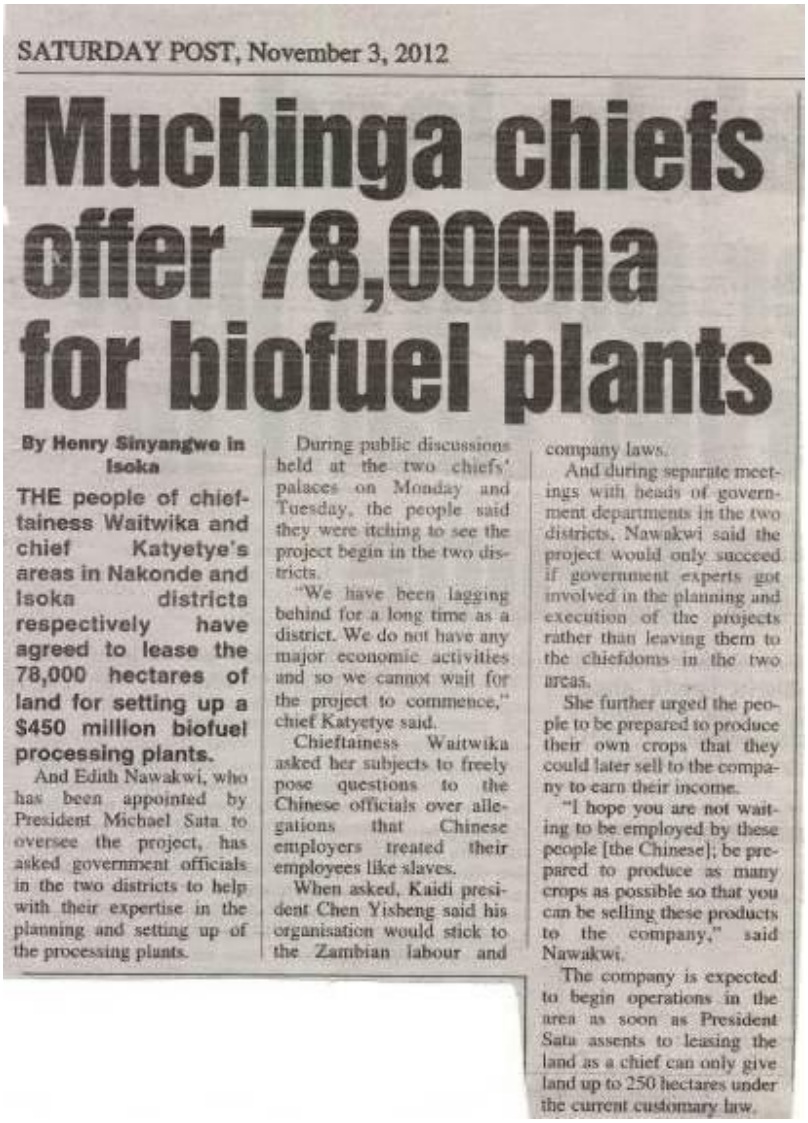
Appendix B: Policies and regulatory parameters on the processes of customary land allocation / acquisition by investors in Zambia [Source: amended from German, et al., 2011c]

1. Types and duration of land rights afforded to investors	
Zambia	Unless approved by the President, a 14-year Provisional Certificate is initially issued. After at least 6 years a 99-year Certificate of Title can be applied for (Lands and Deeds Registry Act, 1914).
2. Provisions to protect customary rights	
Zambia	Customary tenure is recognized and governed by customary law (Land Act,

	1995). The Chiefs and Local Authorities have to approve the alienation of customary land (Land Act, 1995).Customary land can be compulsorily acquired by the state through the right to eminent domain (Land Acquisition Act, 1970). Customary land cannot be alienated without certification that the people's 'interests and rights have not been affected by the approval' (Administrative Circular, No.1, 1985)
3. Initiatives to guide land allocation	
Zambia	In each province land has been earmarked for Farm Block Development (FBD), where infrastructure is to be provided by the government to stimulate commercial agricultural development on agro-ecologically suitable and strategically located land through a core-satellite structure – as a program under the National Agricultural Policy, 2004. The Ministry of Lands and ZDA have established land banks as a service to investors.
4. Process of consultation with customary land users	
Zambia	When alienating land, both Chiefs and District Councils must declare that 'members of the community' were consulted (Customary Tenure Conversions Regulations 2, 1996). Project developers must seek the views of those to be affected by the project and describe 'the socio-economic impacts…, such as resettlement' when preparing an EIA (Environmental Impact Assessment Regulations, 1997).
4.1. Mechanisms for local representation	
Zambia	When approving conversion of customary to leasehold tenure, the Chiefs and District Councils must confirm that the land transfer to the applicant will not infringe on the rights of others (Administrative Circular, No.1, 1985; Customary Tenure Conversion Regulations, 1996, incl. Regulation 2).
4.2. The role of intermediaries	
Zambia	The ZDA, with the Ministry of Lands, 'shall assist an investor in identifying suitable land for investment and … applying to the responsible authorities' (ZDA Act, 2006). The District Council must approve the request of Chiefs to convert customary to leasehold tenure and certify that existing interests in land are not being infringed upon by alienation (Customary Tenure Conversion Regulations, 1996). The Commissioner of Land and the President must approve the alienation (Administrative Circular No.1 1985).
4.3. Compensation mechanisms	
Zambia	When land is acquired compulsorily by the state, compensation should be equal to the open market value of the property (Land Acquisition Act 1970; Constitution, 1991). When land is not alienated for a 'public purpose', the president should always receive compensation for the alienation and ground

	rents (Land Act, 1995). As part of the environmental mitigation measures, proponents should provide compensation (see below).
5. Impact mitigation requirements	
Zambia	Environmental permit holders should adopt mitigation measures, 'to ameliorate or compensate for adverse environmental impacts and losses suffered by individuals and communities and for enhancing benefits (Environmental Impact Assessment Regulations, 1997).
6. Monitoring (social dimensions of, procedures)	
Zambia	The proponent should conduct an 'environmental audit' after 12 months, and thereafter whenever requested (Environmental Impact Assessment Regulations, 1997). An inspector may undertake investigations relating to the implementation of the permit conditions (Environmental Impact Assessment Regulations, 1997). The ZDA may also make inspection to determine whether the investment is being implemented as per investment license conditions (ZDA Act, 2006).
7. Dispute resolution	
Zambia	Any person aggrieved with a direction or decision of a person in authority may apply to the Lands Tribunal for determination at his own expense; persons aggrieved by decisions of the Tribunal may appeal to the Supreme Court within 30 days (Lands Tribunal Rules, 1996; Customary Tenure Conversions Regulations, 1996).
8. Changes in the status or classification of customary land	
Zambia	Customary land must be transferred to state land prior to its acquisition by investors (Lands and Deeds Registry Act, 1914).

Appendix C: Saturday Post article highlighting the poor manner in which biofuels have entered the market in Zambia [Source: Saturday Post, November, 2012]



SATURDAY POST, November 3, 2012

Muchinga chiefs offer 78,000ha for biofuel plants

By Henry Sinyangwe in Isoka

THE people of chieftainess Waitwika and chief Katyetye's areas in Nakonde and Isoka districts respectively have agreed to lease the 78,000 hectares of land for setting up a $450 million biofuel processing plants.

And Edith Nawakwi, who has been appointed by President Michael Sata to oversee the project, has asked government officials in the two districts to help with their expertise in the planning and setting up of the processing plants.

During public discussions held at the two chiefs' palaces on Monday and Tuesday, the people said they were itching to see the project begin in the two districts.

"We have been lagging behind for a long time as a district. We do not have any major economic activities and so we cannot wait for the project to commence," chief Katyetye said.

Chieftainess Waitwika asked her subjects to freely pose questions to the Chinese officials over allegations that Chinese employers treated their employees like slaves.

When asked, Kaidi president Chen Yisheng said his organisation would stick to the Zambian labour and company laws.

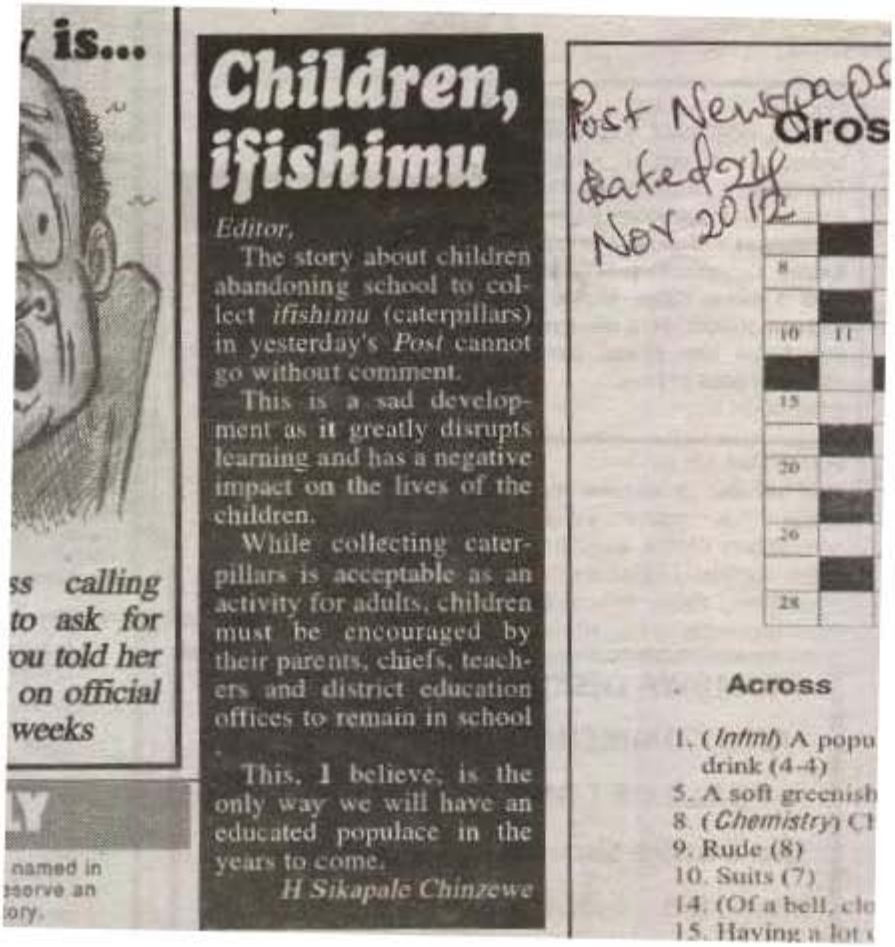
And during separate meetings with heads of government departments in the two districts, Nawakwi said the project would only succeed if government experts got involved in the planning and execution of the projects rather than leaving them to the chiefdoms in the two areas.

She further urged the people to be prepared to produce their own crops that they could later sell to the company to earn their income.

"I hope you are not waiting to be employed by these people [the Chinese]; be prepared to produce as many crops as possible so that you can be selling these products to the company," said Nawakwi.

The company is expected to begin operations in the area as soon as President Sata assents to leasing the land as a chief can only give land up to 250 hectares under the current customary law.

Appendix D: The importance of seasonal collection of ifishimu is highlighted by a contributor commenting on the poor school attendance of school children due to seasonal collection of this valuable caterpillar [Source: Saturday Post, November, 2012]



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Children, ifishimu

Editor,

The story about children abandoning school to collect *ifishimu* (caterpillars) in yesterday's *Post* cannot go without comment.

This is a sad development as it greatly disrupts learning and has a negative impact on the lives of the children.

While collecting caterpillars is acceptable as an activity for adults, children must be encouraged by their parents, chiefs, teachers and district education offices to remain in school.

This, I believe, is the only way we will have an educated populace in the years to come.

H Sikapale Chinzewe

Post Newspaper
dated 24
Nov 2012

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