ASSESSING THE IMPACT OF GROWING *JATROPHA CURCAS* FOR BIOFUEL ON THE LIVELIHOOD OF SWAZILAND'S RURAL COMMUNITY OF MPAKA AT HOUSEHOLD LEVEL.

By

PATIENCE B. VILANE

Submitted in preliminary fulfilment

of the requirements for the degree

of

MASTER OF ENVIRONMENT AND DEVELOPMENT

in the

Centre for Environment, Agriculture and Development (CEAD)

Faculty of Science and Agriculture

University of KwaZulu Natal

Pietermaritzburg

Supervisor: Professor T. Hill

Co-Supervisor: Dr. M. Dent

December 2012

ABSTRACT

As biofuels were growing in importance, Jatropha curcas has been widely promoted as the best suitable source for biodiesel that can be exploited by developing countries .Whilst there were fears that this development may threaten food security and put a strain on other natural resources there was a view that if well managed, the activity may spur rural economic growth thereby reducing poverty and unemployment. The purpose of this study was to investigate the impact that growing Jatropha curcas for supplying the biodiesel industry has made on the livelihoods of the households that were involved within the community of Mpaka in Swaziland. The target respondents were all the farmers that had an agreement with D1 Oils Swaziland and actually planted Jatropha curcas based on the Sustainable Livelihoods framework and using qualitative techniques data were collected using documentation, semi-structured interviews, focus group discussion, and some observation. Content analysis was then carried out to document the history of growing Jatropha curcas in Swaziland; map out the vulnerability context for the community of Mpaka; identify the range of assets that create the different livelihood strategies for the different households; determine the effect of policies and institutional conditions; and describe what the stakeholder's view of growing Jatropha curcas is. The findings of the study revealed that growing Jatropha curcas greatly reduced the households' vulnerability to drought, crops being browsed by livestock and high cost of farming inputs. However the study also revealed that the activity did not yield the desired outcome of income generation as the project did not continue due to bad publicity coupled with a poor policy environment and lack of coordination between and within government ministries and departments. Whilst it can be concluded that that the activity had a negative impact on the households involved it showed a great potential provided government through the relevant ministries and departments creates an enabling environment of proper policies and institutions and by involving all stakeholders at the right time.

DECLARATION

I……Patience B. Vilane……..declare that

i. The research reported in this dissertation is, except where otherwise indicated, is my original work.

ii. This dissertation has not been submitted for any degree or examination at any other university.

iii. This dissertation does not contain any other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other researchers.

iv. This dissertation does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers or authors. Where other written sources have been quoted, then:

   a) Their words have been re-written but the general information attributed to them has been referenced;

   b) Where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

v. This dissertation does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the reference section

Signed: Date:13/12/2012

DECLARATION

"As the candidate's Supervisor I agree/ not agree to the submission of this dissertation"

Signed: (Prof. T. Hill) Date

Acknowledgements

I am grateful to my supervisor Professor Trevor Hill who was willing to take over the supervision of the dissertation within a short space of time and guiding me to the completion of this dissertation. I am very thankful to the staff at CEAD for having remained supportive and doing all possible to see to it that that all necessary help was availed. Special appreciation and thanks to the staff at Higher Degrees office who have also been of tremendous help throughout the duration of this dissertation.

I would also like to thank Dr M. Dube from the University of Swaziland who has provided me with advice and direction. I am also particularly thankful to the all the stakeholders in the project of growing *Jatropha curcas* in Swaziland who gave their time and provided me with as much information as was possible for my research.

Finally I would like to thank my families, friends and the church for their support and prayers. My special gratitude goes to my husband and Pastor Velie Vilane whose support in all areas including financial support, technical expertise, care and love has been tremendous and outstanding. I would also like to thank my children who endured long periods of my absence with patience and still encouraged me to finish, the special cousins (Mabuzas) who were very supportive to me and to my family especially to the children throughout the process.

Above all I would like to thank God who gave me the Inspiration and has remained my guide and anchor throughout the lifecycle of this dissertation.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION AND OVERVIEW

1.1 Introduction

"Development in the biofuels sector by industrialised countries offers both promises and challenges for developing countries in the Sub-Saharan Africa. While sceptics argue that biofuels production will threaten food supplies for the poor, others argue that if well managed, biofuels can be produced profitably and stimulate rural economic growth in developing countries". (Jumbe, Msiska and Mhango 2007:2)

The above statement was made when developing and poor countries were in a challenging time of high food and commodity prices (Jhamtani and Dano 2007). The explanation for these unprecedented increases were firstly a rise in the price of fuel or crude oil which had pushed up production costs and secondly, it was attributed to the conversion of food crops into biofuels resulting in a decrease of surpluses in the food crops which all along had been responsible for keeping food prices low in the world market (Jhamtani and Dano 2007). There were also fears regarding sources of fossil fuels being unaffordable and getting rapidly depleted, prompting a desire to achieve energy security and mitigate climate change especially by developed countries within the European Union (EU) and the United States of America (US) (Jhamtani and Dano 2007; Raswant, Hart and Romano 2008) When these conditions became prevalent they found developing countries like Swaziland already in bad socio-economic conditions characterised by high unemployment rates of 40.6%, high poverty rates (69%) and a high prevalence of HIV/AIDS (25.9%) (VAC 2006) accompanied by recurrent unfavourable weather conditions for crop production (VAC 2006). The statement by FANRPAN (2007) in Jumbe, Msiska and Mhango (2007) brought a glimmer of hope that there were various opportunities that developing countries could exploit and derive economic benefits from, within the biofuels industry. Biofuels were seen as a new commodity for export that developing countries could exploit. This however brought both concerns and interest on how rural households were coping, especially the poor, as they are usually net buyers of food and how they could possibly benefit from such a development.

As well put by Katembo and Gray (2007): "Africa, comprised of 53 nations, is the world's poorest continent in terms of economic instability, inadequate healthcare systems, vulnerable ecosystems and technical infrastructure decay; these deficits are all the more reasons why its

nations, as matter of socio-economic advancement, energy security, currency conservation and clean air initiatives, should vigorously pursue research on and optimal use of green energies" (Katembo and Gray 2007:2).

However it emerges that careful considerations have to be taken for the results to be positive. In Brazil, the biofuels industry has proved to be labour-intensive and the location of the industry in rural areas has significantly contributed to employment and development of the region (UNCTAD 2006). According to UNCTAD (2006), the significant contribution of biofuels to employment and development in Brazil has been made possible by proper public infrastructure policies which have been shown to be essential in providing incentives for the development of a new industry.

In 2004, the Food, Agriculture and Natural Resources (FANR) division of the SADC secretariat released a study on the feasibility of the production of biofuels in the SADC region in the light of rising oil prices. All SADC nations according to the report, were called upon to develop strategies which would make the region self reliant in energy production (RHVP 2007). South Africa was one of the countries which developed her strategy by 2007. According to the Biofuels Industrial Strategy of the Republic of South Africa (Department of Minerals and Energy 2007: 5), "the biofuels program has the potential to uplift agricultural sectors and unlock substantial economic benefits in sub-Saharan Africa, South America and other developing regions. This would be particularly through: attracting investment into rural areas; promoting agricultural development; import substitution of foreign oil with balance of payment savings and overcoming the trade distorting effects that South Africa, African subcontinent and other developing countries have faced over time because of subsidised agricultural production in developed countries".

1.1.1 Overview of Swaziland and Biofuels

Swaziland like other developing countries, within the SADC region, also sought to seize the opportunity to develop its biofuels industry. The country faced with a high poverty rate, characterised by high unemployment rates needed to invest and attract investment in labour intensive industries, which would ensure that a relatively high number of people are employed. The Swaziland Government's Policy on agriculture is to assist farmers to achieve higher productivity and income and to become more market oriented (Carr 1991).However there are underlying issues, like land tenure, which may still have setbacks on such a policy.

In Swaziland there are two Main types of land tenure systems where Agriculture is carried out. These are namely freehold or Title Deed Land (TDL) and Swazi Nation Land (SNL) (Adams, Sibanda and Turner 1999). According to Adams et al the SNL can be further divided into: "1. land held under customary tenure which may not be sold, mortgaged or leased and it is under the control of the chiefs; and 2. land which is leased or held in trust by private companies controlled by the King" (Adams, Sibanda and Turner 1999:11). The population of Swaziland is mainly rural, about 78.9% whilst 22.1% is urban (Carr 1991). Most of the rural population is found in the SNL that is held under customary tenure. This tenure is characterised by power relations that play an important role and underlie its control and allocation so much that there are cases of forced removals that are supported by those in power (Adams, Sibanda and Turner 1999). Most households found under this land tenure practice subsistence farming with maize as the major crop, whereby family labor and drought animals are employed, leading to low productivity levels. Swaziland has always viewed the "rural" areas in the Swazi Nation Land (SNL) as subsistence farming land (Carr 1991).

Needless to say, the issues described Carr (1991) , have the potential to impact on the biofuels industry in Swaziland since it is hugely dependant on agriculture for feedstock production; it does of necessity depend on the rural areas where there is agricultural land. This may be land under freehold which includes commercial farms or SNL in the case of Swaziland.
The Swaziland Government recently finalized its strategy on biofuels (2010) after a number of feasibility studies had been carried out to ascertain the viability of farming for biofuels. Before the strategy could be finalized there was already an investment by a big international company known as D1 Oils Swaziland to have rural farmers grow *Jatropha curcas* for biofuels.

In Swaziland, the company, D1 Oils, invited farmers who had at least a hectare of agricultural land that they were not currently using for growing food crops to join in the growing of *Jatropha curcas* for biofuels so that they could generate some income. The farmers were mostly in rural areas where there is SNL. The company supplied the farmer with seedlings and in return the farmer was expected to sell the seeds only to D1 Oils at a price that the company offers (D1 Oils (undated)). The farmer and the company signed an agreement. The person who joined was usually the head of the household or one permitted by the head of the household as control of such assets as land is with the head of the household.

1.1.2 The Sustainable Livelihoods Framework

Approaches to rural development have evolved in terms of thinking about poverty reduction and the way the poor live their lives and taking consideration of the importance of how structural and institutional issues have an influence on the people's everyday living (Ashley and Carney 1999). This has led to research institutions, non- governmental organizations and donors developing a framework to provide a way of thinking about the objectives, scope and priorities for development, in order to enhance progress in poverty elimination (Ashley and Carney 1999). The framework is the 'Sustainable Livelihoods Framework' (Ashley and Carney 1999).

Households using their capitals, engage in different livelihood activities to gain greater equity, more income, increased well being and reduced vulnerability, improved food security and a more sustainable use of the natural resource base (Ashley and Carney 1999; Carney 1999; Hussein 2002). It can however, also happen that households engage in a livelihood activity which results in undesirable outcomes such as increased vulnerability, reduced income, reduced food security, less equity, decreased well being and less sustainable use of natural resources. For example, if arable land that was all along used for food production is converted for production of *Jatropha curcas* and very little profit is realised by the small holder farmers who are in the production of jatropha seeds to the advantage of the private sector, that is, the oil pressers and processors, the poor may end up being further impoverished (Jumbe, Msika and Mhango 2007).

From the above understanding of a household and its activities for securing a livelihood, it is important to establish the vulnerability of a household. According to the sustainable livelihoods framework, a household's vulnerability is determined by three key aspects which are:

1. The resilience of the livelihood components themselves, that is, the robustness of the household's capabilities, assets and activities and the sustainability of its livelihood strategies.
2. The enabling or protective capacities of the natural and built environment, social and political institutions as well as markets.
3.The degree to which a household and its livelihood strategies are exposed to possible threats, shocks and stresses due largely to its location. This will include exposure to natural forces like extreme weather and other natural events like earthquakes, exposure to social, economic or demographic factors including overcrowding and unemployment (Ashley and Carney 1999; de Satgé 2002; Hussein 2002).

Whatever activity that a household engages in, can be assessed in terms of how it influences the key aspects of a livelihood as described above. Since the growing of *Jatropha curcas* is a new activity, it also has to be subjected to such scrutiny to be able to determine its contribution to the sustainability of the livelihoods of rural households in the different contexts.

When the creation of a new livelihood opportunity is availed, households have options and are expected to make choices. Households may abandon activities that they have been engaged in before to take up the new activity, they may add it onto their existing strategies or make other choices availed to them. An opportunity for a new livelihood activity may not in itself necessitate that households abandon the other livelihood strategies they are currently engaged in to secure themselves a livelihood, but rather they can add it onto their basket of strategies. This results in increasing the diversity of the household's livelihood strategies, creating a safety net. This may however, increase pressure on capitals such as inputs, labour resources and have implications on gender division of labour.

Amidst the worldwide rush for the biofuels industry it is imperative, as mentioned in preceding sections, that caution is taken to ensure that the results of growing crops for biofuels are positive. One of the ways of exercising caution is through research which should be able to place the activity within a conceptual framework that is able to critically uncover all its aspects in relation to rural development and poverty elimination in a holistic manner. Whilst it is appreciated that a project need not be interdisciplinary or holistic in itself, its contribution and entry point should be identified and that the needs addressed in the activities of the project's activities are those that deal with the priority concerns of households and build upon the experience and traditional coping mechanisms households have evolved (CARE: NRAC 1999 in Ashley and Carney 1999).
The research is an effort to place the activity of growing *Jatropha curcas* in a framework that allows the project to be analysed in a holistic manner on how it fits into rural development and poverty elimination. This was done through the evaluation of its impact on the livelihoods of the rural households based on the priority concerns described by the households and on the processes, institutions and policies that are influencing livelihood strategies of the households.
Since growing *Jatropha curcas* for biofuels at a large scale is still a fairly new innovation, it is important that lessons and experiences from the projects be documented so they serve as references upon which to build in forging the best possible ways forward with the activity. It is hoped that the research shall contribute to the body of knowledge and add a different perspective to already existing research work.

Some of the existing gaps on the biofuels industry that were identified during the first high-level biofuels seminar in Africa, include having limited data and information on biofuels and lack of proper channels for sharing and disseminating lessons and experiences of different players and countries (Dufey 2006).

Whilst biofuels offer a great opportunity for diversifying energy sources and the livelihood systems of rural communities through employment creation and income generation from production and processing or marketing of the feedstock crop in this case *Jatropha curcas* that the rural community of Mpaka is growing, there is a great possibility that the rural poor are further impoverished through improper planning and structuring of the activity. There is need to safeguard against such a phenomenon. The outcome of the activity depends on the options and choices that are available and taken; and the policies and institutions within which the communities are carrying out the activity of growing *Jatropha curcas.* According to the agreement that is entered upon by the farmer and D1 Oils, the farmer sells the seeds to D1 Oils at a price that is offered by D1 Oils. Whilst that offers an assured market, it may not assure the best competitive price and it also diminishes the opportunity of diversifying the energy sources for the communities as they do not process the seeds to get the oil, make biodiesel which is what they can use as an alternative source of fuel. In the absence of an EIA for the project and the absence of a government strategy on biofuels during its inception it is important to evaluate the impact that the project has had on the livelihood of the households that are growing *Jatropha curcas* within the existing public infrastructure policies and institutions. The study is to identify the various economic, situational, developmental and socio-cultural factors that contribute to the enhancement or disablement of the livelihoods of the households through growing *Jatropha curcas* for biofuels in order to evaluate whether the project leads to sustainable livelihoods as that is the goal of rural development.

1.2 The Research Aim

The aim of this research is therefore to understand the influence of growing *Jatropha curcas* for biofuels on the livelihoods of the rural households in Mpaka community in Swaziland.
The following sub-objectives will be addressed to achieve this aim:

1.3 Objectives

1. Describe the project of growing *Jatropha curcas* in the community of Mpaka and therefore identify the relevant stakeholders
2. Describe the vulnerability context of the households within the Mpaka community through effective measurements that are able to account for the livelihood conditions of the households.
3. Identify the capabilities, range of assets and activities that create the different livelihood strategies for the different households and how they have been effectively used in the

growing of *Jatropha curcas* for biofuels with what outcomes in terms of income generation, food security and reduction of vulnerability.

4. Determine the effect the policies and institutional conditions, within which the households' livelihoods and the growing of *Jatropha curcas* are shaped, have had on the outcome of the activity.
5. Describe what the stakeholders' view of growing *Jatropha curcas* is as a development project in terms of how it addresses their desired outcomes and also understand what they view as impediments in achieving their desired outcomes and therefore ways in which they think that can be best addressed.

1.4 Clarification of Concepts

The Household

The household, in all its different cultural connotations, is the primary social living unit. In it are encapsulated a cluster of activities of people who live together most of the time and provide mutual physical, socio psychological and developmental support and function within the broader organization and environment of the community (de Satgé 2002).

Livelihood

Every household has means of gaining a living which is termed a livelihood (Chambers and Conway 1991). A livelihood is either sustainable or non-sustainable. The definition for a sustainable livelihood used by the Institute of Development Studies team is as follows:

A livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets while not undermining the natural resource base (Scoons, 2005). A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living (Chambers and Conway 1991).

Assets

Assets of a household includes the resources that the household owns or directly controls and the resources that the household can have access to that do not belong to them. DFID and Oxfam (Hussein 2002) look at assets as divided into five capitals, i.e. human capital, social capital, natural capital, physical capital and financial capital.

Human capital: this includes skills, ability to labor, education and health status of the household members.

Social capital: this includes the networks, organizations, trust and reciprocity within and between households; support by religious, cultural and informal organizations.

Natural capital: this includes land, aquatic resources, woodland, and forest products including edible plants and fruits, thatch, fuel, wood for carving, wildlife, edible insects, honey, and

medicinal herbs and grazing. It also includes climate, soils, land capabilities, minerals, quarries, sand deposits, clay, wetlands, water catchments, groundwater sources and biodiversity.

Physical capital: this is inclusive of farm equipment, shelter, infrastructure which includes clinics, schools, roads, dams, water and sanitary services, electricity supply, communication and information sources such as telephones, radio, television and the internet.

Financial capital: these are the assets and entitlements which have a cash value like livestock, income, remittances from family members working away from the home, sources of credit, pensions, savings, stores of seeds, crops and food.

Household capabilities

This has to do with the household's capacity to secure a livelihood. This is closely linked with the different types of the household capitals that are described above as it refers to the potential the household has of making use of the assets it has to secure a livelihood. It is inclusive of the profile and the composition of the household whereby the profile carries information on the sex, age, health of family members, their education and skills and their availability to labour.

Household Livelihood activities

These are all the activities that the household engages in to survive and reproduce itself. It includes those activities that bring in money and those that do not necessarily bring in money like household chores and community maintenance activities**.**

1.5 List of Abbreviations

DFID- Department for International Development

EIA- Environmental Impact Assessment

FANR- Food, Agriculture and Natural Resources

FANRPAN- Food, Agriculture and Natural Resources Policy Analysis Network

FAO- Food and Agriculture Organisation

HH- household

MOU-Memorandum of Understanding

RHVP-Regional Hunger Vulnerability Programme

SADC- Southern African Development Community

SEA - Swaziland Environmental Authority

SNL-Swazi Nation Land

SSA-Sub-Saharan Africa

TDL-Title Deed Land

USDA-United States Department of Agriculture

1.6 Sequence of Chapters

Chapter 1 consists of the introduction to the basis of the research and the current trends in the biofuels sector generally. It also gives an overview of the study and outlines the approach of the researcher to the topic of growing *Jatropha curcas* for biofuels within the context of rural households who are involved with the cultivation of the feedstock, within the community of Mpaka in Swaziland.

Chatter 2 will consist of the literature review.

Chapter3 will be an outline of the research methodology of this research, which will include a detailed description of the study area, the sample and its selection. It will also include the measuring instruments, data collection and its analysis.

Chapter 4 is the results

Chapter 5 is the discussion of the results and the summary of the research.

Chapter 6 is the conclusions chapter which includes the recommendations. It also gives suggestions on how the research can be further improved.

After this chapter, there is appendix A which is the interview guide and appendix B which is the list of interviewees.

1.7 Chapter Summary

This chapter presents a brief general background on biofuels and the opportunities to be availed by such an industry to developing countries like Swaziland. It describes the need for the research, the research question and the sub-objectives of this research, which is to investigate about the impact farming for *Jatropha curcas*, a non-edible feedstock for the production of biodiesel, has had on the livelihood of the households involved in the activity in terms of how it influences the vulnerability context of the households and capitals of the households. Chapter 2 gives a literature overview on the different aspects of a livelihood framework and the effect of growing *Jatropha curcas* that is market oriented, to the livelihoods of rural households. It will include an overview of cases on communities involved in growing *Jatropha curcas* for biofuels from other developing countries in Africa and other continents. These are used to describe any trends that have since been realized on the effect of growing *Jatropha curcas.*

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The preceding chapter was introducing the whole study by describing the research question, sub-objectives and how the study was carried out. The aim of the study was to evaluate the impact the project of growing *Jatropha curcas* for biofuels has had on the livelihood of the households that are engaged in the activity within the community of Mpaka in Swaziland.

This chapter starts with a discussion of the brief history of biofuels and a brief discussion of the debates pertaining to their relevance in developing countries. Based on Sustainable livelihoods Framework, the definition of a livelihood and the understanding that a livelihood is within a context of policies, institutions and processes, relevant literature on the different aspects of a livelihood are discussed. The chapter also discusses literature on the possible impact that such a natural resource based activity of growing *Jatropha curcas* for biofuels, may have on the livelihood of households drawing from cases of other developing countries.

2.2 Biofuels

Biofuel is broadly defined as a solid, liquid or gas consisting of or derived from recently dead biological material, most commonly plants, used for fuel (UNCTAD 2006). The term biofuels can be crudely divided into traditional and modern biofuels. Traditional biofuels include firewood, animal waste and crop residues that are used by households for heating and cooking whilst modern biofuels will include biomass, used for generating electricity through gasification and fermentation, ethanol and biodiesel used in engines (Rajagopal and Zilberman 2007). This distinguishes biofuels from fossil fuel, which is fuel derived from biological material that died millions of years ago which are petroleum and coal (UNCTAD 2006). Biofuels that have sparked a lot of interest around them and of which the discussion shall be based on, are ethanol and biodiesel (UNCTAD 2006; Rajagopal and Zilberman 2007; Salé and Dewes 2009). The plant materials commonly used the production of these two biofuels (ethanol and biodiesel) include **grains** like maize, wheat, sorghum and rice; **seeds** from sunflower, *Jatropha curcas*, rapeseed,

palm kernels, cottonseed, groundnuts and Soya beans; **grasses** such as sugarcane and sweet sorghum; and **agricultural waste** like stalks and wood waste (UNCTAD 2006).

Biofuels are a source of energy that many communities across the world have used in the past. When there were shortages of fossil fuels, many communities who had no access to kerosene, used oil extracted from *Jatropha curcas* , coconut and castor beans for household consumption such as lighting and cooking, for example during the Japanese occupation in South-East Asia (Jhamtani and Dano 2007).

Whilst biofuels are not a new source of energy, they have grown in importance internationally in the recent past due to their potential to provide reliable and substantial sources of energy which is renewable, and is environmentally friendly by reducing greenhouse gas emissions thereby contributing to the curbing of climate change (Rajagopal and Zilberman 2007). Biofuels have been seen as more practically accessible and usable in many applications which were using fossil fuel (Rajagopal and Zilberman 2007). A report of United Nations Development Program (UN-ENERGY) predicted that the global production of biofuels had doubled over the past five years and expected to double again in the coming four years from 2007 when the report was produced (UN-ENERGY 2007). The European Biodiesel board estimated that total refining capacity in 2004 was 2.2 million tonnes and in contrast the USA produced less than 70 000 tonnes (Wood 2005).The European Union Biofuels Directive, in force since 2003, requires member states to set targets for biofuels (Wood 2005). The European Union has set its target of replacing 10% of its transport fuels with biofuels by 2020 which follows a target of 5.75% for 2010 (RHVP 2007). According to Rajagopal and Zilberman (2007:7-8) there are several reasons for the excitement surrounding biofuels (biodiesel and ethanol):

1. and therefore inexhaustible since the feedstock can be grown over and over through agriculture.
2. The strength of biofuels and particularly biodiesel is that they are a direct low carbon substitute of fossil fuels which account for around 25% of greenhouse emissions in many European countries (Wood 2005). For that reason they can reduce carbon emissions and thus considered as a solution to climate change. Biofuels are replenishable
3. Biofuels can increase farm income in a world whereby decline in farm income has been a general problem (Gardner 2003 in Rajagopal and Zilberman 2007). With biofuels most

countries will be able to grow one or more types of crops on which they would have a comparative advantage in that they can use the crop(s) to meet their domestic or foreign demand or both. . The European Union partner countries can only grow a portion of the feedstock that they require to deliver a secure, low cost supply of biodiesel and therefore need to look at developing countries for supply of the biodiesel (Wood 2005)

4. Closely linked to the above characteristic of biofuels is their potential to provide energy security in that countries can produce their own fuel.
5. Biofuels can create new jobs because they are more labour intensive than other technologies on per unit of energy delivered (Kammen, Kapadia and Fripp 2004). A majority of these jobs can be expected to take place in the rural areas where there is agricultural land (Rajagopal and Zilberman 2007). In the sugarcane business whereby the sugarcane is used to produce both sugar and ethanol (biofuel), Brazil earns US$8 billion a year and generates a million direct jobs. Through its biodiesel programme that is based on oilseeds such as castor and sunflower for each mill worker another thousand are required for harvesting (da Silva 31 May 2007).
6. Biofuels have physical and chemical properties similar to oil such as their liquid state, specific energy density, viscosity and combustion characteristics. They are combustible in existing internal combustion engines with minor modifications such that adapting to biofuels-based infrastructure (at low blending like 10% to 20%) can be achieved more cost effectively than adapting to hydrogen, battery or natural gas-based automobiles (Fulton, Howes and Hardy 2004; Urgate and de la Torre 2006).
7. Biofuels are simple and familiar to consumers, producers and policy makers. Ethanol has been used as an additive to gasoline in several countries for the past two decades.

Whilst the above properties of biofuels make them attractive, a sustainable development of a viable biofuels industry requires a strong, supportive policy, and a firm legal, regulatory and institutional framework to ensure that measures are put in place to harness the contribution of the sector to rural livelihoods (Jumbe, Msiska and Mhango 2007). This is more so because there are also a number of concerns that have been put forward as threats that can be brought about by Biofuels especially at the large scale production. These include:

1. Food security concerns in terms of the competition that could occur between food production and production for energy (UNCTAD 2006).China lowered its ethanol target after corn prices increased by 7% and other grain prices also increase allegedly due to the demand from biofuels plants (China News, AFP 2006 in Tripathi 2008)

2. Land substitution from food to energy. Food security is closely related to land use (UNCTAD 2006). Diversion of land may have serious consequences for rural livelihoods and rural ecosystems (Tripathi 2008).

3. Environmental impacts. The Millennium Ecosystems Assessments finds that agriculture is already the largest factor in ecosystem modification (Alcamo , van Vuuren, Ringler, Cramer, Masui, Alder, and Schulze 2005).The authors note that further to biofuels there is already a lot of pressure on Natural resources leading to habitat losses due to the increase in population and rising income. The other source of environmental concern is that of using agricultural waste for feedstock. The removal of leaves and stalks or other crop residues can negatively impact on the soil structure since these contribute greatly to the organic matter in the soil, it can also promote soil erosion thus negatively affecting the ecosystem (Cloin, Rivalland, Wilson and Nyamba 2007)

4. Water shortage. Biofuels are said to be likely to add pressure on water resources that are already stressed. With the increasing population, income and urbanization water demand will rise and there are already warnings that unless appropriate action is take there is an impending global crisis in terms of fresh water availability (Seckler, Molden and Barker 1998; Rosegrant, Cai and Cline 2002)

5. Socio-economic impacts. Depending on the model that is adopted, biofuels if developed in the business as usual manner are said to be likely to aggravate inequality resulting in the developing countries subsidizing the energy needs of their industrial elites at the expense of the poor's welfare (Jhamtani and Dano 2007). If the developing countries will export the commodity as is usually the case, it may mean that the developing countries are producing biofuels for the unsustainable consumption patterns of the North that is their subsidized industry and unsustainable lifestyles, at the expense of the basic energy needs of their own

people (Jhamtani and Dano 2007).

The above list may not be exhaustive of all issues that are surrounding biofuels but it does reflect that careful planning must go into the development of the biofuels industry in developing countries. Biofuels could have an important place in the development of rural areas if they are approached carefully and with consideration to the unique needs of the poor (RHVP 2007).

2.3 Rural Development

Third world societies are faced with a variety of problems and issues among which is poverty especially in the rural areas where 70% of the world's poor are said to live (Carney 1999). This has given rise to a large body of theory aimed at comprehending these problems to emerge since World War II. As well articulated by Haines (2000: 1) "The hegemony of these schools of thought have changed over time as new or revised theoretical discourses have risen to prominence on development theory". Ellis and Biggs (2001) have described an evolution of rural development discourse from the 1960s to the most current and as also noted by Haines (2000) the 1960s were an era of modernisation where emphasis was on provision of aid and technical assistance to the third world countries. Large industrial projects were seen as the impetus that would see third world societies moving towards rapid economic growth and development, whilst aid and technical assistance were to improve socio-economic conditions in a range of fronts (Haines 2000; Ellis and Biggs 2001).

The 1970s were an era of state intervention, the 1980s an era of market liberalisation and the 1990s as an era of participation and empowerment (Ellis and Biggs 2001). In each era there were a number of theories which supported that way of thinking, planning and carrying out of development projects. New directions were emerging in the theory and practice of development from globalisation to sustainable development then to human development and from there to poverty reduction, alleviation and elimination strategies (Haines 2000). The success of these theories and practices of development in eliminating poverty was limited such that new ideas about development emerged (Ashley and Carney 1999). Poverty analysis has highlighted the

importance of assets, including social capital in determining wellbeing (Ashley and Carney 1999). This was brought about by new approaches to development called Sustainable livelihoods (Chambers and Conway 1991; Ashley and Carney 1999; Hussein 2002). The way poor people live their lives is strongly linked to natural resource management and how they, using their capitals, are able engage in activities that give them a gainful living within a context of policy, institutions and processes. This basically means a household will make a living using its assets and capabilities by engaging in livelihood activities.

"Community-level institutions and processes have been a prominent feature of approaches to natural resource management and are strongly emphasised in sustainable livelihoods" (Ashley and Carney 1999: 4) bringing the theory and practice of development, through Sustainable Livelihoods approaches, to create a link between micro-levels and macro- levels of development (Ashley and Carney 1999).

As outlined by Scoons (1998: 3) "the key question to be asked in any analysis is:-

Given a particular context (of policy setting, politics, history, agro-ecology and socio-economic conditions), what combination of livelihood resources (different types of 'capital') result in the ability to follow what combination of livelihood strategies (agricultural intensification/extensification, livelihood diversification and migration) with what outcomes? Of particular interest in this framework are the institutional processes (embedded in a matrix of formal and informal institutions and organisations) which mediate the ability to carry out such strategies and achieve (or not achieve) such outcomes". This can be summed up in the diagram below (Figure 2.1) developed from the Sustainable Livelihood frameworks used by KHANYA and DFID (Ashley and Carney 1999; and Hussein 2002):

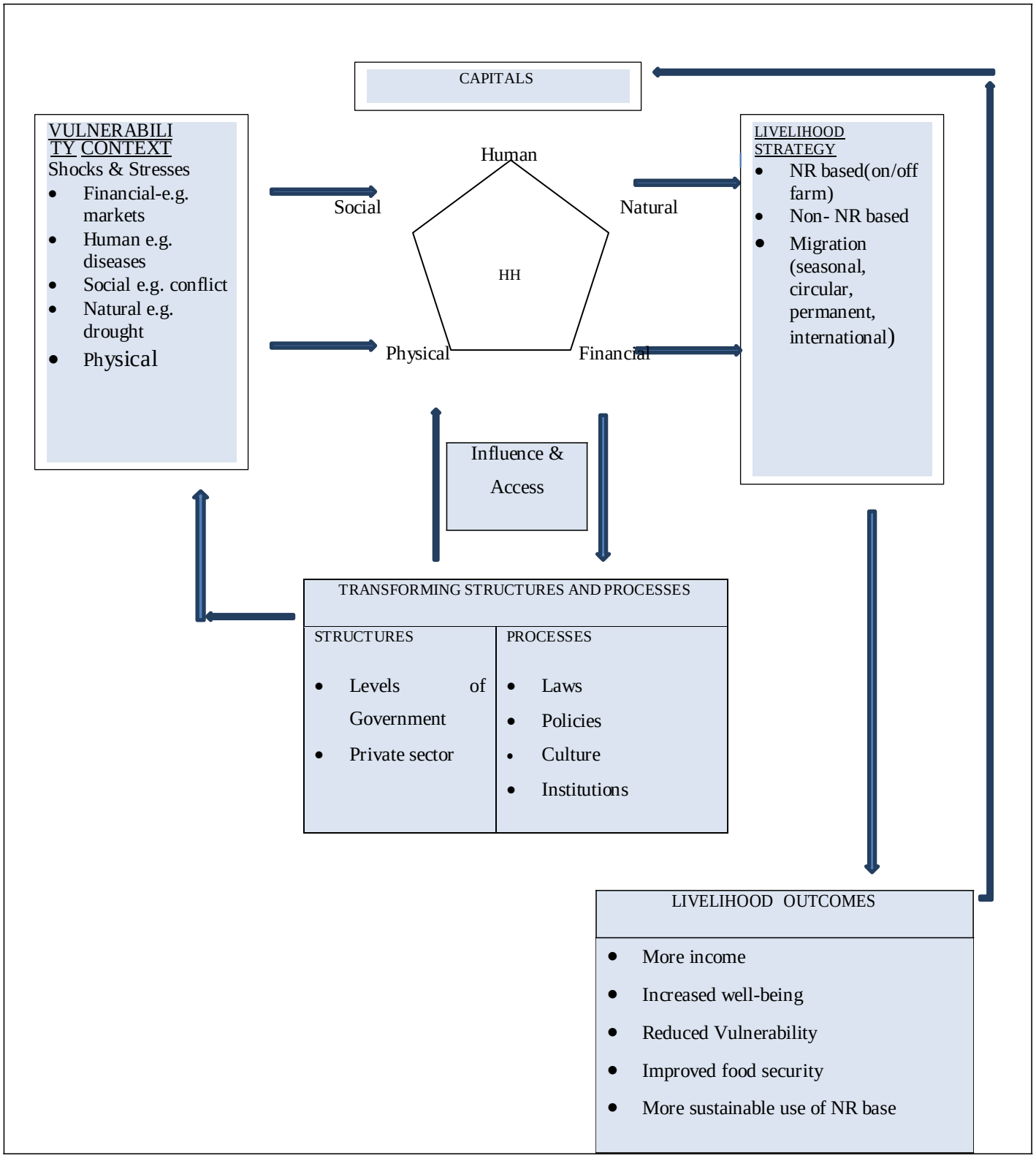


Figure 2.1 Sustainable Livelihood Framework (Ashley and Carney 1999; and Hussein 2002)

For the purposes of this research the question then is: what has been the outcome on the livelihood of households growing *Jatropha curcas* for biofuels given their context, range of capitals and livelihood strategies in the rural area of Mpaka? One of the first desired outcomes as outlined by Scoons (1998) which is an indicator of the sustainability of a livelihood is the creation of working days and the second one is reduction of poverty.

According to Scoons (1998) creation of working days relates to the ability of a particular combination of livelihood strategies to create gainful employment for a certain portion of the year. This may mean on or off-farm, part of a wage labour system or subsistence production. One of the reasons why there has been interest on biofuels is their potential to create jobs or working days on and off-farm as described in the preceding section (2.1). Undertaking a plantation of *Jatropha curcas*, collecting the seeds, processing of seeds to produce the *Jatropha curcas* oil and the further processing of the oil into biodiesel would produce a sizeable employment for the poor (Tripathi 2008). Making estimations, Tripathi (2008) calculated that the plantation of a hectare would give 313 person days and would generate 41man days per year throughout the life of the *Jatropha curcas* plant.

According to the Biofuels Industrial Strategy of the Republic of South Africa (2007:5), "the biofuels industry has the potential to uplift agricultural sectors and unlock substantial economic benefits in sub-Saharan Africa, South America and other developing regions, in particular by: attracting investment into rural areas; promoting agricultural development; import substitution of foreign oil with balance of payment savings and overcoming the trade distorting effects that South Africa, African subcontinent and other developing countries have faced overtime because of subsidised agricultural production in developed countries".

Whilst uplifting the agricultural sector which is based in rural areas where there is agricultural land it is important that a positive frame of thinking is adopted so that instead of seeing the rural areas as being areas where commodities can be grown and exported to the rich, they could become places where commodities are used to enrich the local residents (RHVP 2007). This requires acceptance that current strategies do not help the rural poor and building up on the existing and failing strategies to develop the biofuel industry could possibly make them even poorer (RHVP 2007).

One of the arguments raised about biofuels is that for economic reasons poor farmers may be pressured to grow energy crops instead of food, while not having access to energy themselves (Jhamtani and Dano 2007). They argue that this would be a repeat of the numerous stories of large-scale hydro-power plants, whereby communities were displaced for the sake of providing energy to industries and elites. The displaced communities would themselves be left without electricity. According to Jhamtani and Dano (2007) adopting biofuels as a technology fix would not make the poor less marginalized and disempowered. They argue that there should be a paradigm shift in the energy production and consumption patterns.
Policies should be developed for the greater use of locally –produced biofuels and their by-products by the rural poor to improve their lives and also provide employment (RHVP2007).

The other outcomes that Scoons (1998) describes as outcomes of a sustainable livelihood in making an analysis are well-being, reduced vulnerability resulting in adaptation and resilience, and natural resource sustainability. According to Scoons, "Livelihood resources may be combined creatively and innovatively, often in complex ways, to create more livelihoods in a particular area. For example degraded land may be transformed with the investment in labour and skill, resulting in the accumulation of natural capital, offering the opportunity for more livelihood opportunities. Equally, through the creation of local economic linkages and circulation of knowledge, skills, and resources, livelihood intensity may be increased in an area. Thus investigating the multiplier effects (both positive and negative) of particular options is an important issue in assessing sustainable livelihood outcomes" (Scoon 2005:10-11). He also notes that rural livelihood strategies are often heavily reliant on the natural resource base which includes land (Scoons 2005).

It is evident that there are various livelihood components and factors that have to be understood in assessing the impact that the activity of growing *Jatropha curcas* has on the livelihoods of the people which include:

- The priorities that people identify;
- The different strategies they adopt in pursuit of their priorities;
- The institutions, policies and organisations that determine their access to social, human, physical, financial and natural capital, and the ability to put these into productive use;

- The context in which they live, including external trends (economic, technological, demographic …), shocks (natural or man-made), and seasonality.

(Ashley and Carney 1999: 7)

Whether a household is poor or not poor has been widely used as an indicator of the households' wellbeing and national poverty assessments have been used to inform policy discussion (Chaudhuri, Jalan and Suryahadi 2002). However these authors note that the poverty status of a household may change due to a number of factors. A household that is described as not poor today may be described as poor tomorrow and another which was described as poor may described as poorer because they were faced with a high probability of an adverse shock which they experienced and could not cope with or recover from (Chaudhuri, Jalan and Suryahadi 2002).This then suggests that the current poverty status of a household may not be a good guide to the household's vulnerability to being poor in the future (Chaudhuri, Jalan and Suryahadi 2002:2). The above argument brings about the need to describe not only the current status of the household but to take a forward-looking approach by also describing the vulnerability context of the household.

2.2.1 Vulnerability Context

In the conceptual framework for sustainable livelihood, the starting point is the vulnerability context within which people operate (Adato and Meinzen-Dick 2007) see figure 2.1.

This is well articulated in Carney (1999:3) who notes that in sustainable livelihoods approaches there is emphasis on the multi-faceted notion of sustainability. In rural areas sustainability is often associated with natural resources, which are clearly important but not the only aspect of sustainability which is important. Livelihoods have learnt through participatory assessments that vulnerability is a core dimension of poverty. Reducing vulnerability, helping people to develop resilience to external shocks and increase the overall sustainability is therefore a priority (Carney1999). Other authors sharing the same view, point out that this is because new methods for understanding poverty have highlighted that it is multidimensional, with vulnerability being outstanding as it takes into account the threats to livelihoods from shocks, stresses or trends that people face or fear and may not be able to recover from or cope with. This may throw them into or deeper into poverty (Chambers 1994, 1997; Ashley and Carney 1999; Adato and Meinzen-Dick 2007). This influences the reasons for people adopting or not adopting a new

activity; the kind of impact the activity may have on the livelihood of others and not on other people (Adato and Meinzen-Dick 2007).

Vulnerability analysis incorporates risks and threats as well as people's resistance and resilience to them. Vulnerability factors encompass: 1) Trends in population, resources, and such indicators as prices, governance, or technology; 2) Shocks (a large infrequent, unpredictable disturbance with immediate impact such natural disaster, sudden economic changes. Political conflict among others) and stresses (a small, regular, predictable disturbance with a cumulative effect); 3) Seasonality in prices, agricultural production, employment opportunities, resource availability or health (Ashley and Carney 1999; Scoons 2005; Adato and Meinzen-Dick 2007).

Gender, class, politics, power relations, culture, ethnicity, beliefs and other factors affect the nature and degree of vulnerability and people's resilience (Adato and Meinzen-Dick 2007). Drawing from some case studies, Adato et al (2007) has noted that it is not objective "risk" that matters but people's subjective assessments of things that make them vulnerable because both perceived and actual vulnerability can influence people's decisions and hence their livelihood strategies . With that in mind, one of the major desirable outcomes of a development project should be to reduce the vulnerability of the households that adopt the activity and those that are directly and indirectly affected.

Useful indicators for the vulnerability context of households include levels of food intake and food sources (security), average income level and income range, coping capacities, links to markets, level of asset holdings, education, access to credit and water scarcity (IFPRI 2002; VAC 2006). It is also important to know which households are headed by females, children or the elderly and to know which households have members with chronic illnesses such as AIDS, that render them unable to contribute productively to the household (IFPRI 2002).

Vulnerability of households has been shown to be closely linked with household composition. This includes such variables as whether the household is headed by a man or woman, whether they are single, married, divorced or widowed; the composition in terms adult proportion and the proportion of the different age groups; the education level of the head of the household and the education level of the other household members (Morrow 2000; IFPRI 2002).

It is therefore important when assessing the impact of *Jatropha curcas* on the livelihoods of households, to describe how it has impacted on the indicators of the vulnerability context of the households.

Formal and informal institutions and organisation, policies, laws, and customs shape livelihoods by influencing access to assets, livelihood strategies, vulnerability, terms of exchange and other conditions (Adato and Meinzen-Dick 2007). Attention is given to assets that people can draw upon for their livelihoods. Assets interact with policies, institutions and processes to shape the choice of livelihood strategies which in turn shape the livelihood outcomes which feed back into the future asset base (Adato and Meinzen-Dick 2007:31). As pointed out earlier, natural resources are also a clearly important aspect to rural livelihoods and hence it is important to take into account how a project of such nature impacts on natural resources and their management.

2.2.2 Natural Resource Management

Basically biofuels technology is land intensive. The demand of the biofuels will put pressure on existing use of land including food production and natural habitats (Rajagopal and Zilberman 2007). Of particular concern is the competition for land and water and the displacement of land used for the cultivation of food and other crops (Jumbe, Msiska and Mhango 2007). According Jumbe, Msiska and Mhango (2007) depending on the feedstock and technologies used biofuels may create food supply shortage which may be overcome by putting in place appropriate policy and regulatory framework. If the biofuel or the oil is developed for the greater use by rural folks for example to produce electricity, it would remove the burden on women looking for fuel and on the forests from unsustainable harvest of trees for firewood (UNCTAD 2006).

Adato (2007) has also noted that land tenure arrangements, legal rights to natural capital, marketing institutions, input packages and other policies influence the ability for the farmer to take advantage of technologies.

2.2.3 Land Tenure

Land tenure may be defined as the terms and conditions on which land is held, used and transacted (Adams, Sibanda and Turner 1999). Land rights may include:

- Rights to occupy a homestead, to use land for annual and perennial crops, to make permanent improvements, to bury the dead and have access for gathering timber, wild fruit, thatching grass, minerals and other natural resources;
- Rights to transact, give, mortgage, lease, rent and bequeath areas of exclusive use;
- Rights to exclude from the above listed rights, at community and /or individual levels and
- Linked to the above, rights to enforcement of legal and administrative provisions in order to protect the rights of holder (Adams, Sibanda and Turner 1999:3).

The aspect of land tenure is important in informing the choices and options that households have and take. This is because for those relying largely on local rural resources for their livelihood, a secure place to live, free from the threat of eviction, with access to productive land and natural resources, is essential for rural livelihood (Adams, Sibanda and Turner 1999). This becomes particularly important in that where financial capital is lacking, social capital can provide the basis for a range of livelihood opportunities including customary access to land and natural resources and opportunities for the poor to sell their labour (Adams, Sibanda and Turner 1999: 5). However, tenure insecurity results in uncertainty which makes economic land use too risky for many (Cross 1998).

Levin (1997) points out that in Swaziland there is a considerable ambiguity surrounding the legal definition of Swazi Nation Land (SNL). In his documented study of land tenure in Swaziland, he gives a history of depressed peasant farm production, exploitation particularly women and forced removals on SNL by those in power. He argues that while in abstract ‘communal tenure’ may have allowed for democratic involvement, in the tribal context it has proved a misnomer because it conceals the power relations which underlie it and control land use and allocation. This kind of arrangement increases the vulnerability of households. However this is heavily dependent on the local institutions and structures within each community.

In Tanzania controlled land acquisition under customary rules in the village of Chekereni proved to give landowners the platform to argue and get their claims respected (Lerise 2005). Customary tenure can prove to be secure if all the customary rules are followed as described by Lerise (2005) in the case of Tanzania which is said to have been one of the first few African countries to have nationalized and centralized the control of access and use of land, water and other natural resources post-independence. According to this author the country committed substantial resources in terms of legislation, by-laws and guidelines and plans to intensify land use on a fair and equal basis in the rural areas. Lerise (2005) points out that in reality the aims of the different policies, legislation and plans have not been achieved. This, as stated earlier on, is partly because those who acquired their land through customary tenure hold on to their customary right over the land.

By following their customary rules farmers can obtain permission to use their allocated portion to grow crops for energy. As was the case in this research the farmers had to get the chief to endorse their agreement with D1 Oils to make sure they had followed the proper channels to be allowed to grow *Jatropha curcas* for biofuels.

2.3 *Jatropha curcas*

Jatropha curcas is a hardy tree that produces non-edible seeds with a high oil content of about 37% on average (Katembo & Grey 2007) and under optimal conditions it can produce up to 40% oil yields (Wood 2005). *Jatropha curcas* is an agro-forestry crop which offers advantages over other feedstock in that it grows rapidly from cuttings and seeds taking about two to three years to reach maturity and generate economic yields with minimum water and nutrients (Wood 2005). *Jatropha curcas* is well adapted to arid and semi- arid conditions and generally occurs in seasonally dry areas. It is said to grow in savannah, scrub vegetation and other open vegetation (Edje and Mngometulu 2005). It is said to grow well on well-drained soils and even on poor gravelly land not suitable for most arable crop production. Brinks (2005) in Edje and Mngometulu (2005) says it can grow even on saline soil, drought tolerant growing in areas with rainfall from 300 to 1000 mm/annum and can survive seven or eight months of drought.

Jatropha curcas grows wild across Sub-Saharan Africa, India, South East Asia and China and is often cultivated as a living fence.

The hardy tree is able to tolerate a wide range of climatic conditions with a productive span of over 30 years going up to 50 years (Nabi, Akhter & Islam 2007). *Jatropha curcas* is said to be sensitive to wind but can withstand mild frost (Wiesenhutter 2003). It is a deciduous plant shedding it leaves in the dry season. It grows in climatic conditions commonly found in a band around the globe 30degrees north and south of the equator which places most of the viable *Jatropha curcas* growing regions in the developing world (D1 Oils (undated)). This is because like most oil crops it does well in areas with warm tropical climate (Edje and Mngometulu 2005). Under rain fed conditions, the growth of *Jatropha curcas* is regulated by rainfall, temperature and light. The flowers of *Jatropha curcas* produce nectar, may be scented and are insect pollinated. Their sweet perfume at night and greenish yellow colour suggest that the species is pollinated by moths (Edje and Mngometulu 2005).One of its unusual features is that before falling to the ground, the dry fruits and seeds remain on the tree for some time especially under dry conditions (Nabi, Akhter and Islam 2007). The seed and oil yields vary greatly according to origin and production conditions (climate, soil, plant spacing, water supply, fertilizer). Dry conditions, in particular, increase the oil content of the seeds (Wiesenhutter 2003).

Nabi, Akhter and Islam (2007) highlighted some of the benefits of *Jatropha curcas* oil as follows: *Jatropha curcas* oil has a very high saponification value hence it has been traditionally used for making soaps and candles. The oil is also used as an illuminant and burns without emitting smoke. *Jatropha curcas* is also used in folk medicine; the latex of jatropha contains an alkaloid known as "jatrophine" which is believed to have anti-cancerous properties. The bark of jatropha yields a dark blue dye which is used for colouring clothes, fishing nets and lines (Nabi, Akhter and Islam 2007). Notwithstanding the above mentioned benefits, *Jatropha curcas* until recently had no commercial application (Wood 2005).

2.3.1 Biodiesel

Vegetable oils, such as soybean oil, rapeseed oil, coconut oil and palm oil are major sources of biodiesel (Nabi, Akhter and Islam 2007). However these oils are edible and thus make biodiesel production compete with consumption.

The extracted crude *Jatropha curcas* oil has been found to have the most exciting properties in the field of biodiesel fuel (Nabi, Akhter and Islam 2007). The oil can be refined into high quality biodiesel through a process called transesterification whereby the chains of fatty acids in the oil are broken down to alcohol esters (biodiesel) and glycerine (Nabi, Akhter and Islam 2007) shown as : Oil + ethanol + catalyst ⟶ Biodiesel + glycerol (Nabi, Akhter and Islam 2007). The catalyst may be an alkali such as Potassium Hydroxide (KOH) or Sodium Hydroxide (NaOH) or it may be an acid such as Hydrochloric acid (HCl) or Sulphuric acid (H_2SO_4). Below is the bio-energy cycle of *Jatropha curcas*:

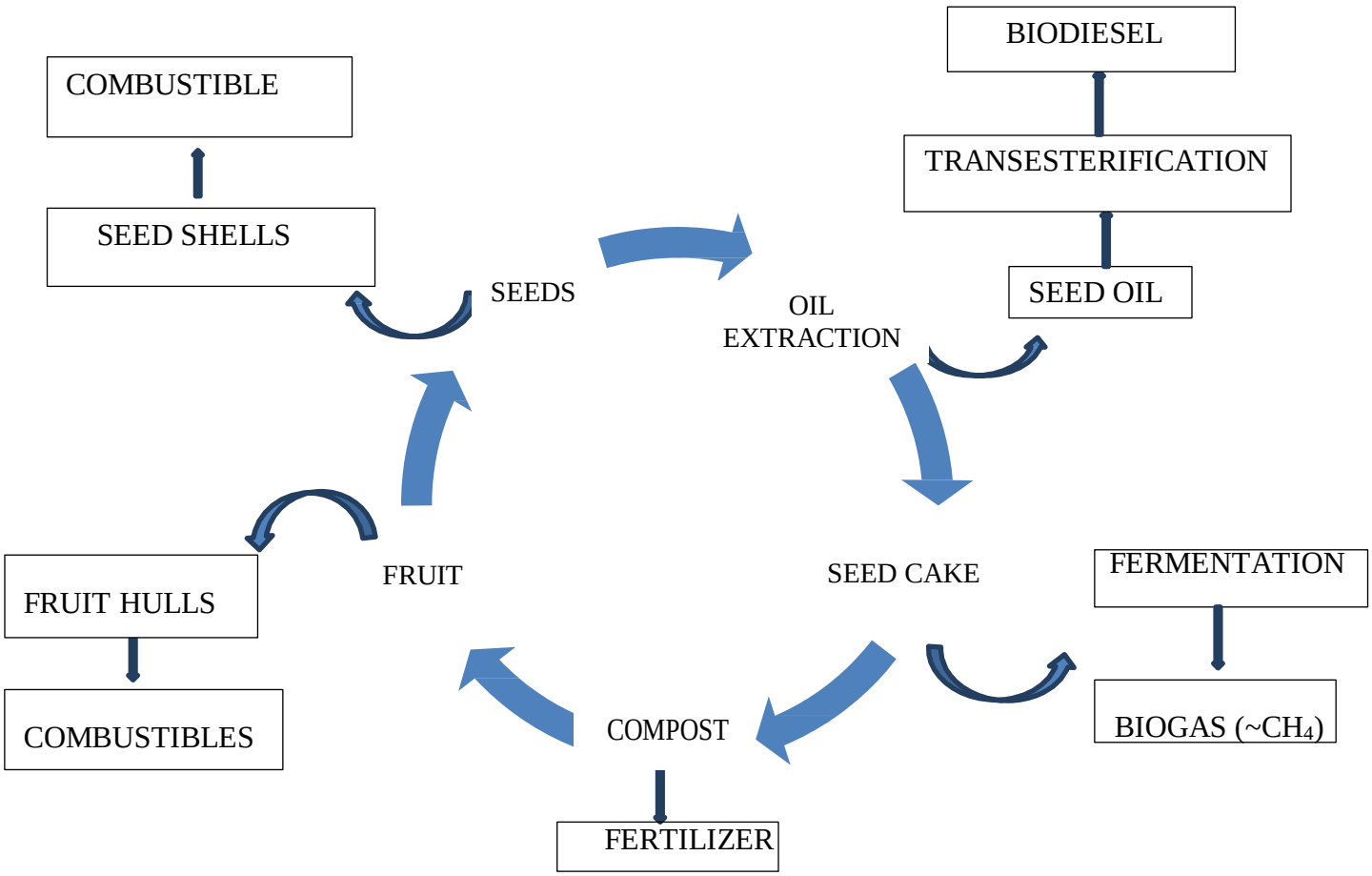


Figure 2.2 Bio-energy cycle of *Jatropha curcas* (Wood 2005; Dubois 2008)

Jatropha curcas biodiesel fully complies with the current European EN14214 standard for automotive diesel with even a higher cetane value that that of mineral diesel which allows it to burn cleaner at higher temperatures (Wood 2005).
In addition to that, as the *Jatropha curcas* trees grow they capture carbon dioxide (CO_2) thus reducing the impact of greenhouse gas emissions significantly. A study from the United States National Renewable Energy laboratory has concluded that Biodiesel reduces net CO_2 emissions by 78 %(Wood 2005).

D1 Oils is a company that was founded to design and build scalable biodiesel refineries for the UK road haulage industry. They first investigated rapeseed as their primary feedstock but found it commercially unattractive because of the relatively high cost when using mid-sized refineries. This prompted the company to search for alternative edible and non-edible vegetable oils suitable for producing biodiesel in volume at low cost. This is how the company identified *Jatropha curcas* as one of the best feedstock in making biodiesel (D1 Oils (undated)). Until recently, the European Union biofuel policy had relied on the assumption that the heavily subsidized production of rapeseed would meet its biofuel targets. Accordingly some three million hectares of agricultural land across Europe produces ten million tonnes of rapeseed but since only about 20% is used to produce biodiesel an equal area would be required to meet the EU targets (Edje and Mngometulu 2005; UNCTAD 2006). However rapeseed is expensive to produce, has heavy demand on soil nutrients and requires expensive crop rotation which is what made *Jatropha curcas* an important optional feedstock for the production of biodiesel (Edje and Mngometulu 2005; UNCTAD 2006).

D1 estimates that a plantation set on waste or marginalized land can support a minimum of 2000 productive trees per hectare and each tree yielding about 3.5 kg of seed, a hectare would have a harvest of 7 tonnes of seed which when crushed would produce about 2.8 tonnes of crude vegetable oil. D1 estimates that each tone of crude *Jatropha curcas* oil produces about 1100 litres of biodiesel (Wood 2005). However according to Jumbe, Msiska and Mhango (2007) all countries in Africa that grew *Jatropha curcas* realised a yield of 1892 litres of oil per hectare. D1 Oils in Swaziland encouraged households to at least have 1 hectare plantations of *Jatropha curcas* in order for the activity to be viable.

2.4 Growing *Jatropha curcas* a Sustainable Technology

The introduction to sustainable technologies is not an easy task as it has been shown through experience that this is a complex and protracted process with a high likelihood of failure even if they promise superior performance compared to incumbent technologies (Caniëals and Romijn 2006). According to these authors that is explained by the fact that technologies are always a part of a broad and complex system of socio-technological (ST) regime consisting of manifold interacting technological and societal elements.

Hoogma, Kemp, Schot and Truffer (2002) defined the socio- technological Regime as "the whole complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures". In turn the regime is embedded in a wider context landscape, which consists of material and immaterial societal factors (Salé and Dewes 2009). van der Laak, Raven and Verbong (2007) points out that systems are locked in through technological, institutional and social path dependency, resulting in a variety of barriers for new innovations such as the lack of a fuel infrastructure, the lack of clear government regulations or fierce competition with a network of incumbent actors that do not support the innovation. The authors also point out that new technologies often suffer from limited technological and economic performance compared to the dominant design, which has already profited from decades of dedicated research and development. Eijck and Romijn (2006) state that innovations with radically new features especially those that aim to improve environmental and social equity-related sustainability, do not sit well with existent socio-technological regime characteristics that reinforce the importance of short-term economic benefits. Before the households that are involved in the project of growing *Jatropha curcas* can realize any outcome of their labour, they have to wait for one and half to three years.

As pointed out by Salé and Dewes (2009) that, new technologies do often get support on the basis of expectations about future performance improvements there is a limit to the adaptability of the regime itself because the regime change is conditioned by landscape factors. This can result in powerful inertia that can prevent new sustainable technologies from gaining ground let alone from unseating incumbent ones.

Rajagopal and Zilberman (2007) have noted that even from an individual decision maker's

perspective, farm planning problems are much more complex, with farmers having to choose from multiple crops and multiple ways of producing them. Choices and decision must be taken on resource allocation. The farmer who is part of a household must make a decision on land use, that is, to decide which crop to grow on which plot or part of the field. The farmer must also decide on the inputs for each of the crops and risk preferences (Rajagopal and Zilberman 2007). With the introduction of biofuels it means new crops, new farm practices, new types of market arrangements, new fuel production technologies and new vehicles will have to be adopted by a wide variety of economic actors (Rajagopal and Zilberman 2007).

Salé and Dewes (2009) suggest that in order to address these problems the Strategic Niche Management (SNM) approach should be taken whereby, protected spaces are created in which new technologies are given opportunities to incubate and mature through gradual experimentation and learning by actor networks of producers, researchers, users, governmental departments and other organisations (Eijk and Romijn 2006).

Whilst this research is not on the SNM, the first process of the SNM is voicing and shaping of expectations meant to match the promises held out by the innovation and the stakeholders' expectations about it, with the needs in society that the innovation is meant to satisfy (Kemp, Schot and Hoogma 1998). Firms, users, policymakers, entrepreneurs and other relevant actors participate in projects on the basis of expectations (Salé and Dewes 2009). Salé and Dewes (2009) point out that articulating expectations is important to attract attention and resources as well as new actors, in particular when technology is still in early development where functionality and performance are still unclear.

The livelihood framework describes the expectations that households participating in the new activity (technology), which is in this case growing *Jatropha curcas* for biodiesel, may have as described in subsequent sections. Whilst these expectations may not be homogenous it is noteworthy that the potential benefits and the limitations of the new technology become clearer as the experiment evolves (Salé and Dewes 2009). People's expectations about it become more specific and consistent ("robust") as initial vague beliefs give way to accumulating facts, figures and experiences (Raven 2005 in Salé and Dewes 2009). This is what can be termed the impacts of the project on the livelihoods of the people.

2.5 Impact of Growing *Jatropha curcas*

The impacts of growing *Jatropha curcas* as a feedstock for biofuels shall be approached by discussing the impact it has had on the different aspects of livelihood for those households in countries where *Jatropha curcas* has been cultivated using literature.

The discussion will range from their vulnerability context, assets and their access to the assets and livelihood strategies.

2.5.1 Impact on the Vulnerability Context

Vulnerability to famine:

The International Food Policy Research Institute (IFPRI) (2002) has noted that about 10 million people in Southern Africa are experiencing famine or the threat of famine where Southern Africa includes Lesotho, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe.

In Swaziland, pronounced drought conditions continue to recur; erratic rainfall patterns, prolonged dry spells and high temperatures have all contributed to the unsatisfactory agricultural production (VAC 2009: 9). According to VAC (2009: 9) these unfavourable conditions occur at critical stages of crop growth leading to poor harvests. According to the 2007 census, an estimated 78.9% of the Swazi population is rural based and derive their livelihood mainly from rain-fed subsistence farming and livestock rearing. Current consumption requirement of maize, the staple food crop, stands at 113000 metric tonnes (MT). In the production years of 2007/2008 the focussed maize production level was 62000MT whilst in 2008/2009 it was 70 672 MT shows a shortfall which is filled by commercial imports and food aid (VAC 2009: 9).

Claims by the proponents of *Jatropha curcas*, are that it requires little water and therefore suited to dry and arid lands and that it will give immense returns after three years (Tripathi 2008, Salé and Dewes 2009). These authors, whilst acknowledging the fact that it is true that perennial plants can survive long spells of drought compared to short duration crops, point out that even trees require well-spaced irrigation especially during the first years of development failing which, their growth and productivity is permanently affected. They have also pointed out that studies on growing *Jatropha curcas* under different conditions are being carried out at institutions like Tamil Nadu Agricultural University which, though have not come up with the optimal water requirement for *Jatropha curcas,* have stated that it is quite likely that fruit and seed production of *Jatropha curcas*

in dry rain fed conditions would be low and therefore be economically unviable. This then means a majority of small farmers might not reap the benefits of *Jatropha curcas* -- *5* biodiesel production as they rely on the rain-fed conditions and do not have access to water in order to make large scale *Jatropha curcas* cultivation that is economically viable (Salé and Dewes 2009).

From the above arguments *Jatropha curcas* is shown to reduce the vulnerability of households of losing a whole crop due to drought.

Impact of growing *Jatropha curcas* on Vulnerability to economic trends:

In Mali *Jatropha curcas* is grown by local communities supported by the Mali-Folke Centre which has been working with local communities in promoting *Jatropha curcas* as a raw material for biodiesel production (UN-ENERGY 2007). Communities living within a 20km radius from the centre benefit from the biodiesel production activities as they provide a local source of fuel for cooking and lighting as well as provide a viable source of livelihood for rural women (Jhamtani and Dano 2007). In addition, these communities are employed to run the power plants for electricity generation thereby creating employment. In the village of Tiecourabongoe, an energy service centre has been established focusing on *Jatropha curcas*. Due to the success of the project the Mali-Folke Centre has embarked on a large-scale15 year rural electrification project in Southern Mali produced from *Jatropha curcas* oil. Under the project, there are 1000 hectares of *Jatropha curcas* plantation (UN-ENERGY 2007).

Jatropha curcas offers particular advantages as an agro-forestry crop in that it grows rapidly from cuttings and seeds, taking two to three years to reach maturity and generate economic yields with a long productive life span. It has a potential to create jobs (Wood 2005; Nabi, Akhter & Islam 2007). In many rural areas particularly in Africa, limited employment opportunities force man to migrate to the cities to find work draining the area of skills and often reducing the standard of living for family members left behind. Another issue is that there has

been a significant decline in migrant labour as the employment opportunities decline and there are job losses in some sectors which has seen remittances, which contributed significantly to rural household economies in the past, being reduced (VAC 2009). Growing *Jatropha curcas* would yield large-scale employment generated from the creation of nurseries, the planting and maintenance of trees and the harvesting and processing of seeds (Wood 2005).

A recent review of biodiesel in South Africa carried out for the City of Cape Town concluded that the employment benefits of biodiesel crops particularly *Jatropha curcas* are almost five times greater than those for crops to produce ethanol (Wood 2005:6).

Whilst this may be true at commercial level the situation may be different for poor farmers who rely on household members for labour within the farm. For economic reasons poor farmers may be pressured to grow crops for biofuels whilst not having access to energy themselves which would be a repetition of large scale hydropower plants displacing communities for the sake of providing energy to industries and cities while leaving poor villages in the same areas without electricity (Jhamtani and Dano 2007).

According to Jhamtani and Dano (2007) growing *Jatropha curcas* for biofuel has the potential to make a real contribution at community level provided it is a community-based biofuel production and consumption as is the case in Mali. They argue that if biofuels develop in the "business as usual" manner the industry will aggravate the energy inequity and this will only repeat the colonisation story of the south, which began with spices, then oil and genetic resources. Developing countries may be subsidising the energy needs of their industrialised elite at the expense of the poor's welfare (Jhamtani and Dano 2007). If the poor farmers grow the *Jatropha curcas* and sell the seed to a company whereby the processing into biodiesel will take place elsewhere the multiplier effects on the value of the crop take place away from the poor farmers and leaving them marginalised and disempowered.

2.5.2 Impact of Growing Jatropha on Land Use

There are claims that since *Jatropha curcas* can grow relatively well in marginal areas compared to other traditional crops, it may help to reclaim degraded land and protect the soil from erosion (Wood 2005; D1 Oils 2007; Nabi, Akhter & Islam 2007).). On the other hand Rajagopal (2007) in points out that to assume zero opportunity cost for wastelands is incorrect as most studies have not included environmental benefits. Diversion of land to industrial biofuels will also divert biodiversity and organic matter from the basic needs of the poor and the maintenance of ecological cycles which will impact negatively on the livelihoods of the poor since their economy is a biomass/ biodiversity based (Tripathi 2008). The biodiversity provides food, fuel wood, fodder, timber and grasses that are used for thatching material and weaving different handwork for domestic and commercial purposes. Tripathi (2008) points out that it will cause total destitution and the collapse of rural agro-systems as biodiversity and water are diverted by industry for biofuels.

Tripathi (2008: 34) explains that livestock is the major livelihood for the poor and they are heavily dependent on the common pastures for grazing their cattle. Livestock also plays an important role in the production system and livelihoods of smallholder farmers (VAC 2009) by providing power for ploughing, cultivating and transport. Their manure provides fertilizer, fuel for fires and making the floors of some houses. The livestock is also used in traditional ceremonies such as marriages and funerals. They are also used for land acquisition and provide food in the form of milk and meat (Magagula, Dlamini and Mkhwanazi 2001).
This means that by planting of *Jatropha curcas* in the wastelands, fodder availability for the livestock will be greatly affected which in turn would impact negatively on the production system and the livelihood of the small holder farmers and the poor.

This negative impact can however be greatly reduced by the right policy that would ensure that the processing of *Jatropha curcas* is carried out within the communities that grow and supply the *Jatropha curcas* seeds. This would be because crushing *Jatropha curcas* seeds to extract the oil also produces seedcake that can be used as organic fertilizer, briquettes for fuel, nutraceuticals, and after further processing, animal feed (Wood 2005). This would be addition to the fruit hulls and seed shells that are useful as combustible material that can be used in the place of fuel wood. As stated in the case of Mali, communities living within a radius of 20 km from the

Mali-Folke centre benefit from the biodiesel production activities.

2.5.3 Impact of growing *Jatropha curcas* on food security

Developing countries which are net importers of food have and will be negatively affected by biofuels due to the increase in food prices either because food crops are converted into fuel or because energy crops displace food crops on agricultural land irrespective of whether they adopt biofuels or not (Rajagopal and Zilberman 2007). Many of the current sources of biofuels are derived from food crops such as corn, sugarcane, rapeseed, soybean and oil palm (Jhamtani and Dano 2007). At the end of 2006, grain prices were the highest they have been in a decade and in February 2007 tens of thousands of people marched through the Mexico City in protest of a 400% rise in the price of tortillas, a food made from corn and a staple food for the poor (RHVP April 2007).

In South Africa, the National Agricultural Marketing council in its March 2007 report stated that although there had been a decrease in the food inflation rate from 9.45% in 2005 to 7.88% in 2006, some important foods which are staples in poor people's diets had increased more dramatically. These include maize where the average price increase was 28% and sugar which rose by 12.6% (RHVP April 2007).

This situation was partly brought about by the fact that the United States which was supplying 70% of all the grain traded internationally was now using 26% of its sorghum to produce ethanol and was set to use 25% of its Maize for the same purpose of biofuels (RHVP April 2007).

Because biofuels are produced from feedstock the competition that could occur between agricultural production for food and production for energy is the origin of various concerns in terms of food security (UNCTAD 2006). Biofuels may mean filling the fuel tanks of the rich at the cost of emptying the stomach of the poor (Rajagopal and Zilberman 2007).

These concerns seem even better founded when a net food importing country starts biofuels production (UNCTAD 2006). However in their argument UNCTAD (2006) point out that a specificity of many developing countries is their commodity dependency. Their export earnings often rely on a few commodities, be they mineral or agricultural of which their agricultural export do not contribute to food security, thus diversification of such exports into biofuels would be of little or no consequences on food security (UNCTAD 2006).

However at a different level, production of energy crops might be attractive in terms of price ratios and income that it may induce the diversion of resources away from food crop production thereby threatening food security (SADC 2005 in Jumbe, Msiska and Mhango 2007). This according to UNCTAD (2006) can be explained by the fact that market liberalisation put low production farmers in competition with highly subsidised and intensive agriculture whereby, storage, transport, grading, sanitary control, investment and all types of infrastructure, which on one hand reduces costs to market products on the other hand create barriers in food production. Therefore according to these authors, there is, however, a potential that food security may be improved through increased income and markets for energy crops, thereby allowing the household to buy their food.

The other argument is that *Jatropha curcas* is non-food feedstock from which biofuels may be produced. Whilst developed countries use feedstock which are food crops such as wheat, maize, sugar beet and rapeseed, to produce their biofuels developing countries would benefit by using the non-food feedstock. This eliminates the impact of biofuels on food security caused by using food crops as feedstock for making biofuels.

Notwithstanding the above discussion, others have expressed that growing *Jatropha curcas* as feedstock for biofuels could have a negative impact to food security through the creation of competition for land and agricultural resources between the energy crop and food crops (Jhamtani and Dano 2007). *Jatropha curcas* has been promoted as a wonder crop that can grow well even in adverse conditions where other ordinary crops may not survive. However Rajagopal (2007) argues that under rain fed condition on poor soils, fruit and seed production may be so low that it may make the activity of growing *Jatropha curcas* economically unviable.

It has also been shown that the jatropha plantations may be inter-planted with other annual crops without changing the traditional agricultural system (Jumbe, Msiska and Mhango 2007). In Madagascar, farmers traditionally use Jatropha curcas trees as supports on which to grow vanilla pods (Wood 2005). D1 Oils is now working with Madagascan communities to harvest the seeds from these trees, which have until now not been used, for processing into oil (Wood 2005).

In India *Jatropha curcas* is intercropped with Gram, a pulse that is used as food (D1 Oils 2006). In the Philippines D1 Oils is investigating intercropping *Jatropha curcas* with coconut palm (Wood 2005). D1 Oils, in their manual for *Jatropha curcas* cultivation (2006), have stated that the intercrop must not compete with *Jatropha curcas* with regard to growth and development nor be a host to pests and diseases that could affect *Jatropha curcas*. It has also been noted that *Jatropha curcas*, as much as it tolerant to a range of diseases and pests, can be a host to diseases for other crops. According to Munch (1986) in Edje and Mngometulu (2005) *Jatropha curcas*, is a host to cassava virus that can be transmitted to cassava. Consequently it should not be used as live fence for cassava field and should not be grown in close proximity with cassava. According to Edje and Mngometulu (2005) since these two crops are adapted to the same environments caution must be taken in the choice of their proximity.

This then suggests that more research is still to be carried out on different food crops within the communities where jatropha is grown to ascertain which of their food crops can be safely intercropped with *Jatropha curcas*. If that is established, it would mitigate the impact on food security as other crops used as food are grown in the same piece of land.

UNCTAD (2006) addressing the issue of risk to food security pointed out that the situation is different for developed and developing countries. Whilst in the developed countries most of the available agricultural land is used in developing countries especially Africa the proportion of unused land that could be cultivated for biofuels is significant.

From the above arguments it is evident that the outcome of a biofuel project is strongly dependant on the policies and institutions that are in place at international, national and local levels.

2.6 Policies and Institutions

Poverty elimination is an enormous challenge that will only be overcome by working at multiple levels, ensuring that micro-level activity informs the development of policy and an effective enabling environment and that macro-level structures and processes support people to build upon their own strengths (Carney 1999). Institutional arrangement for bioenergy and institutional coordination of such development projects should be in place. A clear institutional arrangement and clear coordination mechanisms are critical policy issues that must be addressed to reduce

conflict and duplication of efforts or worse still, a situation where there is no department which can be held accountable on how such projects are implemented (Sasovele 2010).

The biofuels program cuts across different sectors which include agriculture, energy, industry and international trade. As such, some available laws governing energy development and distribution cut across sectorial laws governing forestry, agriculture, environment, water, industry, electricity and petroleum requiring institutional coordination, a complex challenge that is not easily overcome(Bulletin 2007).

There is a general lack of guiding policies and legal framework in many developing countries as pointed out by Jumbe, Msiska and Mhango (2007). Sasovele (2010) noted the same problem in the case of Tanzania. There is a need for an integrated policy that takes into account energy development, transportation, agriculture, land and water issues. This policy would facilitate a policy and legal framework for standards, criteria for investment and targets (blending) to be achieved which would be used in bioenergy investment (Sasovele 2010).

Biofuels programs should be systematically integrated into policy planning processes for the concerned sectors and stakeholders (Bulletin 2007). One challenge that has been identified in to design and implement policy measures to ensure that the growing use of biofuels is conducive to reducing poverty and hunger so that 'bioenergy becomes pro-poor' (IFAD 2008).

According to IFAD (2008) existing institutions also have a crucial role in making bioenergy pro-poor. Examples cited are that cooperatives or producer companies can bundle the interest of the poor, accumulate and attract capital and partnerships for the necessary investments, organize feedstock supplies in large quantities and in turn create a countervailing power to larger firm operating in the energy market (IFAD 2008).

There are other policies that are used in the biofuels spectrum although they are mainly used by developed countries. These include energy and carbon policies which are in the form of taxes, trade policies, government funding for research and development of biofuels and investment incentives (Rajagopal and Zilberman 2007). Jumbe, Msiska and Mhango (2007) reviewing national trade policies of African Countries noted that they have trade and investment policy frameworks to promote or facilitate domestic and foreign investment in various sectors of the countries. The common policy instruments used to promote trade and investment include: tariff structures such as taxes and duty drawback schemes, non-tariff measures such as quotas and

import licensing, trade defence mechanisms such as subsidies and anti-dumping, trade promotion instruments such as export processing zones and international trade instruments such as bilateral trade agreement. Most of these policies are at national and international level and whilst they ultimately impact on the ability of the households to achieve or not achieve their desired outcomes in their livelihood activities including in the growing of *Jatropha curcas* for biofuel, it is beyond the scope of this research to discuss them in detail.

Jumbe, Msiska and Mhango (2007) have however given a snapshot of the challenges that the biofuel industry faces especially in the Sub-Saharan African(SSA) region in terms of policies by analysing some national trade policy documents of some African countries and by comparison with the policy framework of Brazil whose successful biofuel industry dates back to 1975. What is noted is that one marked difference between SSA and Brazilian policy frameworks is that the SSA frameworks do not focus on the biofuel sector but on other sectors of national economy whereas that of Brazil is directly focused on the development of the biofuels sector. One common challenge across the SSA countries with regard to trade and investment promotion include inadequate national capacity to apply the available instruments and in some cases the prevailing policy and regulatory instruments are still not quite conducive for both domestic and international investments in a number of sectors including the biofuels sector (Jumbe, Msiska and Mhango 2007:20).

In Swaziland at the time when the biofuels project of growing *Jatropha curcas* was commissioned in 2005, the feasibility study report on biofuels was not even out and the draft of the Swaziland National biofuels Development Strategy and Action Plan only came out in 2007 and the final strategy and action plan came out in October 2010 (SWADE 2005, Ministry of Natural Resource and Energy (MNRE) 2007& 2010). Articulating such challenges Jumbe, Msiska and Mhango (2007:21) state that the SSA region should not expect the biofuels industry to effectively develop in the presence of the multiple investment huddles that threaten to strangle to death the biofuels industry even before its full potential is realised for the African continent. These authors note that what is needed for the African countries to put in place is appropriate policy and regulatory frameworks that would not only promote biofuel production and processing by foreign and domestic investors, but also

protect poor households from being displaced from their land, creating hunger through large-scale appropriation of arable land meant for food crop production for growing energy crops. The SSA region needs to come up with policies, legislation and strong institutional frameworks that will stimulate production and processing of biofuels in a sustainable manner and in addition build capacity and skills in the production systems through training of experts in biofuel technology (Jumbe, Msiska and Mhango 2007). These same authors highlighted that the above measures must be complemented by an increased investment in infrastructure such as biofuel production plants, storage depots, service stations and transportation system without which it will be difficult for most SSA countries to establish and take advantage of the growing international biofuels markets. UNCTAD (2006) states that the location of the processing of biofuel feedstock in rural areas is what can greatly contribute to rural development, creating employment, improving infrastructure and making agricultural activities more profitable. This calls for an adequate policy framework (UNCTAD 2006). That way the biofuels industry has the potential to greatly contribute to livelihoods at local levels and ultimately rural development in general.

2.7 Summary

According to new approaches to rural development, sustainable livelihood is a way of thinking about objectives, scope and priorities for development (Ashley and Carney 1999).Therefore a sustainable livelihood should be the desirable outcome for each household as it engages in an activity for development (Chambers 1994; Carney 1999; Scoons 2005). Sustainable livelihoods (SL) aim to help poor people to achieve lasting improvements against the indicators of poverty that they (poor people) define (Ashley and Carney 1999).

The Department for International Development's (DFID) core SL principles (Ashley and Carney 1999: 7) are that a poverty-focused development activity should be:

- **People-centred**: sustainable poverty elimination will be achieved only if external support focuses on what matters to people, understands the differences between groups of people and works with them in a way that is congruent with their current livelihood strategies, social environment and ability to adapt.
- **Responsive and participatory**: poor people themselves must be key actors in identifying and addressing livelihood priorities. Outsiders need processes that enable them to listen and respond to the poor.

- **Multi-level**: poverty elimination is an enormous challenge that will only be overcome by working at multiple levels, ensuring that micro-level activity informs the development of policy and an effective enabling environment and that micro-level structures and processes support people to build upon their own strengths.
- **Conducted in partnership**: with both the public and the private sector
- **Sustainable**: there are four key dimensions to sustainability: economic, institutional, social and environmental sustainability. All are important-a balance must be found between them.
- **Dynamic**: external support must recognize the dynamic nature of livelihood strategies, respond flexibly to changes in people's situation, and develop longer-term commitments.

Sustainable Livelihoods approaches must be underpinned by a **commitment to poverty eradication.** Although they can in theory be applied to work with any stakeholder group, an implicit principle for DFID is that activities should be designed to maximize livelihood benefits for the poor (Ashley and Carney 1999:7). This chapter has discussed growing of *Jatropha curcas* by rural households against this backdrop in terms of rural development. The next chapter gives a full description of the methodology followed in the research.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

Whilst chapter 2 was a presentation of the literature on all the aspects that inform the research, this chapter outlines the research methodology and includes a detailed description of the study area, the sample and its selection. It also includes the description of the measuring instruments, data collection and its analysis.

This is an evaluation research which is sometimes called program evaluation. According to Babbie (1986) this form of research refers to a purpose rather than a specific research method and its purpose is to evaluate the impact of social interventions such as teaching methods, innovations and a wide variety of such programs (Babbie 1986). Such programs are undertaken for the purpose of producing some intended results and therefore can be evaluated to determine whether the intended result was produced (Clark and Dawson 1999). What serves to distinguish an evaluative study from other forms of social research is simply a question of purpose. It is conducted to determine the value or impact of a policy, programme, practice, intervention or service with a view of making recommendations for change (Clark and Dawson 1999: vi).

The approach of the research was qualitative and used the Sustainable Livelihoods framework to provide insight to the way of thinking and seeing issues in the innovation of growing *Jatropha curcas* by rural households in Mpaka Swaziland. Within social sciences, there is a multitude of effort to describe, explain or predict phenomena; however a framework allows the researcher to reveal a particular meaning and understanding whilst concealing other meaning and understanding (Anfara and Mertz 2006). As Eisner (1985) in Anfara and Mertz (2006) put that the theoretical framework becomes a window through which a phenomenon can be viewed, next to the window is normally a wall which obstructs other possible views.

3.1 Framework

The sustainable livelihoods framework was chosen as the theoretical framework that can be best used to study this phenomenon since its holistic outlook and emphasis on both the social and economic dimensions of rural life endeavours to explain key causal relationships and influences in a way that the information remains manageable (Carney 1999). This framework entails the analysis of: the context in which the rural people live including the effects upon them of external trends, shocks and seasonality; their access to physical, human, financial, natural and social assets and their ability to put these into productive use; the policies and institutions which shape their livelihoods; and the different strategies they adopt in pursuit of their goals (Carney 1999).This was the best theoretical framework that the researcher found to work well with the phenomena being studied. At the heart of the sustainable livelihoods framework is the household.

The household is defined as the primary social living unit encapsulating a cluster of activities of people who live together most of the time and provide mutual physical, socio-psychological and developmental support and function within the broader organisation and environment of the community (de Satgé 2002). Since the framework has been used and continues to be used by different development agencies it has brought about new understanding about poverty and its complexity (Ashley and Carney 1999; Hussein 2002). It has significantly highlighted the multiple sources of insecurity and vulnerability beyond income alone including health related risks and natural phenomena such as climatic variation, the responses to shocks and stresses together with the coping and adaptive strategies; the importance of the range of assets for the poor which include natural resources and social networks and the diversity of livelihood sources at the household and intra-household level; the vital role played by formal safety-nets for more vulnerable groups; the priority that communities place on making their voice heard at policy level and the need for empowerment at many levels as there is increasing recognition of the need to increase the poor people's influence over the institutions, policies and decisions that affect their lives. It also allows for the analysis of the institutions and processes at play as these affect access to different assets and intermediate outcomes leading to the desired outcome (Ashley and Carney 1999; Hussein 2002).

For the reason that the study is at household level, all these aspects of the livelihood of a household had to be taken into account in order to bring out what the effect of growing *Jatropha curcas* for biofuels has been at this level.

The main tools used in the research were the in depth semi- structured interviews, focus group discussion and documentation. Observation was another tool used in describing the type of housing for the different households. Data analysis was primarily descriptive and undertaken through interpretation and coding whilst regarding issues of reliability and validity. The research was undertaken in the setting described hereafter.

3.2 Setting

The research has been carried out in the kingdom of Swaziland in the area of Mpaka also generally known as Malindza. Swaziland is one of the smallest countries (17 364 square kilometres) within the mainland African continent and it is landlocked. It is mainly surrounded by the Republic of South Africa (RSA) which borders three sides and only one side in the eastern part borders with Mozambique. Swaziland is one of three remaining monarchies in Africa, with the Swazi king wielding executive power. Swaziland's Westminster based constitution was revoked in 1973 and replaced with a system designed to accommodate both the western and traditional styles of government (Forsyth-Thomson 2011). This structure is known as Tinkhundla and enables the people to elect candidates to be their parliamentary representatives according to their respective constituencies (Tinkhundla). However this system of governance does not allow for different political parties (Forsyth-Thomson 2011). Power is vested on the King who appoints the Prime Minister and consults with cabinet headed by the Prime Minister and the bicameral parliament. This forms the western style of government.

The Swazi National Council (Libandla) is the traditional side of government and it is headed by the King and the Queen Mother in accordance with the dual monarchy approach (Forsyth-Thomson 2011). The queen Mother's primary role is to uphold the traditional and cultural elements within the country (Forsyth-Thomson 2011).

Swaziland is divided into four administrative regions which are namely Hhohho, Manzini, Shiselweni and Lubombo and fifty five constituencies (Tinkhundla) for political administration purposes (VAC 2006, Central Statistics Office (CSO) 2007). The regions are administered by Regional Administrators (RAs), while the constituencies are administered by the Constituency Headman/ Headwoman. Within each constituency, are several chiefdoms headed by their respective chiefs and their inner councils. The chiefs report to the king through the Inner Council headed by a Governor.

The country's legal system also operates on a dual basis and embraces both the Swazi National Courts as well as the constitutional courts. The constitutional courts observe the Roman-Dutch law and comprise of a High Court, Magistrate courts as well as the Industrial court (Forsyth-Thomson 2011).

The government headed by the Prime Minister consists of cabinet ministries headed by cabinet ministers and different departments within the respective ministries. The country is administered using the basic structures that have been described.

In terms of interface between civil government's administrative structures, the four Regional Administrators work closely with all the chiefs in each of the regions and are therefore very influential. A Member of Parliament is chosen from each of the 55 constituencies or 'Tinkhundla' (Shown below in figure 3.1). As a rule each Inkhundla is made up of a number of chiefdoms depending on the size. At the Inkhundla level the council is called Buchopho Benkhundla which can be translated as 'the brain of the constituency'.

The most important political unit in the study area is the Chiefdom which constitutes the traditional authority structure. In rural Swaziland the chiefdom is the highest authority on Swazi Nation Land (SNL). Ultimately these heredity chiefs are answerable only to the king regarding their chiefdoms. The chief has a headman (Indvuna) and an inner council (Bandlancane) to work with. These structures make up the Local Traditional Authority. The local traditional authority allocates land, and settles disputes. Where the chief and/or his council are active, they direct development activities within the community but in all cases they are the legal entry point for all development within the community. For this reason the traditional authority is very important in

establishing the legitimacy of a project, its acceptance in the community and its sustainability (SWADE 2012).

Whilst the importance of traditional authority in a project can be appreciated, the rest of the system of governance may present hurdles when mapping out coordination, the levels of commitment and accountability on a project. As Lerise (2005) has shown the two systems of governance (Western and Traditional/ Customary) seem to run parallel to one another bringing about issues of when and where the convergence comes and with what levels of influence on a project. The Western system of governance has all the structures and institutions which form the gateway for investors and other businesses within the country. Rural communities look up to their local traditional structures as the authorities as they carry on with their livelihoods. When coming to a project that involves an investor and rural communities (private public partnership) issues on policy and institutions emerge and may become complex especially in the way they need to be dealt with. It is therefore important for this study to appreciate the systems of governance within which the people of Mpaka and the project of growing *Jatropha curcas* for biofuels exist.

Mpaka falls under the Dvokodvweni constituency. Dvokodvweni constituency is shown encircled in figure 3.1. Figure 3.2 shows Mpaka (encircled) within the Dvokodvweni constituency.

Figure 3.1 Administrative Regions

Figure 3.2 Map of Swaziland showing Mpaka

3.2.1 Population

Officially, the nation's population is currently estimated at slightly over 1.1 million (Central Statistics Office (CSO) 2007). Based on currently available information on HIV/AIDS the country is leading in the world in terms of HIV/AIDS occurrence with up to 25.9% of the sexually active population infected (Swaziland Demographic Health Survey (SDHS) 2006-7). This has seen the life expectancy plummeting from 60 years in 1997 to 37.5 years currently (Central Statistics Office (CSO) 2010).

According to the 2007 census, about 78.9% of the Swazi population is rural based (CSO). These derive their livelihood mainly through rain-fed subsistence farming and livestock rearing. Pronounced drought conditions continue to recur in the country marked by erratic rainfall

patterns, prolonged dry spells and high temperatures leading to unsatisfactory agricultural production levels. The country has a high poverty rate of 69% (VAC 2006) and an unemployment rate of 40.6% (Table 3.1) with the Shiselweni region leading followed by the Lubombo region then Hhohho and lastly Manzini region in terms of unemployment (Table 3.2) (CSO 2010).

Table 3.1 Unemployment rates in Swaziland (CSO 2010)

Area	Total	Male	Female
Swaziland	40.6%	33.6%	47.4%
Urban	19.8%	14.6%	25.9%
Rural	46.6%	39.7%	53.0%

Table 3.2 Regional Unemployment Rates in Swaziland (CSO 2010)

Region	Total	Male	Female
Hhohho	38.5%	31.7%	45.2%
Manzini	35.1%	29.8%	40.0%
Shiselweni	50.5%	44.5%	55.6%
Lubombo	45.1%	34.5%	56.7%

In the past remittances contributed greatly to rural household economies however, with the decline in employment opportunities due to reduced migrant labour and closure of certain sectors leading to job losses, the contribution of remittances to rural household economies has been greatly reduced.

With the majority of the people of Swaziland being rural (78.9%) and the poverty rate at 69% it is likely that the majority of poor are in the rural areas and that means there is a great need to empower rural communities and stir economic activities within their settings. As pointed out in

the South African Strategy for biofuels (2007) that the biofuels industry has the potential to uplift agricultural sectors and unlock substantial economic benefits, the project of growing *Jatropha curcas* by the rural community of Mpaka had the potential to being such. The Lubombo Administrative region within which Mpaka falls has the second highest rate of unemployment rate in the country (table 3.2) and as such effort should be directed to such regions in unlocking economic benefits.

3.2.2 Agriculture and food security

The country is also divided into four agro-ecological zones which are namely the Highveld, the Middleveld, the Lowveld and Lubombo Plateau (VAC 2006). The Swaziland Vulnerability Assessment Committee has further divided the country into what they call livelihood zones which are namely: Timber Highlands, Highveld Maize and Cattle, Moist Middleveld, Dry Middleveld, Lowveld Cattle Maize, Lubombo Plateau and the Peri-Urban (VAC 2010). According to the feasibility study carried out by SWADE (2006) *Jatropha curcas* could potentially be successfully grown in all the agro-ecological zones.

The country has good agricultural and forestry resources, irrigation potential and minerals such as coal, asbestos, and diamonds. Sugar ("Swazi Gold") is the main export, making about a third of the money Swaziland gets from foreign exchange and the sugar cane industry absorbs a vast majority of the manpower. Swaziland also has one of the largest man-made forests covering about 7% of the total area making wood and wood products to be also very important export products. The country's economy is highly dependent on that of South Africa (VAC 2006).

The country is faced with overgrazing, soil depletion, drought and occasional floods such that in 2004-5 a quarter of the population needed emergency food aid (VAC 2006). The country is still unable to be self reliant on its staple food maize. The current domestic consumption of maize is 113 000 MT (VAC 2009). The forecasted maize production for 2008/2009 was 70 672 tonnes which showed a slight increase compared to the 2007/2008 production year whereby 62000 tonnes of maize were produced (VAC 2009). In the season of 2009/2010 the maize yield was forecasted at 75 088tonnes which still showed an increase of 6% compared to the 2008/2009

mainly due to good rainfalls in some parts of the country and the government tractor hire scheme which even though unable to meet the demand of farmers is provided at a subsidized cost (VAC 2010). The shortfall is catered for through food aid and commercial imports (VAC 2009, VAC 2010).

During the 2009/10 season 52 445ha was under maize cultivation which shows a decline compared to the 2007/8 season whereby 60 355 ha were under maize cultivation. The figure is also slightly lower than the five year average between 2005/6 and 2009/10 which stands at 52 806ha under maize cultivation (VAC 2010). There is however an increase in output per hectare as agricultural inputs especially fertilizer and seed have become relatively lower than 2008/2009 production which increased accessibility. Usage by farmers ranged between adequate and satisfactory (VAC 2010). Clearly the country does not have food security as still about 160, 989 people are estimated to be facing income and food deficit (VAC 2010).

A big portion of the land of Swaziland lies fallow such that it puzzled a Taiwanese delegation to think that grass was the staple food of Swazis, thus congratulating their Swazi counterparts for having successfully cultivated the crop (Mtshali 2010). This is unlike South China where Mtshali (2010) during a visit, found that there was no patch of land that was left fallow. Not all crops are suitable for all regions of the country and it is therefore important that the most suitable crops for each of the regions are identified and farmers are encouraged to grow such crops so that portions of land do not unnecessarily remain fallow.

Cattle and other livestock such as goats, sheep, pigs and poultry continue to form a major source of livelihood for most households (VAC 2010). For both domestic and commercial purposes livestock and their products contribute to sources of income and nutrients enhancing household food security. The drive to commercialize livestock enterprises have led to good animal husbandry practices among farmers (VAC 2010).This may be part of the explanation why a portion of the country is fallow as there is need for grazing land among other reasons. Below is a table showing livestock numbers between 2007 and 2009.

Table 3.3 Livestock Populations in Swaziland (VAC 2010)

Census Year	Cattle	Sheep	Goats
2007	637,717	18,770	480,000
2008	618,620	17,657	458,196
2009	608,538	22, 680	509,495

3.2.3 Economic Performance

The economic growth rate of the country in 2008 was projected to 3% but this eventually went down to a rate of 2.4%. In 2009 the economic growth rate went further down to a rate of 0.4% but a slight improvement was expected in 2010 to about 1.1% (VAC 2010). However at the moment the country's economy is so bad that it there International Monetary Fund (IMF) is in the country to monitor Government Expenditures and economic activities. IMF has announced that it is vital for the Swaziland Government to restructure its operation in the face of the poor economic performance especially by reducing the Wage Bill which stands at 51% of recurrent government expenditure (Forsyth-Forsyth-Thomson 2011).

3.2.4 Mpaka

Mpaka is on the Lubombo administrative Region of Swaziland situated 43.8 kilometres east from Manzini the largest and central town in Swaziland (Forsyth-Forsyth-Thomson 2011). The Lubombo Region is on the eastern part of the country running from its north to its south. It is home to the country's greatest concentration of nature reserves collectively known as the Lubombo Conservancy. The region's historic administrative centre is Siteki (formerly known as Sitegi). Mpaka is about 20 km east of Siteki and it falls within the Dvokodvweni constituency which has population estimated to about 23 000 (C S O 2010). The area has a railway station and also has a coal mine which is no longer in operation.

Mpaka falls within the Lowveld ecological region and is within the Cattle and Maize livelihood zone (VAC 2010). This area is known to receive minimal rainfall hence food production, in particular maize, fails in most years. Over the past 10years this livelihood zone has consistently

received food aid hence food relief has become a normal source of food in particular for the very poor and poor wealth groups. This is an indication of chronic vulnerability that may require interventions aimed at mitigating the long term effects of drought (VAC 2010:13)

Judging from the population of Swaziland which is about a million the local area of Mpaka has a significant population which needs empowering in other economic activities that can give them a sustainable livelihood considering the vulnerability of the area to drought and also the closure of the coal mine which used to be a major economic activity. This is the setting of the area in general which is what sparked a lot of interest for the study considering the general need of the area coupled with the promise of hope brought by the biofuels industry and the project of growing *Jatropha curcas.*

3.3 Research Methodology

In order to be able to meet the sub-objectives of the study as listed in chapter 1, the researcher has used the anti-positivist approach using ethnographic methods. The primary task of ethnographic research (collecting field notes) is "to uncover and explicate the ways in which people in particular settings come to understand, account for, take action and manage their situations as well as the problems and difficulties they encounter" (Welman, Kruger and Mitchell 2005:193). Therefore the study was mainly qualitative although there were parts that required quantitative data so as to provide complementary information such as the number of household members, their age, education and food consumption.

3.3.1 Sampling

Sampling is the process of selecting observations (Babbie 1986). This allows the researcher to make relatively few observations and may generalize from those observations to a much wider population (Babbie 1986). Sampling can be divided into two general categories which are probability (random) sampling and purposive or judgmental sampling (Babbie 1986).

For the researcher to gather data that is relevant, purposive sampling was carried out and the choice was the households that are actually involved in project of growing *Jatropha curcas* within the Mpaka community and the other relevant stake holders that are described below. The

researcher used both the list of farmers listed by D1 Oils and snowballing. The other stakeholders were given by their various organisations as the people responsible for the project or the department under which the project falls.

There are 42 farmers from Mpaka who are listed in the D1 Oils list of farmers for *Jatropha curcas.* 22 out of the 42 that are listed have signed the contract with D1 Oils, 5 have not signed whilst for the remaining15 farmers nothing is said about their signing or not signing of the contract. The researcher interviewed 10 of the 22 farmers who already have a contract with D1 Oils; the researcher interviewed 1 household which had mature jatropha trees which were initially not grown for biofuels but had been contracted to join in the program. One of the listed farmers, a lady, in whose home the jatropha trees were also already big and bearing fruit, was deceased. On the field snowballing was used because it was discovered that some of the farmers that were listed went as far as getting listed but either never got to grow the plant or they gave up after the first failed attempt when their plants died.

Other stakeholders that were identified and interviewed were the constituency Headman of the area, officers from the Swaziland Investment Promotion Authority (SIPA), an officer from the Ministry of Natural Resources and Energy, an officer from D1 Oils administrative, the extension officer from D1 Oils.

One of the stakeholders that were identified was the Yonge Nawe Environmental group (Friends of the Earth) but the researcher could not have contact with any of their officers as their office had been closed for failing to pay rent. However the researcher was able to obtain a copy of a report on growing of *Jatropha curcas* in Swaziland which the group in collaboration with others had presented for the Smart Partnership dialogue in 2008 which reliably contained their stand concerning the activity.

The constituency headman was interviewed to provide information on the history of farming *Jatropha curcas* in his area and also provide the data on how they as authorities of the area have experienced the growing of *Jatropha curcas* and how they feel it has influenced the community in general. Provide data on their role as elders of the area, policy and structures that are involved in the activity and are available for the households to utilize.

The field extension officer from D1 Oils is a representative of the proponent and investor in the project of farming *Jatropha curcas*. The contacts of this officer were provided by the general manager of the project of growing *Jatropha curcas* in Swaziland from the D1 head office which was in Mbabane during a contacts establishment session. D1 Oils Swaziland had opted to work with farmers by dividing them according to their regions and each region was assigned its own field officer. The officer whose contacts were given to the researcher was the one responsible for the region under which Mpaka the study area falls. It was important for the research to find information or data that pertains to what the investor's other interests are in terms of the people among which he is investing apart from the obvious of making as much profit as is possible. The researcher wanted to find out how the investor had thought the activity would improve the livelihood of the people who are involved; what activities and provisions are there, that empower the people in terms of accessing information and any other forms of support that is made available to the grower. The researcher also wanted to discuss aspects of the agreement that the farmer and D1 Oils sign and the implications for each of the parties involved and what its implications are as far from the proponent's point of view. This interview was done before the proper fieldwork when still making contacts, such that although notes were taken it was completely unstructured. However it was useful in that it provided the researcher with almost all the information in the form of the brochures for the company, lists of prospective farmers, their marketing tools and a copy of the agreement form.

Officers from Swaziland Investment Promotion Authority (SIPA) also formed part of the sample. SIPA is the department of the Ministry of Enterprise and Employment (Commerce) which facilitated the investment of D1 Oils Swaziland in the project of growing *Jatropha curcas* for biofuels. The officers included the officer who had been responsible for the project of growing *Jatropha curcas* in the country and the officer responsible for foreign investments. The farming of *Jatropha curcas* in Swaziland was a joint venture of the Ministry of Agriculture, the Ministry of Enterprise and Employment (Commerce) together with D1 Oils an international company. These interviewees were to provide the researcher with the government's perspective and view of the activity and also allow for gathering data on the policies and structures that the government had put in place to safeguard the households from being further impoverished by such an activity but instead are empowered so that their livelihoods become more sustainable.

An officer from the Ministry of Natural Resources and Energy was also interviewed as that is the Ministry that was tasked to formulate and draw the National Strategy for biofuels and Action Plan in the Country. This was an officer whose department was responsible for Renewable Energy.

3.3.2 Research Techniques

The techniques that were used were semi-structured in-depth interviews, focus group discussions and documentation in the form of reports, agreement forms, information pamphlets and presentations notes by the different stakeholders. The interview schedule had a section that was in a form of a questionnaire.

- **Questionnaire part of interview Schedule**

  This technique was used to obtain demographic data on the household composition, its assets, its capabilities and its livelihood strategies. This data was to provide the necessary information used in describing the vulnerability context of each household and identifying the assets that the households have put together to engage in the new livelihood strategy of growing *Jatropha curcas* for biofuels as required in some of the sub-objectives of the study.

- **In-depth Semi-structured Interviews**

  This technique was used to gather data that pertains to how each of the stakeholders or participants that are in the sample have experienced the project of growing of *Jatropha curcas* for biofuels and how they relate to it. It was used to gather data that reflects the participants' experiences, feelings and convictions about growing *Jatropha curcas* and how it has influenced their livelihood (Welman, Kruger and Mitchell 2005). This was meant to eliminate the possibility of missing important views from other participants who may have found it difficult to voice their views in focus group discussion because of intimidation in the presence of other participants (Welman, Kruger and Mitchell 2005).The technique was also used because of the recognition that rural households are not homogeneous and that there is a great diversity of rural situations which are important to acknowledge and take into account (Chambers and Conway 1991; Carney1999; Hussein2002).

- **Focus Group Discussion**

This technique is useful in the stimulation and sharing of ideas and thoughts about a subject and obtaining a degree of consensus about the research question (Welman, Kruger and Mitchell 2005). The researcher used the technique to complement and verify the data that was obtained through the in-depth semi-structured interviews. Common issues and concerns were easily identified and noted. That also allowed the research to benefit the participants as it provided a forum where they were able to share their thoughts and ideas and formulated the best possible means of addressing their concerns.

- **Documentation**

This technique is useful when the research concerns investigation of an event that took place with the purpose of establishing a set of propositions about it (Welman, Kruger and Mitchell 2005). It is mainly used in historical research where the concern is not so much in finding new information as is with finding new explanations for, or interpretation of existing information (Welman, Kruger and Mitchell 2005). One of the sub-objectives of the research is to describe the project of growing of *Jatropha curcas* for biofuels in the said area which was meant to establish the level and extent of participation which the rural farmers had in the establishment of the project. This technique was used to also provide triangulation.

- **Observation**

This technique although not used to a large extent was useful for collecting the data for the vulnerability context of the households that are involved in the activity of growing *Jatropha curcas* for biofuels.

3.3.3 Measuring Instruments

The interview schedule was developed by first consulting references on how questions are formulated looking at objectives of the research. As this research was an evaluation research the aim was to find out the how the participants experienced the growing of *Jatropha curcas* for biofuels in relation to the options and choices that they felt were available to them. It was to also uncover the outcomes and the factors which participants felt led to the said outcomes. In this

case the Sustainable Livelihoods framework was used to provide a holistic and integrated view of the processes by which people achieve or fail to achieve sustainable livelihoods (Scoones 1998) and use those to develop the relevant question in reference to the sub-objectives of the research. Insight was drawn from CARE's livelihoods Monitoring system for the PROSPECT project among other sources, whereby household's wellbeing was described using such variables as the family size, number of school going children, number of meals per day and food composition, house ownership, business, assets and the husband (Ashley and Carney 1999).

Following what Bless, Higson-Smith and Kagee (2006) prescribe; this was done by first listing specific issues to be investigated by the questionnaire. It was followed by deciding what kind of data is needed to study those issues then the formulation of specific questions to measure those variables was carried out.

Another reference was made to the type of questions that are used to map the vulnerability context of households in consultation with a member of the Vulnerability Assessment Committee of Swaziland (VAC). This consultation was used bearing in mind that an activity may not address all aspects of a livelihood and since this research was an evaluation of a particular activity it was imperative to pay attention to those aspects which the activity would most likely impact on. The questions of the interview schedule were then refined through consultation with a professional lecturer involved in research at a tertiary institution. This process was then followed by a pilot study where two stakeholders were interviewed in which the questions were further refined.

The first part of the interview schedule was in a form of a questionnaire which was easily filled in by the researcher through asking the interviewee the questions. The second part was an interview which followed a set of structured questions that were mostly open ended and allowed the interviewee to respond freely (Bless, Higson-Smith and Kagee 2006). There were however a few which had the options spelt out by the researcher. The questions also allowed follow through question for clarity or to expand on a particular response to give more understanding to the researcher. That contributed to the unstructured aspect of the interview.

3.4 Procedure

Through reading and listening to current affairs the researcher got interested in the topic on biofuels and news that food for the poor was being turned to fuel so the rich would drive. Once a topic was chosen after recalling and confirming that some action was already taking place on the ground for biofuels in Swaziland, a preliminary literature review was carried out and a research proposal drafted.

Initial contacts were made with some prospective stakeholders. Through snowballing, the relevant stakeholders were contacted which enabled the researcher to find the offices and ministries that were responsible for the initiative. The researcher was also able to make initial contacts with the proponents of the program, D1 Oils. Preliminary non- structured interviews, regarding the background of the project, were carried out with the officers. This yielded a wealth of information and insight, because it was during these contact sessions that a lot of documents were obtained.

The next stage was to get a theoretical framework on which to base the research on before developing the measuring instruments in order to focus the research. Once the focus of the research had been reached, the research instruments were developed. However before the interviews were carried out permission to do so was sought from the authorities of the area of Mpaka and it was granted. A pilot study was carried out and the interview questions were refined. Interviews of farmers were carried out at the farmers' homes. The focus group discussion was done at a church building where they usually meet for other businesses. The interview of the other stakeholder was at their places of work and that was in Mbabane where most offices are based. The researcher is fluent in both English and siSwati and therefore did not encounter any problem in conducting the interviews in both languages.

The difficulty was in establishing to the farmers that this was an academic exercise which was not coming with any kind of financial help and/or intervention or help of any kind without letting them think they were simply objects of study and that the exercise was a waste of their time. The researcher made detailed notes of each interview on a new interview schedule.

3.4.1 Data collection methods and analysis

The nature of the data collected was both quantitative and qualitative. The data was collected through semi-structured in-depth interviews, focus group discussions and observation with the farmers that are listed In D1 Oils Swaziland List of farmers that grow *Jatropha curcas* in the area of Mpaka. The first part of the interview was a questionnaire which had quantitative aspects and was completed at the beginning of each interview then the in-depth semi-structured interview was carried out where notes were taken. Pictures were taken to pick up any other detail that the researcher may find useful in the capturing of the data especially of the fields of *Jatropha curcas*. Notes were also taken during focus group discussion.

In all cases the Data were transcribed from the notes taken during the interviews and focus group discussions. Content analysis was carried out using the livelihood framework as a conceptual framework to provide a coherent approach to analysing and understanding the innovation of growing *Jatropha curcas* a non-edible plant for biofuels, and how it has affected the livelihoods of the different households in the community of Mpaka.

The livelihoods framework examines the different elements that contribute to people's livelihood strategies. It can be used for analysing how forces within and outside the household or community in 'the external environment' affect them (Chambers and Conway 1991; Carney 1999).

3.5 Delimitation of the study

The project of growing *Jatropha curcas* for biofuels in Swaziland was a national programme and involved many communities from the different regions of the country however the study was only limited to the rural community of Mpaka and to only the households that had already been involved in growing *Jatropha curcas* as described in the sample. The study only focused on parameters which informed the vulnerability context of the households, their assets, capabilities, and activities that the households engages in to secure a livelihood and how they had been influenced by growing of *Jatropha curcas*. The study also included the analysis of the external forces that influenced households and the outcome of the programme.

3.6 Validity and Reliability

The validity of study as defined by Bless, Higson-Smith and Kagee (2006), "is the degree to which a study actually measures what it purports to measure whilst the reliability is an estimate of the accuracy and internal consistency of a measurement instrument". These two parameters were taken into consideration when the research was carried out firstly by using triangulation.

The term "triangulation" is borrowed from surveying or navigation where it refers to the practice of establishing the exact position of a given object by taking readings from multiple viewpoints (Clarke and Dawson 1999). In research, using more than one reference point enables greater accuracy of measurement (Clarke and Dawson 1999). Clarke and Dawson (1999) point out that given that each research method has its own strengths and weaknesses, the weaknesses can be compensated for by another method so that the overall quality of research data will be improved by reducing measurement error and help overcome problems of bias. In this view, triangulation guards against threats to both validity and reliability of a study (Clarke and Dawson 1999). Denzin (1970) in Clarke and Dawson (1999) points out that there are four types of triangulation which can be used in research, among which is data triangulation.

For the purposes of this research the researcher chose to use data triangulation by employing three main techniques for collecting data which are the semi-structured interview, the focus group discussion and documentation. Semi- structured interviews are very helpful in exploratory research by clarifying concepts and problems and also allow for discovery of new aspects of a problem by exploring in detail the explanations supplied by respondents (Welman, Kruger and Mitchell 2005). However it has been highlighted in literature that the wealth and quality of the data gathered is strongly dependant on the skill of the interviewer and the confidence inspired in the respondents/interviewee (Welman, Kruger and Mitchell 2005; Bless, Higson-Smith and Kagee 2006). To reduce the threats to the reliability of this research technique a pilot study was conducted to clarify concepts, facilitate the elimination of superfluous questions and reformulation of the ambiguous ones (Bless, Higson-Smith and Kagee 2006). In carrying out the measurement every effort was made to explain to each respondent the nature of the study and that anonymity would be maintained in the writing of the report so as to ensure that respondents would have confidence and be willing to cooperate. The researcher also used the interview

schedule in the same way with each respondent to ensure that each was subjected to similar stimuli and avoid introducing biases (Bless, Higson-Smith and Kagee 2006). The interview was also scheduled to be an hour and that was explained to the respondent at the beginning so as to establish if the respondent would have that time or another appointment could made so as to avoid respondents getting irritated and tired of the interview thereby reducing the quality of their responses to quickly get through with the exercise (Bless, Higson-Smith and Kagee 2006). Whilst all that was done it could not completely eliminate the weaknesses of the semi- structured interview which would be further discussed in detail in the limitations of the study.

To ensure reliability the other source of data collection used was documentation. The documents used included presentation motes for meetings, marketing tools, reports, Government Strategy documents on biofuels, copies of agreement forms and materials used by D1 Oil field officers for educational purposes. This material provided a valuable source of information about the formal aims and goals of the programme. This source also provided information regarding issues of concern by other organization regarding the same programme. Some documents were primary sources whilst others were a secondary source. Whilst these are valuable sources they require careful handling as others may not constitute independent, objective records of events or circumstances (Clarke and Dawson 1999). What is recorded is influenced by social, political and ideological factors. A document by presenting a particular interpretation of events helps in constructing a version of social reality not necessarily an objective, straightforward description of social reality (May 1993 in Clarke and Dawson 1999). May (1993: 138) then points out that "an evaluator (researcher) should be aware that documents may be interesting for what they leave out as well as what they contain".

The other technique that was employed for validity was the focus group discussion. All research participants create meaning and there are differences in the manner in which they create the meaning due to:

- Not hearing the question through the same meaning /frame as that of the interviewer or other interviewees,
- Having their own personal and hidden reasons for responding in particular ways,

- Or being motivated to disguise the meaning of some of their feelings and actions (Bless, Higson-Smith and Kagee 2006).

For the above reason a focus group discussion was used as participants, who consisted of the interviewees or respondents that took part in the semi-structured interviews, were able to discuss the issues in question among each other (Bless, Higson-Smith and Kagee 2006). According to Bless, Higson-Smith and Kagee (2006), one person's ideas may set off a whole string of related thoughts and ideas in another person and similarly one participant may disagree with and question the remarks of another. This then produces a much deeper meaning of the issues as the group explores the disagreement in detail thereby giving the researcher deeper insight into the topic than would have been impossible through individual interviews (Welman, Kruger and Mitchell 2005; Bless, Higson-Smith and Kagee 2006). From the ethical consideration that respondents are not simply supposed to be treated as numbers or objects (Welman, Kruger and Mitchell 2005) a focus group provides an opportunity for participants to learn from each other and perhaps to resolve important dilemmas with which they are confronted (Bless, Higson-Smith and Kagee 2006), that way making the research valuable and beneficial to them.

3.7 Limitation of Study

The limitations of the study were that it was a qualitative study which inherently contains the limitations of the research techniques that were used in data collection. Whilst semi-structured interviews provide a wealth of information they have their disadvantages in that they strongly depend on the competence of the interviewer, recording the comments o f the participants is a delicate matter because of the great variety of answers and their complexity (Bless, Higson-Smith and Kagee 2006) especially without a tape recorder which the researcher thought was likely to threaten the respondents and reduce freedom of expression. Whilst every effort was made to limit the limitations of the instruments through triangulation the study may have benefitted from a quantitative analysis of its different parameters from a different framework so as to establish in terms of numbers or quantifiable terms the issues that are pertinent like using a survey to establish general land use in the area under study.

The other huge limitation of the study was that it was carried out when the government had called for the suspension of further plantings of *Jatropha curcas* until a Strategic Environmental Assessment (SEA) was carried out, which eventually saw D1 Oils Swaziland packing up and closing offices. That actually steered the report of the results and findings to a different angle than was otherwise intended.

Another limitation of the study was in the development of the research techniques in that the study was carried out under serious time and resource constraints such that there was not sufficient consultation with the supervisor when the measuring instruments were developed so as to sharpen the skills of the researcher in formulation of measurement tools and carrying out the measurement or data collection.

Last but not least limitation of the study is in sources of information. As a part time student the researcher has always been faced with a limitation in terms of access to academic sources of information as it is very expensive to subscribe or buy the books and journals even on line and getting to the university library was not always possible because of similar constraints.

3.8 Summary

The chapter began with a description of the research paradigm which included the description of the approach, the theoretical framework and the tools that were used in the research. The chapter also gave a description of the setting within which the research was carried out. This was followed by a detailed methodology on how the research was carried out including a detail of how measuring instruments were developed and used. A description of data analysis was also outlined including validity, reliability, delimitation and limitation of the study. Chapter 4 is a presentation of the results.

CHAPTER 4: RESULTS

4.0 Introduction

Contrary to most evaluation research on programs and interventions which are usually carried out using quantitative methods such as surveys this research was carried out using qualitative methods because of the nature of the variable 'a livelihood'. This variable speaks of evaluating the extent to which some important human need exists in the community population and how it has been met or not met by growing *Jatropha curcas* for biofuels (Chambers et al 1992 in Clarke1999). The results of the study are in the form of a narrative because it is largely an enquiry of experience (Gannon 2009).

The first part of the results is a description of the project of growing jatropha in Swaziland and ultimately in the area of Mpaka using documentation and the narratives as told by the respondents. This is followed by a report of the vulnerability context of the households that were interviewed; the capabilities, range of assets and activities that create the livelihood strategies of these different households and how they have been effectively used in growing *Jatropha curcas*; the description of the policy and institutional environment within which the livelihoods and growing of *Jatropha curcas* are shaped and the final section is on impacts that the project has had on the livelihoods of the households which were growing *Jatropha curcas* as viewed by the stakeholders.

4.1 Description of the Project of Growing *Jatropha curcas* in Swaziland and in Mpaka

The government of the kingdom of Swaziland through the Swaziland Water and Agricultural Development Enterprise (SWADE) commissioned a bio-energy feasibility study in August 2005. The consultants were tasked to provide an overview of the macroeconomics of the whole production process of agriculture crops-both food and energy crops, which would serve as feedstock to the biofuel industry, assess the feasibility (both financial and economic) of producing biodiesel from crops in Swaziland and estimate the quantity of biodiesel that can be produced from the crops identified above including growing, harvesting and processing of crops,

production of biodiesel and any necessary additional infrastructure, facilities, etc. This was to include realistic estimates of production capacity, costs and technologies.

They also had to develop a model to produce energy crops to meet biofuels industry demand, without harming the potential for the production of food crops for Swaziland's needs, assess the market potential of biofuels, with particular emphasis on biodiesel. Extensively consult with government ministries responsible for transportation issues, oil companies, agricultural companies or estates and construction companies using heavy machinery; Assess the establishment or development of a pilot project(s) to demonstrate the viability of the value added from the use of biodiesel, review relevant legislation related to energy developments, with particular emphasis to biofuels and make appropriate recommendations for needed amendments and ascertain the current and desirable role of different stakeholders in biofuels industry including evaluating their capacity. (See Appendix C)

The report on the findings of the consultants came out in May 2006. According to this report *Jatropha curcas* and several other oil crops were identified as crops that could be successfully grown and used in the production of biodiesel for the country of Swaziland (SWADE 2006). On 12thJune 2006 an article with a title '*Bio-energy study affirms viability of producing bio-energy locally'* confirming that the feasibility has come out and its findings was run on the local newspaper The Times of Swaziland (Shongwe 2006). According to Shongwe (2006) the Chief Executive Officer of SWADE said the outcome of a E2 million (R2 million) bio-energy study contract between SWADE and a team of German experts in the bio-energy Industry, had shown that it was feasible for the country to produce its own biodiesel starting with a plant of a scale of 1800 tonnes/year and a maximum of 30 000 tonnes/year. He also stated that the oil crops that were recommended by the study for the production of biodiesel included sunflower, safflower, sesame, *Jatropha curcas* and castor under rain fed conditions whilst sesame and soya beans could be grown under both rain fed and irrigated conditions (Shongwe 2006; SWADE 2006).

Meanwhile in April 2006 the government of the Kingdom of Swaziland had signed a Memorandum of Understanding (MOU) with D1 Oils Swaziland (PTY) Limited as an investor who had identified an opportunity to work with willing communities, for the establishment of *Jatropha curcas* plantations on varied portions of land around the country and to subsequently

develop a processing plant within the country to produce biodiesel. Of noteworthy is that according to the dates government committed herself to such an investment before the feasibility study was out.

In June 12, 2007, D1 Oils made a presentation to the biofuels task team at Esibayeni Lodge on *Jatropha curcas* and on the company itself. As an introductory statement D1 Oils Swaziland was said to be a locally registered company that seeks to empower Swazi farmers with a viable and sustainable livelihood. It also stated that the ultimate goal of *Jatropha curcas* production was the harvesting and sale of *Jatropha curcas* seeds to D1 Oils (D1 Oils Swaziland 2007). D1 Oils also highlighted that *Jatropha curcas* was not a new plant in Swaziland, as the company had found hundreds of *Jatropha curcas* trees growing wild in various parts of the country whereby it was either used as living fence or for shade with no other domestic or commercial use. Since starting its operations in the country in 2005, D1Oils had made remarkable progress as it had planted 1000 ha of *Jatropha curcas* on its own managed farms, facilitated the planting of almost 1000 ha of the same crop on out grower farms and established a regional research centre at Sidvokodvo. As of the 31st March 2007 the company had planted and obtained rights to off take from a total of 156 000 ha (D1 Oils Swaziland 2007).

As a commitment to community development, D1 Oils also signed a memorandum of understanding with World Vision an NGO that supports communities in various ways. As stated by the company, their aim as D1 Oils Swaziland was to facilitate the growing of *Jatropha curcas* as a rural development intervention intended to improve the economic status of rural communities. This was said would, with the support of government, assist to reduce unemployment and boost the economies of the country (D1 Oils Swaziland 2007).

Through its awareness raising campaigns D1 Oils had hundreds of potential out growers who entered into agreements to produce and sell *Jatropha curcas seeds* to D1 Oils. To these out growers, D1 Oils provided seeds or seedlings, support and technical advice (D1 Oils Swaziland 2007). Whilst stating satisfaction by the uptake of *Jatropha curcas* by Swazi farmers, D1 Oils noted that the drought in the early part of 2006 reduced the capacity of out growers to plant due to the dry and hot conditions (D1 Oils Swaziland 2007).

The other means of marketing the project, used by D1 oils was through the media. This was revealed in the interviews with farmers at Mpaka. One lady Farmer says she read about this activity in the Times of Swaziland, where D1 Oils had left a contact number for those who were interested in becoming out growers for *Jatropha curcas*. She said she developed interest in the project after reading the paper and showed the article to another woman who also became interested. They decided to call the contact number in the article and were given a positive reception. She said they were then asked to see if they could actually mobilise and form a group of all those who were interested in the project within their area so that D1 Oils would come to their area to train them on growing *Jatropha curcas* and the business as group, which thing they said they were able to do easily as they already belonged to a cooperative that was involved in other activities. They told the rest of the members who she says also showed interest in the project after which D1 Oils came and started its campaigns in the area of Mpaka.

All the logistics of gaining access to the community of Mpaka were done so much that it was then taken up to the local authorities of the area and was ultimately launched by the then minister of enterprise and employment and supported by the ministry of agriculture (interviewee). Apart from what took place at local level at Mpaka, at national level D1 Oils had planned a high profile launch at a place called Hluti in the south of Swaziland in early 2008. This was pointed out by one of the interviewees who was the local leader in the project and had been elected to be a representative of her area (Mpaka) during the launch of the project by the King and other dignitaries. This is also documented in the report (Burley and Griffiths 2009) prepared for Yonge Nawe (Friends of the Earth) and Africa Co-operative Action Trust (ACAT) Swaziland.

These two Non Governmental Organisations Yonge Nawe and ACAT raised questions about the environmental impact of *Jatropha curcas*, its impact on food security and about D1 Oils' approach to farmers. Within their report they claim they went to the farmers and asked them some questions which the interviewees confirmed and said included the following questions.

What D1 Oils was paying them for their land?

Who was paying them for watering the jatropha seedlings in their fields?

What was the price that was promised would be paid to them for the jatropha seeds?

Why they had agreed to grow this crop because it would destroy their soil?

According to the farmers interviewed they were told that D1 Oils was exploiting them and also said the Yonge Nawe officers came with some foreign nationals who promised to give them a better pay if they would agree to sell the *Jatropha curcas* seeds to them and not D1 Oils. The interviewees claim they were given money to the value of SZL200 which is equivalent to R200. Asked why they were given the money or what were they supposed to use the money for? They had these to say:

"... It was 'just' given us to use as we please"

"... This Yonge Nawe seemed to have lots of money and was really talking us to abandoning this project. Some people uprooted and others just left the seedlings to die by themselves"

"... My husband told me not to plant any of this jatropha trees again because it would destroy the soil as these people from Yonge Nawe were preaching that everywhere"

"... These people of Japanese origin were coming to us with a better offer in terms of the market price they were offering for buying the jatropha seeds from us".

One of the farmers said some foreign nationals looking like they are of 'Japanese' origin said he should say what house he wanted them to build him then they would if he will agree to plant all his fields with *Jatropha curcas* and sell it to them instead of selling to D1 Oils. The farmer said he could not take up their offer because he had signed an agreement with D1 Oils which entailed D1 Oils supplying him with seedlings and technical support and in return he would sell the seeds only D1 Oils for the stipulated period.

In trying to get an interview with officers from Yonge Nawe, the researcher found out that their offices were closed because they had failed to pay their rent and so when called their phone rang unanswered. The researcher had to then rely on the report that had been produced for Yonge Nawe and ACAT which outlined their case on the issue of D1 Oils, growing of *Jatropha curcas* in Swaziland and the responses they had got from farmers around the country. From their report the NGOs laid the following allegations against the project:

Farmers were turning good quality agricultural land over to *Jatropha curcas* under the contract by D1 Oils instead of that land being used to grow food as there is no regulation in place;

The promise of high yields on poor soils were not true as they as NGOs have documented farmers complaining that the *Jatropha curcas* was not growing well under drought conditions and cited that other studies like that of Overseas Development Institute (ODI) suggest that *Jatropha curcas* is unlikely to deliver the promised yields if grown only on marginal land;

Jatropha curcas cannot thrive unless irrigated and claims that the trees have low water usage are not true as farmers report needing to water it between once and three times a week;

Jatropha curcas is noxious and invasive presenting a significant human and animal health risk as it contains carcinogenic substances;

Jatropha curcas was an environmental risk as no environmental risk assessment was undertaken over its cultivation;

Growing *Jatropha curcas did* not present a development opportunity for poor communities as it could not give good yields on marginal land that is rain fed;

There were concerns over the contracts that were issued to farmers by D1 Oils Swaziland as other farmers could not read or understand them and there were no copies left for the farmers of the contract and that the contract could not be terminated;

Growing *Jatropha curcas* could not give Swaziland energy sovereignty as under the current legislation any biodiesel produced could not be distributed in Swaziland and had to be exported

(Burley and Griffiths 2009).

After the project of growing *Jatropha curcas* for biofuel got bad publicity through the above mentioned allegations, the government of Swaziland in April 2008 suspended all further plantings of *Jatropha curcas* until a Strategic Environmental Assessment (SEA) was carried out (MNRE Officer, SIPA officer). D1 Oils Swaziland then closed its offices in Mbabane then it ultimately closed operations on its research centre at Sidvokodvo. In an interview, a SIPA officer said the suspension of further planting of *Jatropha curcas* was because the NGOs

started making a huge noise about the project only to find that during its inception no EIA was carried out resulting in a loophole in the whole project such that he said:

"... For the first time I heard government singing the same tune as an NGO"

When an officer from MNRE was asked if any attempt was made to address the out growers of *Jatropha curcas* on the developments and advise them on what they should do, she said as a ministry there was nothing done and that the ministry of agriculture who they are working closely with has also done nothing in that respect and there was nothing else that they as a Ministry are aware of which was done by government on that regard.

Farmers within the Mpaka community confirmed that no official from either government or D1 Oils came to address them on the developments and to give them a directive as to what they as farmers should do. Farmers were left uncertain on the future of the project.

This is an overview of how the project of growing *Jatropha curcas* at national level was carried out and how it got to the community of Mpaka. This brings us to the results on the vulnerability context of the households who got to grow this crop at Mpaka.

4.2 Vulnerability Context of the Households

In mapping out the vulnerability context of the households one has to take into consideration the locality of the households and describe the natural shocks and stresses such as drought, floods, volcanoes' for example, which the households are prone to because of their location. The other important indicators that are to be collected in describing the vulnerability context of the households include levels of food intake, average income level and income range, food sources, coping capacities, links to markets, levels of asset holdings, and water scarcity (Morrow 2000;IFPRI 2002). It is also important to know which households are headed by females, elderly or children and also which households are affected by Aids (Morrow 2000; IFPRI 2002) and social pathologies such as livestock theft among others. This data was collected and the following are results.

4.2.1 Vulnerability Due to Natural Shocks and Stresses

As stated in Chapter 3 Mpaka falls within the Lowveld ecological region, an area known to receive minimal rainfall hence food production, in particular maize, fails in most years indicating chronic vulnerability that may require interventions aimed at mitigating the long term effects of drought (VAC 2010). During the interviews the persistent drought was cited by 100% of the households as a stress that they had experienced in the last 12 months that affects the household's ability to provide itself especially food. All these households except for three households do not grow any maize or other food crops. They all cite drought as the main reason why they do not grow maize or other food crops. Another reason for not growing other crops that emerged was that of limited resources and power. One interviewee who is a widow said that whilst her husband was alive which she said was about 13years ago, they used to make a living by growing cotton, a drought resistant crop. They used dry thorny bushes, which are the most prevalent vegetation in this area, to fence off their fields. Then when her husband died, she carried on with the activity of growing cotton for two consecutive years but decided to discontinue the activity when she realized that her efforts were not yielding the desired outcome as her cotton was being browsed at by livestock, reducing the yield and making the activity unprofitable. She alleges that her neighbours destroyed her fence, leaving their livestock to browse on the cotton so much that it was a loss for her on both occasions hence she decided to stop the activity. Below are her comments:

"…Being a widow men of this area do not have regard for you, they let their cattle feed on your fields after destroying the fencing. They are aware no one will fight your case… it still happens as several times when I am from selling my wares, I have sometimes found the gate within the compound open with cattle browsing on my vegetables in my home garden…"

The vulnerability to loss of crops due to livestock browsing on it was not limited to this particular widow as the researcher observed that in about 50% of the households the fields were either not fenced including the home or the fencing was not adequate to keep the livestock out. This was confirmed during the interviews and focus group discussion as they agreed among themselves that they decided to grow *Jatropha curcas* because it cannot be browsed by livestock as their fields were susceptible to browsing by livestock due to lack of fencing.

They however, pointed out that their experience of growing *Jatropha curcas* had made them realize that they still needed the fence because as much as the livestock do not browse on the *Jatropha curcas* they break the branches off the trees whilst walking among them or when they decide to scratch themselves against the trees. This they said would greatly reduce the harvest of seeds because the more branches each tree had the more seeds it was likely to bear as each branch brought forth fruits and ultimately seeds. They also highlighted that to be able to intercrop *Jatropha curcas* with food crops sustainably they would still need the fence as the livestock would browse on whatever else was planted in between the *Jatropha curcas* trees when they discover whilst walking among the trees. Vulnerability to serious loss of crop due to poor fencing of fields in rural areas was also listed as forming part of the several challenges that farmers encountered in growing all crops in the report by the Ministry Of Natural Resources and Energy on community consultations regarding biofuels (MNRE, undated).

4.2.2 Vulnerability to Social Pathologies:

Loss of livestock and poultry because of theft was also cited as one of the stresses that some households had experienced. In all instances the household was left under the care of a woman either because they are widowed or the man does not stay at home for most of the time. This confirms the increased vulnerability of women headed households as outlined by Morrow (2000) where women are said to have fewer resources and less autonomy within households and are therefore less able to respond appropriately to a crisis. What the researcher observed in the households where poultry was stolen was inadequate security measures such as lack of proper fencing and a lack of dogs. Following this is results of household compositions starting with the household heads.

4.2.3 Household Heads

One of the first questions that the respondents had to respond to during the interview was who the head of that household and these were the results:

Seven out of twelve (58%) of the households that were interviewed are headed by men even though it's their wives who are listed as farmers in the growing of *Jatropha curcas* except in one household. In all but one household, the husbands were greatly involved in the project of

growing *Jatropha curcas* such that during the interviews they attested to have dug the pits in which the *Jatropha curcas* seedlings were planted and took part in the maintenance of the *Jatropha curcas* fields.

In the one household where the husband is not involved, he works as a migrant worker in South Africa and so he does not stay at home for the most part of the year.

In Seven out of the twelve households (58%) there is single parenting whereby of these households five (71%) are headed by women, four (80%) of which are widowed and one (20%) on separation. Two (29%) of the single parent households are headed by men whereby in all cases the men are widowers.

There was no child headed household involved in growing *Jatropha curcas* which the researcher came across and neither was there a household headed by an elderly involved in growing the same.

In one household the *Jatropha curcas* had been grown by the head of the household who is a widower. However he also does not stay at home as he is reportedly a migrant worker in South Africa, leaving his grown up children who also have their own children, to look after the home who when asked on the growing of *Jatropha curcas* in the household, said this was only known by their father.

4.2.4 Household Composition

Vulnerability of households has also been shown to be closely linked with household composition. The following tables show the profiles of the households that are involved in growing *Jatropha curcas* which were interviewed within the study area:

Table 4.1 Household composition for the different households interviewed in Mpaka

Household code	**HH head**	**Wife/Husband living with**	**Children ≤ 5 years**	**Children 6-17 years old**	**HH members ≥18years old**
01	Woman	widow	0	3	2
02	Man	Wife there	0	1	1
03	Man	"	0	3	1
04	Man	"	0	2	3
05	Woman	Widow	2	0	4
06	Woman	Separated	2	0	4
07	Man	Widower	4	0	3
08	Woman	Widow	5	4	7
09	Man	Wife there	1	1	1
10	Man	Wife there	0	4	5
11	Woman	Widow	5	12	14
12	Man	Widower	0	0	1

4.2.5 Housing

When describing the vulnerability context of households, housing is a crucial element because the poor typically live in poorly built and inadequately maintained housing (Morrow 2000).

100% of the households interviewed, have at least one proper permanent type of housing, with walls constructed from cement blocks and the floor is cement whilst the roof is made of corrugated iron sheets. This is, in all cases, the main house. In half of the households there is a hut that has walls constructed from cement blocks, the floor made of cement and the roof thatched with grass. In three (25%) of the households the outbuildings which are also huts in most cases, are made from stick and mud walls, cement floor and the roof is thatched with grass. The rest have the outbuildings constructed from similar material as the main housing but only

smaller in size. One widow mentioned that the roof of her main house, despite being corrugated iron sheets, had been blown away by the storm two times in different incidences. No other household cited this occurrence. Apart from this case where housing is susceptible to destruction by storms making the household vulnerable to loss of shelter for some time and damage of household items, the rest of the household did not exhibit the same vulnerability.

4.2.6 Water and Sanitation

Seven out of the 12 households interviewed have piped water, which is about 60% of the total interviewed. 90% have no plumbing of the houses instead they have standpipes in their compounds and have pit latrines.

4.2.7 Electricity

Seven of the interviewed households have electricity whilst the rest do not have it and still rely mainly on wood for fuel.

4.3 Capabilities

Objective 3 was to identify the capabilities, range of assets and activities that create the different livelihood strategies for the different households and how they have been effectively used in growing *Jatropha curcas* with what outcomes in terms of income generation, food security and reduction of vulnerability.

A livelihood as has been described by literature as comprised of capabilities, the range of assets and activities required for a living (Scoon 1998). These capabilities include education, health and skills.

4.3.1 Education

In all the households interviewed there is some literacy in household members that enables them to read and write in simple terms and also carry out simple arithmetic so that they are able to engage in petty trade (see Table 4.2). In about four of the households there are members with tertiary education, giving those households more capability to access, assimilate and use information in pursuing activities to a gainful living. It also gives the household members with

tertiary education a better capability to permanent employment. This greatly enhances the safety net of the household as it provides a diversification of the livelihood activities.

In 100% of the households there are members who are still enrolled at school. This shows a great need for income generation especially to pay for the education of these members among other needs requiring money which the households may have.

When the farmers were asked about being taught on *Jatropha curcas* they all said they were taught about the plant and the project of growing the plant for biodiesel by D1 Oils before embarking. Asked if there were any other organisations or the government department who also taught them on the plant apart from D1 Oils they all said there was none.

Table 4.2 Literacy level of members of the different households

HH code	**Education level of head of HH**	**Education level of partner**	**Number enrolled at primary school**	**Number enrolled at secondary school**	**Number enrolled at tertiary level**
01	5	N/A	1	2	1
02	4	3	1		0
03			1	3	0
04	5	4	2	1	2
05	4	N/A		1	0
06	4	N/A		2	0
07	6	N/A			0
08	2	N/A	2	3	0
09	6	5	1		1
10	5	5	3	3	1
11	3	N/A			
12	6	N/A	7	5	0

Legend: Education level:

1 No Education

2 Some Primary Education

3 Primary School Completed

4 Some Secondary

5 Secondary Completed;

6 Tertiary.

4.3.2 Health

Respondents were asked if there were any HH members who had died due to sickness of more than three months in the last twelve months or whether there were HH members that had been affected by illness for more than three months such that it affected their ability to fully perform their duties and or rendered the HH unable to provide for itself. The results were as follows:

In 8 out of the twelve (67%) of the households members are all healthy and show no vulnerability to chronic illnesses that may affect their ability to actively participate in livelihood activities the household is engaged in. These households had no members who had died in the last 12 months from illness of three or more months and they also had no members who had for the past 12months had a health problem of three or more months which prevented them from fully performing their duties.

In one household the grower of *Jatropha curcas* that was listed D1 Oils, who was also a woman had died more than 12 months back and none in the household including the husband took over the growing of *Jatropha curcas* and they did not know much about it, as they had considered it her project. This was attested to by even a woman who is a neighbour to this household:

"... My neighbour, with whom we were actively involved in this project of growing jatropha died last year and unfortunately she is the one who was involved in a lot of the activities that the household is engaged in. there is a young girl left to continue with other activities such as the

milking and sale of the milk and amasi (sour milk) from their dairy cows, but I doubt she will be of help regarding the jatropha, but do try…"

In three (25%) of the households the breadwinner or co-breadwinner suffers from a health condition that limits their ability to take part in other livelihood activities. In one household the breadwinner who is also a widow suffers from asthma. This is what she said:

"…I have asthma which is sometimes triggered by some grass among other things. Apart from growing cassava for sale and domestic use, to make a living I also make straw mats to sell. Not long before you came I had an attack whilst I took out the straw to dry it out in the sun. At times I am not able to make the mats when the asthma attacks are bad. My grown up daughters then help to make the mats during such periods".

In the other household, the co-breadwinner, a woman who is the grower of *Jatropha curcas* listed by D1 Oils, suffered a stroke. This has greatly reduced her capability to take an active part in the activities she used to do to make a living for her and the other household members since she walks with difficulty and the use of her hands is limited. Among the activities she was actively involved in was growing vegetables, sweet potatoes and legumes for sale and domestic consumption. The head of the household, her husband does not stay at home as he is a migrant worker in South Africa. The household is now completely dependent on the income of the husband. According to her and the other interviewees she was one of the most active farmers and her fields were even used for demonstration, as she used to do a lot of intercropping. She intercropped her *Jatropha curcas* trees with the sweet potatoes, mealies, spinach and tinhlumaya (a form of legume).

In another case the household member who is a co-breadwinner and also a woman suffers from chronic backache. This also limits the livelihood activities she takes part in. However in this household the husband stays at home and carries out petty business in the nearby small town of transporting people and their goods using his van. The wife also has a car and she drives. The vehicles greatly improve the capability of this household in carrying out livelihood activities. In one of the households the member with a health condition is a child that is enrolled at school.

The condition makes the child unable to attend school for at least a week within a month and unable to take part in household chores and any other livelihood activities.

In all cases where there was a household member with a health problem they all had been able to get medical help which they continued to use in managing their conditions.

4.3.2.1 Food Security and Nutrition

Food security improvement is one of the desired outcomes that a household would like to realize from a livelihood activity. One of the commonly used definitions for food security for a household comes from the United States Department of Agriculture (USDA):
Food security for a household means access by all members at all times to enough food for an active, healthy life. Food security includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (2) an assured ability to acquire acceptable foods in socially acceptable ways (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies) (WFP 2008).

The WFP's food consumption score (FCS) is a frequency weighted dietary diversity score that is calculated from a seven day household food consumption recall. The FCS attaches greater importance to foods deemed most important for nutritional purposes where highest weights are attached to meat, fish, and milk (4), followed by pulses (3), cereals (2), vegetables and fruits (1), and sugar and oil (0.5) (WFP 2008). The FCS does not include condiments that are consumed in very small quantities and have no significant beneficial impact on the overall diet (such as tea, coffee, salt, fish powder, or very small amounts of milk added to tea or coffee) (WFP 2008). These data were collected by asking for the number of meals a household has per day in what they defined as a normal day, the food consumption for each household in the past seven days and also if there are any coping strategies that they have employed in the past thirty days (See appendix A). In order to analyze the data the South African household subsistence level (HSL) series from the University of Port Elizabeth Institute of Planning and Research (Rose and Charlton 2001) was used as a benchmark against which to evaluate the consumption patterns of the households. For the quantities of milk which are given as grams of skimmed milk powder in the HSL they were

converted into litres by taking quantities used by nestle in reconstituting the Nido Milk for children from one year which is 144g to make one litre . The rationale used was that according to the HSL all age groups required the same minimum amount of milk regardless of age and gender. The results were then put into tables where the recommended values are those from the HSL and are as follows:

Table 4.3 Number of Meals Consumed by Household per Day

HH code	Number of meals for adults/day	Number of meals for children/day
01	2	N/A
02	3	3
03	2	3
04	3	3
05	3	5
06	3	5
07		
08	1	2
09	3	3
10		
11	1	3
12		
Average number of meals	2	3

In this sample of households, the number of meals consumed by adults per day, ranges between 1 and 3 meals and on average adults have two meals a day. For children the number of meals per day ranged between 2 and 5meals with an average of 3 meals per day.

Food Consumption Patterns

Another consideration in the estimation of food security that has to be taken entails what is being consumed during the meal times. This information was also collected using what is termed as a food consumption survey whereby interviewees were asked to recall how many times particular food substances were consumed in the past seven days. This also provides estimations on how nutritious the food consumed is.

The following tables show household's consumption patterns of some commonly used foods:

Table 4.4 Maize Consumption

HH CODE	Number of Days eaten in last 7 days	Source	Quantity (kg)	Recommended Quantity (kg)	Price (SZL)
01	7	Purchased	4	9.45	25
02	7	Purchased	7	6.75	45
03	7	produce	8	9.45	-
04	6	produce/ Purchased	3	11.7	23
05	7	Purchased	12.5	8.1	90
06	7	Purchased	12.5	11.7	90
07					
08	7	Gift/ Purchased	25	31.95	170
09	4	Purchased	5	6.75	30
10					
11	7	Purchased	25	37.2	170
12					
Average	6.5		11	14.78	

Table 4.4 shows that a majority of the households consumed maize in any form almost every day. The range was between 4 and 7 days and on average 6 and half days which rounded up would give 7 days.

Table 4.5 Rice Consumption

HH code	**Number of Days eaten in last 7 days**	**Source**	**Quantity (kg)**	**Price (SZL)**
01	3	Purchased	2.5	20
02	3	Purchased	2.5	20
03	1	Purchased	2.5	20
04	2	Purchased	2.5	20
05	2	Purchased	2.5	20
06	2	Purchased	2	20
07				
08	0	-	-	-
09	3	Purchased	2.5	20
10				
11	0	-	-	-
12				
Average	1.4	Purchased	1.9	

The Consumption patterns for rice showed a range of between 0 and 3 days with an average 1.4 days consumption which when rounded would come to one day in a week.

Table 4.6 Bread Consumption

HH code	Number of days eaten in last 7 days	Source	Number of loaves	Minimum Recommended Number of loaves	Price (SZL)
01	7	Purchased	3	11	21
02	3	Purchased	3	9	21
03	2	Purchased	2	11	14
04	7	Purchased	14	15	98
05	1		2	9	14
06	7	Purchased	7	14	49
07					
08	0	-	-	30	-
09	7	Purchased	5	9	35
10					
11	0	-	-	56	-
12					
Average	3.8		4	17	28

The consumption of bread showed an average of about 3.8days per week per household. It ranges from no bread having been consumed in past seven days to seven days of bread consumption. In this table the households with the most household members do not consume bread often as in the past seven days they showed no consumption at all. Looking at the number of loaves that is recommended from the South African very low cost monthly food rations only one household comes close the minimum number of loaves recommended for this household, the rest of the households fall short with an average of four loaves consumed per week instead of seventeen.

Table 4.7 Milk and Milk Products Consumption

HH code	**Number of days eaten in last 7 days**	**Source**	**Number of litres**	**Recommended number of litres**	**Price (SZL)**
01	7	Purchase	3.5	12.5	35
02	7	Purchase	4	8.3	40
03	7	Produce	7	12.5	70*
04	7	Purchase	7	14.6	70
05	7	Purchase	7	10.4	70
06	7	Purchase	7	14.6	70
07					
08	7	purchase	7	35.4	70
09	7	Purchase	7	8.3	35
10					
11	7	Produce	20	66.7	200*
12					
Average	7		6.9	20.4	

Milk and Milk product consumption showed that in all the households, milk was consumed every day. The * in household 03 and 11 shows that this was an assigned value of the milk produced based on the price with which the other households who purchased their milk bought it for.

Table 4.8 Roots/Tubers Consumption

HH code	Number of days eaten in last 7 days	Source	Quantity (kg)	Price (SZL)
01	3	Purchase	2.5	
02	2	Purchase	5	20
03				
04	2	Purchase	5	20
05	2	Purchase	2.5	15
06	1	Purchase	3	15
07				
08	7	Produce	5	N/A
09	3	Purchase	2.5	10
10				
11	3	Produce	5	N/A
12				
Average	2.5			

On average tubers were consumed for three out of seven days within these households and the range of consumption was between one and seven days. Unfortunately this group of foods have not been included in the very low cost monthly food rations scales used for the household subsistence level.

Table 4.9 Meat Consumption

HH code	Number of days eaten in last 7 days	Source	Quantity	Recommended Quantity of meat (kg)	Price (SZL)
01	3	Purchase/ Produce	3 kg chicken + 1kg other	1.03	80
02	7	Purchase	3 chickens	0.693	120
03	3	Purchase/Produce	2 chickens + 1 kg other	1.03	40
04	7	Purchase/ Produce	3 chickens + 4 kg other	1.28	250
05					
06	2	Purchase	1 chicken +1 kg other	1.18	80
07					
08	2	Produce/ Purchase	1 chicken + 1 kg other	2.85	40
09	6	Purchase/ Purchase	2 kg chicken + 1kg other	0.693	80
10					
11	1	Produce	2 chickens (≈3.0-4.0 Kg)	5.43	80*
12					
Average	3.4		4	1.49	85

Consumption of meat which was inclusive of game and poultry showed that on average the households consumed some meat in three out of the seven days. However the range was between one and seven. Noteworthy is that the households that had the least meat consumption are those households with relatively large numbers of household members. The household with most members also consumes less meat than the minimum recommended.

Table 4.10 Sugar Consumption

HH code	Number of days eaten in last 7 days	Source	Quantity (kg)	Recommended Quantity (kg)	Price (SZL)
01	7	Purchase	3	2.48	16
02	7	Purchase	3	1.8	18
03	7	Purchase	3	2.48	18
04	7	Purchase	3	3.12	18
05	7	Purchase	2.5	2.1	16
06	7	Purchase	2	3.15	14
07					
08	7	Purchase	2.5	7.61	16
09	7	Purchase	2	1.84	12.8
10					
11	7	Purchase	2.5	8.32	16
12					
Average	7	Purchase	2.6	3.6	16

Sugar consumption just like milk consumption, shows a daily consumption pattern for all households. However interestingly, the households with most household members in terms of quantities consumed, consumed less than what some households with the least number of household members consumed and also far less than what is recommended as the minimum a household of that size and composition should consume. This highlights that some of the coping strategies that households can employ which is using less so as to let it go around to everybody.

Table 4.11 Vegetables and Leaves Consumption

HH code	Number of days eaten in last 7 days	Source	Quantity (heads, bunches or packets of 1kg each)	Recommended quantities (kg)	Price (SZL)
01	7	Produce	5	12.5	25*
02	3	Purchase	3	8.67	15
03	7	Purchase	7	12.5	45
04	7	Purchase/ Produce	12	15.075	50
05	7	Produce	7	9.525	35*
06	4	Purchase	4	14.025	20
07					
08	3	Purchase	9	36.037	45
09	7	Purchase	10	8.137	50
10					
11	7	Produce	21	66.263	105*
12					
Average	5.8		8.7	20.3	

The consumption of fresh vegetables and leaves also show a trend where the households consume less than what is recommended with an average of 8.7 kg consumed instead of an average of 20.3 kg that is recommended.

Table 4.12 Legumes Consumption (Beans, Peas, Groundnuts, etc.)

HH code	Number of days eaten in last 7 days	Source	Quantity (kg)	Recommended consumption (kg)	Price (SZL)
01	3	Purchase	1.25	0.393	9
02	2	Purchase	1.25	0.328	9
03	4	Purchase	2	0.393	14
04	1	Purchase	1	0.553	7
05	3	Purchase	1.25	0.358	9
06	3	Purchase	1.25	0.553	9
07					
08	0	-	-	1.203	-
09	1	Purchase	1	0.325	7
10					
11	3	Purchase/ Produce	4	2.015	21
12					
Average	2	purchase	1.4	0.680	9.8

Consumption of legumes is significantly different in that all households except for one consume more than the minimum recommended quantities and averaging 1.4 kg instead of the 0.680 kg recommended.

The consumption patterns shown above, evidently show that all (100%) the households are net buyers of their food especially the staple food maize. Few households show a capacity to provide a food item from their own produce without supplementary purchasing.

4.3.3 Skills

80% of the women interviewed have a skill in sewing. They are part of an association of

women that does embroidery and generates income from that, according to how many pieces of embroidery each has made. In six households this activity was cited as one of their major income generating activities that contributes to their livelihood. Other skills noted was that in one household the woman was able to drive and was licensed. In another household, the woman employs her skill for baking and bakes wares for selling in addition to the skill of sewing.

On the other hand 71% of the men who are heads of the households have skills. These include a senior animal inspector, carpenters, driver and a motor mechanic. In other households there are other members who have skills and use them to contribute to the livelihood of the household. In one household the elder son is a builder that is self employed. In other two households the elder sons are police officers who greatly contribute to the livelihood of the household. High levels of education and skills greatly improve the capabilities of individuals so that they are better prepared to enter formal employment (Hussein 2002) which in turn has the potential to greatly improve the wellbeing of the household as it increases the resilience of the household to some stresses and shocks.

4.4 Assets

In order to create a livelihood people combine the capital endowments that they have access to and control over. These may be made of personal capabilities, tangible assets and intangible assets (Chambers and Conway 1992).

4.4.1 Levels of Asset Holdings

100% of the households are 'owners' of the homes within the parameters of Swazi Nation Land (SNL) tenure and customary law, there are no squatters or tenants. The interviewees did not seem to be particularly bothered by this arrangement but accepted it as when asked why they think it was necessary to ask for the permission of the Chief for them to grow *Jatropha curcas* in what they called their <u>own</u> fields; this is what most had to say:

"...it was important for us to ask the chief's permission for growing jatropha because he must know and approve what is happening in <u>his</u> area".

4.4.2 Land

One of the major tangible assets that each of the households have access to and a degree of control over is land. This is a natural resource. This asset is utilized to construct the home, carry out some farming and harvest some of the natural resources available. For all but four households interviewed, the piece of land which would be used as fields had lied fallow until they planted *Jatropha curcas* trees. They still have other parts of their land lying fallow citing the persistent drought as a reason for not actively cropping their land and also that of the high cost of inputs making planting food crops that require a great deal of inputs very expensive whilst the risk of losing the whole crop was high. The three households out of the four had planted maize on a part of their fields. This is what they had to say:

"... We had grown maize last planting season but we harvested very little as drought resulted in the stunted growth of the crop giving a very poor yield"

"... We always grow some maize on a part of our fields since it forms part of our staple food, sometimes the yield is better depending on when you were able to cultivate your fields. We cannot grow maize or the other food crop in all the fields since it is very risky as over the years we have lost a whole crop due to drought".

"... We always grow a little bit of maize especially meant to be eaten as green mealies, as planting a whole field with maize is too risky. Just when you think all is coming alright then the sun comes with all its might, scorching your entire crop".

Whilst 100% of the households in this area have land as an asset, they are not able to fully utilize it due to the climatic conditions that are prevalent in the area. This result is also confirmed by the report on community consultations that was carried out by the Ministry of Natural Resources and Energy with the support of United Nations Development Programme (UNDP). The report (MNRE 2009) states that in their discussion with farmers it was indicated that not all the farming land was under active cropping as a result of the persistent drought especially in the lowveld and also because of the high cost of inputs such that farmers only cultivate the land within what they can afford.

4.4.3 Water

The other natural resource that is an asset is water. As an area that does not have rivers except for small streams that dry up in winter, there are communal earth dams that are shared by community members to provide water for domestic use and watering their livestock. These are a commonly owned resource which is dependent on the amount of rain received during the rainy season for its existence and then the demand placed on the resource. Whilst it could not be established how such a natural resource is managed to prevent an occurrence such as the "tragedy for the commons", from observation there earth dams are small and therefore cannot support the use of the resource for irrigation purposes. The safety of these water supplies has not been established.

Rural households in developing countries lack access to safe drinking water such that it is estimated that about 1 billion rural households do not have access to a service of safe water (Carney 1999). This may however not always be a result of the service not being available but it may be inaccessible because some households do not have a capacity to pay the capital cost of having such a service as has been observed in the rural households of Mpaka.

There is another source of water for the community which is treated piped water provided by Swaziland Water Services Cooperation. Households that are able to afford the installation fee to have the service availed to them get the service. Not all households are able to afford this service but it remains an option that is available to the households.

4.4.4 Goods and Services from the Natural Ecosystems

Goods and services from the natural ecosystem that were cited by the households were fuel wood which is collected for domestic use and for selling, grass that is used for thatching and timber that is used for construction of houses and fences. Four of the households also cited using thorny bushes to fence their homes and fields and three have used the thorny bushes to fence off their home gardens. The households with cattle also use timber to make the kraals. The veld also supplies fodder for livestock which also enjoys the nutritious green pods from the thorny bushes that grow prolifically in the lowveld.

In the lowveld there is also the marula tree whose fruits have grown in importance. The fruit has a fleshy part that has high alcohol content and is used in making the traditional marula brew and also form the base for the popular marula cream liquor (Forsyth-Thompson 2011). Inside the fleshy part is a hard stone or nut that contains about two oil rich soft seeds. In the past women would crack the stone to get the seeds or nuts for use in preparing their vegetables and other foods such as poultry and meat. However the use of these nuts has been extended to making cosmetic products. A company "Swazi Indigenous Products" produces skin and hair products from the oils which are extracted from the marula seeds under the "Swazi Secrets" brand (Forsyth-Thompson 2011). As stated by this author this was a brainchild of the Queen Mother who identified the potential of the marula tree to generate income for the local women who gather and crack the hard nuts of the marula fruit to release the seed. They sell this to the Swazi Indigenous Products company which situated in close by. Before growing *Jatropha curcas*, 8 of the local women were already involved in this activity.

From the perspective of the interviewees there is not much else that the lowveld has to offer that the households can collect from the veld, especially resources that contribute as food. The veld is however also known to provide medicinal plants that are used by local traditional healers who have knowledge of such plants but none of the interviewed households cited this benefit.

4.4.5 Livestock and Poultry

These include cattle, goats, sheep, donkeys, horses, chickens, ducks, geese, turkey and other forms of poultry. Livestock is important in the livelihood of rural households in that they do not only form a source of food and other services but also act as a security during times of need. In Swaziland cattle are particularly referred to as a bank for the Swazi people. This is because cattle and the other forms of livestock can be sold or battered in order to pay daily expenses, get food for the household, pay medical expenses, acquire land, pay social events, pay for education, finance funerals, pay debt or any other pressing need that may arise within the household. Three (25%) of the households interviewed had cattle, Three (25%) had goats whilst none had the other forms of livestock. Eleven (92%) of the households have chickens, two (17%) have turkey and no other form of poultry was reported to be kept by the households. None of the households reported having sold or battered livestock for the purposes cited above in the last 3 months. In

all three households with cattle they were cited as a source of milk, power and manure. Only one household was producing enough milk to sell and make sour milk (Maas) also for sale. This household has a special breed of cattle for such an activity. However 100% of the households with chickens reported using them for domestic consumption as a source of protein. Only one household reported selling poultry on request because it has so many and therefore willing to sell if anyone comes requesting to buy some.

Below is a table showing the numbers of livestock and poultry owned by the household's interviewed:

Table 4.13 Livestock Owned by Households

	Number of Animals Owned				
HH code	**Cattle**	**Donkey/horse**	**Pigs**	**Sheep/goats**	**Poultry**
01	0	0	0	0	>20
02	0	0	0	0	0
03	9	0	0	0	≥ 8
04	0	0	0	≥10	>50
05	0	0	0	0	0
06	0	0	0	0	≥ 12
07					
08	0	0	0	0	>50
09	0	0	0	0	>30
10	0	0	0	4	>15
11	3	0	0	≈8	>15
12	6	0	0	0	>20
Totals	18	0	0	≈22	≥220

Three households had cattle; there were no households with donkeys, horses or pigs and almost all the households had poultry with the exception of two households who just did not have any form of livestock.

4.4.6 Social Resources

These include networks, social claims, social relations, affiliations and associations.

When respondents were asked if they had received any assistance or support from family or friends in the past six months in terms of food, money, clothing or agricultural inputs, seven responded positively whilst one widow who is still a new resident had this to say:

"…*I am still a new resident in this area and no one really cares about me. Since I came I never received any assistance even in times of severe drought when households considered as needy were being given food aid I was overlooked. I think they think I have enough when in fact I am very needy; my husband was a polygamous man so whatever estate he left was shared among too many of us. What I got was just enough for me to put up this home as we used to stay in a company house where he was working before his demise".*

The others said they had not had a particular need which they could remember which had required such assistance.

All but two of the women interviewed were members of an association which is involved with embroidery and also the collection of marula seeds.

4.4.7 Household Productive Assets

These include sewing machines, hoes, sickle, bush knife, ox-cart, vehicle, radio, television, computer, axe, stove, chairs, table, beds, plough, wheelbarrow, satellite receiver, mobile and landline telephones, three legged pots and other assets which contribute to both productive and reproductive life of the household members.

Table 4.14: Some productive assets for the interviewee households

HH code	PRODUCTIVE ASSETS (number)																	
	Chair(s)	radio	stove	table	bed	TV	computer	sickle	Bushknifeee	DVD/CD player	Hoe	3-L pot	H- mill	tractor	plough	Mobile	Satellite	Sewing machine
01	14	1	1	3	2	1	0	1	2	1	3	4	0	0	0	1	0	0
02	7	0	2	2	2	1	0	1	1	0	3	4	0	0	0	1	0	0
03	7	1	1	2	4	0	0	1	3	0	6	3	1	0	0	1	0	1
04	10	2	2	6	5	2	0	2	2	2	4	3	0	0	0	6	1	0
05	8	1	2	1	5	1	0	0	1	1	1	4	0	0	0	4	0	0
06	8	1	1	3	4	1	0	2	2	1	4	5	1	0	0	1	0	2
07																		
08																4		
09	12	1	2	2	5	2	0	0	2	1	1	1	0	0	0	3	1	1
10	4	1	0	1	2	0	0	0	0	0	3	2	0	0	0	2	0	1
11	0	1	0	1	2	0	0	1	1	0	5	4	1	0	0	4	0	0
12																		
TOTAL	70	9	11	21	31	8	0	8	14	6	32	30	3	0	0	27	2	5

Whilst table 4.3 does not include all possible household assets that households attested to having it does show that the relatively poor households had a few of the productive assets while the households which are not poor had more productive assets. The household with the least number of household assets was the household with the most number of household members (HH code 11).

4.5 Use of Assets and Capabilities on the Activity of Growing *Jatropha curcas*

When the respondents were asked if they had arable land and its size all except one household responded to the positive with households owning between one and two hectares. This one household (05) headed by a widow was a relatively new resident and she said whilst her land was just above one hectare a large portion of it was not suitable for growing maize or other crops as it had a swamp portion. So for the activity of growing Jatropha curcas all the household attested to having the required land (at least one hectare) to grow it.

The next input for the activity was seeds or seedlings and when the farmers were asked how they acquired these they all said D1 Oils supplied the seedlings. This was also confirmed during the interview with the D1 oils officers and the documentation including the agreement forms.

When asked about what other inputs they had used in growing *Jatropha curcas* the farmers listed water, fertilizer and insecticides. Asked if they could estimate the cost for the inputs, all the interviewees were not able as they cited obtaining the fertilizer and insecticides from D1 Oils and using rainwater from the nearby earth dams. Others said even after using water from their standpipes they could not recall the difference in their water bills as it was not very significant as the jatropha had required little water, one 330ml cool drink can per plant three times a week for two to three weeks, after which plants were left to be rain fed.

Asked on who participated in the activity within the household the farmers said it was themselves, those who still had spouses except in one case where the spouse is a migrant worker ,the spouses had participated and the children who are big enough to partake helped especially with watering the seedlings. Otherwise during the planting of the seedlings they had helped each other as members of a group of *Jatropha curcas* farmers.

When asked if they had hired any labour at any stage of growing *Jatropha curcas* they all answered “no” and the main and only source of power cited was human power. They dug the holes for planting the seedlings either as capable members of a household or as a group.

Having employed as many assets as were necessary in the activity of growing *Jatropha curcas* such as hoes, pick axes, containers for fetching water and other household productive

assets as were needed in the process, when households were asked about the impact of the activity on the different aspects of livelihood outcomes such as income generation and on their food security most interviewees said that the project could not have any negative impacts on households' food security because before they grew *Jatropha curcas*, their fields were lying fallow for reasons of drought, destruction by livestock and also inputs for food production being expensive. They also cited that they were able to intercrop jatropha with other food crops which means growing *Jatropha curcas* did not mean complete displacement of food crops. These are some of their responses:

"... I had long given up on growing maize as it was not worth it because of the drought and I had tried growing legumes but had a problem of termites. Before growing jatropha my fields had been fallow for more than 5 years".

"...there is no problem of growing food crops with jatropha. I have been intercropping my jatropha trees with maize, groundnuts, spinach and sweet potatoes".

"... this project was going to give us money to be able to buy food as that is what we do. We buy maize from other people who come from areas where maize grows well".

During the time of the interview the project had already been suspended which happened before the farmers could realize any income from the project.

4.6 Policies and Institutions

4.6.1 Land Tenure

The community of Mpaka is on Swazi Nation Land that is under the authority of the local Chief. Before engaging in the project of growing *Jatropha curcas* the farmers had to seek the permission of the chief. The farmers all said it was necessary so that the chief would know what was happening in *his* area. The type of land tenure under which the farmers live and carry out their livelihood activities also did not present a challenge in carrying out the project of growing jatropha curcas. This is what some said:

"...The chief said if you had a piece of land within what you were allocated, which you think you can use to grow jatropha you are free to do so".

"… the process of getting permission from the chief did not affect my carrying out of the project because there was no difficulty in obtaining the chief's approval"

4.6.2 Project Administration at Local Level

The community of Mpaka is on Swazi Nation Land that is under the authority of the local Chief. Before engaging in the project of growing *Jatropha curcas* the farmers had to seek the permission of the chief. According to the informants the local authorities who include the chief gave D1 oils authorisation to work with the local farmers who were interested in the project. After being taught about the project, the farmers had to sign an agreement form which was a contract between D1 Oils and the farmer. These then had to be signed by the chief and a SZL10 revenue stamp bought by the farmer attached. Both the local authorities and the farmers did not contribute to the formulation of the agreement forms however they do attest to being taken through the agreement forms. During the interview, interestingly none of the farmer respondents could recall what the implications were if either party failed to meet their obligations as they said they did not have any copies of the agreement remaining with them.

When farmers were asked why they think it was necessary to seek the permission of the chief before engaging in the activity, the farmers all said it was necessary so that the chief would know what was happening in his area. The farmers also said that there were no special requirements they had to meet before they could be given such a permit and they were not given conditions under which to carry out the project. This is what one said:

"…The chief said if you had a piece of land within what you were allocated, which you think you can use to grow jatropha you are free to do so".

Asked if seeking for the permission of the chief did not affect them in carrying out the activity they all said it had no effect as one put it this way:

"… the process of getting permission from the chief did not affect my carrying out of the project because there was no difficulty in obtaining the chief's approval"

Apart from having fields that a farmer wanted to grow *Jatropha curcas* on, there were no other conditions that were developed or formulated and set by the local authorities to regulate the

project. There were no set boundaries within which the local farmers had to carry out the project. This information was obtained when the interviewees were asked if there were any set conditions they had to meet before being granted the permission to grow *Jatropha curcas* by the local authorities.

When the growers of *Jatropha curcas* were asked if they had a contact person within the authorities of their area who was tasked with taking their concerns and issues regarding the growing of *Jatropha curcas*, that is a liaison officer, they all responded to the negative and said there was no one.

4.6.3 Project Administration at Investor Level

The private company in the project of growing *Jatropha curcas* for Biodiesel was D1 Oils Swaziland. When the researcher was carrying out the final formal interviews, D1 Oils Swaziland had ceased its operations in the country; the researcher had to then rely on information obtained from the initial interview that was held when still making contacts and the documents obtained thereof. In his response the officer stated that the growing of *Jatropha curcas* may not necessarily make one rich but it had the potential of making a positive contribution to the livelihoods of the farmers as a cash crop that would give a decent income. It was however, not possible to get a view about the future of the activity as a development project after all that had transpired leading to its suspension from D1 oils.

D1 Oils Swaziland signed a memorandum of understanding with the government of Swaziland through SIPA as an investor in the Biofuels industry as a locally registered company seeking to empower Swazi farmers with a viable and sustainable livelihood. D1 oils developed out grower schemes with the collaboration of local authorities and the relevant government Ministries. D1 Oils developed and executed the agreement forms which the farmers had to sign, take to the chief to get approval and then submit to D1 oils. The agreement forms were only written in English, the interviewees attest to being taken through the agreement form by officers from D1 Oils. There were no copies left with the farmers or the local authorities.

From the interviews with the farmers, D1 Oils trained the farmers on the activity of growing *Jatropha curcas*, supplied seedlings to the farmers and also continued to give the farmers technical support. There was a D1 Oils Swaziland extension officer who was always available for the farmers call and they could call him when they had queries.

According to a presentation in the Biofuels Task Team meeting D1 Oils had also signed a memorandum of understanding with World Vision Swaziland with the aim of facilitating the growing of *Jatropha curcas* as a rural development intervention intended to improve the economic status of rural communities.

However when issues began to emerge against the project D1 Oils simply withdrew its officers working with the farmers. Nothing official was reported to the farmers and nothing was communicated to them about the fate of project or the company or the trees that they now had until D1 Oils closed shop without informing these critical stakeholders.

4.6.4 Project Administration at Government Level

At government level three ministries were and are involved in the project of biofuels at varying degrees. These are the Ministry of Natural Resources and Energy, the Ministry of Agriculture and the then Ministry of Enterprise and Employment now known as the Ministry of Commerce. Under the Ministry of Enterprise and Employment was the parastatal known as Swaziland Investment Promotion Authority (SIPA) which is responsible for attracting investors and bringing them to the country. The Ministry of Agriculture is responsible for all Agricultural activities within the country and through SWADE which still under this ministry, the government commissioned a feasibility study on Biofuels. MNRE is responsible for the regulation of natural resources including mining and also the regulation of all forms of energy which includes electricity, fossil fuels and also biofuels. The Government had tasked this Ministry to formulate the National Biofuels Development Strategy and Action plan.

From the interview with the officers at SIPA under the Ministry of commerce which had facilited the investment by D1 Oils Swaziland and represented government in the signing of the MOU with D1 Oils Swaziland, the researcher gathered that after the NGOs raised concerns about the project, the Ministry of Agriculture agreed that since no environmental assessment has been

undertaken over *Jatropha curcas*, when it should have been put under severe scrutiny before it could be embarked on which it said was against the spirit of plant control act of 1981, it presented an environmental risk. This was confirmed by the report of the two NGOs where an officer from the Ministry of Agriculture was quoted expressing these concerns. Government accepted the NGOs lobbying against D1 Oils and the planting of *Jatropha curcas* and suspended further planting but did nothing about the farmers who were left in the dark about the project and neither provided solutions or alternatives for the households as to how best they can use their capacities and assets to make a gainful living. From the interviews with the government officers it transpired that it was not clear whose responsibility it was to liaise with the farmers among the three ministries.

During the life of the project, the local extension officers from the ministry of Agriculture were not involved in the project. This was gathered from the interviews with the local headman and farmers who were growing *Jatropha curcas* when asked if they had received any assistance from government on the project through either education or technical support, they all said no assistance had been given by government. One lady farmer cited having called them several times for assistance as her cassava was dying to no avail. At local level there was no liaison between government, local authorities, D1 Oils Swaziland and the farmers.

4.7 Stakeholders' View of the Project of Growing *Jatropha curcas*

One of the objectives of the research was describing the different stakeholders' view the project of growing *Jatropha curcas* as a development project. This was to be in terms of how it addresses their desired outcomes and what they think were the impediments in achieving their desired outcomes stating how they think that could be best addressed. Following are the responses of the different stakeholders:

4.7.1 Farmers of *Jatropha curcas*

When the farmers that grow *Jatropha curcas* were asked about their view of the activity as a development project, two thirds felt the project had a potential to meet their desired outcomes if

they could find a market for the seeds. They stated that they had fields which they could not utilize fully and the growing of *Jatropha curcas* had proved to be viable as the trees were able to withstand the persistent drought with minimal inputs.

17% felt the project was a letdown after a lot of hard work and were so disappointed with it. They also stated that they no longer wanted anything to do with growing *Jatropha curcas* as they did not think the situation can improve in the future.

Another 16.7% felt they had not had enough education on what can be done with the *Jatropha curcas* such that although they could see that as a crop it was doing well in their area they did not know what it can be used for. They stated that it therefore be difficult to say what its potentials are as a development project.

4.7.2 D1 Oils Officer

When the researcher was carrying out the final formal interviews, D1 Oils Swaziland had ceased its operations in the country; the researcher had to then rely on information obtained from the initial interview that was held when still making contacts. In his response the officer stated that the growing of *Jatropha curcas* may not necessarily make one rich but it had the potential of making a positive contribution to the livelihoods of the farmers as a cash crop that would give a decent income. It was however, not possible to get a view about the future of the activity as a development project after all that had transpired leading to its suspension from D1 oils.

4.7.3 Constituency Headman

The constituency headman expressed disappointment that a project that had shown such great potentials for his area had been stopped when his people were struggling with providing themselves with food because of drought. His view was that jealousy people had seen that they would now be rich and then decided to lobby against the activity. He was however hopeful that if they would have learnt more about the crop and if influential people bringing the activity back on board it had a great potential of yielding a positive outcome in his area.

4.7.4 SIPA Officer

An officer from this government parastatal when interviewed about the project responded in this manner:

"…*why are you flogging a dead horse*?"

Asked what he thought the future of the project was, he said now that government had suspended further plantings and it was said that some farmers had uprooted their plants following the allegations by the NGOs that it would destroy their soil, it was hard to say. He said their office was for facilitating investments after which the relevant ministries and departments then take over. He stated that as far as they could see it, as a development project it had been a failure.

4.7.5 MNRE Officer

An officer from the MNRE when interviewed about what the future of the project was from their point of view said as a ministry since they had developed the national strategy for biofuels they were now working on the aspects of operationalising the strategy by bringing on board all stakeholders to develop the policies, regulatory framework and the necessary legislation. The officer stated that for now they were only rolling it out for ethanol and once they are done with that they will then start on biodiesel. This she said was because as yet they did not have a model showing viability of growing *Jatropha curcas* for biodiesel. She however pointed out that the investor D1 Oils Swaziland had closed its operations and as yet there was no market for the *Jatropha curcas* seeds.

4.8 Summary

This chapter is a presentation of the results that were obtained when the research was carried out using the methods outlined in chapter 3. An outline of the description of the project of growing jatropha in the kingdom of Swaziland at national level as well as at local level in the community of Mpaka was given according to what was found on the documents and also from interviews. This was followed by the results on the description of the vulnerability context of the households at Mpaka, the capabilities and range of assets and activities that create the different livelihoods,

the policy and institutional conditions in the area of Mpaka and at national level and lastly was a report on the stakeholder's view of growing *Jatropha curcas* as a development project. The next chapter will entail discussing these results.

CHAPTER 5: DISCUSSIONS

5.0 Introduction

Whilst chapter 4 was a presentation of the results from the research obtained through the methodology described in chapter 3, this chapter is a discussion of the results in relation to the literature review and the theory on rural development using the sustainable livelihoods framework.

5.1 Description of Project of Growing *Jatropha curcas*

Based on the history of growing *Jatropha curcas* at national and local level (section 4.1) the government of Swaziland made a good start before the country embarked upon the industry of biofuels, to commission that a feasibility study and a national biofuels development strategy are carried out. This was important because when FANRPAN (Jumbe, Msiska and Mhango 2007) made the statement that biofuels offered both promises and challenges for developing countries it was explicit that careful considerations should be taken before such technologies are adopted. One of the potentials of biofuels highlighted in literature was their potential to unlock substantial economic benefits including rural development by attracting investment to rural areas and promoting agricultural development (SA government 2007).

However, in the terms of reference (TOR) that were given to the consultants tasked with carrying out the feasibility study for biofuels, there is no mention of rural communities, natural resource management and the dependency of the livelihood of rural populations and the poor on such resources and the development of a model which should be followed to give optimal results to the majority and also the model that would be best suited to unlock rural development. There is also no mention of the institutional structures that exist in rural areas. This is of concern because biofuels especially in the production of the feedstock are heavily dependent on farming land and that is found in rural areas. As mentioned in chapter 3 in describing the system of governance in Swaziland the traditional authority is very important in establishing the legitimacy of a project, its acceptance in the community and its sustainability. Community level institutions and processes have been a prominent feature in approaches to natural resource management and are strongly emphasised in sustainable

livelihoods (Ashley and Carney1999), It would have been expected that the feasibility study also includes those parameters, so that the rural population is given an opportunity to make meaningful contribution to what would ultimately impact on their everyday life. That would also contribute to the development of the best possible model that would result in maximum benefits to all stakeholders by building on their endorwements.

The recognition that poor people live their lives strongly linked to natural resource management and using their capitals, are able engage in activities that give them a gainful living within a context of policy, institutions and processes has grown and taken rural development theory and practice to another level whereby participation and empowerment have taken centre stage in development (Chambers and Conway 1991; Ashley and Carney 1999; Hussein 2002). However the government of Swaziland in approaching this industry on biofuels did not seem to appreciate or support these approaches to development as there was no consideration of these important and crucial parameters and stakeholders shown at all levels during the development and execution of the biofuels project.

After the feasibility study was carried out, *Jatropha curcas* was publicly declared as one of the crops that can be grown for biofuels under rain fed conditions (SWADE 2006). From the Terms of Reference (TOR) that were given to the consultants, in coming up with the recommendations of the most suitable feedstock for the country to grow and use, the consultants had to take into consideration crops most suitable for use in the context of Swaziland and study the economics of production, climatic conditions, agronomy conditions, availability of land, water and other resources, environmental impact assessment (EIA) requirements. This means *Jatropha curcas* was or should have been subjected to some scrutiny before being listed as a crop that would be suitable for the country to grow as a feedstock for biodiesel production. When an investor showed interest in growing *Jatropha curcas,* it would have been expected that out of the many crops which were listed as suitable for feedstock, *Jatropha curcas* would be singled out and an EIA carried out as per the government's legislative requirement and government should have recognized that when commissioning the project of growing *Jatropha curcas*.

It came up through the documentation that even before the report on the feasibility study was

out, the government of Swaziland signed a MOU with an investor, D1 Oils Swaziland who was promoting growing of *Jatropha curcas* for biodiesel. At this stage one would say the Swaziland Government lost the plot as this suggests that the decision to allow the growing of *Jatropha curcas* for the purposes of biofuels was taken without the consideration of the contents of the feasibility study report. The fact that a little more than two years later from the time the project of growing *Jatropha curcas* was commissioned and the report by the consultants that *Jatropha curcas* was one of the most suitable feedstock accepted, the same government was unsure of the decisions it had taken poses questions on what the contribution of the feasibility study was to the government of Swaziland.

This emerged when the two NGOs, Yonge Nawe and ACAT challenged the project of growing *Jatropha curcas* by D1 Oils. Government could not give the rationale for embarking on the project but instead realized the loopholes as according to the report by the two organizations where an official from the Ministry of Agriculture was quoted saying that no environmental impact assessment was undertaken over *Jatropha curcas* when it was supposed to have been put under severe scrutiny which he said was against the spirit of the plant control act of 1981 (Burley and Griffiths 2009). This was also confirmed during the interview with officers from SIPA. Clearly this shows lack coordination in the government ministries and their organs and a lack of engagement of all stakeholders which would have been facilitated during the EIA process.

What also exacerbated the situation was that National Biofuels Development Strategy and Action Plan was not yet out when the project was embarked upon as it only came out in 2010(MNRE 2010). According to literature in 2004, the Food, Agriculture and Natural Resources (FANR) division of the SADC secretariat released a study on the feasibility of the production of biofuels in the SADC region in the light of rising oil prices (RHVP 2007). All SADC nations according to the report were called upon to develop strategies which would make the region self-reliant in energy production (RHVP 2007). It was imperative how a country approached the industry hence there was need for each country to first formulate a strategy that was suitable for its context then embark on the industry. In this case there was no strategy being followed resulting in serious flaws which ranged from lack of formulation of proper enabling

policy for the industry to the lack of regulatory procedures and the relevant legislature for the guidance and protection of all parties involved and that's how the NGO's succeeded in winning the case against the project.

From analysing the responses and comments by the farmers, the reasons for rallying against D1 Oils and growing of *Jatropha curcas* by the two NGOs were not quite clear as they asked how much was D1 Oils going to pay them for using their fields and told the farmers that they were being exploited by this company. At the same time the NGOs in their report did not table this reason (Burley and Griffiths 2009). Out of all the many issues the NGOs cited as reason for the project not to continue only two were told to the farmers in the Mpaka area: that of being exploited and that the trees would destroy the soil. Asked what they understood was meant by "destroy" all the farmers said they did not understand and they also did not enquire from the NGO people what they meant or how it would happen. It is also not clear if these people whom the farmers thought were of 'Japanese origin' were related to these NGOs or they were opportunists on a different mission. This is because they seemed to have opposing agendas. From their report the two NGOs were saying that *Jatropha curcas* is not supposed to be grown as it poses environmental risks as well as risking food security and that it did not possess the potential to generate income for its growers under rain fed conditions and would destroy the soil on which it was grown. However these so called people of 'Japanese origin' were offering a better pay for the *Jatropha curcas* seeds which means they wanted the farmers of *Jatropha curcas* to continue growing the crop but be either free to sell to whom so ever they would feel like selling to or they should sell to them ("Japanese") as they offered to pay more for the seeds than what had been offered by D1 Oils Swaziland. This was against what the two NGOs were seemingly standing for. It is also not clear why then, the farmers had to be given money. However it was not possible for the researcher to verify some of these comments and the origin of these people who were promising the farmers better prices because of time constraints, capacity and the scope of the research.

Whilst it could have been possible for either the government or the investor to challenge the allegations by the two NGOs, none did that because of having flouted an important government regulatory requirement on projects of such magnitude and nature. According to literature, the sustainable development of a viable biofuels industry requires a strong, supportive policy, and a

firm legal, regulatory and institutional framework to ensure that measures are put in place to harness the contribution of the sector to rural livelihoods (Jumbe, Msiska and Mhango 2007). In Brazil, the biofuels industry has significantly contributed to employment and development of the rural areas and region (UNCTAD 2006). This is said to have been through the Brazilian government's careful consideration of the necessary checks and balances which includes proper public infrastructure policies.

On a different note, the government of Swaziland showed and has continued to show further disregard for the farmers or rural poor, who are the grass root stakeholders by not officially reporting to them about the stalling of the project and also presenting to the farmers what options are available to those who still have their *Jatropha curcas* trees. These farmers are part of households thus the impact of the activity had to be assessed at household level.

For the reason that new directions have been emerging in the theory and practice of development from globalisation to sustainable development then to human development and poverty reduction, alleviation and elimination strategies which includes sustainable livelihoods (Chambers and Conway 1991; Ashley and Carney 1999; Haines 2000; Scoons 2000; Ellis and Biggs 2001), it has been noted that a household that is described as not poor today may be described as poor tomorrow and another which was described as poor may described as poorer because they were faced with a high probability of an adverse shock which they experienced and could not cope with or recover from (Chaudhuri, Jalan and Suryahadi 2002). This brings about the need to describe not only the current status of the household but to take a forward-looking approach by also describing the vulnerability context of the household (Chaudhuri, Jalan and Suryahadi 2002). The second objective of the study was describing the vulnerability context of the households who were involved in the project of *Jatropha curcas* through effective measurements that are able to account for the livelihood conditions of the households (Morrow 2000).

5.2 Vulnerability Context

5.2.1 Drought

Reports from the Swaziland vulnerability assessment committee (VAC) have classified the area

of Mpaka as a livelihood zone that is marked by erratic rainfall accompanied by long dry spells of heat (VAC 2006,2009,2010). As per the results, 100% of the households cited drought as a stress that had occurred in the last twelve months and had affected the households' ability to provide for itself especially food.

Most people experience and respond to shocks and stresses as members of a household. Even in industrialized nations, it continues to be the case that most households are comprised of families which implies some degree of resource sharing and dependence on each other's capabilities (Morrow 2000). Whilst this is often thought of in terms of economic resources which makes the association of poverty and vulnerability easy, the mechanisms by which certain physical and social attributes (such as age, race, ethnicity and gender) and living arrangements (such as single parent households, child headed households) are likely to be associated with limited resources and power and thus increased vulnerability are less understood (Morrow 2000: 2). Morrow (2000) also notes that whilst these vulnerability factors are not mutually exclusive they tend to occur in combinations thereby intensifying exposure to certain stresses.

5.2.2 Household Composition in Relation to the Vulnerability Context

According to literature vulnerability of households has been shown to be closely linked with household composition (Morrow 2000; Chaudhuri, Jalan and Suryahadi 2002). This includes such variables as whether the household is headed by a man or woman, whether they are single, married, divorced or widowed; the composition in terms adult proportion and the proportion of the different age groups; the education level of the head of the household and the education level of the other household members (Chambers and Conway 1991; Ashley and Carney 1999; Morrow 2000; Chaudhuri, Jalan and Suryahadi 2002).

Whilst 100% of the households cited drought as a stress they had experienced, only the households that were woman headed or under the care of a woman for most of the time cited theft of livestock and poultry as one of the stresses that the households have experienced. The women headed households showed an increased vulnerability to social pathologies such as theft and violation.

Among the households that were interviewed, there were no child headed households and thus

nothing could be added to the vulnerability context of the household in Mpaka from that perspective. In yet another case of a woman headed household lack of resources and power were cited as a reason for not being able to grow other crops as they used to do when her husband was alive. This household while the man of the house was alive had a degree of resilience to the drought through planting a cash crop in the form of cotton which was able to give the household an income. Now that the man of the household is deceased and this household is headed by a woman its exposure to the stress of drought and loss of crops to livestock had been intensified as the woman feels she does not have the power to take her neighbours who are destroying her fence to task and neither did she have enough resources to erect a proper fence. This has meant that she cannot utilize the land which fortunately all the households 'own' and have access to. That shows clearly that whilst in the case of Mpaka there were no differences in terms of ethnicity or race other social attributes and living arrangements do indeed affect exposure to certain stresses and shocks as said by Morrow (2000).

The other contribution of household composition to the vulnerability context of a household is the number of household members. In the two households (08 and 11) with most members (sixteen and thirty one respectively), there seemed to be an increased vulnerability to food insecurity hence there were constant coping and adaptive strategies such as reducing the number of meals per day especially for adults and also decreasing dietary variation. In these households most members who are not attending school and are adults are not employed. Except through reproductive activities, they do not contribute to income generation within the household. These two households are both headed by widows. When compared with the other two households also headed by widows (01 and 05) but with fewer household members (five and six respectively) there was an increase in food security among the households with fewer household members as could be seen through the increase in the number of meals per day and also the increase in the dietary variation. As pointed out households at Mpaka are net buyers of their food as production is adversely affected by the constant drought. This creates a great need for households to have income generating activities which will enable them to make the money to buy their food.

5.2.3 Housing

Literature shows that poor households typically live in poorly built and inadequately maintained

housing which increases their vulnerability for being adversely impacted by natural phenomena leading to loss of housing (Morrow 2000). In the case of Mpaka all the households do have at least one robust house that is made of blocks and good roofing materials such as corrugated iron sheets or tiles. For those household with a relatively high number of household members they supplemented the good structure with less robust structures made with timber and mud, thatched with grass, having cement floors which were well maintained for their nature. In these households the ratio of the stick and mud houses, as they are popularly known, is higher than that of the robust housing. This trend is in line with what literature shows. Whilst one household has suffered the loss of shelter due to storms blowing away the roof in two separate incidents the rest did not cite that happening to their houses since construction which generally indicates low vulnerability to loss of shelter due natural phenomena associated with poor housing. The resilient housing also adds to a secured asset base from which the households can build to create a sustainable livelihood. In terms of maintenance, only two households have plumbed indoor toilets and baths, the rest use pit latrines and tubs. Following that this is an acceptable way of living in rural Swaziland these households can be said to have adequately maintained houses within their means and context. In the case of Mpaka, all the households that were interviewed are homeowners within the parameters of Swazi law and custom. This means they obtained land or they inherited it through family succession in accordance to the Swazi law and custom and they then built their own structures.

5.2.3.1 Water and Electricity

A majority (7/12) of the households have electricity and potable water however the poorest of the household do not have either. These amenities are still relatively expensive to install in Swaziland and hence if a household is poor they cannot afford such services instead they use other sources of energy such as firewood for cooking and paraffin and candles for lighting. They obtain their water from earth dams and also collect rainwater during the rainy season. For these households there is increased vulnerability to waterborne diseases and sickness due to water contamination. Whilst these diseases have not been cited as having occurred or affected the households, the use of such sources of water have that inherent threat to undermine the health of household members negatively impacting the household capability (Chambers and Conway 1991; Ashley and Carney 1999; Scoons 2000). Potable water in a standpipe within the compound

of a household greatly reduces the household's vulnerability to such diseases and threats contributing to an increase to the household's capabilities. Electricity and portable water in a standpipe within the compound of a household also greatly contributes to the asset base of the household as it increases the household's choices and options in terms of livelihood activities that can be carried out.

The other measurement used in mapping out the vulnerability context of a household is food security and nutrition bringing the research to the next discussion.

5.2.4 Food Security and Nutrition

According to the sustainable livelihoods framework, one of the most important outcomes that a household will engage to a livelihood strategy for is increased food security (Chambers and Conway 1991; Ashley and Carney 1999; Scoons 2000). Food insecurity has been shown as one element of entrenched and escalating vulnerability (Misselhorn 2004). The community of Mpaka has increased vulnerability to food insecurity due to the chronic drought which has also been confirmed by the Swaziland Vulnerability Assessment Committee. Misselhorn (2004) has pointed out that food insecurity and the factors that determine it are experienced at the level of the household and the individual. Closely linked to the household composition and vulnerability is limitation of resources which may include food stores. The households within the Mpaka area are all exposed to a common natural shock which is drought, however as pointed out my Morrow (2000) combinations with other factors, may intensifying exposure to certain stresses and shocks. Within the area of Mpaka all the households are net buyers of their food. however those households who had the worst food insecurity, characterized by one meal per day for adults (see Table 4.3) and a diet that is monotonous with a few days per week of eating meat especially red meat, are headed by widows (See Tables 4.4-4.12) .

"Poor households often cope with poverty by adopting a very monotonous diet that may nevertheless address their basic nutritional needs" (Rose and Charlton 2001:387). One household mainly survives on maize which is bought, take to a nearby miller to make mealie meal and taken with green leafy vegetables from home garden and are sometimes purchased and milk from the 3 head of cattle the household owns. It is occasionally taken with poultry from own produce. In this household rice did not form part of their weekly diet. The other household

with similar dietary characteristics also grows cassava and that contributes greatly to the diet of this family as the household head said that instead of buying bread they have cassava with tea otherwise they use sour porridge for breakfast. "Food crises together with chronic food shortages lead to compromised human well-being, hunger and malnutrition posing serious challenges to governmental and non-governmental institutions, and formal and informal policy and decision makers at all levels"(Misselhorn 2004: 1). Non-governmental and international organisations are doing what they can to find long term measures to stimulate agriculture, rural development and sustainable livelihoods towards food security in the developing world (Misselhorn 2004). This shows the importance of agriculture in stimulating economic growth.

Within the context of the Mpaka area there is need for the stimulating of one such agriculture that will be well adapted to the prevailing natural climatic conditions of the area. According to Scoons (1998) sustainability of a livelihood entails the creation of working days which relates to the ability of a particular combination of livelihood strategies to create gainful employment for a certain portion of the year on or off-farm as part of a wage labour system or subsistence production. The project of growing jatropha was one such activity that had a potential of providing such for that area as this is a drought tolerant crop. As pointed out by literature a household will make a living using its assets and capabilities by engaging in livelihood activities.

The third objective of the study was to identify the capabilities, range of assets and activities that create the different livelihood strategies for the different households and how they have been effectively used in the growing of *Jatropha curcas* for biofuels with what outcomes in terms of income generation, food security and reduction of vulnerability.

5.3 Capabilities, Range of Assets and Activities for Livelihood

5.3.1 Capabilities

This has to do with the household's capacity to secure a livelihood and refers to the potential the household has of making use of the assets it has to secure a livelihood. It is inclusive of the profile and the composition of the household whereby the profile carries information on the sex, age, health of family members, their education and skills and their availability to labour

(Chambers and Conway 1991; Ashley and Carney 1999; Scoons 2000).

5.3.1.1 Health

Swaziland is leading in the world in terms of HIV/AIDS occurrence with up to 25.9% of the sexually active population infected (Swaziland Demographic Health Survey (SDHS) 2006-7). This has seen the life expectancy plummeting from 60 years in 1997 to 37.5 years currently (Central Statistics Office (CSO) 2010). Whilst for ethical reasons the researcher could not establish the HIV status within each of the households, the researcher asked if there were members within the household which had been sick for a period of three months or more and also if there had been any members who had died within the past twelve months due to an illness that lasted three months or more. The largely negative responses in having lost household members due to long illnesses with a few cases of chronic illnesses gives the indication that the households' capabilities are largely not affected by illness which can be associated with HIV/AIDS and tuberculosis. The one case whereby illness impacted negatively on the capabilities of the household is the case whereby the woman farmer suffered a stroke as that has made her unable to actively take part in the livelihood activities of the household especially in farming activities including that of *Jatropha curcas*. All the cases of ill household members have been able to get clinical help which is a positive indication that the households have not got to a state of poverty whereby households will employ coping strategies that include decreased expenditure on essential goods and services such as education, healthcare and agriculture to name a few (Misselhorn 2004).

5.3.1.2 Education

In all the households that were interviewed the head of the households had obtained enough education to be able to do basic reading and writing. The lowest having gone up to grade three in primary school. Whilst this level of education can allow one to do simple computations such as adding and subtraction to carry out the petty businesses it is not sufficient for reading and understanding some complex documents such as the agreement forms that they had to sign with D1 Oils. In all the households, there are members who have finished high school education and only four households have members with tertiary education whereby one is head of household. Literacy according to literature "provides people with the option of becoming members of a self-

confident and informed populace that can understand issues, represent themselves, take responsibility for self-improvement and family health, and better participate in civic affairs" (Tripathi 2008:24-25). The low level of literacy is evident with this group of farmers in that they have not been able to organize and represent themselves to be better able to demand for answers from government concerning the project which they were made to partake in and it was later stalled without their consideration or involvement.

5.3.1.3 Social Resources

These include networks, social claims, social relations, affiliations and associations. This resource is very significant especially in when response to difficult times is needed. This may be response to everyday needs or it may be response to stresses and shocks. Morrow (2000) citing Bolin (1982) states that the extent to which individuals and households possess "institutional and kinship embeddedness" is an important response factor. Lack of family and social networks can a limiting factor. One widow who became a resident to the area of Mpaka in 2003 had this to say when asked if she had received any assistance or support from family, friends or NGOs in the past six months in terms of food, money, clothing or agricultural inputs :

"…*I am still a new resident in this area and no one really cares about me. Since I came, I never received any assistance even in times of severe drought when households considered as needy were being given food aid I was overlooked. I think they think I have enough when in fact I am very needy; my husband was a polygamous man so whatever estate he left was shared among too many of us. What I got was just enough for me to put up this home as we used to stay in a company house where he was working before his demise".*

This is in line with literature as Morrow (2000) notes that recent migrants may lack connections to the larger community and may hesitate to seek help.

Among the social resources which the farmers point out, was extended family support which was cited by one household in that the household's goats were being kept and looked after by the parents of the head who stay within the same community but a distance away. Another household said it did occasionally get some assistance with maize from some relatives.

The other social resource that was cited is the informal women's association where they do embroidery to sell. This was one activity which had easily facilited the activity of growing *Jatropha curcas* and was also cited as one of the major income generating activities of the households. The women who were widows said they helped each other as an association to plant the jatropha seedlings.

The households at Mpaka were then building upon their strengths by engaging in the activity of growing *Jatropha curcas* whereby they used land which is an asset they have access to but are not able to utilize efficiently due to drought and socio-economic factors. Growing *Jatropha curcas* was an on-farm activity that required few inputs on the part of the farmer so anyone even the poor could engage in the activity so long as they had access to land. All that was required of the famer was the ability to labour, if they were healthy and fit to be able to dig the pits for the seedlings of *Jatropha curcas* which were provided and be able to get water from the earth dams to water the seedlings about three times a week until they were established.

The farmers agreed that it was hard work digging the pits, citing that their soil is clay and therefore hard to dig. However they said they went on to carry out the activity because they said the hard part was only in establishing the *Jatropha curcas* plantations which was once off, thereafter maintenance was relatively easy. They were motivated by having to only plant once and be able to harvest 2-3 times/year from the same crop and generate income for 30years going up to 50 years. All the farmers except one did not harvest any seeds as the project was stalled before the trees reached maturity. Only one interviewee had harvested seeds from his trees and stored them hoping there would be a market for them as promised. Even that one cited not being vigilant in harvesting the seeds as they ripen throughout the year because he had lost faith in the project.

Whilst the farmers were building upon their capabilities and assets to engage in an activity that they perceived as having a potential to contribute positively to a sustainable livelihood they were doing so within a framework of policies and institutions which then had their influence on the outcome of the activity.

5.4 Policy and Institutional Conditions

From the responses of officers from SIPA and MNRE and from the documentation when the project of growing *Jatropha curcas* was commissioned in Swaziland there was no proper coordination of the different sectors that were to be affected or involved with the project. The project started even before the feasibility study on biofuels for the country was out. The strategy for biofuels which was being developed by MNRE had also not been completed. Apart from being a foreign investment project which complied with investment policy frameworks as outlined by SIPA because the then Minister of Enterprise and Employment representing the government was able, on behalf of government to sign the MOU with D1 Oils Swaziland as an investor represented by its Chief Executive Officer, the project was not properly placed.. Through the Ministry of Enterprise and Employment government had given the project an approval whilst the same government through the ministry of Agriculture was "…*Singing the same tune with the NGOs against the project"* as put by the officer from SIPA. This highlights the lack of coordination between the ministries which were involved or were supposed to have been involved in the project

This result is in line with what literature says, as in Tanzania, Sasovele (2010) writing on policy challenges related to biofuel development, noted a lack of integrated guiding policy and legal framework that takes into account energy development, transportation, agriculture, land and water issues. Sasovele (2010) also noted a lack of clear institutional arrangements and clear coordination mechanisms. These are the issues that have characterised the development of biofuels in Swaziland.

The lack of a specific office at local level that could liaise with government officials so that information gets to the farmers and they can also take their issues and concerns to the national level where the decisions which have ultimately affected their livelihood were taken simply means there is no follow up or institutional support for the farmers and their project at local level. The local authorities also did not develop any regulatory measures for growing of *Jatropha curcas* which would safeguard against for example the taking of land that was initially used for growing food crops and using it for growing a non-food crop, drawing up of communal water , to irrigate *Jatropha curcas.* Whilst these may not have been issues of concern for the farmers in this

community however in terms of natural resource management, measures have to be put in place so that the authorities of the area are proactive instead of being reactive.

So as households built upon their strengths in terms of capacity and assets and engaged in the activity of growing *Jatropha curcas*, policy and institutional failures at national level undermined their efforts such that because of frustrations encountered at macro-level the investor closed business leaving the household without a market for the jatropha seeds.

Whilst these policy and institutional failures are at national level they still had such a huge impact on the ability of the households to generate an income from the activity of growing *Jatropha curcas*. As described by literature micro-level activity informs the development of policy and an effective enabling environment and that macro-level structures and processes support (or not support) people to build upon their own strengths (Carney 1999). Ultimately the impact that growing *Jatropha curcas* had on the livelihoods of the households that were involved in the activity was shaped by these conditions.

As literature points out, one common challenge across the SSA countries with regard to trade and investment promotion include inadequate national capacity to apply the available instruments and in some cases the prevailing policy and regulatory instruments are still not quite conducive for both domestic and international investments in a number of sectors including the biofuels sector (Jumbe, Msiska and Mhango 2007:20). One such policy in Swaziland is the land tenure.

5.4.1 Land Tenure

The households in the area of Mpaka are all found in Swazi Nation Land and they are all ‘owners’ of their homes. Why the households are called ‘owners’ is because under the SNL tenure, the land which rural communities occupy is said to be under customary tenure and therefore cannot be sold, mortgaged or leased (Adams, Sibanda and Turner 1999). Under this tenure, Levin (1997) points out that there is “a history of depressed peasant farm production, exploitation-particularly of women- and there are forced removals with the tacit support of those in power”. To say the chief must know and approve what is happening in his area means the people see the chief as having an authority over the land they occupy and hence as farmers they cannot just decide by themselves what they would rather do

with the land they are said to 'own' and have access to. Tenure insecurity results in uncertainty which makes economic land use too risky for many (Cross 1998).

This result is similar to that obtained by the MNRE in their community consultations whereby farmers are said to have indicated that they were under the SNL tenure whereby they are not the custodians of the land but were merely subjects with user rights only, as the land was solely under the authority of the Chief (MNRE undated).This suggests that there is some underlying vulnerability to losing the land because of the nature of tenure under which the land is held even though none of the interviewees explicitly cited it as a concern or perceived it as a threat. The reason may, as literature puts it, be because this is heavily dependent on the local institutions and structures within each community (Adams, Sibanda and Turner 1999). Carrying out the activity of growing *Jatropha curcas* in such a context of policy framework and also within the governance conditions as outlined in chapter 3 (3.2), may have influenced government not to regard the activity as having been a serious undertaking and investment for the farmers. For the farmers it was an important undertaking as they invested in their time, energy and the other resources as discussed earlier, thus the project had an impact in their livelihoods.

5.5 Impact of Growing *Jatropha curcas*

Having analyzed, reported and discussed the different aspects of livelihoods including the vulnerability context of the households in Mpaka this section is a discussion of the impact growing *Jatropha curcas* for biofuels had on the different aspects of livelihoods as perceived by the households or the farmer representing the household themselves.

5.5.1 Impact on Vulnerability Context

Drought stood out as the most perceived stress that made households unable to provide themselves with adequate food thus becoming vulnerable to famine. All the interviewees said that they took the option of growing *Jatropha curcas* because it was suitable for their area as it is drought resistant and reduced their vulnerability to losing a whole crop due drought. *Jatropha curcas* according to literature is well adapted to arid and semi-arid conditions and generally

occurs in seasonally dry areas and grows in grass savannah, scrub vegetation and other open vegetation (Edje and Mngometulu 2005)

Growing of *Jatropha curcas* was also said to have been taken as their best option because it is not browsable by livestock and since about 50% of households do not have proper fencing for their fields they were highly susceptible to losing a food crop to livestock. Growing of jatropha then reduced this vulnerability to losing crops due to it being browsed by livestock especially for the households with poor or no fencing at all for their fields.

Growing *Jatropha curcas* also had a positive impact on the vulnerability to economic trends such as the increase of prices for agricultural inputs. Since Jatropha requires minimum inputs of which in this case farmers were supplied by D1 Oils, it greatly reduced the burden of having to acquire inputs for growing crops.

5.5.2 Impact on Food Security

At country level most developing countries are net importers of food which is what Swaziland is. At household levels, 100% of the households that were interviewed are net buyers of their food especially maize which is a staple food for Swazis. This is attributed to the persistent drought which has been cited as a hindrance for households to grow their own food crops especially maize.

When asked about the impact growing *Jatropha curcas* had on their food security most interviewees said that the project could not have any negative impacts on households' food security because before they grew *Jatropha curcas* their fields were lying fallow for reasons of drought, destruction by livestock and also inputs being expensive. They also cited that they were able to intercrop jatropha with other food crops which meant growing *Jatropha curcas* did not mean complete displacement of food crops. These are some of their responses:

"... I had long given up on growing maize as it was not worth it because of the drought and I had tried growing legumes but had a problem of termites. Before growing jatropha my fields had been fallow for more than 5 years".

"...there is no problem of growing food crops with jatropha. I have been intercropping my jatropha trees with maize, groundnuts, spinach and sweet potatoes".

"... this project was going to give us money to be able to buy food as that is what we do. We buy maize from other people who come from areas where maize grows well".

Apart from its resistance to drought and foraging by livestock jatropha has been shown to be a tree crop that can be intercropped with other food crops. All the farmers present in the focus group discussion agreed that they were able to intercrop their jatropha with food crops such as sweet potatoes, spinach, groundnuts, maize and some legumes. They particularly cited the case of a lady farmer who had been able to intercrop with all such crops mentioned above that she was able to supply her domestic consumption and sell to the rest of the community. Literature however warns farmers that whatever food crop they intercrop *Jatropha curcas* with, should not be a host to *Jatropha curcas* diseases and pests (D1 Oils 2005).

It has however been also shown that jatropha can be a host to food crop diseases. Munch 1986 in Edje and Mngometulu (2005) states that studies have shown that *Jatropha curcas* should not be grown with cassava as it carries a cassava virus that can be transmitted to the cassava if they are grown in close proximity. Among the farmers who were interviewed but not present in the focus group discussion, there is one who is a widow said she grows cassava as well as *Jatropha curcas* in the same field. This lady asked if the researcher could help her since her cassava was dying from an unknown cause. Asked what the response of the local agricultural extension officers has been, she replied that she had made several calls to them asking for assistance but to no avail. They never came to have a look at her fields because that would allow them to see that her cassava was growing in close proximity with the *Jatropha curcas* which was quite likely to be the cause for her cassava plants dying. Unfortunately for her the extension workers from D1 Oils are no longer active after the company's operations were suspended. As much as this farmer cannot associate her cassava plants dying because of their close proximity with *Jatropha curcas* trees, this way, the *Jatropha curcas* is shown to be having a negative impact on food security for this household. This household uses the cassava for household consumption and some income generation.

From the point of view of these farmers, there was no way that growing *Jatropha curcas* impacted negatively to their food security. They instead spoke of its potential to enhance their food security through income generation that would enable them to buy their food as they are net buyers of food.

Literature has pointed out a possibility that growing of non-food crops for biofuels may have a negative impact on food security especially if they will displace the growing of food crops (UNCTAD 2006; Tripathi 2008). In their report, Yonge Nawe and ACAT Swaziland cited some farmers within the country saying that they stopped growing maize to grow jatropha because they were promised they will make lots of money from it. Whilst the researcher could not get a response to that effect in the study area of Mpaka, such a possibility is documented in literature that production of energy crops might be so attractive in terms of price ratios and income that it may induce the diversion of resources away from food crop production to crop production for biofuels thereby threatening food security (SADC 2005 in Jumbe, Msiska and Mhango 2007:16). This impact generally at country level was confirmed by the researcher talking to a person outside the scope of the research about the research who said:

"...the first time I heard about this jatropha was from my maid, who having gone home in the area of Mantambe (South of Swaziland), *came back expressing shock that she has found that her family and the people in her home area had abandoned growing maize to grow this jatropha she could not understand what it was all about since it was not food".*

Whilst this area was outside the scope of this research the comment confirmed what literature has pointed out about rural communities and their contexts and needs not being homogeneous and so are even households within the same community. This highlights the need for a regulatory framework at national and local levels since communities are not homogeneous and also to safeguard households from abandoning activities which seem unattractive because they seemingly do not contribute to income generation yet they contribute immensely to the food security or the well-being of the household. This brings the issue of energy crops having potential to compete for resources such as land, water and inputs with food crops which literature has pointed out leading to the need to look at the impact this project had on these parameters.

5.5.3 Impact on Land Use and Water

100% of the interviewees said they had used land which was allocated them to use as fields for growing crops. Having failed to grow other crops including food crops due to the circumstances described in subsequent sections (4.4.1), they used those same pieces of land to grow *Jatropha curcas.* So in the area of Mpaka there is no negative impact on land use as pointed out by some literature that growing *Jatropha curcas* for biofuels had a possibility of impacting negatively on land use in that even land that is considered as marginal and not suitable for crop production may be useful and important to the livelihood of rural people.

Such lands are said to benefit rural livelihoods by providing natural resources such as grasses used for thatching and weaving different handiwork for domestic and commercial purposes. They also provide fodder for livestock, timber for the construction of houses and other household necessities. This is feared to have the potential to bring total destitution and collapse of rural agro systems.

One of the interviewees, a widow who has just recently(2003) settled in the area of Mpaka said her portion of fields was not suitable for growing maize so she thought because *Jatropha curcas* was a tree crop it would be able to grow well where this other crop was failing. Her *Jatropha curcas* had indeed grown well. According to literature jatropha grows well even on poor or gravelly land not suitable for most arable crop production (Edje and Mngometulu 2005; Wood 2005).

Regarding the impact on water, analysis of the responses of the farmers suggests that *Jatropha curcas* had little impact on water resources as very little water was required per plant for a short period of time (330ml/plant for 4days a week over three weeks). With literature citing that a plantation set on waste or marginal land can support a minimum of 2000 productive trees per hectare (D1 Oil, 2006) this translates to about 7920 litres of water required to establish a hectare of *Jatropha curcas* plantation , thereafter the trees are rain fed. From observation the researcher did not see any plantation from the farmers interviewed which could have possibly had 2000 trees per plantation which is probably why the farmers could have felt that there was little impact on water resources. Their source of water being water holes that depend on rain, each farmer would require 27 of 25litre containers to be able to water a hectare of jatropha plantation

per day, which would mean many trips to the water holes which also supply water for domestic use and livestock for the households that do not have standpipes or the use of some form of transport if the household had many or big containers. Based on the fact that the area of Mpaka is charecterised by erratic rainfall and recurrent drought if more households would take the activity and establish 1 hectare plantations probably there would be a significant impact on their water sources which are dependent on rain as there are no running rivers or streams. However the farmers did not cite this significance as they all said they had had sufficient water to water their plants.

5.5.4 Impact on Capacity

On this aspect the research focused on education especially on *Jatropha curcas* for the growers of this crop. That is because literature had shown that "through the creation of local economic linkages and circulation of knowledge, skills, and resources, livelihood intensity may be increased in an area" (Scoons 2005:10). The farmers in the community of Mpaka expressed that the education they were given on growing *Jatropha curcas* and its use was adequate. The lessons were only offered by D1 Oils. As a company interested in the processing of *Jatropha curcas* oil into biodiesel, it is not surprising that the content on the uses of *Jatropha curcas* was limited to what was in the interest of the company. This was evident in that when asked on other uses of *Jatropha curcas* apart from making biodiesel the farmers did not know any. This has resulted to a state whereby since the disappearance of D1 Oils, the farmers are not collecting the *Jatropha curcas* seeds; they let them fall on the ground as they do not know what else they can use them for since they do not have another market for the seeds.

In other African countries such as in Tanzania the oil is extracted at village level and is used for making soap for domestic needs and for selling whilst in Zimbabwe it has been documented that the monthly demand for *Jatropha curcas* oil for making soap is 2000L (Anon 1998 in Edje and Mngometulu 2005). The *Jatropha curcas* oil has also been shown to be effective against some pests for different crops such as maize, sorghum, potatoes, pulses and cotton (Edje and Mngometulu 2005). In the case of Mali the biodiesel is produced local communities to provide a local source of fuel for cooking and lighting (Jumbe, Msiska and Mhango 2007). Before the farmers can be able to exploit such opportunities on the use of the jatropha oil there is need for

capacity building in the form of education and a paradigm shift in terms of the model which was being used in the project.

When respondents were asked about receiving any form of assistance from other sources such as NGOs or Government they responded to the contrary. D1 Oils signed a memorandum of understanding with World Vision a NGO that is involved with rural development but it was not active in the community of Mpaka. The NGO or even government through its agricultural extension officers would have moderated the biases in terms of the content of the education on *Jatropha curcas* so that it is balanced and possibly captures a wide range of aspects on the crop. The biases and limitations of the content of what was taught to the farmers were evident as one farmer did not know that she could not plant *Jatropha curcas* and cassava in close proximity, so she planted these two crops in the same field and now her cassava is dying. This also evident in that the farmers do not know what else *Jatropha curcas* could be used for other than making biodiesel.

The other aspect where the farmers needed capacity building was in the aspect of the agreement forms. The forms are written in English with some legalese. Whilst the farmers said they were taken through the agreement form before signing it, 71% could not recall what the consequences of breaching the agreement were. The others said there was nothing they knew was said would be a consequence of breaching the agreement.

Whilst it is true according to the agreement that none of the parties would be liable for any failure to fulfil its obligations if and to the extent that the failure is caused by circumstances beyond its reasonable control including but not limited to flood, fire, earthquake, war, tempest, hurricane, industrial action, government restrictions, or acts of God (D1 Oil Supply Agreement Form) the respondents were not certain. If after sixty days the other party is unable to fulfil its obligations the other party is expected to write a notice of terminating the agreement in its sole discretion. The farmers could have utilized that to terminate their agreement with D1 Oils so that they could seek ways of generating income from the activity independent of D1 Oils.

Whilst the activity of growing Jatropha curcas improved the farmers capability in terms of education in that they got to know about a new crop (plant), an alternative source of fuel, it was biased and not adequate as it was only offered by D1 Oils hence it did not offer balanced

information on the crop.

5.6 Summary

This chapter presented the discussion on the results of the research in light of the livelihood framework and the literature regarding growing of *Jatropha curcas* and the objectives of the research. The following chapter will outline the conclusions that can be drawn from the results and discussions.

CHAPTER 6: CONCLUSIONS

6.0 Introduction

This study was to assess the impact growing *Jatropha curcas* for biofuels has had on the livelihoods of rural households which were involved in the activity in the area of Mpaka in Swaziland. The study was stimulated by the growing interest on biofuels internationally and the impact it had shown at global level which prompted questions on how it was impacting on livelihoods at household levels especially in developing countries. To answer this research question, the key findings were presented in the preceding chapter and the outcomes were compared with the findings from literature which informed expectations. In this chapter the summary of key findings are presented and a number of conclusions drawn. Also presented are the recommendations for the different stakeholders. In addition, there are suggestions on further research and how this research would have been possibly improved.

6.1 Summary of Key Findings and Recommendations

To be able to tackle the research question, the study had a number of sub-objectives namely: to describe the project of growing *Jatropha curcas* for biofuels in the Mpaka community thus identifying the relevant stakeholders; describe the vulnerability context of the households within the Mpaka community through effective measurements that are able to account for the livelihood conditions of the households; identify the range of assets , activities and capabilities that create the different livelihood strategies for the different households and how they have been effectively used in growing *Jatropha curcas* and with what outcomes in terms of food security, reduction of vulnerability and income generation; determine the effect policies and institutional conditions, within which the households livelihood and growing of *Jatropha curcas* are shaped, have had on the outcome of the activity; and describe what the stakeholders view of growing *Jatropha curcas* is as a development project in terms of how it has addressed their desired outcomes and ways in which they think that can best addressed.

6.1.1 Description of the Project of Growing *Jatropha curcas* at Mpaka

The government of Swaziland made an effort to follow the advice of taking precautions before embarking on the industry of biofuels, as all the SADC countries had been called to(RHVP 2007), by commissioning the bio-energy feasibility study through SWADE in August 2005 which, in May 2006, appraised feasibility of producing biodiesel. This was followed by the drafting of the Bio-Energy Strategy and Action Plan for Swaziland by the government through the Ministry of Natural Resources and Energy, however before the strategy and action plan were in place, in April 2006 the government through the Ministry of Enterprise and Employment signed an MOU with an investor on biofuels, D1 Oils Swaziland, a company incorporated in the Kingdom of Swaziland which was based on growing *Jatropha curcas* as feedstock for processing into biodiesel. Whilst the government of Swaziland was cognisant of the fact that caution and proper planning had to be taken before getting into the biofuels industry it would seem it was under pressure to get into the industry of biofuels sooner and hence could not wait for the completion of the preparatory stages or there was lack of coordination between the different government ministries. Therefore the company D1 Oils began its operations immediately after signing the MOU with the government.

When the project started getting bad publicity as the two NGOs, Yonge Nawe (Friends of the Earth) and Africa Co-operation Action Trust (ACAT) raised issues concerning the growing of jatropha and the way D1 Oils was dealing with farmers amongst other issues, the government could not defend the project and itself which resulted in the suspension of further plantings on April 2008 pending the carrying out of a Strategic Environmental Assessment for growing *Jatropha curcas*, after acknowledging through the Ministry of agriculture that before the project was undertaken there was no Environmental Impact Assessment undertaken on growing *Jatropha curcas*. For reasons that the researcher could not establish, the investor lost interest on the project and closed operations in Swaziland leaving the poor farmers in rural areas uninformed and disempowered.

New approaches to rural development emphasize the importance of macro-level policy and institutions on the livelihood options of local communities and individuals, including the

very poorest. They also stress the need for higher-level policy formulation to be based on insights gained at the local level (Carney 1999). It was noted in the terms of reference (TOR) that were given to the consultants that were to carry out the feasibility study for biofuels for the country of Swaziland that there was no provision for consultation with rural communities to find out how they think such a development may affect their livelihood options so that the policies pertaining to the biofuels industry would be developed in such a way that they give maximum possible benefit from such developments to the rural households as advocated for in rural development (Jumbe, Msiska and Mhango 2007).

Knowledge of rights and information about the way government functions has been observed to be lacking in rural areas (Carney 1999). This, according to Carney (1999), makes it hard for rural communities to exert pressure for change in systems which have often discriminated against them. Before the conclusion to stop further plantings of *Jatropha curcas* in Swaziland, the communities were again not consulted and neither was there any consideration shown in terms of how such a verdict would ultimately impact on the livelihood of the households that had been involved in the activity. Even after so much time has passed since the verdict was passed in parliament, government has not made an effort to get to the grassroots to address the rural communities about how and why such a decision was taken, what the implications of such a decision were to the rural community members who were involved in the project and what possible options were available to them.

There has been no recognition of the investment in terms of time, effort and resources that the households had put into the activity of growing *Jatropha curcas*, hence why they were not even considered as stakeholders worth consulting in coming up with such a decision or even addressing after the developments. In the meantime the farmers do not have information and they do not know how they may obtain it and stated by literature they have not mobilised to seek for answers either. It is recommended that the government through the relevant ministries addresses the farmers at grassroots level on the state of affairs concerning the project.

The bad publicity that the project was subjected to was exacerbated by the fact that government gave D1 Oils a go ahead with its project without the carrying out of an Environmental Impact Assessment (SIPA Interviewee). Because this procedure had been overlooked or not enforced in

order to comply with existing legislature, it was difficult for the company (D1 Oils) to defend itself from the allegations that were levelled against it and against the plant *Jatropha curcas* by the two NGOs Yonge Nawe and Africa Co-operation Action Trust (ACAT) Swaziland. It was also difficult for the government to act in a way that would be contrary to the existing requirements that are provided for by the existing legislature.

There is need for proper coordination of the offices for investment promotions and the other government ministries and departments. As pointed out in the results, clear institutional arrangements and clear coordination mechanisms are critical policy issues that ought to be addressed to reduce institutional conflict and even duplication of efforts. Sasovele (2010) pointed out that bioenergy development projects are projects that go beyond the energy sector and as it has been proven in the case of Swaziland they even go beyond the sector of enterprise and employment, calling for their development and decision making process to be a process that involves all relevant sectors and stakeholders including NGOs.

Proper enforcement of relevant legislature and regulatory requirements to protect poor rural populations who are powerless and protect government itself from such an embarrassing situation where it had contradicted itself through its different organs losing the confidence of the investor and risking loss of confidence by its own citizens. The EIA process is a process which would have allowed all stakeholders to present their views and fears about the activity of growing *Jatropha curcas* before the commencement of the D1 Oils Swaziland's project during the scoping.

A sense of accountability and duty of care is important to all the sectors and departments which are stakeholders in development projects especially when a new technology is to be introduced to rural areas where there is a relative lack of knowledge and capacity to acquire it. None of the households had a computer which obviously means no internet connectivity showing a huge limitation to independent knowledge acquisition.

The government ought to also streamline its operations with current trends in theory and practice of development and also utilise the expertise within non-governmental organisations that are involved in rural development especially in projects that are to involve rural populations if it has to realise objectivity and positive contribution towards poverty eradication and the other

millennium development goals.

6.1.2 Vulnerability Context of the Households in Mpaka

The Area of Mpaka is found within a livelihood zone which the Swaziland Vulnerability Assessment Committee has described as zone that is characterized by erratic rainfall accompanied by long dry spells of heat. Households are vulnerable to famine due to recurrent drought which has been shown to affect 91% of the households in their ability to provide adequate food. More than half of the households are not able to provide proper fencing for their fields and even their homes making them vulnerable to loss of food crops through animals browsing on the crops.

Whilst most of the households did not exhibit indicators to vulnerability to diseases that reduce their capacity to carry out household activities especially diseases such as tuberculosis, HIV and Aids, single parenting especially by women was recorded in more than half of the households. This made these households vulnerable to theft of assets such as poultry and general lack of power.

The households (100% of those interviewed) in the area of Mpaka are net buyers of their food and therefore are greatly and negatively affected by higher food prices irrespective of whether they adopt biofuel crop production or they don't. This makes them vulnerable to shocks brought by economic trends such as an increase in food prices.

The existing agro-ecological conditions and capacity in terms of assets for a majority of the households do not support the growing of food crops especially maize which is a staple food for the households to be able to feed themselves confirmed that on average its consumption was seven out of seven days. Most of the households (58%) depend on petty businesses mostly carried out by the women to generate income that enables them to buy food, pay for the education of the children, get medical assistance and fulfil all the fiscal needs of the household. Of the 58% that depend on petty businesses that constitutes 80% of the widows and 57% of the single parent headed families that are headed by women. From these results most of the farmers are women who bear the responsibility for meeting the daily needs of household members particularly dependent children and elderly (Morrow 2000) and have been shown to have less

power. For these women the project of growing *Jatropha curcas* presented an opportunity that they greatly welcomed as it had the potential to allow them to generate more income without a huge capital investment and less maintenance as they largely depended on petty businesses for buying food and sustaining their households. As shown in literature food security and nutrition were also largely dependent on the household's acquisition and allocation behaviour in terms of fiscal resources (Pinstrup-Andersen 2008). The households with relatively large numbers of household members and school going children showed some coping strategies which included less meals consumed per day and also the composition of their food was relatively monotonous and greatly dependant on what they produce.

Growing *Jatropha curcas* for biofuels did not require a lot of assets from the household as even the poorest of the household with very few reproductive assets were able to partake in the project. Competition between food crops and *Jatropha curcas* for resources including land was minimal as it was shown in 8.3% (one out of twelve) of households and may also have been a result of ignorance resulting from the biases in the training on *Jatropha curcas* that was offered by D1 Oils.

The project of growing *Jatropha curcas* did not give the desired outcome of income generation as described by the respondents that they engaged in the activity because it was within their capacity so they could generate income for buying food, paying for the education of their children and grandchildren, as a retirement project to feed themselves with during old age and for the general welfare of the household. As much as it ultimately did not give the income, it showed a potential to impact positively on the livelihood of the households as it reduced their vulnerability to lose a whole crop due to drought. The trees of jatropha, as according to literature, are drought tolerant. The households reported that it did not require much watering as each plant was given about 330ml(cool drink can) of water three times a week until they were established which they said took between two and three weeks.

The *Jatropha curcas* crop also greatly reduced their vulnerability to losing a crop because of livestock browsing on it. Since most households could not afford to have proper fencing for their fields, jatropha grew relatively well except that livestock broke branches off the trees as they scratch themselves against the trees which was feared, would reduce the yield of the jatropha

seeds significantly.

Having little to do in terms of on-farm activities, because of the prevalence of drought and *Jatropha curcas* being of low maintenance, growing *Jatropha curcas* did not impact negatively on the availability of labour within the Mpaka households. Maintenance of the *Jatropha curcas* plantations was also made easy through intercropping as it kept weeds at minimum and also improved the food security of the household.

6.2 Policy and Institutions within which Livelihoods are Shaped and their Effect

The project of growing *Jatropha curcas*, as well put by Jumbe, Msiska and Mhango (2007:21), was in Swaziland "strangled to death the even before its full potential was realised" for the country. This is because the project did not have a niche. This was a new technology and as such needed to be provided with a proper environment in all aspects which would give the technology an opportunity to develop and mature through gradual experimentation and learning by actor networks of producers, researchers, users, government and other organizations (Sal and Dewes 2009). There was need for a proper foundation of proper policies and institutions to have been established including the development of a model how the country wants to run its biodiesel project. That is whether it will start as a local consumption project as is the case in Mali and grow or it will be for export purpose in which case describe what shall be exported , the commodity (unprocessed seeds or oil) or it would be all processed within the country and biodiesel be exported.

Whilst the production of raw materials for biofuels is an opportunity to diversify agricultural production, for developing countries it is important that proper investigation is made on all possible issues that the production of such materials may give rise to. For production of a feedstock such as *Jatropha curcas* which is an agro-forestry crop that takes time before income generation is realised, 11/2 to 3 years, there is a need to introduce other income generation activities to sustain livelihoods during that period. One way which has been used is to promote various food crops that can be intercropped with the trees. This must be done in accordance with the needs, capacities, existing agro-ecological conditions, existing farming practices, and

household knowledge, skills and labour available.

NGOs and Government should have formed partnerships with D1 Oils (private sector) to ensure balance on the quality of capacity building for the farmers and government officers that are deployed in these communities so they could be of assistance. There should also be a recognition and use of institutions that have the capacity to carry out research in an objective manner and provide reliable information such as the University of Swaziland, the Malkerns Research Centre and other similar institutions. This is critical when other activities to sustain livelihoods during the gestation period of the energy crops such as intercropping are introduced, to avoid cases such as the one of the farmer planting *Jatropha curcas* and cassava in close proximity resulting in a negative impact on the livelihood of the household.

Overall the finding was that the farmers at Mpaka who had grown *Jatropha curcas* still perceived it as a crop with a great potential for their area which is drought stricken with unemployment and other socio-economic conditions restricting the choices they have for making a livelihood, if they could find a market for the *Jatropha curcas* seeds.

The recommendation is that there is need for the farmers who grew *Jatropha curcas* to be empowered through training on other uses of jatropha oil which may give them an income such as the soap and candle making. Most of the farmers are women who bear the responsibility for meeting the daily needs of household members, particularly dependent children and the elderly (Morrow 2000) and are also dependant on petty businesses for income generation. Diversification of their products through soap and candle production would improve their income generation activity. Whilst literature has shown that there is possibility that income generated through cash crops may be diverted from buying food for the household and used for other purposes leaving the household food insecure, in this case whereby the farmers of jatropha are women who are the ones usually faced with burden of providing food for the family on an everyday basis it is hoped they would want to ease themselves and use the money obtained to improve the food security of the households.

6.3 Improvements to Methodology

The findings made and conclusions made on the impact of growing jatropha to the livelihood of

the households at Mpaka are at best limited to this community. This is because other communities in other regions of the country may be in a different context with different agro-ecological conditions and therefore it would be expected that the outcome of the research would be different.

As an evaluation research it would improve the quality of the findings to have included quantitative measurements whereby the amount of *Jatropha curcas* seeds obtained by the different farmers relative to the area planted under the said conditions of Mpaka would be measured to evaluate the economic viability of the project. There is evidence that evaluators are increasingly adopting diverse methods in tackling evaluation problems (Clarke and Dawson 1999). Mixed method research designs in some cases integrating quantitative and qualitative methods, are now an established feature of programme evaluation research and policy evaluation studies (Clarke and Dawson 1999: 86).

6.4 Further Research

It is difficult to have a complete study within the confines of time and budget. Further research would be suggested in the area of policies, institutions and governance in Swaziland together with government departments that are currently regulating the biofuels industry in Swaziland.

The other area of study would be to include the farmers that were not involved in growing *Jatropha curcas* to include their perspective especially in defining the vulnerability context of the community of Mpaka and to explore the possible role of local government (Authorities of the area) in influencing macro-level governance.

6.5 Summary

This chapter was a presentation of how the data gathered and synthesised, complemented by literature addressed the objectives of the study by describing the key findings and making recommendations based on these findings. It also outlined how the methodology can be improved and what further research may be carried out based on this study. It is hoped that this study, by highlighting how growing *Jatropha curcas* for biofuels has impacted on the livelihoods of the rural households of Mpaka in Swaziland and discussing the factors which have led to this outcome, will influence the way that governments at macro-level take decision, especially the

timing involved. It is hoped that it will also influence the way regulatory mechanisms are enforced as the study has shown that even an investment initially perceived as having potential to improve the livelihoods of those who stand to benefit from it, may end up disadvantaging them if the proper environment of policies and institutions is non-existent and the necessary spadework is not carried out on time.

References:

Adams M., S.Sibanda and S. Turner. 1999. *Land Tenure Reform and Rural Livilihoods in Southern Africa*. London: Overseas Development Institute.

Adato M. and Meinzen-Dick R., 2007. *Agricultural Research, Livelihoods and Poverty: studies of economic and social impacts in six counties.* Washington D.C. International Food Policy Research Institute (IFPRI).

Alcamo J., D. van Vuuren, C. Ringler, W. Cramer, T. Masui, L. Alder, and K. Schulze. 2005. Changes in Natures Balance Sheet: model-based estimates of future worldwide ecosystems services. *Ecology and Society* **10** (2):19. Resilience Alliance. [online] at http://www.ecologyandsociety.org/vol10/iss2/art19 accessed 12 February 2009.

Anfara V. A, Jr and Mertz N. T. 2006. *Theoretical Frameworks in Qualitative Research.* London. Sage Publications Ltd.

Ashley C. and Carney D. 1999. *Sustainable Livelihoods: Lessons from early experience.* U.K. Department for International Development (DFID).

Babbie E. 1986. *The Practice of Social Research.* California. Wadsworth Publishing Co.

Bless C, Higson-Smith C and Kagee A. 2006. *Fundamentals of Social Research Methods- An African Perspective.* Cape Town. Juta and Co. Ltd.

Bulletin. 2007. *Draft Action Plan for Biofuel Development in Africa in:* The First High Level Biofuel Seminar In Africa. International Institute for Sustainable Development [on line] at www.unudo.org/fileadmin/user_media/.../Draft_Action_Plan.pdf accessed 28 March 2008.

Burley, H. and Griffiths H. 2009."*Jatropha: Wonder Crop? Experiences from Swaziland".* A Report Prepared for Friends of the Earth.

Brinkhoff T. 2009. Swaziland: Districts & Urban Centers- Statistics and Maps on City Population [online] at http://www.citypopulation.de/Swaziland.html accessed 15 February 2009

Caniëls M. C. J and H.A. Romijn. 2006. Strategic Niche Management as an Operational Tool for Sustainable Innovation: Guidelines for Practice. Eindhoven University of Technology, Netherlands. [Online] http://www.ounl/Docs/Faculteiten/MW/MW%20Working%20Papers GR% 2006-03%20Caniels%20en%20Romijn%20maart%20.pdf accessed 14 March 2009

Carney D. 1999. *Approaches to Sustainable Livelihoods for the Rural Poor.* London. Overseas Development Institute [online] at publications@odi.org.uk accessed 12 February 2009

Carr M (ed). 1991. *Women and food security*: *The experience of the SADCC countries*, Intermediate Technology Publications, London.

Central Statistics Office Swaziland. 2010. *2007 Population and Census Report.* Swaziland. Government.

Central Statistics Office Swaziland (CSO). 2007. *Swaziland Demographic and Health Survey 2006-2007*. Ministry of Economic Planning and Development. Mbabane.

Chambers, R and Conway, G R. 1991. *Sustainable Rural Livelihoods: practical concepts for the 21st century.* London. Institute of Development Studies.

Chaudhuri S., J. Jalan and A. Suryahadi.2002. *Assessing Household Vulnerability from Cross Sectional Data: A Methodology and Estimates from Indonesia.* Discussion Paper. Columbia University.

Clarke A and Dawson R. 1999. *Evaluation Research: an introduction to principles and methods of practice.* London. Sage Publications Ltd.

Cloin J., R Rivalland, M Wilson and F Yamba. 2007. *Biofuels:ACP's Response to fossil fuels dependence*. Workshop Paper, Wageningen. The Netherlands.

Cross C. 1998. 'Rural land tenure reform: Surrounded by hungry allocators'. *Indicator*. Vol.4, No.2. Durban: University of Natal.

da Silva L. May 31, 2007. *Brazil Does It Better* [online] at http://commentisfree.guardian.co.uk/lula_da_silva_2007/05/the_challenge_of_sustainable_d.html accessed 3 March 2008

Department of Minerals and Energy. 2007.Biofuels *Industrial Strategy* of *the Republic of South Africa*. South Africa.

de Satge´ R. 2002. *Learning about Livelihoods: Insights from Southern Africa.* Peri Peri Publications/Oxfarm Publishing. South Africa/ U.K.

D1 Oils (undated) [online] at http://www.d1africa.com/aboutHistory.php. accessed in 20 May 2008.

D1 Oils (undated). *Biodiesel, Fuel that doesn't cost the earth*. D1 Oils Africa. Johannesburg.

D1Oils. 2005. *Growing Jatropha Curcas*. D1 Oils India. New Delhi.

D1 Oils. 2007. *Biofuels Task Team Meeting*. D1 OilsSwaziland. Mbabane

Dlamini B. 2010. SD's Unemployment Rate Rises to Over 40%.*Times of Swaziland.* 12 November. p.2-3.

Dufey A. 2006. *Biofuels Production, Trade and Sustainable Development: emerging issues.* International Institute for Environment and Development. London.

Edje, O. T and Mngometulu. 2005. Jatropha: The Plant That Produces Diesel Oil in: Edje, O.T (ed in chief). UNISWA Journal of Agriculture. Swaziland. UNISWA.

Ellis F. and S.Biggs. 2001. 'Evolving Themes in Rural Development 1950s-2000s', *Development Policy Review*, Vol. 19, No.4, pp.437-448 [online] www.ruta.org:8180/xmlui/bitstream/handle/...1542/RN76.pdf?.../ accessed on 14 February 2009.

Food and Agriculture Organisation (FAO). 1996. *Declaration on World Food Security*. World Food Summit. FAO. Rome.

Farrington J., D. Carney, C. Ashley and C.Turton. 1991. *Sustainable Livelihoods in Practice: Early Applications of Concept in Rural Areas in* Natural Resource Perspectives.Institute of Development Studies. London. [online] www.odi.org.uk accessed on 6 March 2008.

Forsyth-Thomson C. 2011. *Swaziland*. Swaziland Tourism Information Office. Swaziland

Fulton L., T. Howes and J**.** Hardy. 2004**.** *Biofuels for transport: an international perspective*. International Energy Agency (IEA).Paris.IFRI

Gannon S. 2009. *Rewriting "the Road to Nowhere". Place Pedagogies in Western Sydney*. University of Western Sydney. Australia. [on line] accessed October 2011.

Haines R. 2000. Development Theory in *Introduction to development Studies.* Oxford. Oxford University Press.

Hill T. H. and T. Birch-Thomsen. 2005. Theoretical Background in: Traynor Catherine H(ed). *The SLUSE Model of Natural Resource Management: From Theory to Practice through field based training-Experiences from Southern Africa*. South Africa. SACUDE_SLUSE.

Hoogma R., R. Kemp, J. Schot and B. Truffer. 2002. *Experimenting for Sustainable Transport. The Approach of Strategic Niche Management*, London: EF&N. [online] books.google.com/book? isbn=0415271177

Hussein K. 2002. *Livelihoods Approaches Compared: A Multi-Agency Review of Current practice.* London. Department for International Development (DFID). [online] at www.eldis.org accessed in 12 February 2009.

International Food Policy Research Institute (IFPRI).2002. Fighting famine in Southern Africa. Steps out of the Crisis. Washington D.C . [Online] at http://www.ifpri.org/pubs/newsletters/ifpri.forum.accessed 13 February 2009.

Jhamtani H and E. Dano. 2007. Biofuels: The illusion and the reality in: *Third World Resurgence. 200:* 6-10.

Jumbe C., F. Msiska and L. Mhango. 2007. Report on National Policies on Biofuels Sector Development in Sub-Saharan Africa. Food Agriculture and Natural Resources Policy Analysis Network(FANRPAN)For the COMPETE(Competence Platform on Energy Crop and Agroforestry Systems for Arid and Semi-arid Ecosystems-Africa) Work Programme No. 6 – Policy Development[Online] http://www.fanrpan.org/documents/d00462/COMPETE_National_Policies_Biofuels_Dec2007_draft.pdf. accessed 3 March 2008.

Kammen D. M., K. Kapadia and M. Fripp. 2004. *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* RAEL Report, University of California, Berkeley. [online] http://socrates.berkeley.edu/~rael/papers.html accessed 13 February 2009.

Katembo B.I.M and P.S Gray. 2007. *Africa, Jatropha Seeds and Biofuel.* Research Paper. Conference Presentation.

Kemp R., J.Schot and R. Hoogma. 1998. 'Regime Shifts to Sustainability through Processes of Niche Formation: the approach of strategic niche management' *Technology Analysis and Strategic Management* 10(2) pp.175-196

Lerise S F. 2005. *Politics in Land and Water Use Management: Study in Kilimanjaro, Tanzania.*Dar es Salaam,Tanzania. Mkuki na Nyota Publishers. Ltd.

Levin R. 1997. *When the sleeping grass awakens: Land and power in Swaziland*. Johannesburg: Witswatersrand University Press.

Long F.J. and Arnold M.B.1995.*The power of Environmental Partnerships.* United States of America. Harcourt Brace College Publishers.

Magagula S.D.M, E.V Dlamini and E. M. Mkhwanazi. 2001. Agriculture in Swaziland. In Macdold Ann(Ed) *Modern Agriculture for Swaziland.* South Africa: Oxford University Press

Ministry of Natural Resource and Energy (MNRE). 2007. *Draft Swaziland National Biofuels Development Strategy and Action Plan*. Swaziland Government.

Ministry of Natural Resource and Energy (MNRE). 2009. *Report on Community Consultations on Biofuels for the NBDSAP*. Swaziland Government

Ministry of Natural Resource and Energy (MNRE). 2010. *Swaziland National Biofuels Development Strategy and Action Plan*. Swaziland Government.

Misselhorn A. A. 2004. What drives food insecurity in southern Africa? A meta-analysis of household economy studies. School of Geography, Archaeology and Environmental Sciences, University of the Witwatersrand, South Africa. [online] www.sciencedirect.com . Accessed 2 September 2010.

Moseley W.G and I. B. Logan. 2004. *African Environment and Development.*
England. Ashgate Publishing Limited.

Morrow B. H. 1999. Identifying and Mapping Community Vulnerability in *Disasters ODI.* Oxford. Blackwell Publishers.

Mtshali P. 2010. Is grass a staple food in Swaziland? *Farmers Weekly*. 29 January, p. 78.

Nabi N., S. Akhter and F.K.M Islam. 2007. *"Prospects of Biodiesel Production from Jatropha Curcas, a promising non-Edible oil seed in Bangladesh"* Department of Mechanical Engineering. Rajshahi University of Engineering and Technology. Rajshahi.

Pinstrup-Andersen A. 2008. Food Security: Definition and Measurement. Cornell University. USA.

Rajagopal D and D. Zilberman. 2007 Review of environmental,economic and policy aspects of biofuels policy *ResearchWorking Paper Series 4341*. The World Bank.
[Online] http://econ.worldbank.org. Accessed 12 February 2009.

Raswant V., N. Hart and M. Romano. 2008. *Biofuel expansion: challenges, risks and opportunities for rural poor people. How the poor can benefit from this emerging opportunity*. IFAD, Rome .

RHVP. 2007.*Biofuel Production and the Threat to South Africa's food Security*. Wahenga Brief Number 11. [online] www.wahenga.net Accessed 12 February 2009.

Rose D. and Charlton K.E. 2001. Prevalence of household food poverty in South Africa: Results from a large, nationally representative survey. South Africa. University of Cape Town.

Rosegrant MK, X. Cai, S.A. Cline. 2002. World Water and Food to 2025. Washington (DC): International Food Policy Research Institute. [Online] www.ifpri.org/pubs/books/**water2025/water2025**.pdf Accessed 12 February 2009.

Sasovele H. 2010. Policy Challenges Related to Biofuel Development in Tanzania in *African Spectrum*. Germany. Hamburg University Press. [Online] at www.africa-spectrum.org Accessed 14 June 2009

Salé N.A.C. and H. Dewes. 2009. *Opportunities and challenges for the international trade of Jatropha curcas-derived biofuel from developing countries*. African Journal of Biotechnol, 8(4): 515-523. [online]www.academicjournals.org/AJb/.../abs2009/...Sale%20and%20Dew...

Seckler D., D. Molden and R. Barker. 1998. *Water Scarcity in the Twenty-First Century*. Water Brief 1, International Water Management Institute, Colombo, Sri Lanka: IWMI.

Scoons I. 2005. *Sustainable Rural Livelihoods: A framework for Analysis*. U.K. Institute of Development Studies.

Shongwe F. 2006. *Bio-Energy study affirms viability of producing bio-energy locally* in the Times of Swaziland. June 12, p16.

SWADE. 2006. *Bio-Energy Feasibility Study*. Farming for energy project-F013.SWADE. Swaziland.

SWADE. 2012. *LUSIP II Draft Feasibility Study Report, Water Supply and Sanitation*. Swaziland . SWADE.

Tripathi S. 2008. *Social Impact of Biofuels in India*. Indira Ghandi Institute of Development research. [Online] http://ssrn.com/abstract///3994. Accessed 2 March 2009.

United Nations Conference for Environment and Development (UNCED).1992.*The Global Partnership for Environment and Development. A guide to Agenda 21*. Geneva.

United Nations Conference on Trade and Development (UNCTAD). 2006. *Challenges and opportunities for developing countries in producing biofuels* [online] at UNCTAD/DITC/COM/2006/15 accesed 11 February 2009

United Nations Development Programme. 2007. Sustainable Energy: A Framework for Decision Makers. UN-Energy.

Urgate D. and G. de la Torre. 2006. "Developing Bioenergy: Economic and Social Issues," in *Bioenergy and Agriculture: Promises and Challenges*, International Food Policy Research Institute. [Online] at http://www.ifpri.org/sites/default/files/publications/focus14_02.pdf accessed 11 February 2009.

van der Laak W. W. M., R. P. J. M. Raven and G. P. J Verbong. 2007. Strategic niche management for biofuels: Analysing past experiments for developing new biofuel policies. *Energy Policy*, Vol. 35**,** pp.3213-3225.

van Eijk J. and H. Romijn.2006. Prospects for Jatropha biofuels in developing countries: an analysis for Tanzania with Strategic Niche Management, 22 p. [online] http://fp.tm.tue.nl/ecis/Working%20Papers/Ecis%20wp151.pdf accessed 12 February 2009.

Van Rensburg, J.E. 2002.*Environmental Education Ethics and Action in Southern Africa*. Pretoria. Human Sciences Research Council.

Vulnerability Assessment Committee Swaziland. 2006. *Swaziland Annual Vulnerability Assessment & Analysis Report*. Swaziland. Government.

Vulnerability Assessment Committee Swaziland. 2009. *Swaziland Annual Vulnerability Assessment & Analysis Report*. Swaziland. Government.

Vulnerability Assessment Committee Swaziland. 2010. *Swaziland Annual Vulnerability Assessment & Analysis Report*. Swaziland. Government.

Welman C., S. Kruger and B. Mitchell. 2005.*Research Methodology*. South Africa. Oxford University Press South Africa.

Wiesenhütter J. 2003. *Use of the Physic Nut (Jatropha curcas L.) to combat desertification and*

reduce poverty. CCD Project Document.

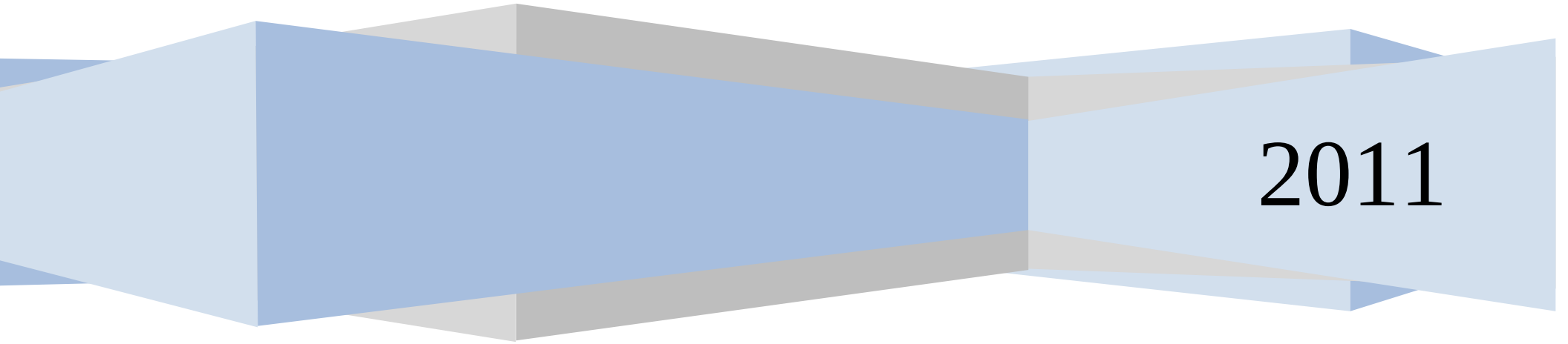
Bonn, GTZ. [online]www.fao.org/docrep/012/i1219e/i1219e04.pdf accessed 8 March 2008.

Wood P. 2005. *Refocus*. Out of Africa: Could Jatropha vegetable Oil be Europe's biodiesel feedstock? ScienceDirect.Elsevier Ltd. [online] http://www.sciencedirect.com/science. Accessed 4 June 2009

World Food Programme (WFP). 2008. *Food Consumption Analysis*: *Calculation and Use of the Food Consumption Score*. Rome

Impact of Growing *Jatropha curcas* to the Livelihoods of Rural households in Swaziland

Interview Schedule for households participating in the activity



2011

Name of area:

Type of land tenure: Swazi Nation Land [ ] Title Deed Land [ ]

Is the head of House Hold (HH) an owner [ ] tenant [ ] or squatter [ ] in the area?

For how long have you been in this area?

Who is the head of household?										
Marital status of head of HH		Married civil [ ] Married SLC [ ] Consensual [ ] Divorced [ ] Separated [ ] Widow(er) [ ] Never married [ ]								
HH member	Age	Sex	Relation to HH head	For ≥3monthsdid you have any problem that prevented you from fully performing you duties within last 12 months?	What did you suffer from?	Did you get medical treatment? If not why?	Education: 1.non 2. Some primary 3.primary completed 4.some secondary 5.secondary completed 6. tertiary	School enrolment	(Absent for ≥week or dropped out) reason for absence	Parental status

Part 2: Vulnerability of household

1. How many adults are employed? [ ]
2. Has the household lost any of its members due to illness of ≥ 3 months in the past 12 months? Yes [ ] No [ ]
3. If yes,

Cause of death	Age	Sex	Position in HH

(Options for cause of death: 1. TB; 2. Illness of ≥3 months; 3.Short illness of < 3months; 4. Accident; 5 other)

(Options for position in HH: 1. Primary breadwinner; 2. Secondary breadwinner; 3.adult member; 4. Child member)

4. During the last 6 months has anyone from the HH left the village for at least one month and not returned?
   No [ ]; To Work [ ]; For School [ ]; To help other HH member [ ]; Marriage [ ]; To relieve Strain on HH [ ] Death of parent or caretaker [ ] other……

5. Did you experience any unusual situation during the past 12 months that affected the HH ability to provide itself, eat in the manner you are accustomed to or affected what the HH owned?

	Drought/irregular rains, prolonged dry spell		Theft of productive sources		Hailstones		Loss or reduction of employment for a HH member
	Unusually high level of livestock diseases		floods		Weeds and alien invasive plants (*Chromolaena odorata*)		Serious accident or illness of breadwinner
	Serious illness or accident of another member of HH		Unusually high level of crop diseases and pests		Reduced income		Insecurity/ violence
	Unusually high prices for food		Erosion		Unusually high cost for agricultural inputs		Eviction

6. Did the problem result: in loss or decrease in income in cash or in kind [ ], decrease or loss of assets or belongings [ ], create a decrease in HH's ability to have enough food [ ], other ?

……

7. What did the household do to manage the effects of shock?

……

8. Has the household recovered from the effects of the shock? No [ ] Yes [ ] Partially [ ]

Part 2: Food security

I would like to ask a few questions about food consumption in your HH.

1. How many meals did the adults have yesterday in this HH?[ ]

……

2. How many meals did the children have yesterday in this HH? [ ]
3. Is it usual at this time of the year? No [ ] Yes [ ]
4. Could you please tell me how many days in the past one week has the household eaten the following foods and what were the sources?

Food Item	No. Days eaten in last 7 days	Food source	Unit of measurement (Kg, g or number)	Quantity	Price
Maize					
Rice					
Bread					
Other cereals					

Roots /tubers					
Legumes(Beans, peas, groundnuts					
Vegetables and leaves					
Fruits					
Meat (domestic or wild)					
Poultry					
Fish					
Eggs					
Oil, fat, butter					
Sugar and sugar products					
Milk and milk products					

(Options for sources of food:1. Own produce; 2. Hunting, fishing or gathering; 3.Exchange (labour for food); 4. Borrowed; 5.Purchased; 6. Gift (family/friends); 7. Food Aid (UN, Gov't, NGOs)

5. In the past 30days, how frequently has your household resort to using the following strategies in order to have access to food?

Strategy	Never	Seldom(1-	Sometimes(1-	Often (3-6	Daily

		3days/month)	2 days/week)	days/week)	
Skip entire days without eating					
Limit potion size at mealtimes					
Reduce number of meals/day					
Borrow food or rely on help from family /friends					
Rely on less expensive or less preferred food					
Purchase or borrow food on credit					
Gather unusual types or amounts of wild food/ hunt					
Harvest immature crops (e.g. green mealies)					
Send HH members to eat elsewhere					
Send HH members to beg					
Reduce adult consumption so children may eat					
Rely on casual labour for food					

6. Have you sold any HH assets to buy food? No [ ] Yes [ ]

Part 3: Household and Productive Assets

1. How many of the following assets are owned by you or any other member of the household?

Chair		Radio		Stove		Vehicle		DVD/CD player		Harrow		Mobile Phones	
Table		Fishing equipment		Sickle		Hoe		Three legged pot		Plough		Satellite Receiver	
Bed		Canoes		Axe		Ox Cart		Hand Mill		Sewing Machine		Wheelbarrow	
TV		Computer		Panga		Tractor		Bicycle		Hammer Mill			

2. How many of the following animals does your household own?

Cattle [ ] Donkeys/ Horses [ ] Pigs [ ] Sheep/ goats [ ] Poultry [ ]

3. Have you sold or battered any cattle, sheep/goats in the past 3 months? No [ ] Yes [ ]
4. If yes why? No longer needed [ ] Pay daily expenses [ ] Buy food for HH [ ] Pay medical expenses [ ] pay social event [ ] pay school cost [ ] pay funeral [ ] pay debt [ ] other
   ……
5. Based on observation the house(s) are made of:

ROOF	FLOOR	WALL
Grass	Earth	Mud and poles
Corrugated iron	Dung	Stone
Asbestos	Wood	Grass
Tiles/Slate/concrete	tiles	Wood
Traditional hut	Cement	Cement bricks/ blocks
other	other	Corrugated iron
		Mud blocks

Part 4: Livelihood Activities

1. What are the HH main livelihood activities throughout the year and who participates in the activity?

Activity	Participant(s)	Decision Maker(s)

(Possible livelihood sources: Remittance, Food crop production/sale, Cash crop production/sales, livestock production/sales, Poultry production/sales, small business, petty trade, skilled labour, formal salary/wage, brewing, pension, vegetable Production/ sales, food assistance, other assistance/begging/gifts)

2. Who makes decisions on how to use resources from each of the activities?

   ……
   ……
   ……
   ……
   ……
   ……

3. Using the 'divide the pie' method or piling, what is the relative contribution of each of the activities?

   ……
   ……
   ……
   ……
   ……
   ……...

4. During the past 6 months has your HH received any of the following support from Family/friends? Food [ ] Money [ ] Clothing [ ] Agricultural inputs [ ]
5. During the past 3 months did you or any member of your HH borrow money? NO [ ] Yes [ ]
6. What was the primary reason for borrowing? To buy food [ ] pay healthcare [ ] pay funeral [ ] pay for social event [ ] buy agricultural inputs [ ] pay for education [ ] other [ ] ……..
7. From whom did you borrow? Friend/ Relative [ ] Money Lender [ ] Bank /formal lending Institution [ ] Informal savings group [ ]

Part 4: History of growing *Jatropha curcas*

1. How did you get to know about growing *Jatropha curcas*?
   .....
   .....
   .....
2. Please tell me more about the stages and the officers responsible during introduction to growing *Jatropha curcas*

officer	Organisation	No. of visits	Nature of visit	Place of visit

3. Did you participate or contribute in the formulation of the agreement form? Yes [ ] No [ ]
4. Were you taken (taught) through the agreement form before you signed it? Yes [ ] No [ ]
5. Who took you through the agreement form?

   ……
   ……
   ……
   .
6. What are the consequences of either party (yourself or D1 oils) breeching the agreement?

   .....
   .....
   .....
7. What did you use the piece of land on which you have now planted jatropha for in the past?.....
   .....
   .....
8. What other options of land use did you have for the piece of land on which you grow the jatropha?.....
   .....
   .....
9. Why was the option of growing jatropha taken?

   .....
   .....
   .....
10. What was the expected outcome from this activity?

    ……
    ……
    ……
    .

……
……

11. What has been the outcome?

……
……
……
…

12. Did the activity yield the desired outcome? Yes [ ] No [ ]
13. What are the factors you feel led to the said outcome?

……
……
……
……
……
……
……

Part 5: Growing jatropha

1. Does your household have access to any arable land? Yes [ ] no [ ]
2. What is the total land on which you grow *Jatropha curcas*?

   <0.5 ha [ ] 0.5-1 ha [ ] 1-2 ha [ ] 2 ha or more [ ]

3. What is the total area of land on which you grow other crops?

   <0.5 ha [ ] 0.5-1 ha [ ] 1-2 ha [ ] 2 ha or more [ ]

4. How do you acquire seeds/seedlings for growing *Jatropha curcas*?

   .....

5. What other inputs did you use in growing *Jatropha curcas*?
6. How did you acquire the inputs?

……
……
……
……
……..

7. What is the main source of draught power?
   Tractor [ ] Cattle [ ] Donkeys [ ] non [ ]
8. Would you give the estimated cost of inputs?
   ……
   ……
   ……

9. Who participates in the activity of growing *Jatropha curcas*?
   ……
   ……
   ……
   ……..

10. Do you have hired labour at any stage growing *Jatropha curcas*? Yes [ ] No [ ]

11. If yes, how much labour is required over what period?
    ……
    ……
    ……

12. How much income has been made from growing *Jatropha curcas*?
    ……

……

13. How has the income contributed to the livelihood of the HH?

……
……
……..

14. Would you recommend the activity to somebody else? Yes [ ] No [ ]

15. Why?.....
.....
.....

Part 6: Policies and institutions in Growing *Jatropha curcas*

1. Before engaging in the activity of growing *Jatropha curcas* you had to obtain permission of the chief in that he had to approve and sign for you in your agreement form do you know why that was done?

……
……
……
…….

2. How did you go about applying for such an approval?

……
……
…….

3. Were there any particular requirements you had meet in order for the chief to give such an approval that you can carry out the activity?

……
…….

4. How do you think such an approval affected your carrying out of such an activity?

.....
.....

……
……
……

5. Are there any conditions that were set by the Chief (authorities) of the area within which you carry out the activity of growing *Jatropha curcas*?

……
……
……
……
……

6. Is there any contact person from the authorities of your area through which you can take your concerns and issues regarding the growing of *Jatropha curcas*?

……
……
……
……
……

7. Is there any assistance you have received in growing *Jatropha curcas* from government [ ] NGO [ ] D1 Oils [ ] other[ ]

Source of assistance	Nature of assistance	Frequency of assistance

8. Would you say assistance was adequate [ ] inadequate [ ] lacking [ ]?
9. Would you have any other comments concerning the growing of *Jatropha curcas*?

.....
.....
.....
.....
.....
.....
.....

Appendix B

List of interviewees

1. Farmers of *Jatropha curcas* at Mpaka
2. D1 Oils' officers
3. Constituency headman
4. SIPA officers
5. MNRE officer

APPENDIX C

TERMS OF REFERENCE FOR SWADE FEASIBILITY STUDY

The government of the kingdom of Swaziland through the Swaziland Water and Agricultural Development Enterprise (SWADE) commissioned a bio-energy feasibility study in August 2005. The consultants were tasked with the following terms of references:

Task 1: bioenergy production whereby they had to provide an overview of the macroeconomics of the whole production process of agriculture crops-both food and energy crops- which would serve as feedstock for the Farming for Energy Project in Swaziland and production of biofuels and cogeneration opportunities.

Assess the agricultural potential of the various food and energy crops suitable for biofuels production, in particular biodiesel production by evaluating agricultural suitability of various feedstock for biofuels. These were to include soya beans, *jatropha*, and African palm oil for biodiesel whilst for ethanol it would include sweet sorghum, sugarcane/ molasses, maize and cassava. Perform a rapid assessment to identify the potential crops most suitable for use in the context of Swaziland.

Study the economics of production, climatic conditions, agronomy conditions, availability of land, water and other resources, environmental impact assessment requirements and support requirements for identified potential crops.

Review the marketing prospects for all identified crops and their likely profitability to growers.

Assess the feasibility (both financial and economic) of producing biodiesel from crops in Swaziland and estimate the quantity of biodiesel that can be produced from the crops identified above including growing, harvesting and processing of crops, production of biodiesel and any necessary additional infrastructure, facilities, etc. This should include realistic estimates of production capacity, costs and technologies, etc.

Task 2: Economic and Financial considerations and benefits whereby they had to evaluate/assess the target markets as well as potential volumes of biofuels, marketable in Swaziland (local consumption) and in South Africa (exported from Swaziland). The assessment should also

include food production requirements so that biofuels do not impact negatively on the food production;

Explore opportunities to be provided by bioenergy developments, including possibilities of cogeneration from biomass;

Investigate required investment to produce biodiesel for the Swaziland Market including export. Recommend appropriate financing models for biofuel production;

Consider economic issues such as taxes, levies, rebates and incentives;

Develop a model to produce energy crops to meet biofuels industry demand, without harming the potential for the production of food crops for Swaziland's needs;

Describe the potential additional benefits of biofuel development to Swaziland under the clean Development Mechanisms of the Kyoto Protocol;

Assess the market potential of biofuels, with particular emphasis on biodiesel. Extensively consult with government ministry responsible for transportation issues, oil companies, agricultural companies or estates and construction companies using heavy machinery.

Assess establishment/ development of a pilot project(s) to demonstrate the viability of the value added from the use of biodiesel.

Task3: Blending and biofuels infrastructure whereby they had to determine blending standards for biodiesel and bioethanol appropriate for Swaziland conditions. In consultation with all relevant authorities including petroleum refinery and oil marketing companies and automobile dealers, recommend appropriate standards for the bioethanol and biodiesel to be produced and determine blending ratios. Also recommend modifications that may need to be carried out in engine and fuel tank components to handle the recommended blended fuel;

Ascertain biofuel quality and specifications issues for Swaziland market for Swaziland conditions;

Assess biofuels infrastructure capacity and suitability;

Ascertain establishment of collaborative links with other stakeholders in the biofuels industry.

Task4: Legislative issues whereby the consultants were to review relevant legislation related to energy developments, with particular emphasis to biofuels and make appropriate recommendations for needed amendments;

Recommend legislation that will facilitate the integration of biofuels and fossil fuel marketing;

Recommend appropriate policy proposals on biofuels that will be conducive to biofuel investment in the country;

Review existing national policies, for example Swaziland environmental plan, plan to combat desertification, national energy policy and action plan, with a view to integrate into existing policy landscape.

Task 5: Institutional Issues,

Whereby they had to; ascertain the current and desirable role of different stakeholders in biofuels industry including evaluating their capacity. Determine the scope of institutional actors such as regulators, investors, facilitators in biofuels industry in Swaziland. Where appropriate recommend institutional set up;

Assess/determine environmental, health and social costs and benefits (for example CO_2 emissions reductions, local air quality impacts, fuel scarcity and regional economic development benefits);

Assess technical and implementation issues related to technological feasibility of biodiesel production and likely barriers/ challenges.

Task 6: The consultant had to provide a review and assessment of the potential effects of biofuel development on the environment, labour market, economic growth and international trading practices in Swaziland.

Task 7: They had to undertake information gap analysis to establish if all the necessary information is available to make important decisions, (for example which crops to use, mix of diesel vehicles versus petrol vehicles in Swaziland etc)

Task 8: They then had to develop a logical framework analysis for the Farming for Energy Project (Bio-energy Study) in Swaziland.