

**FACTORS INFLUENCING SUSTAINABILITY OF RURAL
COMMUNITY BASED PROJECTS; A CASE OF JATROPHA CURCUS
GROWING PROJECT IN GARSEN CONSTITUENCY – TANA DELTA
COUNTY**

BY

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MASTER OF ARTS DEGREE IN PROJECT PLANNING AND
MANAGEMENT OF THE UNIVERSITY OF NAIROBI**

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DECLARATION

This research project report is my original work and has not been submitted to any other university or institution of higher learning for examination.

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This research project report has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

This work is dedicated to my lovely family of three sons: Kevin, Collins and Comfort for their daily inspiration.

A special feeling of gratitude to my late husband; Mr. Francis Mutanda who inspired and instilled in me the love of reading and respect for education.

I also dedicate this work and give special thanks to my sister; RodaManase and his husband Rev. Mr. Francis Tumaini for being there for me throughout the academic pursuit.

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LIST OF ACRONYMS AND ABBREVIATIONS

ASAL	Arid and Semi Arid Lands
COMESA	Common Market for East and Southern Africa
EMCA	Environmental Management and Coordination Act
ERC	Energy Regulatory Commission
ESD	Energy for Sustainable Development Africa
GoK	Government of Kenya
ICRAF	International Centre for Research on Agro-Forestry
IDA	International Development Association
ILRI	International Livestock Research Institute
KenGen	Kenya Electricity Generating Company
KEFRI	Kenya Forestry Research Institute
KEREA	Kenya Renewable Energy Association
KEPHIS	Kenya Plant Health Inspectorate Services
KETRACO	Kenya Electricity Transmission Company
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KPLC	Kenya Power and Lighting Company Limited
MOE	Ministry of Energy
MOF	Ministry of Finance
NGO	Non Governmental Organization
REA	Rural Electrification Authority
RED	Renewable Energy Directive
RET	Renewable Energy Technologies
SWH	Solar Water Heaters
UNEP	United Nations Environment Programme

ABSTRACT

A large number of jatropha (*Jatropha curcus* L.) projects have been implemented in various countries to develop a viable bioenergy cropping system, based on the understanding that the tropical woody perennial tree or shrub species may survive in harsh climate and soil conditions (Attaya et al. 2012). The *Jatropha* plant was named in 1753 by the Swedish botanist Carl Linnaeus. The purpose of this study was to examine the factors influencing the sustainability of rural community based projects; a case of *Jatropha curcus* growing project in Garsen constituency, Tana Delta County. The study was guided by four objectives that sought to determine the extent to which financial resources influence the sustainability of *jatropha curcus* growing project in Garsen constituency, examine the extent to which socio-cultural factors influence the sustainability of *jatropha curcus* growing project in Garsen constituency, examine the extent to which the market influences the sustainability of *jatropha curcus* growing project in Garsen constituency, and establish the extent to which technology influences the sustainability of *jatropha curcus* growing project in Garsen constituency, Tana Delta County. The objectives also form the themes in literature review. A descriptive research design was adopted for the study. Quantitative and qualitative data was collected from 97 respondents and analysed. The target population was about 3,200 but a population sample of 97 was used as calculated by the Yamane formula. A pilot study was conducted to check the instruments reliability and validity. Structured questionnaires were used to collect the data, which was administered via e-mails, enumerators and personally picked them after they had been filled. Data was coded and analyzed using the SPSS version 20.0. The data was analyzed and variables correlated to check the relationship of data. Chi-square method was used to test the hypothesis. The study revealed that for sustainability of *Jatropha* projects in Tana Delta, financial resources are central in the acquisition of quality farm inputs, labour, relevant market identification and many more. In relation to socio-cultural factors the study revealed that without the community giving their land for plantation as opposed to grazing, the *Jatropha* plant will miss a place to grow. The levels of poverty have also forced the local community to start participating in subsistence farming thus affecting the small scale production of *jatropha*. The study also revealed that technology is significant in areas not limited to quality seeds acquisition, pests and disease control, irrigation, cultivation, harvesting, processing and marketing. For the survival and continued operations, beside the future success of the *Jatropha* fuel projects in Kenya, the study recommends that the NGOs, CBOs, Ministry of energy and County government of Tana River must avail sufficient funds to both the farmers and the expertise for the acquisition of quality seeds, technology, landscape, market expansion and many more. Modern technology should be subsidized and availed for both projects running and *jatropha* production. The Ministry of energy should also come up with strategies that should popularize the products of *jatropha* just like Tanzania has done.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

A large number of jatropha (*Jatropha curcus* L.) projects have been implemented in various countries to develop a viable bioenergy cropping system, based on the understanding that the tropical woody perennial tree or shrub species may survive in harsh climate and soil conditions (Attaya et al. 2012). The *Jatropha* plant was named in 1753 by the Swedish botanist Carl Linnaeus. The name *Jatropha* comes from the Greek words *iatrós* (doctor) and *trophé* (food), which shows the *Jatropha* has been used for medicinal purposes (Nielsen, 2010). In many countries *Jatropha* is known by a name meaning ‘the castor oil plant’, which shows that the oil has been the main purpose of planting *Jatropha*. Another common name is ‘hedge castor oil plant’, showing that it was used to be grown as a hedge (van der Putten, 2010). According to Münch and Schultze-Motel (2010), some common names for *Jatropha* are: physic nut, purging nut (English), mbono (Swahili) and purgerbuske (Swedish).

In his study on the Role of Biofuels in Environmental Protection in India and China, Rijssenbeek, (2010) writes that *Jatropha curcus* L. (hereafter referred to as “*Jatropha*”) has become an example for the tremendous hope placed in novel crops that “offer all the benefits of biofuels without the pitfalls” to deliver oilseeds from marginal lands in (semi-) arid regions without compromising food production, diminishing natural resources or ecosystem services, such as carbon stocks and soil fertility. As a result it has been praised as an economically and environmentally sustainable feedstock for biofuel production. Governments in producing countries, for example in India and China, have launched supporting programs for the promising *Jatropha* cultivation industry (Nielsen, 2009). While singling out *Jatropha curcus* programs in India for example, Nielsen found out that the government supported the cultivation, processing and marketing of products from *Jatropha curcus* programs in 2008 to 2012 to the degree of 55% compared to other biofuel crops like soybeans and sugarcane bagasse. The major reason behind the government’s hand in this program was to take care of the ever increasing costs of fuels and animal feeds in the major semi-arid areas of the country that received less than 250mm rainfall pa.

According to Mc Lea, (2009), the potential for pro-poor development has motivated India’s governmental and non-governmental development organisations to involve smallholder farmers in growing the energy crop. Projects range from schemes involving smallholders planting windbreaks

and hedgerows to large monoculture plantations spanning several thousand hectares. However, since the initial wave of excitement about *Jatropha* broke in around 2008, many projects have failed. Despite setbacks, *Jatropha* production is still being promoted and new projects are being undertaken. At the time when initial investments in large-scale commercialization of *Jatropha* were being made in India, little was known about *Jatropha*'s basic agronomy (Achten *et al.* 2010). The failure of many *Jatropha* projects confirmed the concerns of those who recognized the economic risk of cultivating an undomesticated plant (Fairless, 2007).

Therefore, a study by Achten & Verchot (2011) indicated that for sustainable *Jatropha* projects in India, factors like market availability, modern storage, harvesting and handling facilities, modern irrigation methods and pests/diseases control methods, proper and qualified management were necessary. In Brazil for example, the *Jatropha* projects are competing with the soybeans and sugarcane bagasse biofuels due to keen look into factors like proper management of the projects, availability of modern technology, community support, both local and international markets and support and many more. This has seen the country have increased *Jatropha* projects being implemented in central, southern and eastern parts of Brazil at a tune of 20,000 biofuel production per annum.

According to Jongschaap *et al.* (2012) in sub Saharan Africa, about 20 countries have owned the *Jatropha* projects from small scale to plantations planting. Remarkably is Mozambique whereby data collection on the *Jatropha* project was conducted in 2012 and relied on a comprehensive project inventory conducted by the coordinator from Utrecht University J.A.J. van Eijck in Mozambique in the year preceding the survey. It was found that *jatropha* activities in that country are almost completely in the form of large plantations. Data were subsequently collected by a representative of IIAM together with Jouke Rom Colthoff (UU) in April- May 2012. The representative of IIAM focused on the agronomic questions and also translated the responses, whilst Rom Colthoff concentrated on the other aspects. Compiling good data about the "business case" of the large plantations was challenging. The projects and outgrowers analysed in Mozambique that touched on projects like: Projects/plantation fields like AVIAM, ADPP, Niqel, MoçamGALP, SAB, Sun Biofuels, and, Smallholders/outgrowers like ADPP outgrowers. The study showed that the cultivation and implementation of *Jatropha* projects in Mozambique has been on an increase since 2009 due to factors like good will of the local communities, financial support from the central and non-government bodies, the high qualified technological application, ready market, qualified management and many more. This has been found to be a factor that has greatly influenced the sustainability of these projects in Mozambique (FACT Foundation, 2010).

Across east Africa, Jatropha projects have been promoted and sold in almost all the countries in the region with the least being in Burundi. In Ethiopia, Tanzania and Uganda for example, Jatropha projects have been implemented and have been successful since 2009 up to the percentage of 45%(DECON/REAC, 2013).In Tanzania for example, about Tsh.2billion were channeled towards small scale and middle scale Jatropha cultivators in areas like Tharime, Shinyanga, Mwanza, Kigoma, Dar salaam, Mbeya and many more; a factor that increased its production between the years 2012/2013(Townsend&Porder , 2012).According to Titapiwatanakun, Sooksathan&Punsuvon (2012), Tanzanian projects have spread all over the country producing the biofuel that is used to supplement the firewood for cooking and this has seen major operators come up with jikos that use their products even before processing. Major projects in Tanzania include:Diligent Tanz. Ltd, Tatedo, MatumainiMapya, EWC / Rotiana, Tanzania Jatropha Ltd (part of Japan Jatropha), Max Havelaar, KNCU, Kilimangu Estate, VincentianSisters, Kiumma, Prokon-Ajuaye-Kundi, Leguruki, Engaruka, Bukoba, Terat, Tunduru, Mpanda and many more. The projects have managed to stay put and continue to be in operation due to factors that have been cited by Thetingand Brekke(2010) in their study, 'The Sustainability of Biofuel Projects in Africa'. The factors for continual operations of these projects include: The availability of land from the marginalised communities in Tanzania, the government support of these projects, the political good will of the local leaders, the rate of return of the projects' products and the level of management support towards these projects.

In Kenya, The Jatropha plant seems to have been introduced about a century ago (The Insolvency Service, 2012) and has been grown in Kenya for many decades, but for other purposes than for bio-fuel production (GTZ 2009, 9). In 2009 GTZ (2009, 51) found Jatropha plants of 30 to 50 years or more wild or as fences in, for example, Nyanza Province, Rift Valley Province, Central Province, Easternit was planted as a fence to keep elephants away in Eastern Province and in about the year 2000 Jatropha was planted in western Kenya as support plant for vanilla veins. Kenya has no locally produced fossil fuels, and the import of huge amounts of fuel gives the country large costs every year. This is why Kenya needs to encourage wider adoption of renewable energy technologies (Muok &Källbäck 2008) such as e.g. Jatropha production. GTZ (2009) writes, that Jatropha has become known as a biofuel feedstock only in the past few years, and that especially smallholder farmers began planting the Jatropha, a plant promoted by many NGOs, without much information on cultivation, management requirements or market for the seeds.

Kenya faces great problems with deforestation, desertification, soil erosion, degraded water quality and water shortage, domestic and industrial pollution and poaching. The Jatropha can be planted in most of the semi-arid areas, and in the agro-ecological zones III-IV in Kenya. It controls land

degradation, reverses deforestation and also sequester carbon. Growing of *Jatropha* also increases the land cover, which is badly needed in the arid and semiarid lands (ASALs) in Kenya. *Jatropha* production may also play a role in controlling the rural urban migration through employment creation in the ASALs, which is 80 % of Kenya's total land mass and hosts 10 million people and 70 % of the land's livestock herd (Muok &Källbäck 2008).

A research done by GTZ in 2009 (7) shows that the *Jatropha* projects yields in Kenya are much lower than has been reported in the literature. The claims that *Jatropha* has low nutrient requirements, is drought-tolerant, grows well under saline conditions and is tolerant or resistant to pests and diseases are shown to be incorrect for high oil production (Lyon & DeWitt, 2012). The results of the GTZ research show that a small *Jatropha* farm (1 acre) practicing monoculture or intercropping will not get any profit for at least the first ten years, assuming the selling price for seeds is 15 Kshs. per kg (GTZ 2009). The growing of *Jatropha* as a fence starts giving a profit after about three to four years, it is a sound investment for the farmers while it also serves as protection against wild animals and it is also no threat to food production (GTZ, 2009).

Based on these research findings GTZ (2009) conclude by saying *Jatropha* production in Kenya for now is uneconomical and they do not recommend smallholder farmers to start growing *Jatropha* as monoculture or intercropped with food crops until more research is done. The only form of *Jatropha* growing they can recommend for now is the fence type. Also the Kenyan magazine *The Organic Farmer* Nr. 67 in December 2010 writes that the Kenyan Forestry Research Institute (KEFRI) and the World Agroforestry Centre (ICRAF) now have advised the Kenyan government to stop the promotion of *Jatropha*, as the *Jatropha* plant has little value when grown in plantations or as a single cash crop (Baumgartner &Kamau 2010). Muok and Källbäck(2008) writes more positively that there is a potential for biodiesel industry in Kenya, and that the expansion and development of the biodiesel industry would have positive development impacts on the economy, the people and the environment in Kenya. Important to remember is, that there is a great difference in talking about *Jatropha* production as a biodiesel crop and talking about the benefits for small-scale farmers growing *Jatropha*.

Dr. Jacob Kithinji of the University of Nairobi chemistry department did the oil analysis work for the *Jatropha* projects in Malindi, Thika, Namanga, Kitui and many more and the finds were: The percentage oil on the plant were highly varied (ranging from 24-44% (Ovanda-Medina, et al., 2011) and 8-54% (Khetri)), while still others have observed that that the oil content differed considerably from the same trees between two sequential fruiting seasons (Kaur, et al., 2011).In his conclusion

however, he argues that the *Jatropha* projects biofuel projects are the suitable ways of taking care of ASAL lands and for their sustainability, factors like financial resources mobilization, technology investment, political support from both the local and national leaders, improved awareness to the locals, market, proper management and many more must be put into consideration. Other factors cited included employment of modern methods of cultivating the crop, managing the crop, harvesting, pests/diseases control, processing and branding of the products (Ovanda-Medina, et al., 2011).

1.2 Statement of the Problem

Africa faces rising population and the effects of climate change and the (inefficient) production of charcoal remain one of the few sources of rural income and source of energy despite its dangers. There is an urgent need to provide alternatives to the region's very high dependence on wood biomass. Predominant reliance on open wood fires contributes to extensive deforestation. The time, energy and physical costs of collecting wood fuel are borne mostly by women and children. Many chronic diseases result from indoor air pollution from inefficient cooking methods and stoves. With an estimated 800,000 children dying each year from acute lower respiratory diseases, indoor air pollution is the highest cause of morbidity and mortality in children under five. It is responsible for more deaths than malnutrition, diarrhoea or childhood disease (Boerstler, 2010).

Electricity costs in Sub-Saharan Africa are twice those in most developing countries. Because of unreliable supply and frequent power cuts, even those who are connected to the grid are often forced to buy diesel generators as backups. This particularly applies to industries seeking a steady reliable supply of electricity to keep their processes going. Even in countries such as Kenya, which includes some hydro and geothermal power in its main grid, the high costs associated with the limited and unreliable distribution system continuously challenges investors and producers. Access to and the cost of liquid fuels entail the same problems of uncertain availability, as well as considerable price fluctuations around a steadily rising trend line that lies above the world average (Ross, 2011). In his writing, Rafii *et al.* (2010) argues that Kenya has greatly invested in *Jatropha* projects in many areas including Vipingo Plantations Ltd – Kilifi, Kofinaf Company Ltd-Thika, Tropical Farm Management (Kenya) Ltd -Makuyu, Lesiolo Grain Handlers Ltd. (LGHL)-Nakuru, Small-scale extension in Bungoma, Kordes, Roses East Africa (Kenya)-Nairobi with Saffron Energy Ltd Kenya- Laikipia, Vegpro Kenya-Naivasha, Economic trials in Kibwezi and

many more. Other areas like Tana River and more particularly the Garsen areas have seen these projects being into action though their sustainability is questionable.

Factors like lack of sufficient financial resources, proper and streamlined management, corruption, poor community mobilization and sensitization, poor employed technology, poor farming methods, undefined local/regional markets and political interferences have greatly influenced the rate at which the future of these projects operate in Kenya (Popluechai, 2010). This report therefore sought to investigate the factors that could possibly influence the sustainability of Jatropha projects in Garsen constituency of Tana River County.

1.3. Purpose of the Study

The purpose of this study was to examine the factors influencing the sustainability of rural community based projects; a case study of jatropha curcus growing project in Garsen constituency, Tana Delta County.

1.4. Objectives of the Study

The study was guided by the following objectives:

- i. To determine the extent to which financial resources influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- ii. To examine the extent to which socio-cultural factors influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- iii. To examine the extent to which the market influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- iv. To establish the extent to which technology influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.

1.5. Research Questions

The objectives of this study were-

- i. To what extent do financial resources influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County?
- ii. What is the extent to which socio-cultural factors influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County?

- iii. What is the extent to which the market influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County?
- iv. To what extent does technology influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County?

1.6 Research Hypotheses

The study was guided by the following research hypotheses that:

- i. H₁: Financial resources have an influence in the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- ii. H₁ :Socio-cultural factors have an influence in the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- iii. H₁ :Marketing has an influence in the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.
- iv. H₁: Technology has an influence in the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.

1.7 Significance of the Study

With the ever increasing number of population in Kenya, need for more food, need for more electricity/power and need for more land for settlement (FAO, 2012),the need for alternative source of fuel that is environmental friendly is evident. This called for the introduction of Jatropha projects in the country and Africa at large, though a number of them have failed in the recent past.

Therefore, these study findings will be of great importance to the government of Kenya, the non-governmental organisations and the international community that supports the Jatropha plant as an alternative source of biofuel production by giving the required information on the survival and longtime sustainability of these projects. The findings of this study will be used by these afore mentioned bodies to get the insight of real financial resources weakness, technologic weakness, socio-cultural weakness and market weakness with Jatropha projects sustainability.

The findings will also contribute reliable knowledge for vision 2030, MDGs as it regards to sustainable energy by giving stakeholders information know which areas of management/operation to focus on so as to make it a reality for the survival and continued operation of Jatropha projects in the country.

The local community will be in the position of knowing which methods to employ that will see their efforts in the Jatropha plant adoption bear fruits for a long time by understanding the sustainable measures to be taken and therefore providing employment to both the youths, aged and jobless people in the community.

The finding will be important to academicians and researchers as basis for further researches. The study will provide the background information to research organizations and scholars who would want to carry out further research in this area. The study will facilitate individual researchers to identify gaps in the current research and carry out research in those areas.

1.8 Basic Assumptions of the Research

The study presumed that Jatropha projects operating/those that might have operated in the Garsen's Tana Delta County are under small scale or plantation form and they are legally registered or attached to a particular NGO, government body, individual or firm and from the records, they operate under relevant ministry.

The study also assumed that almost 50% of the Jatropha projects operating in Garsen have a challenge of sustainability.

The study further had a general assumption that factors like level of technology, financial resources availability, socio-cultural subscriptions and market base/structure have a great influence in Jatropha projects sustainability.

Finally, the study assumed that the respondents could sincerely fill the questionnaires without any subjectivity and all these assumptions held during the research.

1.9 Limitations of the Study

The major limitations of the research were time and financial resources. For example, time allocated for the research, the family and for the work place was greatly in competition.

However this was overcome by creating time during the weekends, evenings, at times travelling during lunch breaks to link with the supervisor in the University at Mombasa town and taking a leave so as to contact the respondents in various places in Garsen constituency.

Financial constraints are expected to be a major challenge especially where the researcher was required to travel to rural places like interior parts Tana Delta whereby at times communication and transport could be a challenge to gather information. However this was overcome by using strategic

informants in the field and using alternative sources of transport and communication like motor bikes.

Tana Delta is a war zone area and this in away limited accessibility to various information in the region. This made it difficult to access most of the respondents without suspicion; since they treated one suspiciously.

1.10 Delimitations of the Study

The study delimited itself by specifically concentrating on the factors influencing the sustainability of rural community based projects; a case study of jatropha curcus growing project in Garsen constituency, Tana Delta County.

The researcher found it convenient doing the research since she works in Kenya coast region and she has a fast knowledge of community based organisations especially the jatropha biofuel projects.

The researcher used a consent form seeking the acceptance or rejection of the respondents to participate in the study and this assured the respondents of their voluntarism in participation in the research. The researcher was set to interview by administering questionnaires to the managers of various NGOs or government bodies handling the jatropha projects, the individual owners of projects and other community members who directly benefit from the products of the projects and this will improve the integrity of the research in terms of quality.

The researcher administered both questionnaire and key informant guide to the respondents in order to obtain both quantitative and qualitative information and this improved the research findings in terms of quality.

1.11 Definitions of Key Terms

Financial Resources- Refers to all the funds required by a business to operate; both capital and operational finances.

Marketing - Are services related to different stages of production and sale that are offered as a package by the same service provider with the aim of increasing the sales base.

Projects-refers to undertakings that take in inputs and are expected to give some desired results after a given period of time.

Small scale farmers-Refers to farmers who cultivate less than 4 acres of land at any given time.

Socio-culture-Issues related to the ways of living of a particular group of people or society.

Sustainability-The capacity of a business enterprise to stay beyond an external funding period and giving benefits its intended to give without support given by the stakeholders.

Technology - Is the use of new knowledge or adoption of new technology into an enterprise in a way that leads to improvement of production and profitability in short or long term.

1.12. Organization of the Study

This project research report is organized into five chapters: Chapter one deals with the introduction, problem statement, purpose of the study, objectives of the study, the research questions, the study hypotheses, significance of the study, limitations and delimitations of the study, basic assumptions of the study, definition of significant terms and the organization of the study. Chapter two of the study consists of the literature review with information from other articles which are relevant to the researcher. Chapter three entails the methodology to be used in the research .Chapter four data analysis, presentation and interpretation. Chapter five consists of summary of findings, discussions, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The reflection and collection of the literature review to this chapter attempts to present a review of various previous studies that have been undertaken in relation to the sustainability of community based projects implementation with a strict emphasis on *Jatropha curcus* projects .Various studies on this subject are reviewed herein to provide a broad perspective on how to implement sustainably the *Jatropha curcus* projects in various communities in Kenya.

2.2 Financial Resources Influence on the Sustainability of *Jatropha Curcus* Projects

In their study about the future of *Jatropha Curcus* projects in Zambia, Malawi and Tanzania, Andreasson and Richard (2011) stressed that financial resources are of great significance for any *jatropha* project to run / operate smoothly. Just like any projects that require financial resources investments, the *jatropha* projects require massive finances for their operations and survival. The major finances required in this case include money for labour, seed protection, land obtaining, technology and many more. However, due to the endless sector that need mammoth financial investments in the project cycle, our research will be restricted into the sources of finance in Kenya for *jatropha* projects and the capital cost investments of the projects.

2.2.1 Sources of Funds Available for *Jatropha* Investments Projects

According to Belewuet *al.* (2010), possible funds for *Jatropha* development in Kenya include local financial agencies and foreign investors. Locally among the possible source of funds are loans from Agricultural Farcers Co-operative (AFC). Equity bank has also recently initiated low interest rates loans to farmers. According to scholars Belewuet *al.* (2010) financing an emerging technology such as *Jatropha curcus* with extra equity to absorb the need for on-going varietal and good agricultural practices research is necessary in both developed and developing countries. Setting up management teams with different expertise during the set up and establishment phases is a factor that requires huge finances that could be far ahead of the finances available for use by the projects. This will entail either setting up a research oil testing laboratory, partnering closely with university or research consultancy platforms, trialing different harvesting equipment and techniques, pest and diseases management practices, as well as having extra agronomy and engineering capacity to

monitor results closely as well as maintaining sophisticated financial auditing and costs modelling (Brittaine and Litaladio, 2010).

According to Boestler F., (2010), possible funds for Jatropha development projects in Kenya include local financial agencies and foreign investors. Locally among the possible source of funds are loans from Agricultural Farcers Co-operative (AFC). Equity bank has also recently initiated low interest rates loans to farmers. Over 100 organizations, including about 50 NGOs, practice some form of microfinance business in Kenya. About 20 of the NGOs practice pure micro-financing, while the rest practice micro-financing alongside social welfare activities. Major players in the sector include Faulu Kenya, Kenya Women Finance Trust (KWFT), Pride Ltd, Wedco Ltd, Small and Medium Enterprise Programme (SMEP), Kenya Small Traders and Entrepreneurs Society (KSTES), Ecumenical Loans Fund (ECLOF) and Vintage Management (Jitegemee Trust). The list is long to the point that even local organisations and Chama have joined hands in regions like Thika, Kirinyaga, Kajiado, Maua and Mbeya Tanzania to raise funds meant to see their projects survive and expand their borders (Belewuet *al.* 2010).

However, the finances provided have been found to be insufficient and some lending bodies have been found to be so strict on the use and utilization of these funds; limiting the scope of applicability that is associated with deteriorating innovation and creativity that has led to failure of most projects (Andreasson and Richard , 2011). The role of microfinance sector in jatropha projects has gained criticism as it regard to the projects sustainability of late and many scholars have had variant opinions. According to Bashaet al. (2009), the role of microfinance sector in Kenya and east Africa by extension includes: The provisions of financial services to the low-income households and micro and small enterprises (MSEs), provide an enormous potential to support the economic activities of the poor and thus contribute to poverty alleviation.

The potential of using institutional credit and other financial services for poverty alleviation in Kenya is quite significant. About 18 million people, or 60% of the population, are poor and mostly out of the scope of formal banking services. According to the National Micro and Small Enterprise Baseline Survey of 1999, there are close to 1.3 million MSEs employing nearly 2.3 million people or 20% of the country's total employment and contributing 18% of overall GDP and 25% of non-agricultural GDP. The MSEs include small groups projects or individual projects just like the jatropha projects operating in Zambia, Zimbabwe and India which have not only elevated the lives of the poor but have created millions of employment to the poor unskilled people in the villages. Despite this important contribution, only 10.4% 51 of the MSEs/small projects like the jatropha

receive credit and other financial services. The formal banking sector in Kenya over the years has regarded the informal sector as risky and not commercially viable. According to the Poverty Reduction Strategy Paper (PRSP), a large number of Kenyans derive their livelihood from the small projects and individual undertakings like substance farming (Behera, 2010). Therefore, development of this sector represents an important means of creating employment, promoting growth, and reducing poverty in the long-term.

However, in spite of the importance of this sector, experience shows that provision and delivery of credit and other financial services to the sector by formal financial institutions, such as commercial banks has been below expectation (Behera, 2011). This means that it is difficult for the poor to climb out of poverty due to lack of finance for their production activities especially in the ASAL areas and other marginalized areas like the Kenyan coast. Therefore, new, innovative and pro-poor modes of financing jatropha projects based on sound operating principles need to be developed (Boestler,2010).The available sources of funding have strict rules and regulation, are very inflexible and rigid, are lacking sufficient information to the locals and some need security like tittle deed; that are missing among 90% of the locals of Tana Delta and the coast at large. The long processes of obtaining the finances and the insufficient amounts allocated to farmers especially those in groups has greatly been a determinant factor in deciding the future of jatropha projects in Kenya and the other small areas within the country like the Tana Delta. This has been supported by Chao et al., (2012) who collectively argued that sources and amounts of finances allocated by supporting bodies to farmers dealing with jatropha curcus biofuel in Uganda, Tanzania, Ethiopia, Zambia, Zimbabwe and Brazil have greatly influenced the survival of the projects by giving them the required tools, seed, capital and personnel besides technology for production.

2.2.2 Financial Investments

Financial investments determine whether the project will survive or die on the way. Jatropha financial investments range from capital investments, production investments and marketing investments. As per total capital investment, this is the amount of money that must be supplied or required to finance the purchasing of equipment as well as its auxiliary parts, spare parts, construction of the plant and the acquisition of items necessary for plant operation. The total capital investment comprises the fixed capital, i.e. investment needed to supply all production facilities as well as supply of construction overheads and plant components that are directly or indirectly related the biodiesel process from jatropha; and the working capital, i.e. the amount of money needed to start the project. This is normally estimated as 0.15times the Fixed Capital Investment. Total capital

cost may include costs of land, equipment and installations, building and construction costs (Davison, 2011).

However the capital investments have been hindering the commencement of up to 56% of the projects in Kenya, Tanzania, Ethiopia and Burundi. The major challenge for the future green energy projects in Kenya is the low amounts of capital allocated to the sector (World Bank, 2010), the low levels of investments done from the willing parties and the NGOs world (KNERA, 2012), and the low technology available due to low investments on capital for the biofuel project in our endeavors (World bank, 2010).The future of the projects in Tana Delta hangs at 41.12% due to the poor capital systems investments(DECOR/REAC 2013).

As it pertains to total production investment, the total production investment involves the cost needed to run the jatropha project including marketing of the product. This generally consists of the variable cost, fixed costs and general expenses. Variable cost consists of direct and indirect costs. Generally, variable cost may include costs of raw materials like seeds, utilities, miscellaneous materials, shipping and packaging which are negligible in this work because the biodiesel processor is fabricated locally in most countries in Africa like Kenya and Ghana. Fixed costs also include the cost of maintenance, operating labour, supervision, plant overheads, capital charges, Insurance rates and Royalties. General expenses are made up of administrative costs, engineering and legal costs, office maintenance and communications, distribution and selling cost(FACT Foundation, 2010).

However, studies have shown that almost 59% of the jatropha projects in Kenya have failed after sometimes especially the small scale ones because they miss the production finances as compared to the large scale producers. In Kajiado, Muranga, Kilifi, Shimba Hills and Maralal for example, the farmers have from time to time failed on the way of production due to the fact that most of the projects have lacked finances on the way, have lacked quality seeds and some tools that could see their survival. Therefore, according toFACT Foundation (2010) it is evident that production cost is part and parcel of the success or failure of some projects that are aimed at strengthening the jatropha projects across the country (Gachimbi, 2002).

When it comes to harvesting financial investments, common sense has it that harvesting consumes reasonable amounts of funds and the best quality harvesting is the manual harvesting since it can selectively choose the only yellow ripe fruits as opposed to semi-mechanized and mechanized harvesting. The quality enhancing manual plucking of the jatropha fruits requires a bigger number of people manually working in the fields compared to semi-mechanized and mechanized harvesting

and this will in turn increase the harvesting costs; which most of the farmers cannot meet even after hawking their products in east Africa (Gachimbi, 2002). A study carried out by Silip in the hidden costs in jatropha harvesting in Shinyanga, Morogoro, Kilifi, Thika and Rachuonyo found out that the few seeds that were ready to harvest by the end of the project time period were simply collected in bags by hand, and so this section highlights some of the issues connected with using different methods at different scales of jatropha production and points the reader to in-depth information.

After optimizing yields, one of the key challenges is that in many provenances fruits in the same bunch ripen at different stages. Wisdom has it that free fatty acids are lowest and oil content highest in yellow fruit, so one key agronomy challenge is finding out whether the bunches that do ripen at the same time, are the product of chance, genetics, or certain agro-climatic factors. The advantage of manual harvesting is the ability to be selective. The problem with manual harvesting is the cost (Silip, 2010).

Silip and others found that regardless of the extraction method used, oil yield increased as fruits mature, ripen and senesce (2010). Studies on the differences between chemical and mechanical extraction processes, as well as the oil content of seeds at different stages of maturation, found using crushed and warmed black seeds gave the highest oil yield (yellow seeds gave the highest using chemical extraction processes) (Silip et al., 2010). However, further studies have found that, while the volume of oil may be similar, the free fatty acid content of seeds from yellow fruit, as well as oil pressed from such seeds, remains more stable whatever the storage temperatures (World Bank, 2011). This harvesting cost has been a challenge to the sustainability of almost all the jatropha projects in the country and in Tana delta by limit.

2.3 Socio-Cultural Factors and their Influence on Sustainability of Jatropha Projects

According to the Friends of the Earth (2010) any project in the world is just part and parcel of the community. It eats from the community and gives back to the community. According to their argument, a project is just like a young child interacting with the environment/community and once the child gets well with what the society holds, he/she will be progressively valued and once the child deviates, the society disregard and at times disowns the child. GTZ (2013) did an exploratory study on factors which affects the failure of local small and medium enterprises and found that the entrepreneurs' personal attributes and shortcomings had a significant impact on the performance of

a business enterprise. Another study by GTZ (2013) on the Jatropha projects in Zimbabwe, Zambia, Tanzania and Ethiopia found some of the strongest socio cultural factors that were determinants of sustainability to be : land tenure system, perception towards the jatropha curcus plant and the agricultural food plants, education and levels of community awareness/knowledge and many more.

2.3.1 Land and the Society

Despite all the emotion packed into some of the issues surrounding jatropha propagation, it was not within the purview of this project to take sides on contentious issues especially on the land issue that for a long time has fuelled troubles in the black continent. Nevertheless, the projects maintained a pro-poor, socially and environmentally sustainable inclusive land stance as far as in Egypt, Ethiopia, Tanzania, and Kenya among others. It is important to note, watch, and report on the different viewpoints informing the debate and, more than anything, attempt to provide evidence of the possible intended and unintended consequences of certain paths of action that touch on the only capital resource called land in most of our societies. In this regard, different communities hold different ties towards their lands. In the Maasai community in Kenya and Tanzania, Fulani of Nigeria, Karamojongi of Uganda and many more who believe that land is a collective property and always belief that it is a taboo to rob land by cultivating it (Andreasson and Richard, 2011).

The Pokomo, Oromo and the nomadic pastoralists of the Tana Delta are also thorn in this belief whereby land is owned by the community in the communities that do grazing while the view – otherwise seen as deviants who do farming in the shores of river Tana-have not for a long time identified ways of accessing legal documents for land ownership; thus limiting their future plans of joining the larger jatropha project in Tana delta for the biofuel cultivation. The other challenge that has faced the projects especially those in Kilifi, Shimba hills and the Tana region at large is the issue of land grabbing. This has been arrived at by a number of scholars who argue that a number of companies have come in the name of jatropha cultivation, only to land at grabbing lands and converting them into their personal use illegally thus angering the locals (Behera et al. 2010).

In 2012 The Greenleaf Global example highlights the challenge faced by those commenting on African biofuels and using only headlines and Internet searches to assess the actual number of hectares planted, rather than ‘planned’, ‘proposed’ or ‘reported as’ on the ground. To our knowledge, the only large-scale EIA approved jatropha project to date in Kenya is a controversial 10,000 hectare project for Bedford Biofuels in the Tana River Delta. Nevertheless, Friends of the Earth’s report, Africa Up for Grabs: the scale and impact of land grabbing for agrofuels (2010), had a map of Africa showing Japanese, Belgian and Canadian Companies planning to plant up to

500,000 hectares in Kenya, even including proposed sugarcane expansion of up to 40,000 hectares. The figures do not relate to the facts on the ground. The reported map is titled 'Reported cases of land grabbing and agrofuel development across Africa'. A look at the reference section shows much reliance on Friends of the Earth's own previous work, headlines and websites.

While anti-biofuel campaigners jostle to arouse emotions, for African decision-makers emotive discussion needs to be separated from the deep issues of inclusion and exclusion in large-scale development projects, the ownership and use of community and public land, and the power of corporations and governments to appropriate traditional lands for any large-scale agricultural, extractive, touristic, or other activity. Fostered by centuries of invasions, migrations, imperialism, and colonialism, as well as large-scale land 'allocations' to and by those in power over the last 60 years, this issue has dogged Africa for decades. Now that Africa seeks to industrialise and needs foreign investment to do so, this issue needs urgent, deep and informed discussion. Even constitutional efforts, such as in Kenya, to bring some clarity to ownership and entitlement processes, can still leave grey areas open to different interpretations, and exploitative implementation processes.

In turn, some 'land grab' reports (e.g., FOE, 2010; Sulle, 2010; Spire, 2010) seldom go deeply into patterns of overall land allocations, their histories and realities within each country, let alone into who and how many people actually currently own what percentage of arable land. Rightly or wrongly, specific cases are not contextualized or compared with other co-existing realities within a country. Given that processes of rural communal land leasing or tenure in East Africa are not that clear, an FDI company will find they often cannot win, especially when looking at green field sites. The more ethical ones will follow the rules presented to them by an agent or government representative, and then get blamed for 'taking advantage of unclear land rules'. Report writers may not 'visit villages physically' (Sulle, 2012, p. 10) and may not complete a comprehensive anonymous survey of all the surrounding villages and villagers. In some reporting, levels of analysis can get muddled and less cogent issues are included.

While so much obfuscation and 'noise' can still result in some useful and very pertinent developmental and human rights activities, it usually does not directly assist East African/Kenya's government ministries to align the multiple and conflicting existing laws, regulations, vested interests and different stakeholder groups. Nor does it greatly assist in developing scientific, fact-based national natural resource management and development plans. When international NGOs use figures that do not reflect the actual 'snapshot of reality' on the ground, those working within

Africa to fuel pro-poor ‘inclusion’ not ‘exclusion’ (Sulle, 2010) and to move swiftly on finding alternatives to wood fuel for cooking, cannot use these reports. ‘Headline’ as opposed to ‘ground-survey’ reporting can make government personnel more suspicious and increase the tendency to view those urging a precautionary scientific approach as also potential ‘radical environmentalists’ and against industrial development, when the opposite is true. It is these scientific internet based researches about land that have left most projects in the country including the jatropha in Tana Delta seen as a land grabbing scheme meant to benefit people from abroad and those from the upcountry; most of whom are employed in this project (Herrera *et al*, 2010).

2.3.2 Poverty, Environmental Degradation and the Community

Arid and semi-arid lands (ASALs) are home to the world’s poorest and most marginalized people in the world (Hawkins and Chen, 2011), In Kenya, the ASALs occupy over 80% of the country and host about 10 million people. These areas have the lowest development indicators and the highest incidence of poverty. Over 60% of ASAL inhabitants live below the poverty line (subsisting on one dollar per day). Although there is great potential for ASAL development in Kenya, the current picture is rather grim. The economy of the drylands is over-dependent on livestock production. Droughts and conflicts which are common in these areas and which affects livestock production have adverse impact in both lives and livelihoods in these areas. The growing population has put enormous pressure in the natural resources of the country. Over exploitation of the natural vegetation for timber and fuelwood has continued to cause land degradation and loss of genetic resources all posing serious challenges to sustainability of the rural economy. The worst affected areas being the Arid and semi-arid lands (ASALs) with its fragile ecosystem(Lyon DeWitt,2012).

There is therefore need to diversify livelihoods in the ASALs. Furthermore interventions on sustainable energy and environmental management are directly linked to poverty, food security and issues of equity in integrated rural development. However, the national governments and county governments have never seen the need to elevate the lives of these suffering poor in these drought hit areas so that they can easily manipulate and use them especially during the electioneering times. For example, the conflicts and wars experienced between the poor Pokomo and Oromo communities in the Tana region in 2012 is said to have been structured by some politicians who were holding the security docket so that the locals could be shaken and vote in someone who could be seen as their sympathizer (BBC, 2012).This wars caused by poverty have left the environment ruined whereby unsustainable grazing/ farming is done leaving the poor Kenyans in the Tana Delta

poorer than they were previously and thus hindering/limiting major development projects like *Jatropha* that could help the living poor.

2.3.2 The Changing Global Perceptions and Fortunes of *Jatropha Curcus*

In 2006/2007, despite talks about establishing huge plantations and projects, there had been little actual research into *jatropha* yields under various conditions in various countries; Kenya included. No one was able to solidly refute the hype that *jatropha* could be commercially productive on marginal soils in semi-arid conditions. The unrealistic hype, unfavourable locations, poor management of initial funds, and all-too-often limited knowledge about Africa's agro-ecological realities resulted in many large-, medium- and small-scale projects coming and going during this period, from Ethiopia all the way through East Africa, as well as in Zambia and Mozambique (Hawkings and Chen, 2011). The results of many projects indicate that most available *Jatropha curcus* varieties need optimal soils, temperature regimes and rainfall patterns (or specific mitigating set-up circumstances) to be commercially sustainable.

As the 'land grabbing', 'food for fuel' debate started to gain momentum in 2008, the German government was cautious about investing in a biofuel Private/Public Partnership. However, this kind of partnership and resulting viability trials were exactly what the OECD countries and other multilateral donors were calling for to bring commercial reality to the hype, and so a decision was made to move forward with the project.

In 2012, *jatropha* was still very much in the process of being domesticated and adapted to different agro-climatic conditions. Some (Volckaert, 2009) predicted a 106% increase in yield by 2018, of which 62% would come from improved agronomic practices and the rest from selection and breeding. Work being done by serious researchers, and on well-run plantations (e.g., Sunbiofuels, Mozambique, Kenya Oxfam) and within smallholder and out-growers' schemes (e.g., D1 Oils, Zambia, D4 Shimba Hills) that have access to appropriate agronomic knowledge, good locations, and that are supported with adequate financing, are still working to prove the commercial case. There are other smaller projects that entail low opportunity costs and which were set up to support communities and provide rural incomes. These include Kakute Ltd, Diligent Oils, Tatedo in Tanzania, and Biocarburant in Mali. These continue as model projects that have so far presumably managed to absorb annual variations in *jatropha* yields. In this spirit, Maitima (2012) argue that the community perceptions about the biofuels have greatly influenced the survival of these projects since their inception to date by 35.1% in Tanzania and 27.1% in Kenya while the perception has negatively favored the Tana case by 45% in 2009/12.

2.4 Market and Sustainability of Jatropha Projects Sustainability

In their research on economic viability of jatropha projects in Shimba Hills in Kwale County, Mogaka et al (2009) singled out market as the major booster of cultivating and upbringing of the plant as opposed to the green fuel friendliness of its product. The products were hot in the market especially in the neighboring Tanzania between 2008-2009 whereby one litre of the locally processed bio-fuel was trading at about Tsh.3, 850; a figure that was found to be 5 times higher than the price of the same quantity of milk and 11.6 times one kilogram of dried maize in the county.

According to Athanne (2011), marketing is the one and only functional area that links the products/services of any business/products of any given project to its customers. Therefore, it is vitally important to ensure that this function is properly performed. He adds that, to have a good chance of survival, all the projects need to know the target market and their products. The failure of projects to know their market targets, market changes and trends within the preferences of the customers has left many projects fail after sometimes. He adds on that, minor fluctuations in markets can topple a newly established product/project, particularly where it is reliant on a small number of customers.

In their writing on the work entitled 'Reality or Romanticism?' Mogaka, Iiyama & Nzuma (2010) argue that the marketing expansion of the jatropha biofuel in east Africa still remains below the limits with the market reached being low than the required sustenance threshold. In Uganda for example, the people around Jinja have never internalized the need for jatropha biofuel oils use due to the fact that they are close to the high power producing River Nile source, they get alternative energy source from the sugarcane bagasse from the Nile sugar company and many more (Mohan, Nikdad, & Singh, 2011). They continue to argue that stiff competition in the market from other sources of energy has put the future of the jatropha biofuel at a hanging point in Uganda, the limited popularity of the product has also limited their spread and the rate at which the product is being processed has limited its availability in the market thus limiting the number of customers.

As there is no substantial production of jatropha in Uganda, Tanzania or Kenya, there is no commercial supply into local markets as such (Mitchell, 2010), and in order to look at this sector in any depth, an investor would need to assume that the national markets are directly correlated to the costs of replacing kerosene for domestic use with jatropha pure vegetable oil (Ministry of Energy and Minerals 2011), or trans-esterified biodiesel for standing generators and/or blended car fuel (Misra and Misra, 2010). There would be no problem selling Jatropha either as straight

vegetable oil or biodiesel if it was price-competitive. At this point, East African governments are unlikely to provide any tax incentives or subsidies.

The only product of jatropha that has penetrated a niche market in Tanzania so far is jatropha soap. Jatropha seedlings, cuttings, seeds and oil transactions are still confined between seeds collectors, oil extractors and soap makers. Diligent and others have created a small local market around their activities. The current price of jatropha seed in Tanzania is about Tsh 250-300/kg. The price of the oil is roughly 1 Euro at the factory gate. The seed cake is mainly sold as briquettes for Tsh 200/kg (Van Peer, pers. comm., 2011). KAKUTE's jatropha soap is now sold in Dar es Salaam, Mwanza, Moshi and other major town centres in Tanzania. KAKUTE produces around 1000kg of soap per year and sells it in the form of pieces of 30 and 90 g each. Their revenues from the sale of soap are about Tsh 6 million (about US\$ 6,000) (van Eijck, 2007, pp. 136-146). The export potential of jatropha soap from KAKUTE is emerging with products being sent to USA.

There is a trend that seed prices continue to go up due to the fact that Diligent is facing competition from an NGO buying seeds to produce oil and electricity (Energy & Water Social Investment Company (EWC)). EWC is involved in electricity supply, biofuel production (by processing jatropha seeds), biogas production, and rural water supply, and will become engaged in processing drinkable bottled water. They are part of the OMASI structure, which includes DosiEngiteng[milk processing units in Maasai land (Longido, Terrat, Naberera, Orkesumet and Same)]. The southern Kenyan and northern Tanzanian Maasai Steppes are potentially limiting areas for jatropha, as was shown in Manyara. According to Mogaka, Iiyama and Nzuma, (2010) the Kenyan production and marketing of jatropha has not greatly caught the local market. About 20% of the locally processed jatropha products like soap, biofuel and the animal products have reached the market especially in the Kilifi areas, Kwale areas and other areas of the Kenyan-Tanzania border like Isibania in Kuria, Namanga in Kajiado and Taita Taveta in Taita County. The rest has been overtaken by the stiff competition from the carbon fuel like kerosene that is found to be relatively cheap despite their unfriendliness to the environment.

Mortimer (2011) argues that, unlike Tanzania, Kenya has not had creativity in expanding its jatropha products market and neither has it made major strides in giving required information to its citizens on the importance of biofuel energy and the conservation of the environment according to the Kyoto Protocol. The government for example has never been seen promoting the production of alternative sources of energy through the mass media or its national government notices and gazettes as it does to other situations like the case of petroleum. This has for a long time limited the

future of the jatropha projects in the country because they are viewed as undertakings by the NGOs aimed at minting money for the foreigners and stealing from the innocent disadvantaged Kenyans. This has made it easy for the Tana Delta project for example experience a shrinking market from time to time and face both consumer rebellion and duties rebellions from the locals and at times from the county government and local politicians (World Bank, 2010).

2.5 Technology and Sustainability of Jatropha Projects in Tana Delta.

According to Ntayi et al. (2011), technology enhances competitiveness in business and also promotes industrial development. Competitiveness enables a firm to acquire customers and access to markets which constitute future profitable growth hence sustainability. Competitive forces drive firms to innovate in order to develop more efficient production processes and adjust their products in response to changing consumer demand. Technology transfer is the use of knowledge while application of technology refers to a process by which technology developed for one purpose is used either in a different application or by a new user. In line with a common thought by most developing countries that the transfer of technology from developed countries is significant element of growth, the investment efficiency to a great extent depends on the capacities of the firms to acquire new technologies and adopt them to local conditions.

Jatropha projects just like any business undertaking need to lower the production costs, increase quality of products and reach and expanded market. This can be only achieved by adoption of new technology and use of the technology in the projects survival. In the projects, technology will be significant in areas not limited to: quality seeds acquisition, pests and diseases control, irrigation, cultivation, harvesting, processing, marketing etc.(Chao et al., 2012).

2.5.1 Technology and Seeds Acquiring

According to Chao et al., (2012) up to 90% of the seeds used in the seedlings production of jatropha in east Africa have been imported from Germany in the years 2007-2013 with a kilo of dried quality seed going for up to 3euros. This has been attached to the fact that these seeds from Germany and other European countries are of high quality since they have been manufactured in high levels of technology and are thus drought resistant, pest and diseases resistant, mature faster and give high quality. Such technology is missing in east Africa in general; leaving most small scale jatropha producers with no option except that of using poor quality seeds that are vulnerable to diseases, droughts and minimal yields of bio oils.

In Kwale, Kajiado, Rachuonyo and Kilifi for example, farmers have been using crude methods of identifying seeds for nursery propagation, have been using crude methods of seeds preservation that include smoking of the seeds and to some extent some farmers in the Maasai Kajiado area have been using cattle dung to preserve the seeds; a factor that has for long left their seeds vulnerable to attacks from insects like weevils. The case has never been different in Tana Delta as now the projects imports only 40% of the planting seeds from Brazil while the rest is locally obtained and given to the factors; a factor that has disadvantaged the farmers who are newly investing in the jatropha planting to substitute the larger jatropha projects in the area. This factor of technology application in quality seeds production has been a challenge that has been researched by a great number of scholars operating in the sub-Saharan Africa (Muok et al.2010)

2.5.2 Technology and Pests and Diseases cubing

According to Pan & Xu (2011), pests and diseases have an effect of lowering yield and the survival of jatropha projects in Japan and Africa by almost a half. Therefore, modern technology must be employed in checking this. In their study in east Africa for example, they wrote on Control measures of pests and diseases of jatropha and argued that, Research on biological control measures using modern technology from India and Japan is ongoing in Kilifi, Nakuru, Kirinyaga, Shinyanga, Kigoma, Mbeya and Busia-Uganda, but currently there is no knowledge about the efficiency of various methods, so specific recommendations cannot yet be made (Raj et al 2011). However, methods that work with other crops may be efficient in jatropha too. It is also likely that local methods can be developed in many cases so experimentation is encouraged. Chemical pesticides are used successfully against major pests in *Jatropha curcus*, including: Pesticides containing Chlorpyrifos or Cyphenothrin are efficient against *Apthona* spp. Captafol at 3000 ppm is recommended as a dip for the eradication of super elongation disease (Lozano et al 1981) in cassava cuttings- It is likely to be efficient for *Jatropha* too, Collar rot can be controlled with 0.2% Copper Oxy Chloride (COC) or 1% Bordeaux drenching (FACT Seminar 2007), Bark eater (*Indrabela* sp.) and capsule borer can be controlled with a mixture of vitex, neem, aloe, Calatropis or Rogor @ 2 ml/lit of water. Alternatively, spraying Endosulfan @ 3 ml/lit of water can be used (Paramathma et al. 2004). Many countries have banned endosulfan (WFO, 2013).

Another technology being tried in projects in east Africa is 'Preventive Measures'. This entails: Use resistant jatropha varieties-presently there is no systematic knowledge about resistant varieties. However, non-diseased plants should be selected as "mother plants" for seeds and cuttings, Don't plant *Jatropha curcus* when the pest pressure is high- high pest pressure is normally found towards

the end of the rainy season when temperatures and the relative humidity is high. A recent study (Ovando , 2011) found that *Jatropha curcus* planted when the pest pressure was high showed increased infestation rates years after planting. According to the World Bank report of 2012, the adoption of sanitary measures can be taken as preventive measures. This includes: Disinfect tools used for cutting and pruning-alcohol, chlorine and household cleaners like Lysol are quite efficient but may not be feasible for small farmers (Cleaning with water, grass or sand is not very efficient for removing latex but is better than nothing, or if a fire is available flaming may be the most efficient low-cost method), If possible avoid using the same cutting & pruning tools for cassava and jatropha, Uproot diseased plants -inspection should preferably be done at least weekly during the first few months. If nurseries are used, inspection and "rogueing" should be part of the routine. Whiteflies, which are responsible for spreading important viruses, do not feed on wilted leaves, so they will usually not touch uprooted plants etc. However, the above has not been practised in Tana Delta and it is at the trial levels; leaving most of the projects at the hanging balance.

2.5.3 Harvesting Technologies

One of the main impediments to producing bio-oil from the jatropha plant in Kenya is the relatively high cost of harvesting. These high costs, compared to other oil-producing crops, have a number of causes: The jatropha fruit ripens over a long period (requiring weekly picking for weeks up to many months a year), The uneven ripening of the fruit means only some of the fruit of a bunch can be harvested at one time: (i.e. yellow, brown and black fruits are ripe and can be picked), The jatropha fruit can so far only be hand-picked. This requires a lot of time, as each fruit is small (e.g. three seeds in a fruit weigh about 2 grams), and The production of jatropha fruit on a hectare basis is moderate: i.e. the density of fruits in the field is low, requiring more transport distances in the field.

This makes manual picking of jatropha seeds more economical but very expensive; the commonly used harvesting method in Kenya (Peer Ab van, 2010). According to Scharschmidt (2010), it is good to first know that the definition of picking is not always well defined. For example, is it the picking proper; or does it also include bagging to the drying area; and transport to the pressing plant. It also is not always clear if it concerns dry seed or fresh seed. Data of general picking rates are found in a number of studies. The individual data show a large variation, but an average of all these figures however, provides useful indications, as shown below: Nicaragua 50 kg/day to 80 kg. The best pickers in Nicaragua harvest up to 30 kg of fruit/ hour, which would mean approximately 18 kg of seeds/hr, or 144 kg/day, Tanzania assumption, Picking seeds. Between 2 and 10 kg of seeds can be picked per hour, (it depends on the density of the plants).

In Kenya: collection of seeds: 2 kg of dry seeds in 1 hour- 52 kg/dry seed per day. In a number of case studies where relatively high picking rates were used (60kg dry seed/day), the operating costs of a jatropha plantation of approx US\$600 per ha per year, include roughly US\$200 in harvesting, more than 30% of the operating cost. Currently, under the presumption that only manual harvesting is possible, it appears that jatropha is not a good choice for planting for a country where the labour costs exceed approximately US\$4/day. This rule of thumb is based on experience in several projects over the period 1999-2012. The alternative is mechanical picking, and although not fully developed in Kenya, this might bring down costs in the future.

Mechanical harvesting solutions are seen as the only solution attached with new technology in lowering cost in Kenyan jatropha harvesting. Due to increasing labour costs, mechanical systems were developed and allowed for substantial expansion of areas. The obvious way of looking at the problem is comparing plants with similar size of fruit and ripening patterns and how they are mechanically harvested. The next step is to try to adapt the technology to jatropha. Plants with similar-sized fruit are a number of nut trees, like walnut, and fruit trees like apricot and cherry. Also olive and grapes can be compared, but to a lesser extent. Jatropha fruit are best harvested when yellow. Seeds from dried fruits have slightly lower oil content, while green fruit are low in oil. Jatropha seeds build up Free Fatty Acids (FFA) once they have ripened and lie on the ground (Sulle and Nelson , 2009).

Several mechanical harvesting techniques for plants with a similar fruit size and shape as jatropha exist. These modern technologies in harvesting includes: Tree or stem shakers - A mechanical grip system is put to the stem and then it is shaken so that all ripe fruits fall down (for jatropha this might work if the grip/tool has the ability to open the fruit when drying, or when the yellow fruit will fall down when shaken), Nets to prevent fruits falling on the ground -These nets prevent the fruit from bruising and rotting on the ground. For jatropha, such nets can be interesting if the yellowing or ripe fruit would easily be shaken off while the green ones would not (Jatropha fruit, once on the ground, will lose their seeds. Seeds do not easily decay on the ground. Nets need to be relatively small gauge as the fruit/seeds are of small diameter of less than 6 to 8 mm, Strippers - In this case the branches are raked and all fruit are stripped off the branches (this poses a problem in the ripening of the Jatropha fruit. If the fruit ripen over a longer period, the stripping of the branches is not adequate. The stripping also would require the branches to be strong and flexible enough not to break)(Sulle and Nelson, 2009).Many other methods of modern harvesting exist but the challenge is that the jatropha projects in Kenya are still far behind in applying these methods (Word bank, 2012)

2.6 Conceptual Framework

The conceptual framework outlines the dependent, independent moderating and intervening variables as discussed in the literature review and elaborated in the Figure 1 below.

Independent variables

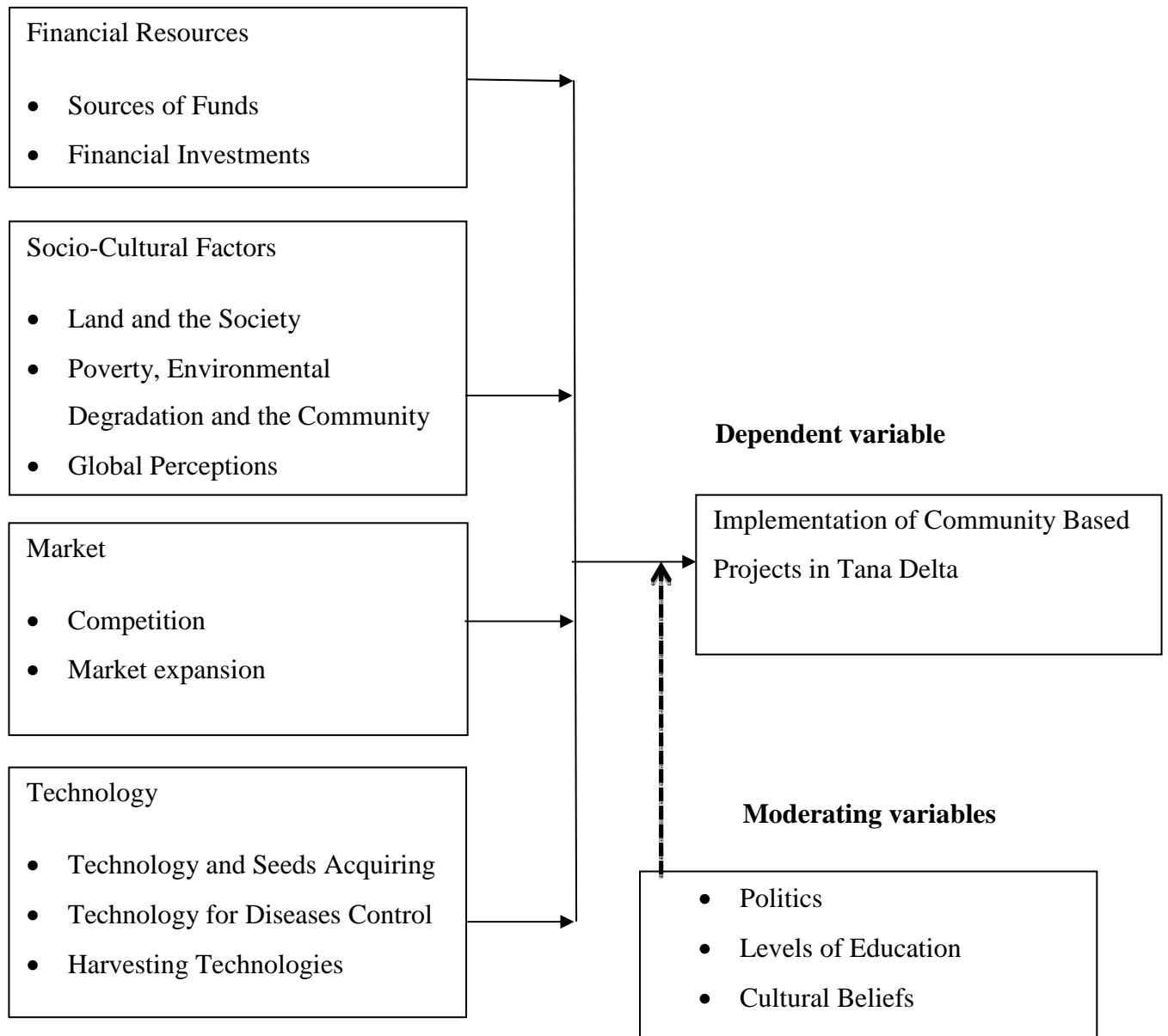


Figure 1: Conceptual Framework

From the conceptual framework above, a number of variables called independent variables are interacting to determine the future of community based projects in the Tana Delta with emphasis on the jatropha project that is considered to be the dependent variable. The independent variable include: financial resources, socio-cultural factors, market and technology. These factors from the literature have played a role to see the jatropha project be where it is today, though some of them

like technology that is poor are limiting, lack of sufficient finances has put the projects at the miniscule roads and the ever competition for the markets and the high rates of shrinking of these markets has been a challenge.

Both intervening variables and extraneous ones have also been introduced to give the wider scope of the intermingles that are limiting/accelerating the implementation of these jatropha projects in the county.

2.7 Summary of Literature Review

A series of researches have been carried out in the world on jatropha projects and their sustainability. However, no study has been done in the Tana Delta jatropha project to address the factors of its future sustainability. The research therefore intends to address the factors that are paying a vital role in determining the future of the jatropha projects in the Tana Delta area with emphasis on how the community has implemented the project. This chapter highlights the theoretical reviews of literatures which is guided by the objectives and are under different sub-topics which are: market, financial resources, socio-cultural factors and the influence of technology. The chapter also highlights the conceptual framework, relationship between variables and research gaps.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design employed in the study putting into perspective the characteristics of the target population, Sampling procedure and Sampling size ,Data collection instruments ,Pilot testing of the instruments, Validity of the instrument, reliability of the instrument ,Data collection procedure, Data analysis techniques, Ethical consideration and Operationalization.

3.2 Research Design

This research was a descriptive study concerned with finding out what, where and how of a phenomenon. The study used quantitative research method, however some aspects of qualitative approach were used in order to gain better understanding concept is to select several targeted cases where an intensive analysis was to identify the possible alternatives for solving the research questions on the basis of existing solution applied in the selected.

Research design provides an operational framework within which the facts are placed, processed through analyzing procedures and the valuable research output is produced. Research design is therefore defined as the structure of the research, it's the "glue "that holds all elements in a research project together (Donald, 2006). The research problem will be studied through the use of descriptive research design. The study attempts to describe and define a subject, often by creating a profile of group of problems (Cooper and Schnindler, 2003). Thus Tana Delta jatropha project was the focus of the study which will provide a natural setting on which data was collected.

3.3 Target Population

The study population targeted all the employees of the jatropha project in the Tana Delta and other small scale jatropha projects holders. Target population was the 3200 women and men who have benefited from the jatropha project as direct employees, casual labours, or community project implementation between 2009- May 2015 as per the recorded figures obtained from the International jatropha projects management system. According to Julke (2009) the element of the target population are often people, households or companies for the purpose of use within a survey.

Table 3.1: Target Population

Name of Category	Number Workers 2009-May 2015	Percentage
Permanent Employees	320	10 %
Contract Employees	800	25%
Casual Laborers	1000	31.25%
Small Scale Producers	1080	33.75%
Total Target Population	3,200	100%

Source: Ministry of Energy, 2014.

3.4. Sample Size and Sampling Procedure

Sampling means deliberately limiting the number of cases in the study. It involves a risk of study finding being not true for some of the left out cases, but this risk can often be calculated and restricted on a tolerable levels.

3.4.1. Sample Size

The researcher used Yamane formula (Yamane 1967) to calculate the population sample size. According to Evans (2000) sample size is the number of observation in a sample. The actual sample of the population will be drawn using stratified simple random procedure. As EHS manual (2011) (as quoted by Tolonen 2008) that sample size relates to statistical precision of survey results, whereas bias is the concern related to low response rate

Sample size calculation (Yamane formula 1967)

$$n^o = N / (1 + Ne^2)$$

$$n^o = \frac{3200}{1 + 3200(0.1)^2} = 96.96$$

$$n^o = 97 \text{ respondents}$$

Where:

n^o = sample size

N = the population size

e^2 =error limit at 95% level of confidence.

97 responses was therefore the lowest acceptable number of responses to maintain a 95% confidence level and a 10% error level. The sample size formulas provide the number of responses that need to be obtained. Many researchers commonly add 10% to the sample size to compensate for persons that the researcher is unable to contact.

Table 3.2 sample size

Population (N)	Number Workers 2009-May 2015	Sample size (N/3200x97)
Permanent Employees	320	10
Contract Employees	800	24
Casual Laborers	1000	30
Small Scale Producers	1080	33
Total Target Population	3,200	97

3.4.2 Sampling Procedure

This research applied both probability and non-probability sampling techniques and they included purposive sampling and stratified sampling techniques to collect data. Across sectional study was conducted where a total of 97 men and women involved in Jatropha projects in Tana Delta were considered. Sampling techniques provide a range of methods that facilitate to reduce the amount of data, there is need to collect data from the subgroup rather than all cases or elements. At the time of conducting research, it's often impossible or too expensive to collect data from all the units of analysis included in the research problem.

Ngechu (2004),emphasized the importance of selecting a representative sample through making a sample frame, A population frame is a systematic list of subjects ,elements, traits or objects to be

studied, in this study population frame of the required number of subject ,respondents and elements were selected in order to make a sample. Sampling ensures that elements of a population are selected as riding representative of the population (Keya, 1989). The study used stratified random sampling, this procedure helped minimize bias in the study and increase the level of the finding. Stratified sampling technique divides the population in different strata. According to Kerry and Bland (1989) the technique produce estimates of overall population parameters with greater precision and ensures more representative sample is derived from a relatively homogeneous population. Stratification aims at reducing standard error by proving some control over variance (Cooper and Schindler, 2003).By using Yamane formula of sample size with an error of 10%and 95% degree of confidence(Yamane 1967).The calculation of 3200n (previous workers) approximately came up with a sample of 97respondents.

3.5 Data Collection Instruments

The study employed the use a survey questionnaire administered to women and men who are involved in one way or the other with jatropha curcus projects in Tana Delta. The questionnaire was designed to have both open and close ended question. The closed ended question provided more structured response to facilitate tangible recommendation. It was also be used to test rating of various attributes. Open ended questions helped in gathering additional information. The questionnaire was carefully designed and tested to enhance validity and accuracy required while collecting data in this research. According to Ngechu (2004) the choice of tool and instrument depends on the attributes of the subject, research topic, problem question, objectives and expected results. Primary data was gathered and generated from respondents while secondary data were gathered from related literature, books, research work, and internet among other sources.

3.5.1 Pilot Testing of the Instrument

Content validity will measure the degree to which data to be collected using a particular instrument represents a specific domain or content of a concept. In order to minimize errors in the questionnaire, a pilot testing was done by half split test. The pilot study helped reduce ambiguity, vague items or words that have been unidentified during formulation of the tool. Berg and Gall (1989) defines validity as the degree by which the sample of test item represents the content the test is designed to measure.

3.5.2 Validity of the Instruments

To establish validity of the research instrument the study sought the opinion of experts in the field of the study. Validity of the questionnaire assessed content of the questionnaire to determine whether it addresses all relevant aspects of variable and whether the results correlate sufficiently. The study compared the results from different questionnaires to help assess their accuracy. The most important criterion of research is validity. Validity is concerned with the integrity of the conclusions that are generated from a piece of research. It was also concerned with whether or not the items actually elicit the intended information. Validity suggests fruitfulness and refers to the match between a construct, or the way a study conceptualizes the idea in a conceptual definition and the data generated. It refers to how well an idea about reality fits in with actual reality. Qualitative research is usually aimed at giving fair, honest and balance account of social life from the view point of someone who lives it every day (Neumann, 2003).

In other words, validity is concerned with whether the findings are really about what appears to reality on the ground. Validity defined as the extent to which data collection method(s) accurately measure what they are intended to measure (Saunders, 2003). According to Yun (2003), "he states that no single source has a complete advantage over others". The different sources are highly complementary, and a good case study should use various sources of evidence and when applied they will confirm the validity of data and relevant results.

3.5.3 Reliability of Instruments

Validity of the questionnaire was assessed through the use of half split test method. Split half designs are commonly used in survey research to experimentally determine the difference between two variations of survey protocol characteristics, such as the data collection mode, the survey recruitment protocol, or the survey instrument. Reliability of the instrument was done using Cronbach's Alpha to measure internal consistency by establishing if certain item within the scale measures the same construct. According to Kilin (2003) established that Alpha value threshold at 0.6 thus forming the study benchmark. Cronbach's Alpha was established for each objective which formed the scale. The reliability value exceeded the prescribed threshold of 0.6 with a mean score of 0.806. Random assignment of sample members to the different treatments is crucial to ensure the internal validity of the experiment by guaranteeing that, on average, any observed differences between the two groups can be attributed to treatment effects rather than to differences in sub

sample composition half split test have been successfully used in various survey settings to study reliability of the instruments.

Samples of 20 questionnaires were used to test validity of the tool where they were randomly divided into two (odd and even numbers) sets. According to Gomm (2008), reliability determines the consistency of a research instrument in its performance. In this type of experimental design, the sample is randomly divided into two halves, and each half receives a different treatment.

3.7 Data Collection Procedure

Data was collected by the use of questionnaires and with the aid of research assistants supervised by the leader. Respondents were the workers, managers, casuals and other small scale handlers of jatropha projects in Tana Delta. They were required to fill the questionnaires and in cases where one could not read/write, the research assistants were used for translations.

3.8 Data Analysis Techniques

Before processing the responses, questionnaires were edited for completeness and consistency. Quantitative data collected was analyzed by the use of descriptive data analysis using Statistical package for the social sciences to generate frequency tables and range of scores from indicators of closes ended questions on the independent variables. A descriptive data analysis was used since it assisted in generating summaries and organizes data effectively and in a meaningful way. According to Nachamias, (1996) it provides tool for describing collection of statistical observations and reducing information to an understandable form. The data from open ended questions were analyzed by examining the responses to identify any major patterns, trends and a summary of whatever was discovered from the responses generated. These were then interpreted in a descriptive text incorporating narratives directly from the respondents.

According to Baulcomb(2003), content analysis uses a set of categorization for making valid and replicable inference from data to their context. The data was broken into different aspects of factors that would influence sustainability of jatropha projects in Tana Delta. Data collected was analyzed both qualitatively and quantitatively as appropriate. Hypothesis was tested by use of Chi-square.

Data was analyzed using the SPSS programme to group data since the programme has the capability of handling recurring needs of data analysis. This enabled the researcher record variables and effect transformations.

3.9 Ethical Considerations

Ethical consideration included, but not limited to; respect of respondent privacy and freedom, the right to self-determination, autonomy, volunteerism, confidentiality and safety. While caring out this research, research assistants sought voluntary informed consent of participants before administering the questionnaire, and without subjecting them to any form of threat or undue influence. The respondents were assured that their participation was to be kept confidential and used solely for purpose of this research and they were to remain anonymous; they were not allowed to write their names on the questionnaire. Appropriate chain of command was observed such as obtaining prior government approval where applicable before commencing the process of collecting data. Ethics refers to matters of what is right and wrong. Anyone involved in any form of research should be aware of agreements shared by a researcher(s) and participants about what is proper and improper while conducting a research (Babbie and Mouton, 2001).

3.10 Operation of Variables

The variable of the study are operationalized and indicators determined as indicated by the table below, all the variables were measured at nominal scale.

Table 3.2 Operational Table

Objective	Variable	Indicators	Measurement scale	Types of analysis
To determine the extent to which financial resources influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.	Financial Resources	Sources of Financial Resources Financial Investments	Nominal Scale Ordinal	Descriptive
To examine the extent to which socio-cultural factors influence the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.	Socio-Cultural Factors	Land and the Society Poverty, Environmental Degradation and the Community Global Perceptions	Nominal Scale Ordinal	Descriptive
To examine the extent to which the market influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.	Market	Competition Market expansion	Nominal Scale Ordinal	Descriptive
To establish the extent to which technology influences the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.	Technology	Technology and Seeds Acquiring Technology for Diseases Control Harvesting Technologies	Nominal Scale Ordinal	Descriptive

CHAPTER FOUR

DATA PRESENTATION AND INTERPRETATION

4.1 Introduction

The data collected was keyed and analyzed by simple descriptive analysis using Statistical Package for Social Scientists (SPSS). The data was then presented through frequency tables and narrative analysis.

4.2 Response from the Field

In the study, ninety questionnaires were administered to ninety seven respondents in the various categories but seven were not returned achieving high (92.78%) response from the participant.

4.3 Background Information

The information concerning the gender of the respondents, ages, working experience were sought for and information below reached at.

4.4 Responses on Financial Resources

The research sought to find out whether respondents felt that finances have an influence in the sustainability of community projects in Tana Delta like the *Jatropha Curcus* project and results below arrived at.

Table 4.1 Response of Finances

Response	Frequency	Percentage
No	30	33.33%
Yes	60	66.67%
Total	90	100%

From the responses, 33.33% of the respondents felt that financial resources have no major influence in the sustainability of the *Jatropha* projects in Tana Delta while the remaining 60 who represented 66.67% went for yes. Those for yes when asked to support their answer they argued that, financial resources are central in the acquisition of quality farm inputs, necessary labour, relevant market identification and many more. Those for no felt that financial resources alone are not sufficient since other factors like; government support, community stability and perceptions play a central role.

Table 4.2 Basic Information on the Respondents

Response	Frequency	Percentage	Total
Gender			
F	(30)	33.3 %	
M	(60)	66.7 %	
			90
Age Bracket in years			
18-30	(21)	23.33%	
31-40	(45)	50.0%	
41-50	(18)	20.0%	
Over 51	(6)	6.67%	
			90
Academic qualifications			
Secondary	(45)	50%	
Diploma	(27)	30%	
Bachelor's degree	(18)	20 %	
			90
Work Experience			
Less than 1 year	(54)	60%	
1-2 years	(18)	20%	
2-4 years	(9)	10%	
Over 5 years	(9)	10%	
			90
Average Total		100%	90

From the responses gotten in the field, 30 respondents were women who represented 33.33% while the remaining 60 respondents who represented 66.67 percent were male.

From the table also, ages between 18-30 attracted 21 respondents, 31-40 attracted 45 respondents, 18 respondents were between ages 41-50 while over 51 age bracket attracted 6 respondents.

Respondents with secondary education were 45 representing 50%, 30 percent representing 27 went for diploma while the remaining 18 respondents who represented 20% went for bachelor degree. The remaining two categories didn't have respondents.

Finally, 60% of the respondents were of less than 1 year experience, 20% went for between 1-2 years, 10% were of 2-4 years while the remaining 9 who represented 10% had over 5 years' experience.

Table.4.3 Rating of Financial resources on a scale

Respondents were asked on a scale of 1-5 where 1= strongly disagree; 2 = disagree; 3 =weakly agree; 4 =agree; 5 = strongly agree the issues below in relation to the sustainability of jatropha projects in Tana Delta and results below reached at:

Statement	1	2	3	4	5
Sources of Financial Resources influence the future of Jatropha projects.	6	4	15	15	50
Financial Investments is a strategy that influences jatropha projects sustainability.	6	10	12	30	32
Varied sources of finances for the project enable its continued operations.	5	12	13	17	43

In relation to the statement that read, Sources of Financial Resources influence the future of Jatropha projects, 6 went for strongly disagree, 4disagree, 15 weakly agree, 15agree while the remaining 50 went for strongly agree. On the second statement that read, Financial Investments is a strategy that influences jatropha projects sustainability, 6 went for strongly disagree, 10 went for disagree, 12 for weakly agree, 30 for agree while the remaining 32went for strongly agree. Finally, a number of respondents went for different options in relation to the statement, varied sources of finances for the project enable its continued operations as sown below.5went for strongly disagree, 11 went for disagree, 13 for weakly agree, 17 for agree while the remaining 43 went for strongly agree.

4.5 Hypothesis Testing

H₁: Financial resources have an influence in the sustainability of jatropha curcus growing project in Garsen constituency, Tana Delta County.

Table 4.4 Showing Chi-Square Testing

O	E	(O-E)	(O-E) ²	(O-E) ² /E
6	18	-12	144	8
4	18	-14	196	10.89
15	18	-3	9	0.5
15	18	-3	9	0.5
50	18	32	1024	56.89
				$\sum (O-E)^2/E = 76.78$

$\chi^2_{c=76.78} > \chi^2_{0.05} = 9.488$ at 4 degrees of freedom and 5% level of confidence.

Since the calculated chi-square value of 76.78 is greater than the critical chi-square value at 5% level of confidence, we accept the alternative hypothesis. Thus, financial resources have an influence in the sustainability of jatropha Curcus growing project in Garsen constituency, Tana Delta County.

4.6 Socio-Cultural Factors

Respondents were asked whether they thought that social cultural factors influence the sustainability of jatropha projects in Tana Delta and their responses were as shown below:

Table 4.5 Responses on Socio-Cultural Factors

Response	Frequency	Percentage
No	18	20%
Yes	72	80%
Total	90	100%

From the response, 20% of the respondents felt that social cultural factors have no influence in the sustainability of jatropha projects in Tana while the remaining 72 who represented 80% went for the idea. This was supported by an average of 80% of the respondents who gave an explanation that without the community giving their lands for plantation as opposed to grazing, the jatropha plant will miss a place to grow. Also they argued the levels of poverty have forced the local community to start participating in subsistence farming thus affecting the small scale production of jatropha. Those who went for no had not mentioned any apparent reasons to support their reasoning.

Table 4.6 Degree of Socio-Cultural Factors

Respondents asked a question that read, ‘to what extent do you agree or disagree with the following statements? Use a scale of 1-5 where **1= strongly disagree; 2 = disagree; 3 =not sure; 4 =agree; 5 = strongly agree.**

Statement	1	2	3	4	5
Land and the Society Poverty influences jatropha projects sustainability.	5	10	15	21	39
Environmental Degradation and the Community influences sustainability.	11	5	6	28	40
Global Perceptions about jatropha project influences the project sustainability.	7	8	11	14	50

From the table, 5 respondents went for strongly disagree in relation to the idea that said, Land and the Society Poverty influences jatropha projects sustainability, 10 went for disagree, 15 went for not sure, 21 agreed while the rest 39 strongly agreed with the idea. In relation to the second statement that said, Environmental Degradation and the Community influences sustainability, 11 strongly disagreed, 5 disagreed, 6 were not sure, 28 agreed while 40 strongly agreed. Finally, Global Perceptions about jatropha project influences the project sustainability attracted 7 who strongly disagreed, 8 disagreed, 11 were not sure, 14 agreed while 50 strongly agreed.

4.7 Hypothesis Testing

H₁: Socio-cultural factors have an influence in the sustainability of jatropha Curcus growing project in Garsen constituency, Tana Delta County.

Table 4.7 Showing Chi-Square Testing

O	E	(O-E)	(O-E) ²	(O-E) ² /E
5	18	-13	169	9.39
10	18	-8	64	3.56
15	18	-3	9	0.5
21	18	3	9	0.5
39	18	21	441	24.5
				$\sum (O-E)^2/E = 38.45$

$\chi^2_C = 38.45 > \chi^2_{0.05} = 9.488$ at 4 degrees of freedom and 5% level of confidence.

Since the calculated chi-square value of 38.45 is greater than the critical chi-square value at 5% level of confidence, we accept the alternative hypothesis. Thus, socio-cultural factors have an influence in the sustainability of jatropha Curcus growing project in Garsen constituency, Tana Delta County.

4.8 Market

The respondents were asked to whether they supported the idea that both the global and local markets influence the sustainability of jatropha curcus projects in the Tana delta. Their responses were as follows in table 4.11 below.

Table 4.8 Market and Sustainability

Response	Frequency	Percentage
No	27	30%
Yes	63	70%
Total	90	100%

From the responses, the no attracted 27 respondents who translated to 30% while the yes idea had a majority at 70% composed of 63 respondents. In the idea section where the respondents were given an open ended question which required them to give their reasons, over 70% of the respondents said that what demoralizes people is the idea that the market for their products from jatropha is shrinking

every day and is getting limited from time to time due to the fact that petroleum has taken centre stage in fuel use.

Table 4.9 Rating of Market and Sustainability of Projects

The respondents were asked to show how they agreed or disagreed with the following. (1= strongly disagree; 2 = disagree; 3 =not sure; 4 =agree; 5 = strongly agree.)on a scale and the reports below were reached on.

Statement	1	2	3	4	5
Competition from both east Africa countries and global giants influences sustainability.	5	7	14	35	29
Market expansion has an influence in the sustainability of jatropha projects.	4	6	12	30	38

On the idea of competition from both east Africa countries and global giants' influences sustainability, 5 respondents strongly disagree, 7 disagreed, 14 were not sure, 35 agreed while the remaining 29 strongly agreed. Market expansion has an influence in the sustainability of jatropha projects attracted 4 respondents who strongly disagreed, 6 who disagreed, 12 who were not sure, 30 who went for agreeing while the rest 38 strongly agreed.

4.9 Hypothesis Testing

H₁.Marketing has an influence in the sustainability of jatropha Curcus growing project in Garsen constituency, Tana Delta County.

Table 4.10 Chi-Square Testing for the Third Hypothesis

O	E	(O-E)	(O-E) ²	(O-E) ² /E
4	18	-14	196	10.89
6	18	-12	144	8
12	18	-6	36	2
30	18	12	144	8
38	18	20	400	22.22

$$\sum (O-E)^2/E = 51.11$$

$\chi^2_C = 51.11 > \chi^2_{0.05} = 9.488$ at 4 degrees of freedom and 5% level of confidence.

Since the calculated chi-square value of 51.11 is greater than the critical chi-square value at 5% level of confidence, we accept the alternative hypothesis. Thus, Marketing has an influence in the sustainability of jatropha Curcus growing project in Garsen constituency, Tana Delta County.

4.10 Technology

Respondents were asked to rate the extent to which the following factors influence the sustainability of jatropha projects. Using a scale of 1-5 where, not at all =1, little extent =2, moderate extent=3, great extent =4, very great extent =5)and gave the following

Table 4.11 Rating of technology Factors

Factor	1	2	3	4	5
Technology for jatropha seeds acquisition influence sustainability.	5	8	7	25	45
Technology for jatropha diseases control influence sustainability.	3	4	4	15	79
Jatropha harvesting technologies influence sustainability.	7	12	10	18	43

From the responses, 5 respondents went for not at all in relation to the idea that read, technology for jatropha seeds acquisition influences sustainability, 8 went for little extent, 7 went for moderate extent, 25 went for great extent while the remaining 45 went for very great extent. In relation to technology for jatropha diseases control influence sustainability, 3 went for not at all, 4 went for little extent, 4 went for moderate extent, and 15 went for great extent while the remaining 79 went for very great extent. Finally, on the idea that Jatropha harvesting technologies influence sustainability attracted 7 respondents who went for not at all, 12 who went for little extent, 10 went for moderate extent, 18 went for great extent while the remaining 43 went for very great extent. When asked to give some reasons, over 75 respondents argued that if modern technology was applied in providing drought resistant seeds, control pests and diseases, do the harvesting of the seeds etc., the projects would continue to operate for long.

4.11 Hypothesis Testing on Technology

H₁. Technology has an influence in the sustainability of jatropa Curcus growing project in Garsen constituency, Tana Delta County.

Table 4.12 Hypothesis Testing

O	E	(O-E)	(O-E) ²	(O-E) ² /E
3	18	-15	225	12.5
4	18	-14	196	10.89
4	18	-14	196	10.89
15	18	-3	9	0.5
79	18	61	3721	206.72
				$\sum (O-E)^2/E = 241.5$

$\chi^2_{C=241.5} > \chi^2_{\alpha, 0.05} = 9.488$ at 4 degrees of freedom and 5% level of confidence.

Since the calculated chi-square value of 241.5 is greater than the critical chi-square value at 5% level of confidence, we accept the alternative hypothesis. Thus, technology has an influence in the sustainability of jatropa Curcus growing project in Garsen constituency, Tana Delta County

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study findings, discussions, conclusion and recommendations of the research. The chapter also contains suggestions of related studies that may be carried out in the future.

5.2 Summary of Findings

The purpose of this study was to examine the factors influencing the sustainability of rural community based projects; a case study of jatropha Curcus growing project in Garsen constituency, Tana Delta County. From an analysis and review of the research data and additional data gathered through questionnaires, the following became apparent.

From objective one that sought to determine the extent to which financial resources influence the sustainability of jatropha curcus growing project in Garsen constituency, the following results were arrived at. 33.33% of the respondents felt that financial resources have no major influence in the sustainability of the Jatropha projects in Tana Delta while the remaining 60 who represented 66.67% went for yes. Those for yes when asked to support their answer they argued that, financial resources are central in the acquisition of quality farm inputs, necessary labour, relevant market identification and many more. In a rating scale, in relation to the statement that read, Sources of Financial Resources influence the future of Jatropha projects, 6 went for strongly disagree, 4 disagree, 15 weakly agree, 15 agree while the remaining 50 went for strongly agree. In relation to the statement, varied sources of finances for the project enable its continued operations as sown below.5 went for strongly disagree, 11 went for disagree, 13 for weakly agree, 17 for agree while the remaining 43 went for strongly agree.

In relation to the second objective which sought to examine the extent to which socio-cultural factors influence the sustainability of jatropha curcus growing project in Garsen constituency, 20% of the respondents felt that social cultural factors have no influence in the sustainability of jatropha projects in Tana while the remaining 72 who represented 80% went for the idea. This was supported by an average of 80% of the respondents who gave an explanation that without the community giving their lands for plantation as opposed to grazing, the jatropha plant will miss a place to grow. Also the argued the levels of poverty have forced to local community to start

participating in subsistence farming thus affecting the small scale production of jatropha. On a rating, 5 respondents went for strongly disagree in relation to the idea that said, Land and the Society Poverty influences jatropha projects sustainability, 10 went for disagree, 15 went for not sure, 21 agreed while the rest 39 strongly agreed with the idea. In relation to the second statement that said, Environmental Degradation and the Community influences sustainability, 11 strongly disagreed, 5 disagreed, and 6 were not sure, 28 agreed while 40 strongly agreed.

On the third objective that sought to examine the extent to which the market influences the sustainability of jatropha curcus growing project in Garsen constituency, from the responses, the no attracted 27 respondents who translated to 30% while the yes idea had a majority at 70% composed of 63 respondents. In the idea section where the respondents were given an open ended question which required them to give their reasons, over 70% of the respondents said that what demoralizes people is the idea that the market for their products from jatropha is shrinking every day and is getting limited from time to time due to the fact that petroleum has taken centre stage in fuel use. On a rating scale, the idea of competition from east Africa countries and global giants' influences sustainability had 5 respondents who strongly disagreed, 7 disagreed, and 14 were not sure, 35 agreed while the remaining 29 strongly agreed. Market expansion has an influence in the sustainability of jatropha projects attracted 4 respondents who strongly disagreed, 6 who disagreed, 12 who were not sure, 30 who went for agreeing while the rest 38 strongly agreed.

In relation to the fourth objective that sought to establish the extent to which technology influences the sustainability of jatropha curcus growing project in Garsen constituency, 5 respondents went for not at all in relation to the idea that read, technology for jatropha seeds acquisition influences sustainability, 8 went for little extent, 7 went for moderate extent, 25 went for great extent while the remaining 45 went for very great extent. In relation to technology for jatropha diseases control influence sustainability, 3 went for not at all, 4 went for little extent, 4 went for moderate extent, and 15 went for great extent while the remaining 79 went for very great extent. Finally, on the idea that Jatropha harvesting technologies influence sustainability attracted 7 respondents who went for not at all, 12 who went for little extent, 10 went for moderate extent, 18 went for great extent while the remaining 43 went for very great extent.

5.3 Discussion of Findings

Results from the above have shown a number of respondents and views from the field are tied with the finding in the review of the secondary information in chapter two. For example, from objective one that sought to determine the extent to which financial resources influence the sustainability of jatropha curcus growing project in Garsen constituency, the following results were arrived at. 33.33% of the respondents felt that financial resources have no major influence in the sustainability of the Jatropha projects in Tana Delta while the remaining 60 who represented 66.67% went for yes. Those for yes when asked to support their answer they argued that, financial resources are central in the acquisition of quality farm inputs, necessary labour, relevant market identification and many more. In agreement to this, in their study about the future of Jatropha Curcus projects in Zambia, Malawi and Tanzania, Andreasson and Richard (2011) stressed that financial resources are of great significance for any jatropha project to run / operate smoothly. Just like any projects that require financial resources investments, the jatropha projects require massive finances for their operations and survival. The major finances required in this case include money for labour, seed protection, land obtaining, technology and many more. This is further supported by scholars Belewu et al. (2010) who argue that financing an emerging technology such as Jatropha curcus with extra equity to absorb the need for on-going varietal and good agricultural practices research is necessary in both developed and developing countries. Setting up management teams with different expertise during the set up and establishment phases is a factor that requires huge finances that could be far ahead of the finances available for use by the projects.

In relation to the second objective which sought to examine the extent to which socio-cultural factors influence the sustainability of jatropha curcus growing project in Garsen constituency, 20% of the respondents felt that social cultural factors have no influence in the sustainability of jatropha projects in Tana while the remaining 72 who represented 80% went for the idea. This was supported by an average of 80% of the respondents who gave an explanation that without the community giving their lands for plantation as opposed to grazing, the jatropha plant will miss a place to grow. Also they argued the levels of poverty have forced the local community to start participating in subsistence farming thus affecting the small scale production of jatropha. On a rating, 5 respondents went for strongly disagree in relation to the idea that said, Land and the Society Poverty influences jatropha projects sustainability, 10 went for disagree, 15 went for not sure, 21 agreed while the rest 39 strongly agreed with the idea. When this is linked to the literature review, a study by GTZ (2013) on the Jatropha projects in Zimbabwe, Zambia, Tanzania and

Ethiopia found some of the strongest socio cultural factors that were determinants of sustainability to be: land tenure system, perception towards the jatropha curcus plant and the agricultural food plants, education and levels of community awareness/knowledge and many more. Also, Friends of the Earth (2010) argue that any project in the world is just part and parcel of the community. It eats from the community and gives back to the community. They further argue that, a project is just like a young child interacting with the environment/community and once the child gets well with what the society holds, he/she will be progressively valued and once the child deviates, the society disregard and at times disowns the child.

On the third objective that sought to examine the extent to which the market influences the sustainability of jatropha curcus growing project in Garsen constituency, from the responses, the no attracted 27 respondents who translated to 30% while the yes idea had a majority at 70% composed of 63 respondents. In the idea section where the respondents were given an open ended question which required them to give their reasons, over 70% of the respondents said that what demoralizes people is the idea that the market for their products from jatropha is shrinking every day and is getting limited from time to time due to the fact that petroleum has taken centre stage in fuel use. On a rating scale, the idea of competition from east Africa countries and global giants' influences sustainability had 5 respondents who strongly disagreed, 7 disagreed, and 14 were not sure, 35 agreed while the remaining 29 strongly agreed. In agreement to this, in their research on economic viability of jatropha projects in Shimba Hills in Kwale County, Mogaka M. et al (2009) singled out market as the major booster of cultivating and upbringing of the plant as opposed to the green fuel friendliness of its product. Athanne (2011) argues that to have a good chance of survival, all the projects need to know the target market and their products. The failure of projects to know their market targets, market changes and trends within the preferences of the customers has left many projects fail after sometimes. He adds on that, minor fluctuations in markets can topple a newly established product/project, particularly where it is reliant on a small number of customers.

In relation to the fourth objective that sought to establish the extent to which technology influences the sustainability of jatropha curcus growing project in Garsen constituency, 5 respondents went for not at all in relation to the idea that read, technology for jatropha seeds acquisition influences sustainability, 8 went for little extent, 7 went for moderate extent, 25 went for great extent while the remaining 45 went for very great extent. In relation to technology for jatropha diseases control influence sustainability, 3 went for not at all, 4 went for little extent, 4 went for moderate extent, and 15 went for great extent while the remaining 79 went for very great extent. This has been

shown by Chao *et al*(2012) who argue that, Jatropha projects just like any business undertaking need to lower the production costs, increase quality of products and reach and expanded market. This can be only achieved by adoption of new technology and use of the technology in the projects survival. In the projects, technology will be significant in areas not limited to: quality seeds acquisition, pests and diseases control, irrigation, cultivation, harvesting, processing, marketing etc.

5.4 Recommendations

Based on the findings of the study that has come from the respondents in the field and the literature review, the researcher recommends that the for the survival and continued operations, besides the future success of the jatropha fuel projects in Kenya, both the NGOs, CBOs, ministry of energy and county government of Tana River must avail sufficient funds to both the farmers and the expertise. This money will be used for acquisition of quality seeds, technology, land space, market expansion and many more; a factor that will see the future survival of the projects.

In relation to the second objective, the researcher recommends that both the county government and the national government through various stakeholders should come up with regulations that will give the local community enough education in relationship to jatropha propagation, land use, poverty trends perceptions and hopes for change in the land use criteria and many more. Also security in Tana Delta should be checked on so that projects like this for jatropha can have a tomorrow.

The study farther recommends that the ministry of energy and that aimed at environmental conservations should come up with strategies that should popularize the products of jatropha just like Tanzania has done. This will give the jatropha projects in Kenya a wider coverage that is normally tied with increased financial gains thus increased production and survival of the projects.

Finally, the researcher recommends that modern technology should be subsidized and availed for both projects running and jatropha production. For example, seeds that have undergone modern standardization, modern pests and diseases control, modern non-defective fertilizers and modern harvesting/storage technology should be applied so that the projects continue with their production. This will ensure their operations for long.

5.5 Suggestions for Further Research

- i. Due to the nature of the study, this study was carried out in one constituency in county only and therefore, similar studies can be done in other constituencies in the , county, other counties and in the whole country.
- ii. This research can be re-done again as in a way that the researcher will pick both the factors taken as the extraneous and intervening factors and making them the central points for the objectives of study. Also, someone can re-do the objectives studied above because the time spent in this study was not enough to cover all the massive information available in the region.
- iii. Finally, a study can be done to examine the negative impact of jatropha Curcus projects implementation in Tana River County.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

“Factors Influencing the Sustainability of Rural Community Based Projects: A Case of Jatropha Curcus growing project in Garsen constituency, Tana Delta County Kenya.”

Researcher: Eva MayaaManase

Address : P.O Box 82156-80100

Mombasa .

Phone : 0712262095

E-mail : manaseeva@yahoo.com

Dear participant,

My name is Eva Manase and I am a student undertaking a Master of Arts Degree in Project Planning and Management at the University of Nairobi. To fulfill the completion of this course, I am carrying out a study on the factors influencing the sustainability of rural community based projects; a case of jatropha Curcus growing project in Garsen Constituency, Tana Delta County. Since the matter affects the whole community, I am inviting you to participate in this research study by completing the attached questionnaire and sincerely answer the questions in the interview schedule.

If you choose to participate in this research, please answer all questions as honestly as possible. Participation is strictly voluntary and you may decline to participate at any time. In order to ensure that all the information will remain confidential, you do not have to include your name. The data collected will be for academic purposes only.

There will be no direct benefit to you for your participation in this study. However, the information gathered in this study is aimed at helping inform Tana Delta County Government, National Government, NGOs and other stakeholders on factors influencing rural community based projects in Tana South, Garsen Constituency, Tana Delta County.

Thank you.

Yours faithfully

Eva Manase

**APPENDIX II:
RESEARCH QUESTIONNAIRE**

Section A:

BACKGROUND INFORMATION

1. Your gender: Male [] Female []

2. Your age bracket (Tick whichever appropriate)

18-30yrs [] 31 - 40 Years []

41 - 50 years [] Over 51 []

3. What is your highest education level? (Tick as applicable)

Secondary certificate [] Diploma/certificate []

Bachelors' degree [] Postgraduate degree []

Others-specify.....

4. Working Experience.

a) Less than 1 year () b) 1-2 years ()

c) 2-4 years () d) 5 years and above ()

Section B: Financial Resources

1. Do you think that financial resources have an influence in the sustainability of community projects in Tana Delta like the Jatropha Curcus project?

Yes () No ()

2. If yes, please give some reasons for your answer.

3. If no, explain while giving relevant examples.

4. What extent do you agree or disagree with the following? Use a scale of 1-5 where

1= strongly disagree; 2 = disagree; 3 =weakly agree;
 4 =agree; 5 = strongly agree.

Statement	1	2	3	4	5
Sources of Financial Resources influence the future of Jatropha projects.					
Financial Investments is a strategy that influences jatropha projects sustainability.					
Varied sources of finances for the project enable its continued operations.					

II. Socio-Cultural Factors

5. Do you think that social cultural factors influence the sustainability of jatropha projects in Tana Delta?

Yes { } No { }

6. Explain your support in 5 above

7. To what extent do you agree or disagree with the following statements? Use a scale of 1-5 where

1= Strongly disagree; 2 = Disagree; 3 =Not sure;
 4 =Agree; 5 = Strongly agree.

Factor	1	2	3	4	5
Land and the Society Poverty influences jatropha projects sustainability.					
Environmental Degradation and the Community influences sustainability.					
Global Perceptions about jatropha project influences the project sustainability.					

**APPENDIX III:
TIME SCHEDULE**

This is the approximate time that was to be used to finish the research.

	Feb 2015	March 2015	April 2015	May 2015	June 2015	July 2015	August 2015
Writing of research proposal							
Proposal correction and piloting							
Data collection							
Data analysis							
Research report writing							
Submission of project for examination							

**APPENDIX IV:
PROPOSED BUDGET**

Serial No	Item Description	Unit	Qty	Rate	Amount
1	Laptop	Pc	1	35,000	35,000
2	Printer	Pc	1	12,000	12,000
3	Stationery				
	Printing Papers	Boxes	5	400	2,000
	FoolsCaps	Boxes	2	350	700
	Pencils	Pcs	10	20	200
	Rubber	Pcs	10	10	100
	Pens	Pcs	20	20	400
	Binding	Pcs	10	50	500
	Notebooks	Pcs	10	70	1,050
4	Allowance for 5 Days staff at Kshs. 500		30	2500	75,000
5	Contingencies			20,000	20,000
6	Allowance for 2 data entry clerks	Days	5	1,000	5,000
Total					151,950