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MORINGA OLEIFERA BIODIESEL

[1]DR. DENNIS OSORO MARANGA, [2]DOLLYCATE NEBUCHADNEZZAR, [3]MELODY KERUBO, [4]CALVINS ORUKO, [5]JOSEPHAT NDIGWA

[1]PhD (Finance), Department of Accounting and Finance, Kenyatta University, Kenya
[1]MBA (Finance), CPA (K), Bed Science (IT), Director Shareholder, Qaribu Discount Limited, Kenya,
[1]Patron-Science Club, St Angela Sengera Girls High School, Kenya,
[2,3]Student-Science Club, St Angela Sengera Girls High School, Kenya,
[4]Patron-Science Club, Kisumu Senior Academy, Kenya,
[5]Patron-Science Club, St Angela Sengera Girls High School, Kenya,

Abstract: Due to depletion of the world's petroleum reserve, global warming and environmental concerns there is need for alternative energy sources to petroleum based fuels. The social and economic pillar of vision 2030 of the government of Kenya form the basis of producing an alternative source of fuel which will contribute to the economy of the country financially and socially. Due to global warming effects arising, this study investigated the production of biodiesel from Moringa Oleifera seeds to replace the current crude oil products that have higher carbon percentage than the biodiesel. Petro-diesel based fuels used in engines emit poisonous gases such as carbon (II) oxide, hydrogen carbon and a lot of smoke which are pollutants and lead to greenhouse effect. Petro-diesel based fuels on the other hand also are depleting due to increased demand in the market thus increase in price. However, biodiesel is clean and renewable thus considered best than petro-diesel. The most commonly used biodiesel is Jatropha Curcas of which previous studies have indicated that it produces toxic alkaloids from its root and hence harms other plants therefore it cannot be intercropped. Hence many people are shying away from planting Jatropha Curcas and hence interfering with the production of Jatropha plant. Therefore the specific objectives of this study were to provide an alternative source of biodiesel oil that is friendly and supports crop production; to intensify the use of Moringa Oleifera plant which has a lot of significance in the farm and to reduce dependence on foreign oil. The data was collected from Sengera town, in Gucha town, Kisii County, Kenya. This study analyzed data using tabular and graphical analysis. Where the work of other authors was used, due acknowledgement was done. Where the work of other authors was used, due acknowledgement was done. The researcher obtained a research permit from St Angela Sengera Girls' High school and Kenya Science and Engineering Fair in order to enable collection of data. It was noted that many of the farmers were abandoning Jatropha Curcas farming because of the negative effects and adapting the planting of Moringa Oleifera because it is can be intercropped and has good fuel properties compared to Jatropha Curcas. This is indicated by a higher Cloud point of Moringa Oleifera, a higher flash point and a higher calorific value of Moringa Oleifera compared to Jatropha Curcas. With this innovation, the hypothesis has been proved by achieving the stated objectives. We recommend this project to institutions of higher learning and to the government research agencies for further research and improvement. All the future research adjustment to this project can be advised by relevant stake holders accordingly.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Due to depletion of the world's petroleum reserve global warming and environmental concerns there is need for alternative energy sources to petroleum based fuels (Graboski and McCormick, 1998). The two most popular biofuels are biodiesel and bio-alcohol. Biodiesel is used in diesel engines and is produced from high

oil content crops such as sunflowers and rapeseed, waste vegetable oils such as cooking oil and animal fats such as tallow. Biodiesel is a clean and renewable fuel which is considered to be the best substitute for diesel fuel (Knothe, 2005). Moringa Oleifera seeds oil is one of the major feed stocks for biodiesel production. In addition to biodiesel production soy beans can be used to produce ethanol. The Moringa Oleifera seeds hull contain a large quantity of carbohydrate for ethanol production and hence producers prefer to use Moringa Oleifera seeds hulls for animal feeding because of its high protein content (Kim and Ismai, 2014).

Although biodiesel is usually used as a blend with petro-diesel at varying ratios, it can also be used to fuel compression ignition engines alone. The results of engine emission tests shows that use of biodiesel alone produced less emissions of Carbon (II) oxide smoke than petrol –diesel (Zhao, Zhang and Shao, 2016). Moringa Oleifera seeds are known to contain a large number of active photochemicals such as isoflavones, saponirs and protease inhibitors. The isoflavones enriched extracts have been evaluated in the prevention of a wide range of health problems associated with menopause, cardiovascular disease, colon cancer and others (IEA, 2015).

1.2 Statement of the problem

Due to global warming effects arising, this study investigated the production of biodiesel from Moringa Oleifera seeds to replace the current crude oil products that have higher carbon percentage than the biodiesel. Petro-diesel based fuels used in engines emit poisonous gases such as CO, HC and a lot of smoke which are pollutants and lead to greenhouse effect. Moringa Oleifera seeds biodiesel on the other hand, does not emit such gases instead it produces more usable energy used to ignite engines. Petro-diesel based fuels on the other hand also are depleting due to increased demand in the market thus increase in price. Biodiesel is clean and renewable thus considered best than petro-diesel. However the most commonly used biodiesel is Jatropha Curcas of which previous studies have indicated that it produces toxic alkaloids from its root and hence harms other plants therefore it cannot be intercropped. The chemical produced remains in the soil for a long time even after the plant has been removed and does not allow the growth of other plants different from Jatropha. Jatropha

plant is also poisonous to livestock and human beings. Hence many people are shying away from planting Jatropha Curcas and hence interfering with the production of Jatropha plant.

1.3 Objectives of the study

1.3.1 General Objective of the study

To produce and evaluate biodiesel from Moringa Oleifera seeds.

1.3.2 Specific Objectives of the study

i. To provide an alternative source of biodiesel oil that is friendly and supports crop production

ii. To intensify the use of Moringa Oleifera plant which has a lot of significance in the farm

iii. To reduce dependence on foreign oil.

1.4 Research Hypothesis

For subsistence agriculture to take place and support food security, a non-poisonous and friendly source of oil should be used for biodiesel production.

1.5 Research question

How can Moringa Oleifera biodiesel be made friendly to sustainable agriculture?

1.6 Assumptions of the study

- Jatropha is the current source of biodiesel oil.
- Jatropha has many limitations.

1.7 Variables of the study

In the study, the independent variable is the type of biodiesel. The dependent variable is the method of fuel content. In the study, the independent variable is also the type of biodiesel while the dependent variable is the number of farmers who plant the type of biodiesel.

1.8 Organization of the study

The study is divided into five chapters. Chapter one brings out the introduction to this study. This chapter will include the background of the study, the statement of the problem, the research objectives, the hypothesis, the significance, the scope and the limitations of the study. Chapter two will entail the Literature review of the study Chapter three of the study will have the research methodology of this study. Chapter 4 will include the Data analysis and discussion while chapter 5 will entail the conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Empirical Literature Review

According to Zhao, Zhang and Shao (2016), Rudolf Diesel developed a new engine with the intention that it could use a variety of fuels, including vegetable oil. When he showcased it to the public at the 1900 Paris World's fair, he had the engine run on peanut oil. As the diesel engine became more widely adopted in subsequent years, however, petroleum-based diesel fuel proved to be less expensive and became the fuel of choice. The current study sought to produce biodiesel from Moringa Oleifera seeds that would be less expensive compared to the petroleum-based diesel fuel since biodiesels are lesser pollutants than petroleum-based diesel fuel.

According to the International Energy Agency (2017), by weight, biodiesel contains less carbon, sulfur and water and more oxygen than diesel. The reduced carbon content decreases tailpipe emissions of carbon monoxide (CO), carbon dioxide (CO2) and soot (elemental carbon). The lower sulfur content of biodiesel is important for two primary reasons. First, as a low sulfur fuel, biodiesel produces little or no emissions of sulfur dioxide (SO2). SO2 contributes to respiratory illness, aggravates existing heart and lung diseases, contributes to the formation of acid rain, can impair visibility, and can be transported over long distances (15). Second, EPA regulations will reduce the level of sulfur in highway diesel fuel by 97 percent by mid-2006. Biodiesel's higher oxygen content allows it to burn more completely than conventional diesel, thereby reducing hydrocarbon and carbon monoxide emissions. Thus, biodiesel is safer to handle at higher temperatures than diesel. The current study sought to produce biodiesel from Moringa Oleifera seeds that would be safer compared to the petroleum-based diesel fuel.

According to the National Renewable Energy Laboratory (2009), performance of any fuel can be judged by the power and torque output that it can generate. Biodiesel has a higher cetane number than conventional diesel, but has a lower energy content per volume. Because of the lower energy content, using biodiesel without any change in the fuel injection system would result in a slight loss of engine power. The current study sought to

produce biodiesel from Moringa Oleifera seeds that would have more power and torque compared to the petroleum-based diesel fuel.

2.2 Summary of Empirical Literature Review

Author and Context of Study	Objectives	Findings	Knowledge gaps	Research gap filled by the current study
Zhao, Zhang and Shao (2016),	Rudolf Diesel developed a new engine with the intention that it could use a variety of fuels, including vegetable oil.	When he showcased it to the public at the 1900 Paris World's fair, he had the engine run on peanut oil.	As the diesel engine became more widely adopted in subsequent years, however, petroleum-based diesel fuel proved to be less expensive and became the fuel of choice.	The current study sought to produce biodiesel from Moringa Oleifera seeds that would be less expensive compared to the petroleum-based diesel fuel since biodiesels are lesser pollutants than petroleum-based diesel fuel.
International Energy Agency (2017)	By weight, biodiesel contains less carbon, sulfur and water and more oxygen than diesel.	The reduced carbon content decreases tailpipe emissions of carbon monoxide (CO), carbon dioxide (CO2) and soot (elemental carbon).	Biodiesel's higher oxygen content allows it to burn more completely than conventional diesel, thereby reducing hydrocarbon and carbon monoxide emissions. Thus, biodiesel is safer to handle at higher temperatures than diesel.	The current study sought to produce biodiesel from Moringa Oleifera seeds that would be safer compared to the petroleum-based diesel fuel.
National Renewable Energy Laboratory (2009)	Performance of any fuel can be judged by the power and torque output that it can generate.	Biodiesel has a higher cetane number than conventional diesel, but has a lower energy content per volume.	Because of the lower energy content, using biodiesel without any change in the fuel injection system would result in a slight loss of engine power.	The current study sought to produce biodiesel from Moringa Oleifera seeds that would have more power and torque compared to the petroleum-based diesel fuel.

CHAPTER THREE

METHODOLOGY

3.1 Materials

- Moringa Oleifera Seeds
- Grinder
- Water
- Heating
- Beakers
- Methanol
- Sodium hydroxide
- Plastic bottle (1 Liter)
- Separating funnel
- Sieve

3.2 Procedure

- Grind the Moringa Oleifera seeds and pour into boiling water.
- Seave the mixture to remove waste.
- Decant the top layer of the filtrate and put in the sun so that water can evaporate leaving behind Moringa Oleifera oil.
- Pour the oil at $3^1/_4$ level of the plastic bottle
- In the beaker mix 20 ml of methanol and 5 g of sodium hydroxide.
- Pour the mixture into the oil in the plastic bottle and shake well to mix.
- Pour the mixture into a separating funnel and allow to settle for an hour.
- Separate the glycerol from the biodiesel.
- **NOTE**: Excess methanol can be recovered by distilling from the biodiesel.

3.3 MECHANISM

Moringa Oleifera seeds contain fatty acid which is an ester with long carbon change.

In this project, we are extracting oil from the Moringa Oleifera seeds, then performing a chemical process to form biodiesel.

We are using the oil which is rich in fatty acid (ester) and converting it to biodiesel (ester)

The fatty acid in the oil react with methanol to produce Biodiesel and Glycerol. Sodium hydroxide is only used as a catalyst.

Fatty Acid + Methanol (Alcohol) ⟶ Biodiesel+ Glycerol (Ester)

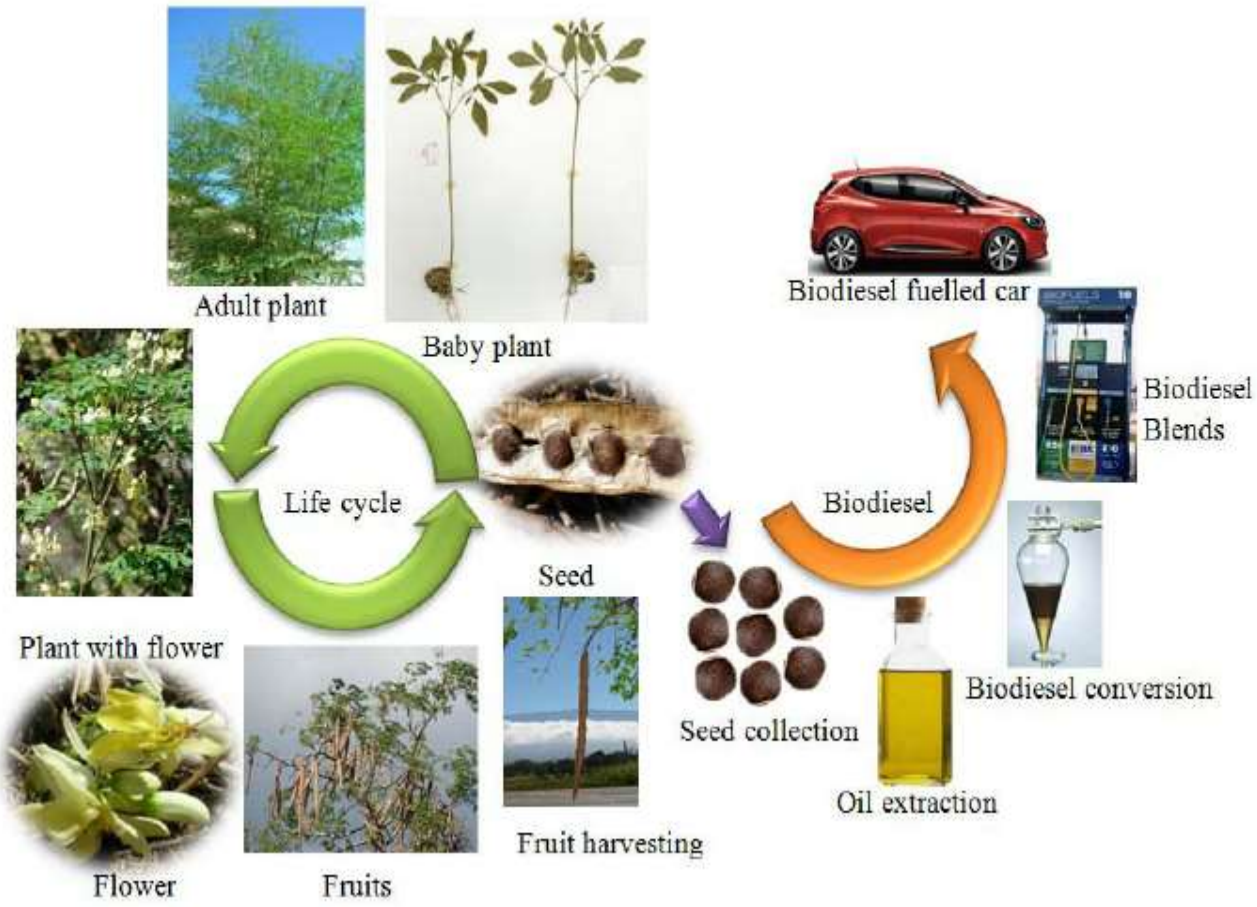
In this project, we are achieving two products; biodiesel and glycerol

Fig 3.1 Moringa Oleifera Plant

Fig 3.2; Moringa Oleifera seeds

Fig 3.3; Moringa Oleifera Oil

Fig 3.4; Biodiesel Production



3.4 PRECAUTIONS

- Ensure that the oil has no traces of water because this can lead to production of soap instead of biodiesel.
- Methanol is poisonous, keep away from children.

3.5 LIMITATIONS AND CONSTRAINTS

The limitations of this project is the use of chemicals like sodium hydroxide and methanol which are limited and must be bought.

3.6 MERITS

- Moringa Oleifera has significant uses as an efficient use of biodiesel oil.
- Moringa Oleifera tree is Agri-Friendly.
- Moringa Oleifera grows in limited supply of water. Thus can be grown in even arid and semi-arid areas

- Moringa Oleifera produce more seeds and oil compared to jatropha carcus.

3.7 DEMERITS

- Sodium hydroxide and methanol must be bought there for making this production of biodiesel challenging.
- The parameter to consider in this project is the compatibility of the biodiesel source with other food crops in the farm.

CHAPTER 4

DATA COLLECTION, ANALYSIS AND DISCUSSION

4.1 DATA COLLLECTION

This involved a descriptive cross sectional study involving farmers who were planting Jatropha before but abandoned it. Our case study is Sengera, Kisii County.

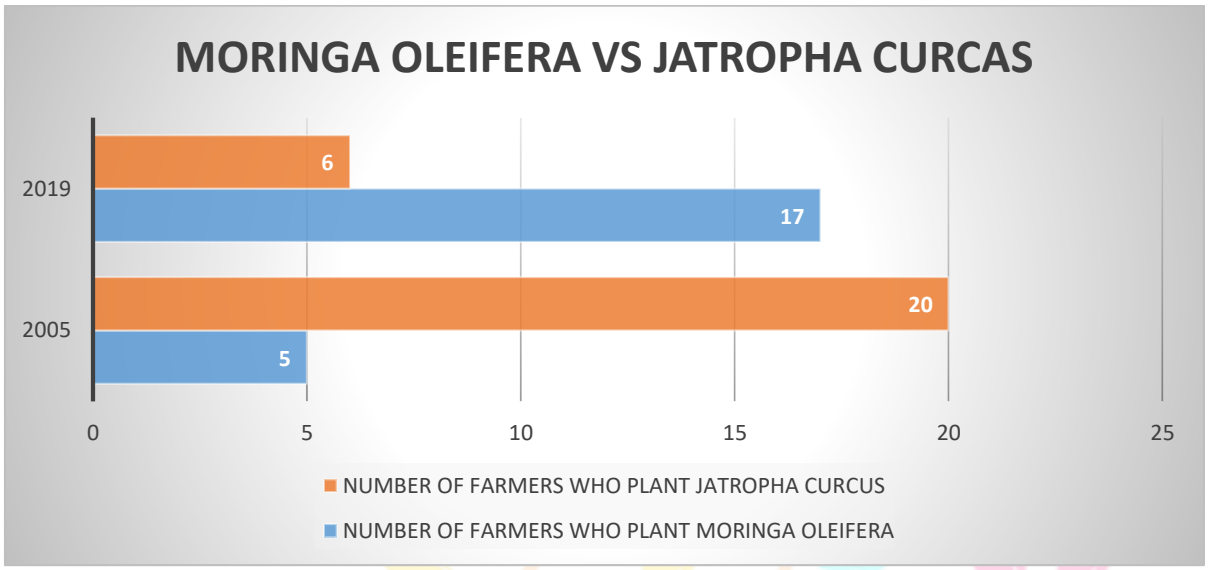
We sampled 20 farmers as respondents to our study. We collected data through questionnaires, interviews and by laboratory experiments comparing the fuel properties of Moringa seeds and Jatropha Curcas.

4.2 DATA ANALYSIS

Table 4.1; Farmers who plant Moringa Oleifera and Jatropha Curcas in 2005 against those who plant it currently.

YEAR	NUMBER OF FARMERS WHO PLANT MORINGA OLEIFERA	NUMBER OF FARMERS WHO PLANT JATROPHA CURCAS
2005	5	20
2019	17	6

Fig 4.1; Farmers who plant Moringa Oleifera in 2005 against those who plant it currently.

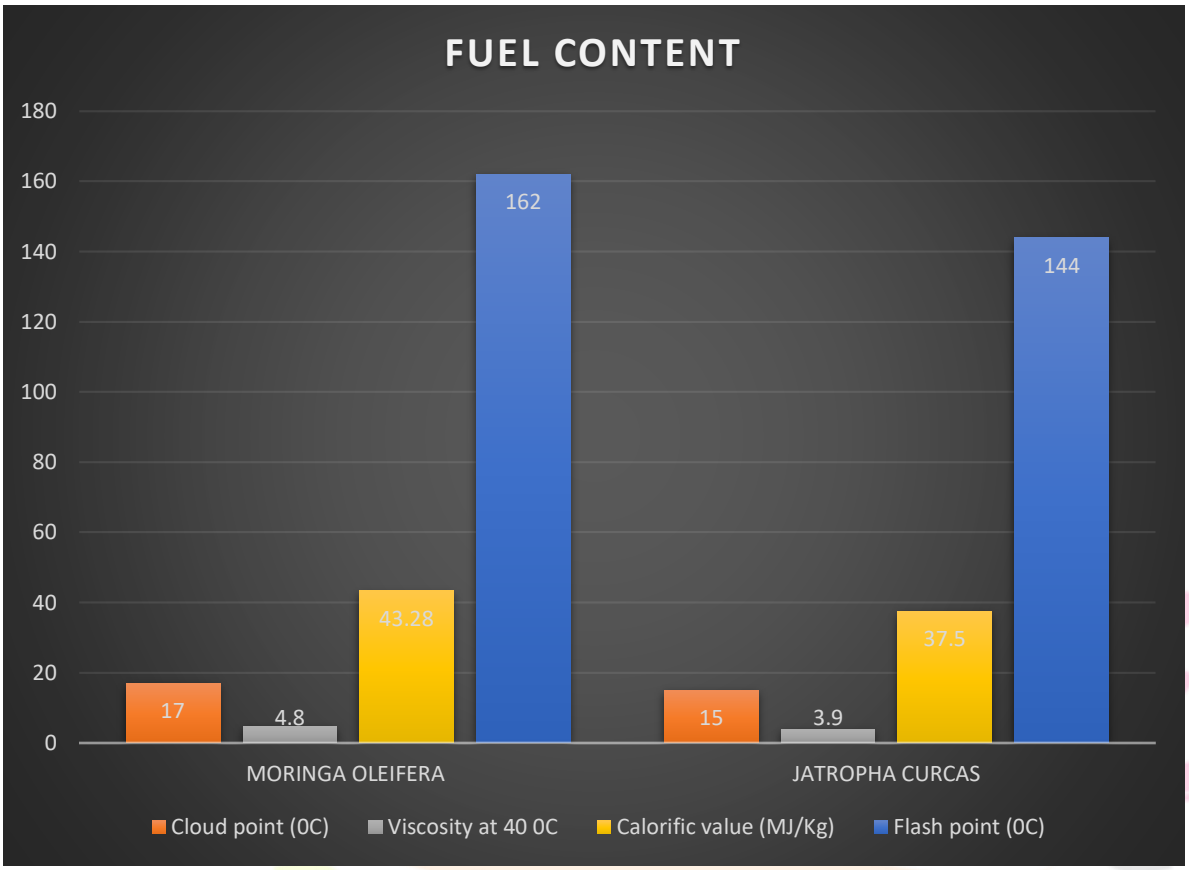


The study conducted laboratory experiments comparing the fuel properties of Moringa seeds and Jatropha Curcas

Table 4.2; Fuel content of Moringa Oleifera Versus Jatropha Curcas

FUEL CONTENT	MORINGA OLEIFERA	JATROPHA curcas
Cloud point (^{0}C)	17	15
Oleic acid (%)	72	55
Viscosity at 40 ^{0}C	4.8	3.9
Calorific value (MJ/Kg)	43.28	37.5
Flash point (^{0}C)	162	144

Fig 4.2; Fuel content of Moringa Oleifera Versus Jatropha Curcas



4.3 DATA DISCUSSION

- From our data in Table 4.1 and Fig 4.1, it was noted that there is a large number of farmers who have abandoned the planting of Jatropha Curcas while there is an increase in the number of farmers who have adapted the planting of Moringa Oleifera.
- From our data in Table 4.2 and Fig 4.2, it was noted that the Cloud point of Moringa Oleifera is 17 ^{0}C while the cloud point of Jatropha Curcas is 15 ^{0}C. It was also noted that the flash point of Moringa Oleifera is 162 ^{0}C while the cloud point of Jatropha Curcas is 144 ^{0}C. It was also noted that the Calorific value of Moringa Oleifera is 43.28 MJ/Kg while the Calorific value of Jatropha curcas is 37.5 MJ/Kg. These results indicate good fuel properties for Moringa Oleifera compared to Jatropha Curcas. These results agree with the study conducted by Azad, Rasul, Khan, Subhash and Islam (2014). It was also noted that Moringa Oleifera had a higher viscosity compared to Jatropha Curcas.
- A decrease of above 80% shows that there is a great problem and if something is not done, all will abandon the planting of Jatropha Curcas.

- From our research we concluded that many of the farmers were abandoning Jatropha Curcas farming because of the negative effects and adapting the planting of Moringa Oleifera because it is very Nutritious, it is rich in antioxidants and Moringa May Lower Blood Sugar Levels and reduces the arsenic level of the soil Azad, Rasul, Khan, Subhash and Islam (2014).

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

It was noted that many of the farmers were abandoning Jatropha Curcas farming because of the negative effects and adapting the planting of Moringa Oleifera because it is can be intercropped and has good fuel properties compared to Jatropha Curcas. This is indicated by a higher Cloud point of Moringa Oleifera, a higher flash point and a higher calorific value of Moringa Oleifera compared to Jatropha Curcas. With this innovation, the hypothesis has been proved by achieving the stated objectives. We recommend this project to institutions of higher learning and to the government research agencies for further research and improvement. All the future research adjustment to this project can be advised by relevant stake holders accordingly.

This project comes at a time when so many farmers are abandoning Moringa Oleifera Farming because of the several negative effects such as producing toxic alkaloids from its root and hence harming other plants therefore it cannot be intercropped. Jatropha plant is also poisonous to livestock and human beings.

The results in chapter 4 indicate good fuel properties for Moringa Oleifera compared to Jatropha Curcas.

5.2 FUTURE RESEARCH AND ADJUSTMENTS

In future we look forward to look for a cheaper substitutes to the chemicals; methanol and sodium hydroxide in order to make this project more efficient. More fuel properties will be investigated in future on the biodiesel.

5.3 RECOMMENDATION

We recommend this project for further research and improvement to look for cheaper substitutes to the chemicals methanol and sodium hydroxide in order to make this project more efficient more fuel properties will be investigated in future on the biodiesel

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APPENDICES

APPENDIX I: LETTER TO THE RESPONDENT

Dear Respondent,

I am currently a teacher at St Angela Sengera Girls' High School, Kenya. My Science club students are currently carrying out a research study on a project whose topic is:

"MORINGA OLEIFERA BIODIESEL".

I therefore request for your information and cooperation in this exercise. All information will be treated with confidentiality.

Yours with regard

DR. DENNIS OSORO MARANGA

PhD (FINANCE)

KENYATTA UNIVERSITY