

Creating a Sustainable Economy through Cultivating Jatropha as an Environmentally Friendly Alternative Fuel in the City of Surabaya

Siti Inayatul Faizah*, Maghfira Julietta, Rewwina Layyinatul Ummah

Faculty of Economic and Business, Universitas Airlangga, Surabaya, Indonesia

siti-i-f@feb.unair.ac.id,

Article Info

Volume 83

Page Number: 3580 - 3589

Publication Issue:

March - April 2020

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 23 March 2020

Abstract:

This writing aims to explain how the role of Jatropha cultivation in a sustainable economy. The background of this writing is because the fuel that we use so far comes from fossil energy sources, fossil energy has a limited nature. With the increasing need for motorized vehicles every year, the increasing need for fossil fuels is needed. Of course, this can lead to a significant imbalance between the number of motorized vehicle users and the number of available energy reserves, besides that it can affect how the air quality in the country and the city. This writing uses using qualitative literature study methods. The author collects data with observation techniques. The results of this paper concluded that the Jatropha plant has a role in a sustainable economy. This is because fence distance has properties as renewable energy, jatropha also has several other economic benefits. As we know sustainable economies in the development of the use of natural resources today to meet the needs of not having to sacrifice the needs or rights of future generations. Also, Jatropha has several advantages when compared to oil palm.

I. Introduction

Background Research

[1] shows that consumption of all energy produce carbon emission. Therefore, any increasing of all energy consumption will increase the carbon emission but with the different amount [1]. Utilization of Jatropha as one of the sustainable development efforts has been proven by previous studies such as [2]; Wherein his research he discussed how we can utilize materials contained in nature to meet daily needs without the need to cause damage (bio mix fuel). The difference between the research of Vikas Sharma and others with the research conducted by the author lies in the research of [2], Proving that biom

axisagoodapproachtoutilize all food ingredients that cannot be eaten with food ingredients.[3]; Where in this study two MILP models have been developed to optimize innovative and green technologies for renewable and sustainable energy funding. The differences between R.R Tan's research, et al. With the authors' research located on two MILP models have been developed to optimize innovative and green technologies for renewable and sustainable energy funding [4]; Where in this study discusses the technology that can be used to utilize energy resources. The difference between H.xu's research, et al. With the research conducted by the aut

horliesinrepresentinghowallfactorywastesare managed into energy resources. Based on the research it can be concluded that there are vegetable sources that can be managed as an alternative, environmentally friendly energy sources (*Jatropha curcas*).

Fossil fuels are natural resources that can be used to meet energy needs for the survival of the community. The high number of residents influences the need of motorized vehicles so that it can cause a significant imbalance between the number of motorized vehicle users and the number of oil products

produced. According to data from the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas), the amount of Indonesia's oil consumption in 2015 was 1.592 million barrels per day and in 2016 it rose to 1.615 million barrels per day. On the other hand, the amount of production is relatively stagnant. In 2015, the country's crude oil production amounted to 786,000 barrels per day and in 2016 amounted to 831,000 barrels per day. And according to data held by the Central Bureau of Statistics, it is said that the number of motorized vehicle users in 2015 reached 121,394,185 vehicles, in 2016 it reached 129,281,079 and in 2017 it again increased to 138,556,669 [5]. The increasing number of motorized vehicles can affect how the air quality of a region. According to WHO data it is said that 9

out of 10 people breathe air containing high pollutants, WHO estimates that every year around 7 million people die from exposure to fine particles in polluted air.²

To reduce the existing problems, research is conducted on the management of plants (vegetable sources) as a friendly alternative fuel environment. *Jatropha* now tends to be known as a plant that has properties in the medical world only, but actually, *Jatropha* plants contain ingredients that

can be used as a substitute for fuel. *Jatropha* itself has many advantages over other plants, including the costs needed in its management, which are cheaper compared to the management of oil palm plants because *jatropha* can be planted in various types of soil structures and weather conditions.

1.2 Problem Formulation

What is the role of *Jatropha* plants (vegetable sources) in sustainable economic development?

1.3 Research Objectives

To determine the role of *Jatropha* plants in sustainable economic development.

Benefits of Research

For academics, the results of this study are expected to contribute to sustainable literacy in economic development, as well as insight in the field of natural resources. For social, the results of this study are expected to be able to provide information about the conditions that can be caused by the continuous use of fossil fuels in large quantity. For the government, the results of this study are expected to be able to provide government attention to the management of vegetable sources as renewable fuels.

II. Library Studies

2.1 Previous Research

Previous research was used as a reference for the formation of papers to enrich the theory and prove the truth about the research being carried out. From some previous studies, it did not find the same title as the author's research. In addition to these previous studies, several studies or references are also used to strengthen existing research.

2.2 Theoretical Foundation Fossil Fuels

Fossil fuels are resources that cannot be renewed because it takes millions of years to form. According to the Ministry of Energy and Mineral Resources, the petroleum industry in Indonesia is old, more than 100 years and its production are declining. In 2014, oil production was only around 789 thousand bpd or decreased to 96% compared to 2013 at 824 thousand bpd. Since 2010, in 2014 decreased production by an average of about 4.41% per year [6].

2.3 Amount of Pollution and Motor Vehicles

Every year the number of motorized vehicles continues to increase, this can be seen through data held by the Central Bureau of Statistics, in 2015 the number of motorized vehicles reached 121,394,185 vehicles, in 2016 it reached 129,281,079 vehicles and in 2017 it again increased to amounting to 138,556,669 vehicles. In addition to causing a significant imbalance between the amount of fossil energy reserves and the number of uses of motorized vehicles, this also causes other negative impacts, namely the occurrence of air pollution. According to data owned by Air Visual that almost every city in Indonesia, especially big cities, has quite bad air quality, in big cities like Jakarta, Surabaya, Yogyakarta [7]. From the monitoring carried out by Greenpeace regarding the status of air quality in 2018, the capital city of Jakarta kept the tenth rank with poor air quality. The average annual concentration of PM_{2.5} in the city of Jakarta reaches four times above the annual safe limit according to the standards of the World Health Organization (WHO), which is 10 µg / m³. This figure also far exceeds the annual safe limit according to national standards in PP No. 41 of 1999 concerning Air Pollution Control, which is 15 µg / m³ [8].

2.4 Energy Dissemination and the Concept of

Sustainable Development

Attention to this concept has existed since Malthus in 1798 but the term sustainability (sustainability) only emerged several decades ago. Then the attention to this concept intensified after

Meadow and his colleagues published a publication that reads "The Limit to Growth" in 1972, which in its conclusion that economic growth would be severely limited by the availability of natural resources.

With limited availability, the demand for goods and services will not always be carried out continuously. This concern for sustainable concepts re-emerged in 1987 when the World Commission on Environment and Development (WCED) published a book entitled "Our Common Future". This publication then triggers the birth of a new agenda on the concept of sustainable economic development, this agenda states that sustainable development is a development that meets the needs of the present without having to sacrifice the needs or rights of future generations.

Biofuel is a renewable energy that can be used as a substitute for other alternative fuels. Biofuel is a biofuel, interpreted as fat or oil derived from plants such as jatropha, oil palm, sugarcane, and cassava.

2.5 Fence Distance

Jatropha is a type of plant that has economic value, it can be seen from everything that is owned by jatropha plants can be managed to be used, as well as the skin of the plant, the sap, the fruit, and seeds. Jatropha can also be used as an alternative fuel. Jatropha seeds contain 35% -45% yield of vegetable oil, castor oil can be managed as the main raw material for making biodiesel. The development of Jatropha as a raw material for biodiesel has considerable potential because it produces oil with high productivity.

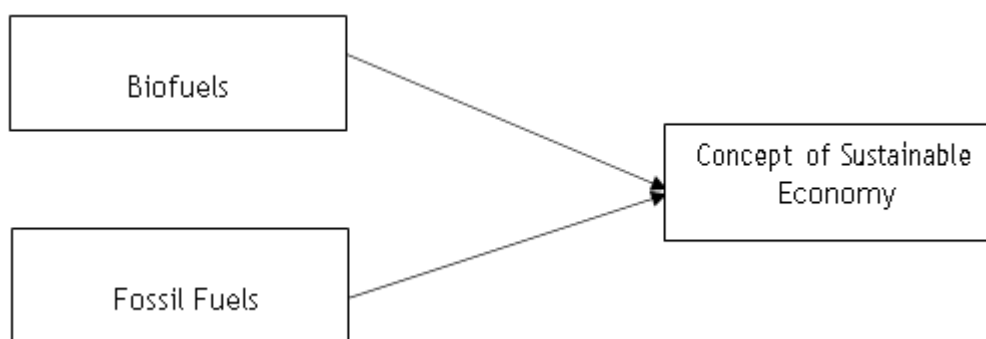
2.6 Hypothesis

Based on the explanation of the background, the formulation of the problem, the purpose of the research, and the literature review, the hypothesis proposed in this study are:

Hypothesis 1

:Jatropha is a vegetable source that can be used as environmentally friendly alternative fuels can affect the concept sustainable economy.

Hypothesis 2



III. Research Methodology

3.1 Research Approach

Based on the problems faced in this research, the suitable method used is a qualitative method with observational study data collection and the use of literature studies that support and relate to this research. This research begins by describing the use of Jatropha as an alternative fuel that is environmentally friendly and proves that small things can have a major impact on the future of the environment and economy.

3.2 Research Design

The design of this study uses descriptive qualitative which is describing, describing, and describing the object under study. Thus, this study covers the existence of realistic facts

:Jatropha is a vegetable source that can be used as environmentally friendly alternative fuels do not affect the concept sustainable economy.

2.7 Analysis Model

An interactive analysis model according to miles and distance is that qualitative research allows analysis and when researchers are in the field or after returning from the new field, an analysis is conducted.

regarding Jatropha plant content which is useful as an environmentally friendly alternative fuel which has an impact on the future of the environment and the economy.

3.3 Data Collection Techniques

To explain and support research, significant data is needed. The researcher chose to use a qualitative method using field observation studies to be able to pay close attention and directly how to manage Jatropha plant content as an alternative fuel offered by researchers to reduce the danger of gas emissions generated by users of motorized vehicle since increasing every year and utilizing resources natural power which has great benefits on the environment and economy later. Also, the use of a review literature study is needed in data collection to compare and be a reference for

the success of this study.

3.4 Triangulation

To ensure that research results can be accepted scientifically and logically, researchers have conclusions through the results of field observations and literature studies. Not only that, but researchers also apply and manage directly from the content of substances contained in *Jatropha* plants. This is done to deepen the understanding of researchers towards the data obtained as well as the object under study.

3.5 Data Analysis Techniques

Through various stages and steps, namely collecting, summarizing, and interpreting the data obtained, researchers can directly process, analyze, and deduce data to answer various questions and problems that exist. Also, the researchers compared previous studies with data obtained by researchers at this time. This was done to obtain accurate and significant data to be able to provide complete information and knowledge of the problems studied.

IV. Research Findings and Discussion

4.1 Research Findings

4.1.1 Fossil and Vegetable Fuels

Fossil fuels are natural resources that contain hydrocarbons, which are formed from the remnants of plants and animals which for a very long time (around millions of years). Here it can be seen that fossil fuels are a type of non-renewable energy, such as kerosene, coal, etc.

Biofuel is a natural resource that is formed from vegetable oil (plants that are still alive) and for its formation requires a faster time when

compared to fossil fuels. Plants that have the potential as alternative fuels, namely *jatropha*, oil palm, etc.

4.1.2 Potential of *Jatropha curcas*

Previously *Jatropha* plants did not get special attention from the government, then *Jatropha* plants began to get special attention in 2005 when the fuel crisis hit. *Jatropha* plants have the potential as a substitute for alternative fuels or substitutes for fossil energy materials (diesel, kerosene and fuel oil) [4].

Jatropha plants have properties that are capable of regenerating so that they are included in renewable energy sources. In addition to having properties that are capable of regenerating, this plant can grow in any type of soil on low land with dry climate and temperature $> 20^{\circ} \text{C}$. Judging from the properties possessed by *Jatropha* plants, it can be said that *Jatropha* has a role in the concept of a sustainable economy, where resources are used for now without sacrificing in the future because it can reduce the greenhouse effect and the effects of pollution air. Here we take a sample of one area in the city of Surabaya, namely at Airlangga University, in UNAIR itself has a pretty good potential for doing *Jatropha* cultivation.

4.1.3 Economic Benefits of *Jatropha* Cultivation

Not only from the environmental aspect, but *Jatropha* also has an impact on the economic aspects, with the holding of *jatropha* cultivation, it can open up several opportunities in the economic aspects such as increasing demand for the labor needed, increasing agriculture. With the increase in demand, it can participate in helping improve people's welfare and reduce the existing

unemployment rate. Not only that, if *Jatropha* can also grow well, it can attract investors to participate in investing [9].

4.1.4 Prospects for Jatropha Curcas in the Future

Jatropha cultivation has good potential in the future, not only in the economic field but also in the environment. In terms of its own economic consumption of biodiesel has a positive trend with a growth of 37% per year, the capacity of biodiesel in Indonesia itself has almost doubled from 5.85 million kl in 2011 to 11.36 million kl in 2016. *Jatropha* cultivation is still quite rare done but has good prospects in the future. In terms of its own environment as we know that biodiesel comes from vegetable sources, namely renewable and environmentally friendly resources because it produces zero waste. This is certainly very positive for the environment, especially for the air aspect because it does not cause pollution. The results of the analysis of the economic aspects of this biodiesel plant are:

Total investment capital: Rp. 60,193,014,795,

Production costs: Rp. 23.608.165.734, -

Annual sales: Rp. 42,122,663,352,-

Net profit: Rp. 12,977,648,332, -

Profit margin: 43.95%

Break-even point (BEP): 45.15%

Return of Investment (ROI): 21.56%

Pay Out Time: 4.64 years

Return of Network: 35.93%

Internal rate of return: 31.09%

From the results of the analysis of economic aspects, it can be concluded that *Jatropha*

cultivation for the manufacture of biodiesel is feasible to be established.

Discussion

The Advantages of Jatropha Plant

As a plant that is better known in the medical world, it turns out that there are many ingredients from *Jatropha* plants that are less known to the public. I further researched on *Jatropha* plants has enormous benefits in every part of her body. The advantages of using *Jatropha* seeds in the use of alternative fuels include:

Jatropha plants are included in the category of plants that are adaptable and easily managed in any land.

The oil contained in *Jatropha* seeds is not included in the category of edible oil.

Jatropha is a plant that has rapid growth.

There is a fuel oil content of 30-45%.

In management *Jatropha* plants have a fairly economical cost.

Fence Distance Cultivation Planting of Jatropha curcas

The most suitable growth time for *Jatropha* plants is during the summer or before the rainy season. The land to be used must be cleaned first and then made a hole of 30cm x 30cm with a spacing of 2 meters. After that, planting seeds is done, after planting weeds are cleaned for the next 4 months [10].

4.2.3 Harvest Jatropha Seeds

Jatropha harvesting can be done on ripe fruit with black skin or open fruit skin. Then the fruit is taken per panicle, the fruit taken must be dried in the sun first. Separation of fruit skin can be done manually or by machine, after

drying and then stored in a plastic bag which is then tied tightly using a rope and then placed on the floor with a wooden floor, it is to avoid moisture.

The Process of Extracting Oil from Jatropha Seeds

Two methods can be used to extract oil from castor beans, which can be done by pressing and extracting solvents. The pressing process itself is usually done using a hydraulic / thread press.

The pressing process usually leaves pulp which still contains 7-10% oil

[11]. While using the solvent extraction method can take oil more optimally. The most commonly used solvent liquids are technical hexane or petroleum ether with a boiling range of 60-70°C [12].

Production Costs

The production costs needed by Jatropha plants are relatively cheap when compared with the growth of oil palm, this is because Jatropha plants are relatively easy to plant and are very tolerant of various types of soil and weather.

In this paper we take the example of Jatropha cultivation that we will do will produce with a capacity of 8000 tons/year and operate for 330 days a year. Then the estimated production costs needed are:

1. The labor needed to carry out jatropha cultivation is 100 person. 2. Production costs: Rp. 23.608.165.734,- (mini-press tool with a cost of only Rp. 1,500,000 and a squeezed device greater plasticity around Rp. 4,000,000 - Rp. 25,000,000) This fee includes: when using party scale biodiesel production unit equipment, steam requirements, water needs and management, chemical needs,

electricity needs.

Comparison of Jatropha Plants with Palm Oil Plants

Palm oil is known as one of the most managed oils in the world. Apart from being known to be managed as cooking oil, oil palm has a content that can be used as fuel (biofuel or biodiesel) as well as jatropha plants. But oil palm has some disadvantages when compared to Jatropha plants such as:

Oil palm requires a large enough area for its planting process so that it often causes large-scale deforestation to occur without thinking of the next living generation.

In contrast to Jatropha plants, oil palm is not included in the type of plant that is easily adapted to the soil textures so that it requires several places that have either right soil textures such as latosol soil, organosol soil, and alluvial soil.

Palm oil also requires a long harvest period when compared to Jatropha plants, oil palm requires a harvest period of 3-4 years after the tree is planted.

In the management of oil palm, the costs are quite fantastic when compared to Jatropha curcas. Costs needed in processing palm oil:

Costs that contain an estimated cost for processing at the plant for one year. These costs cover the salaries of factory employees, maintenance materials and all costs that make palm oil and the kernel. The results of the discussion for per kg of palm oil and palm kernel, namely:

$\text{Rp } 310,722,111,000 = \text{Rp } 819.98 / \text{Kg}$
 $378,938,867 \text{ Ha}$

Transportation costs Costs which contain estimate

transportation costs which cover the cost of plant area per ha with transportation costs as follows:

$$\text{Rp. } 31,675,752 = \text{Rp. } 402.49 / \text{Ha } 78,699.28 \text{ Ha}$$

General Costs are prepared based on operating costs that are included in the harvest costs, processing costs, and transportation costs as follows:

$$\text{IDR } 44,406,300 = \text{IDR } 564.25 / \text{Ha } 78,699.28 \text{ Ha}$$

Mean to produce palm oil requires a composition of 60.46% of oil palm fruit and 39.54% empty bunches. The oil palm fruit itself has a mesocarp component of 78.4% consisting of 77.43% oil, 10% water, and 12.57% fiber. Also, oil palm fruit contains shells of 12.6% and fruit core of 9%. With this composition, oil palm can produce 89,742 tons of oil/year with a plant design capacity of 237,600 tons/year which costs Rp. 791,676,181,296 for sales / year. These costs include raw materials, utilities, packaging, labor costs, supervision, machinery, and laboratories.

V. Conclusion

The fuel we have used so far comes from fossil resources. As we know, fossil fuels are natural resources that contain hydrocarbons, which are formed from the remnants of plants and animals which for a very long time (around millions of years). In Indonesia alone motor vehicle users always experience a significant increase every year, causing fuel to continue to thin out. Besides causing this, the use of motorized vehicles can also cause air pollution and the greenhouse effect which endangers every human health.

This is not following the concept of sustainable economics, where in the concept it is concluded that the use of natural resources today to meet needs does not have to sacrifice the needs or rights of future generations. To overcome this, we can use vegetable resources as an environmentally friendly alternative fuel. Jatropha plant has the potential as a substitute for fuel, besides having economic benefits, Jatropha also has several other advantages compared to oil palm plants, such as the costs incurred to manage it are more economical, adaptable to various types of soil textures, have a harvest period fast, etc.

conomics, where in the concept it is concluded that the use of natural resources today to meet needs does not have to sacrifice the needs or rights of future generations. To overcome this, we can use vegetable resources as an environmentally friendly alternative fuel. Jatropha plant has the potential as a substitute for fuel, besides having economic benefits, Jatropha also has several other advantages compared to oil palm plants, such as the costs incurred to manage it are more economical, adaptable to various types of soil textures, have a harvest period fast, etc.

Reference

- [1] Farabi A, Abdullah A and Setianto R H 2019. Energy consumption, carbon emissions and economic growth in Indonesia and Malaysia Int. J. of Energy Econ. and Policy 9(3) 338-345
- [2] Sharma V 2018 Impact of bio-mix fuel on performance, emission and combustion characteristics in a single cylinder DIC I VCR engine.
- [3] Tan R R 2019 Optimization models for financing innovations in green energy technologies.
- [4] Xu H 2019 Towards higher energy efficiency in future waste-to-energy plants with novel latent heat storage-based thermal buffer system.
- [5] Syah A N A 2006 Mengenal Lebih Dekat Biodiesel Jarak Pagar (Tangerang: PT. AgroMedia Pustaka)
- [6] BPS 2017 Accessed <https://www.bps.go.id/linkTabelDinamis/view/id/1133>
- [7] Burhanuddin 2016 Integrasi Ekonomi dan Lingkungan Hidup dalam Pembangunan yang Berkelanjutan 2
- [8] Direktorat Jenderal Minyak dan Gas Bumi Kementerian Energi dan Sumber Daya Mineral 2017 Statistik Minyak dan Gas Bumi 2016

- [9] Kementerian Energi dan Sumber Daya Mineral Rencana Strategis 2015-2019
[10] Syakir M 2010 Prospek dan Kendala Pengembangan Jarak Pagar (*Jatropha curcas* L.) Sebagai Bahan Bakar Nabati di Indonesia92

- [11] Prihandana R and Hendroko R 2006 Petunjuk Budidaya Jarak Pagar (Jakarta Selatan: PT. AgroMedia Pustaka)
[12] Rama Prihandana 2007Meraup Untung dari Jarak Pagar (Jakarta Selatan: PT. AgroMedia Pustaka)

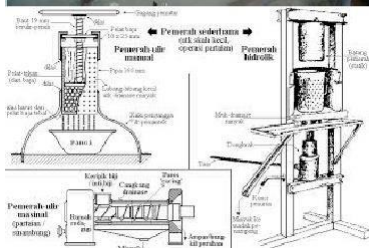
APPENDIX



A.) Prototype of manual hydraulic manual oil reducer



B.) Equipment for scale party biodiesel production units



C.) Three examples of oil reducer



D.) The condition of one of the vacant lots on the Airlangga University campus



E.) Water conditions in the UNAIR Campus c F) Soil Conditions in the UNAIR campus c

Appearance of the Environment of Airlangga University

A.	Physical Chemistry	
1.	Climate	: Tropical
2.	Air Quality	: Air temperature between 28°- 33° C
B.	Physiography	
1.	Land Area	: 650.308 m ²
2.	Green Open Land Area	: 428.748m ²
3.	Stretch of Territory	: Airlangga University is in the center of Surabaya, close to settlements and various public facilities such as hospital, and shopping centers
4.	Location	Airlangga University Campus A (JlProfDr. Mustopo) Airlangga University Campus B (Jl Airlangga no 4-6) Airlangga University Campus C (JlMulyorejo)
5.	Distance	a. Distance to Settlements±50m b. Distance to Hospital±300m c. Distance to Shopping Centers±450m
C.	Soil	
1.	Soil Texture	Have good enough quality for planting
2.	Soil Colors	Dark Chocolate