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JATROPHA CURCAS: A RENEWABLE BIODIESEL PLANT

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Abstract: Our human race is achieving throttling advancement in modern scenario which leads to crisis of petroleum based oil which bound us to the pavement for search of biodiesel. Biodiesel is an alternative fuel for diesel engine. The paper investigates the prospect of making cultivation & economic analysis of biodiesel from Jatropha oil. Jatropha is a renewable non edible plant which grows in arid & semi arid region of the country on degraded soils having low fertility & moisture. Jatropha seeds contains 50%-60% oil which after three years of cultivation have an oil yield of 2.5- 1.2 tons per hectare & the by- product of this biodiesel is glycerine which has different applications. Jatropha oil widely viewed as a fuel capable of growing in marginal areas where other crops can't yield satisfactorily with astonishing Capability of producing biodiesel on a very wide scale.

Keywords: Jatropha Curcas, Bio-fuel, Bio Plant, Renewable Energy, Energy, Green Energy, Future Energy

I. INTRODUCTION

Jatropha Curcas is a plant or shrub with various properties & which found all over the tropical region. Jatropha carcass is a native pant of Mexico & Centre America but today it is widely distributed in countries like Latin America, India, Africa & south-east Asia. Jatropha tree is 3-5 tall, smooth gray bark, having later & heart green leaf [1]. The flowers are small in size, white color &, much male flowers then female flowers & the fruits are in green color in beginning & it turns into yellow & dark brown at the ripen stage. The fruit contains 2-3 seeds. The seed is black in color with oval shape at the top there is a while point oil content in the seed is 50-54% [2, 3]. Without it's seed coat. It is well adapted to arid & semi-arid condition. Jatropha is a diploid species with 2n=22 chromosomes. Jatropha genome size (416 MB)[3] is about equal to rice genome (400 MB) as well as castor genome (323 MB). The seed gild reported for Jatropha varies from 0.5-12 ton year-1 ha- 1 depending upon soil nutrient & rainfall condition & the tree has productive life of over 30 years [4].The seed contains 30-35% oil that can be renewed into good quality of biodiesel by tranesterification [5]. Jatropha is also a meal for animals which shows it's another application as a food for animals and fish. Jatropha is an eco friendly product to entrant biodiesel [1]. The policy makers & when development mechanism project developers are interested in Jatropha carcass to tackle the challenges of energy supply & green house gas (GHG).

A hectare of Jatropha plantation to yield 2.5-3.5 tones of seeds in the third year & increased sharply to 5,000-12000 terns per hectare from the sixth year on words [8]. According to achteelal, 2008, at full output hydrocarbon emission level using neat Jatropha oil was observed to be 532 PPM against 798 PPM for fossil diesel; NO level was 1163 PPM against 1760 PPM &smoke reduced to 20 BTU against 2.7 BTU [9].

II. METHODOLOGY

This content will be divided into 2 segments. 1st segment is about agronomy, entomology biodiesel production & seed cake utilization. 2nd segment is about the capital

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investment, total production, investment, and profitability analysis & sensitivity assessment.

i. Methodology About Plantation & Production

A. Agronomy

To obtain high yield of Jatropha proper spacing between plants and use of fertilizer has been investigated in this section. An experiment has been carried out on 2 plantations. 1st plantation for spacing and 2nd plantation was to observe Fertilizer the collected data are the seed yield number of fruits weight of the seed plant height during one year cultivation time [10].

Fig. 1 (A Jatropha plant grown by farmer)[11]

B. Entomology

There are three investigation in this area namely insects, nature predations of Jatropha insects & pollinator. Each investigation was separately carried on lye different research for the insects, mealy bug was controlled by household chemical & natural predator (green lace wing) green lace wing is effective natural predator not only for mealy bug but also aphids [10].

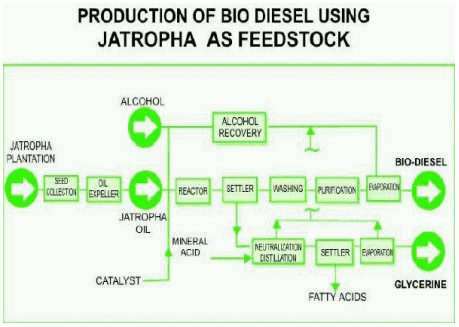
Fig. 2 (a) (Mealy bug on Jatropha Tree) [10]

Fig.2 (b) after treating with SLS [10]

Fig. 2 shows the mealy bug before and after the treatment of sodium laurel sulphate (SLS). As can be seen in Fig.2b SLS dissolve wax on the mealy bug's body [10]

C. Engineering (biodiesel production)

The use of biodiesel is an effective way of substituting diesel fuel in the long run. One important conclusion that can be drawn from the work done earlier is that the vegetables oils can't be used directly in the diesel engine. Several oils can't be used directly in the diesel engine. Several problems crop up if unmodified fuel is used and viscosity is the major factor. It has been found that transesterification is the most effective way to reduce the viscosity of vegetable oils and to make them fit for their use in the present diesel engines without any modification. In this process an ester reacts with an alcohol to form another ester and another alcohol [12]. The catalyst for this reaction is KOH or NaOH. The industrial-scale processes for transesterification of vegetable oils were initially developed in the early 1940s to improve the separation of glycerin during soap production. The primary input is assumed to be oil that has previously been extracted from Jatropha oil seed [12].



(Production of biodiesel and its by-product)[11]

To accomplish the trans etherification reaction described above, the oil, methanol, and catalyst are mixed together in a stirred reactor. 55 º-60 º C temperatures will cause the reaction to reach equilibrium more rapidly; in most cases the temperature is kept below the normal boiling point of the methanol (65ºC) so the reactor does not need to be pressurized [12].Three moles of methanol react with one mole of triglyceride. In practice, most producers will use at least 100% excess methanol (6:1 molar ratio) to force the reaction equilibrium towards a complete conversion of the oil to biodiesel. The reaction is slowed by mass transfer limitations since at the start of the reaction the methanol is only slightly soluble in the oil and later on, the glycerin is not soluble in the methyl esters. Since the

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catalyst tends to concentrate in the glycerin, it can become unavailable for the reaction without agitation [12].After the biodiesel is separated from the glycerol, it contains 3% to 6% methanol and usually some soap. If the soap level is low enough (300 to 500 PPM), the methanol can be removed by vaporization and this methanol will usually be dry enough to directly recycle back to the reaction. Methanol tends to act as a co-solvent for soap in the biodiesel, so at higher soap levels the soap will precipitate as a viscous sludge when the methanol is removed [12].

(Various stages in a life cycle of Jatropha plant)[11]

After the methanol has been removed, the biodiesel needs to be washed to remove residual free glycerin, methanol and soaps.

D. Seed cake utilization

As known that one liter of Jatropha oil comes from about 4kg of seed which will give 3kg of seed cake & this cake is used as a natural fertilizer for the vegetable cultivation

ii. Methodology On Economic Analysis

A. Capital Investment

The total amount of money required to purchase the plants, equipments construction of pant end all this investment is directly related to the biodiesel process from Jatropha i.e. amount of money needed to start the project. This is normally estimated as 0.15 times fixed capital investment [13].

B. Total production investment

The total production investment is the cost needed to the cost needed to sum the project. This consists of 2 types' variable cost & fixed cost. Variable cost includes cost of raw materials; utilities, shipping & packaging & fixed cost also include maintenance, operating later. Capital changes & sodalities [13].

C. Profitability analysis

The method is estimating the profitability of the project are rate of return (ROR) payback period breakeven point discounted cash flow Rate of Return (RCCFRR) & net present future value [14].

III. Comparison Between Petroleum Diesel & Jatropha Biodiesel

TABLE 1

Properties	Jatropha Oil*	Biodiesel	50% Biodiesel & 50% Diesel	Diesel *
Density [gm/cc]	--	0.62	0.58	0.84
NO level	1163 PPM	1760 PPM	---	---
Calorific value [MJ/kg]	39.5	41	42.7	45
Kinematic viscosity at 30°C	55	5.34	6.86	4.0
Cetane number	43	---	----	47
Solidifying point	-10	---	---	-14
Boiling point °C	286	255	----	248

(_Table showing comparison between Jatropha and other fuels.) [12]

In this section we are comparing properties of Jatropha biodiesel with petroleum diesel. We have discussed about various prospective of using Jatropha oil as a biodiesel now we are comparing Jatropha Curcas with the petroleum based diesel. Jatropha biodiesel is an eco-friendly clean renewable energy source which has almost zero carbon dioxide emission which alters the level of carbon dioxide in atmosphere where as petroleum diesel emits large amount of CO2 in atmosphere which causes increase in global warming. In some researches which compared the biodiesel from fossil diesel it has been seen that biodiesel generally causes a decrease in unbiased HC carbon

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monoxide (CO) & partial (PM) emissions along with an increase in NOx emission [15-16].It is being seen in some experiment blending methanol or ethanol with fossil diesel is a new way of reducing smoke & NOx [17-18].

(Comparison of biodiesel with other fuel options)[11]

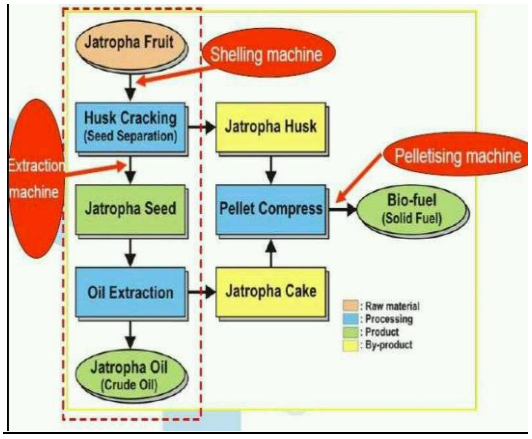
IV. Advantages of Jatropha oil & its by-product

- The by-product of Jatropha is glycerine which is used for making soap with high sponification value.
- Jatropha oil is used as a fuel for lamp, stoves & poorly running engines.
- Jatropha is used as a raw material for pharmaceutical industries because of its anti cancerous, anti malaria &anti tumer properties.
- Jatropha Curcas bark produces a dark blue dye used for colouring cloth & fish net.
- Jatropha leaves act as meal for animals and fish.
- Jatropha is a plant so it maintains the ecosystem of our atmosphere.
- Jatropha biomass acts as a natural organic fertilizer.
- It has been found the Jatropha may display positive result in curing of H.I.V. AIDS research is still running on this topic [12].

V. RESULT

From this paper we have come to this result that Jatropha is a renewable biodiesel plant whose seeds contain (50%-60%* without its seed coat) which can be directly converted into biodiesels or can be used in a mixture with petroleum diesel so as to obtain biodiesel which is cleaneco-friendly and above all it emits zero carbon dioxide in comparison to petroleum diesel. In this paper we have found that bio diesel releases nil amount of carbon mono-oxide into atmosphere which decreases level of hydrocarbons in atmosphere in this result section we have shown two different charts in comparison with diesel, biodiesel and 50%-50% biodiesel and diesel and we can clearly see how efficient, eco-friendly is Jatropha biodiesel. It also helps in decreasing NOx level.

We have also found that plantation of Jatropha bio diesel is not difficult as it can be grown on low fertile soil or soil with low moisture content and can be grown in continent like America, Asia & Africa but it will need capital investment for setting up the production plant and spending money on its accessories .



(Chart showing Jatropha bio fuel and its by-product) [11]

Jatropha Curcas always have an upper hand over petroleum diesel or have various advantages over the petroleum products even its by product shows various different properties and can be used for making soaps, lubricants and fertilizer but still Jatropha oil is not planted by the farmers on a large scale because of an inadequate knowledge of farmers about the agronomy of Jatropha plant and it's applications. So the world councils and the government of countries should take steps in education of their farmers and citizens about Jatropha Curcas as a bio fuel because Jatropha Curcas is a boon to the mankind by nature.

TABLE -2

% of sample gas	Diesel	Biodiesel	50%Biodiesel & 50% Diesel
CO2	9	1.33	5
O2	5	17.60	8
CO	1	0	1

(Exhaust gas emission by petroleum diesel& biodiesel)[12]

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Biodiesel is a viable substitute for non renewable petroleum based diesel fuel because of clean emission s which reduces global warming. Biodiesel has various advantages like improved lubricity, higher cetane number but Jatropha oil production will require significant commitment of resources land for production, biodiesel plant storage facilities construction are needed to encourage development of industry.

Total revenue earned from Jatropha is less than the other crops because farmers have not accepted the plant as their own. The low yield is due to inadequate knowledge in the agronomics Practices by the farmer so the government of countries as well as U.N.O (United Nation Organization) should take steps so as to increase knowledge of the farmers and to encourage them to grow crops like Jatropha.

From the yield obtained it is evident that Jatropha will take some time before it becomes a reliable biodiesel feed stock per se. However the Question of what they will do after 5 years when Jatropha plants are big enough with shading effect to interpose remains unanswered. It is clear that Jatropha yield important is the challenge & it needs the integrated research of agriculture, engineering &science.

VI. ACKNOWLEDGEMENT

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VIII. BIOGRAPHIES

Debojyoti Sen has a teaching experience of years and he is presently working as an Asst. Prof in (IMSEC, Ghaziabad).

PROFESSIONAL QUALIFICATION

M.Tech in Renewable Energy from. He has experienced in The Energy Resource Institute as an intern and he was associated with implementation of AC/DC grids in Dhenkenal District of Odissa started in making of DPR, technical load assessment, project management, monitoring operation of the grid. He also have a knowledge on renewable software's like PVSYST, eQuest , design builder, Retscreen Homer, Wasps, Energyplus and few other engineering software's like Matlab , Dialux and c++.

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