Cotton Seed Oil and Rice Bran Oil as a Source of Biodiesel in India

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Abstract. Energy consumption is increased due to urbanization and developing population. At the same moment society is aware of the decreasing fossil fuel and increasing environmental pollution. Biodiesel is the suitable option to meet future energy demand and improve the domestic economy. Developed countries are using edible oils and the edible oils, which are used, are not sufficient to produce the biodiesel. Non edible oils can be examined as a hopeful replacement for conventional edible oil for biodiesel production. But the edible oil cost is high to be used as fuel. Non edible oil is the right solution to overcome all problems related to the edible oils. There are various plant seeds remain unutilized; these seeds have shown their own potentiality. Due to harmful factors in non-edible oils it is unacceptable for human food. In developing countries non edible oil plants are grown easily. Biodiesel originated from the non-edible plant, is more feasible compared to the alternative fossil fuel. Production of biodiesel using cottonseed oil and rice bran oil appears to be a suitable substitute. The current research paper is aim to review the potentiality of the cotton seed oil and the rice bran oil in production of biodiesel in India.

Keywords Cotton seed oil; Rice bran oil; Metric million tonnes; Biodiesel; Non edible

1. Introduction
1.1 Background of the Study
The world population growth has absorbed as fossil fuel to be the greater source of energy, it anticipated to hike 40% by 2025 [1]. Many developing countries have motivated to look at the alternatives for the fossil fuel due oil demand and environmental condition. Diesel engines need a clear burning fuel that achieve under several of operating situation. Biodiesel is the option to suit any existing and unaltered diesel engines. Biodiesel has its own identical characteristics to diesel fuel; therefore mixture in various ratios with diesel fuel is possible. Biodiesel is produced from locally cultivated oil seed plants, reduce the dependence of imported petroleum, increasing the agricultural fund and creating new employment due to producing biodiesel from locally cultivated seeds.

Biodiesel is cost effective, environment friendly and smoothly available. Developing countries and developed countries increase the use of biodiesel. Rise in the growth of economy results in increasing the demand of oil for the developing countries. Only 30% of petroleum fuel is producing India. India is the 5th highest consumer of energy [2]. The objective is to produce biodiesel is to help the rural areas and encourage the renewable energy. Very important economic aspects to acknowledge for capital of biodiesel production are the feed stock, which operation cost is 75-80% [3].

China and India’s yearly oil consumption growth rate is 7.5% and 5.5% respectively Around the world government, the emerging policy implies that 60% of energy will be required in the year 2030 in which 45% of energy will utilized by China and India Transportation is the main industrial sector that uses 27%
of basic energy [4]. Current stunning rates of consumption, in 45 years the world fossil oil reserve will be exhausted [5]. Due to more population in India the usage of energy rate has been grown at a rate of 1.58%. In the next few decades India will get energy shortfall due to energy insecurity and high energy cost [6]. Developing country like India has the fast growing economy in the world and energy plays a main role in economic growth. In India, energy infrastructure development will be very strong in future. Renewable energy is cost effective, improves the country economic growth and reduces the climatic changes.

Transport industrial sector and agriculture sector are using diesel fuel that results in increase of imported fossil fuel, it motivates the researches to find an alternative to fossil fuel [7]. 70% of petroleum is consumed by the automobile industry. India is facing problem because of shortage of fuel due to higher demand of transportation sector. Automotive diesel demand in the world is high prioritized in India. Higher gasoline than diesel fuel is utilized by all the countries in the world, whereas India uses 5 higher diesel than gasoline [8]. In India, a high importance has been provided in search for alternative fuel to fossil fuel and for using biodiesel, Therefore, Biodiesel is the best option for the fulfillment of future requirements.

2. Objective of the Present Study
Biodiesel is the major alternative fuel that has attracted a consideration during the past decades. In biodiesel the usage of raw material cost is very high that is considered to be the main drawback to commercialize the biodiesel. Non edible seed and oil cost is less, therefore non edible oil has been the major source of vegetable oil. The price of the biodiesel is to be reduced by opting cotton seed oil and rice brain oil as the major source.

3. Alternative to Diesel Fuels
The regular usage of diesel fuel will decrease the fossil fuel. Diesel fuels are non renewable usage of such fuels will be energy dead lock for the country and world. Researchers consider that by the year 2070, non renewable fuel will be exhausted. Using non renewable fuel creates the environmental pollutants and increases the environmental problems. Fossil fuels are more important in some of the nation, remaining developing countries such as India and China mainly depends on the production of oil and gas. The country economy and the foreign exchange will affect the import of oil and gas [9]. The energy from the different origin is used to fulfill the demand in India. There are benefits obtained by using crops like rapeseed and soybean oil that escalates rural economic development, energy surveillance and environmental assistance. The crops are been utilized for the power development, which is beneficial for the farmers to get motivated by themselves to use the land and to create an employment opportunities. [10].

3.1 Biodiesel
Biodiesel is developed from sustainable waste like vegetable oil and animal fats [11]. Carbon Dioxide is been released from the biodiesel which will be more effective for the vegetable oil crops. [12]. There are two transportation fuels that can be reinstate diesel and gasoline, those fuels are biodiesel and bio-ethanol [13]. Biodiesel do not possess sulfur compound and aromatic compound and the burning of biodiesel also results in lesser emissions [14, 15]. Transesterification process is widely used for producing biodiesel. Vegetable oil has very high viscosity; during transesterification process it reduces the thickness of the oil. Transesterification is the mechanism to remove the glycerides from vegetable oil [16].

3.2 Source of Biodiesel
Vegetable oils are renewable in nature. Vegetable oils are obtained from the feed stock for biodiesel production [17]. Above 95% of biodiesel developed from edible oil due to availability in many regions and the properties are suitable to be used as diesel replacement [18]. Edible oil results to the problems such as increase in the price of the edible oil market which result in increase the price of edible oil and biodiesel and also because of this increase many forest are been destroyed for this purpose [19]. Non edible oil crops are well suitable in the waste land and also the price of farming is much lesser because non edible oil crops have high yields without much investment [20]. Animal fats have more level of saturated fatty acids that create a problem in biodiesel production process. Animal fat biodiesel cost is higher than vegetable oil [21]. The biodiesel source depends on the crop adoptable to the country climatic condition, Soybean oil is mainly used as the biodiesel feed stock for United States. In Europe
rape seed oil is the source of biodiesel, palm oil for south east Asia and coconut oil for Philippines these are the main alternative for diesel [22].

4. Food vs. Fuel
Every country in the world has initiated for the argument whether deviation of farm land for biodiesel lead to the short fall in food grains. The biodiesel production mainly relies on the food crops which are the main reason for the increase in price of the food security and food cost. And also utilization of land and water increases. Oil crops provide lesser quantity of biodiesel for blending with fossil fuel. Oil crops are incapable to provide higher volume of biodiesel that to displace fossil fuel. Biodiesel derived from edible oil is not cost effective. 70% - 90% of biodiesel price results from cost of raw material [23]. Non edible oil plants will be grown in unused urban land which is not useful for food [24].

5. Cultivation of Oil Seeds in India
5.1 Biodiesel feed stock in India
India is inefficient, as the edible oil cultivation mainly depends upon the import of other vegetable oils like palm oil to be suitable for their need. In India every year 1.2 million tones of tree borne edible oil seeds are been produced [25]. In India biodiesel are mainly produced from non edible oil seeds of plants [26,27].

5.2 Potential of Non-edible Oil Feed Stock in India
Non edible crops are planted all over the world. More than Three Hundred and Fifty oil-related seeds considered as possible resource for biodiesel production. The main resource for biodiesel production from non-edible oils are Jatropha, cotton seed oil, rice bran oil, mahua seed oil [28]. Some of other feed stocks that are used is fish oil, and used cooking oil to a very less extent. Potential of non edible oil plants in India are shown in table 1 [29].

| Scientific name | Common name | Potential (MT/PA) | Oil (%) |
|-----------------|-------------|------------------|---------|
| Cyanophyta      | Algae       | 157.4–629.8      | 20–40   |
| Ricinus communis| Castor      | 790,000          | 46–55   |
| Gossypium hirsutum| Cotton     | 851,000          | 18–25   |
| Pongamia pinnata| Karanja     | 2,00,000         | 30–40   |
| Linum Usitatissimum L| Linseed | 150,000          | 35–45   |
| Madhuca indica  | Mahua       | 5,20,000         | 35–40   |
| Azadirachta indica| Neem      | 5,00,000         | 35-45   |
| Oryza sativa    | Rice bran   | 474,000          | 16–32   |

The production of oil seeds are shown in table 2 and table 3 [30]. Insecure supplies and subsequent cost increases of non renewable fuels in the market are serious issues and economic threat for developing countries like India. Amongst the different non edible oil seed crops, Cotton and Rice plant is considered as the sole source that can meet the growing demand of biodiesel in India. Cotton seed oil and rice bran oil is consider due to their high productivity and recovery will be considered in the present paper.
Table 2 Production of Oil Seeds in 2002-2003 in the World and India

| Oilseed  | World Production (Lakh Tonnes) | World Production (Lakh Tonnes) | Oil Availability (Lakh Tonnes) |
|----------|-------------------------------|--------------------------------|--------------------------------|
| Soya bean| 1232                          | 43                             | 6.3                            |
| Cottonseed| 343                         | 46                             | 3.9                            |
| Groundnut| 193                          | 46                             | 7.3                            |
| Sunflower| 252                          | 13.2                           | 4.6                            |
| Rapeseed| 347                          | 43                             | 13.7                           |
| Coconut  | 49                            | 6.5                            | 4.2                            |
| Rice bran| NA                           | NA                             | 6.0                            |

Table 3 In India Price crop Seeds in 2002-2003

| Seed    | Oil Cost (Rupees / Quintal) |
|---------|-----------------------------|
| Soya bean| 4300                        |
| Cottonseed| 3200                      |
| Groundnut| 6200                        |
| Sunflower| 5360                        |
| Rapeseed| 5167                        |
| Coconut  | 3035                        |
| Rice bran| 2000                        |

6. Cotton Seed Oil as a Source of Biodiesel

India has a capacity to make more renewable oil to meet its oil demand and also for production of biodiesel. In India every year 3 million tonnes of cotton seed oil is been produced. Cotton is cultivated from major states in India [31]. In India cotton is the most important commercial crops. The temperature 25-35 degree Celsius is suitable for cotton cultivation in India. Cotton is the major crop which will provides job to 6 million farmers and 40-50 million people for cultivation and processing. The research studies indicate that the biodiesel produce from this crop is to be economic so it result the researchers to cultivate in large scale [32].

6.1 Botanical Features

The botanical name of cotton seed plant is G. hirsutum and Gossypium herbaceum. The cotton seed is like the other vegetable oil seeds like sunflower seed and oil is generated from the kernel, which is enclosed by a hard outer hull [33,34]. Cotton trees are high yield in regions with rain fall 850-1100 mm, low yield in the region with a rain fall less than 500 mm [35].

6.2 Fatty Acid Distribution

Cottonseed oil contains fatty acids it contains 70% unsaturated fatty acids including 18% of oleic, 52% linoleic and 26% primarily palmitic and stearic [36].
7. Rice Bran Oil as a Source of Biodiesel
Rice is the major crops in Asia, and it is a constant food for a people especially in Asia, and it is the most dominated cereal grain [37]. For the replacement of fossil fuel in developing countries a few investigation has been carried out on rice bran oil. Rice bran is used as cattle feed in China. Rice bran oil offers good potential as a low-cost feedstock and alternative for biodiesel production in India and many other countries [38]. The annual productions of rice bran oil in the world are shown in table 4 [39,40].

| Country   | Rice  | Rice Bran Oil |
|-----------|-------|---------------|
| China     | 1810  | 24.7          |
| India     | 1370  | 10.2          |
| Indonesia | 500   | 6.8           |
| Bangladesh| 380   | 5.1           |
| Vietnam   | 320   | 4.4           |

7.1 Botanical Features
Rice is belonging to the grass family. Rice refers to oryza and oryzaglaberrima of grass. The rice plant is required warm and moisture to grow. The rice plant will grow 2-6 feet.

7.2 Fatty Acid Distribution
Rice bran oil contains a range of fats, with polyunsaturated 33%, 20% saturated and 47% of its fats monounsaturated [41].

8. Cotton Seed Oil and Rice Bran Oil vs Other Biodiesel
The Jatropha is expected to use large-scale cultivation in various places including India with a increasing attention of food security. The crop is suggested for cultivating in urban soil to evade the clash with food seeds. All waste area consists of low fertility levels. Therefore cost of cultivation is more without an assurance on the production level. Under this condition it’s not economic. Therefore, it could not be recommended as such for a commercial biodiesel generation from urban land in India. A Jatropha plant is reduce the diversity of fast-growing trees vegetation. Jatropha plantations are likely to intensify soil erosion trouble. [42]. Jatropha crops would not be able to replace fossil fuels in the anticipated future. This picture will not be same if cotton seed oil and rice bran oils are used as a source of biodiesel. No other potential sources of biodiesel come closer to the cotton seed oil and rice bran oil.

9. Need for Blending Different Biodiesel
The engine performance and emission will not increase at single biodiesel at a time. But blend of two or more biodiesels may be able to achieve this goal [43]. These bio diesels were combined with diesel at numerous blending propositions. They found that the improved performance and emissions using dual blend [44].

10. Conclusion
Currently, biodiesel is very attractive because of its cost effective. Biodiesel production from non-edible oil acts as a major role to reduce the land issues. The requirement for non-edible oil sources is to be higher in future. Researchers have concentrated on very few varieties of non-edible vegetable oils for biodiesel production. The investigation shows that feasibility, availability technical and commercial aspects and the growth of cotton trees and rice trees in various states of India and all over world. It influences great assurance to the rural areas of India to meet the energy requirements. Cotton seed oil and rice bran oil biodiesel are considered as the convenient alternative for fossil fuel as it has high potential and less cost and economic in India. In future it is recognized that cotton seed oil and rice bran oil biodiesel would be advanced as a substitute source of energy.
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