

# Bio-fuels: Indian Scenario-A Review

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## ABSTRACT

In order to realize the goal of sustainability in a brisk and efficient way, waste oils can be recycled into high grade ecofriendly fuel. In this process, there is approximately 85 percent less emission of carbon-di-oxide gas. Now-a-days, biofuel or its blend has totally reinstated the conventional transport fuel in many of the developed countries. India has also done significant research and development in this field particularly in the bio-fuel production and utilization. Nearly 800 million people residing in Indian rural areas have been using forest wood cut or bio-mass as their primary fuel source. The devastating impacts of massive deforestation due to this practice are quite detrimental and challenging for environment and sustainability. To overcome these challenges, strong measures need to be taken so that waste-lands can be utilized for the production of ecofriendly fuels instead of deforestation. Government of India in December 2009 has already sanctioned the National policy for bio-fuels which promotes the use of alternate fuels and renewable energy resources as supplement of conventional chemical fuels like petrol and diesel (transport fuels). In addition, National Bio-diesel Mission (NBM) declared tree-borne oil-seeds of *Jatropha curcas* as the best source for the production of bio-diesel. Currently, many private and government institutes, state level bio-fuel boards, agricultural universities, industrial sectors and many other agencies are engaged in the bio-fuel projects as well as in providing financial and technical support to such ventures. This review describes the need of bio-fuels, its mechanism of usage by various methods alongwith planning, challenges and future aspects of bio-fuels in India.

**Key words :** Bio-diesel, *Jatropha*, Waste oil, Bio-fuel, Production

## Introduction

As a result of urbanization and industrialization, the demand of fuels has increased many folds, resulting in the increase in pollution and global warming. Its adverse effects on environment, humans, flora and fauna can be seen worldwide in form of change in climate pattern, melting of snow glaciers, increase in sea level near coastal areas, immunity and health pattern in human-beings, crop ripening cycle and breeding pattern etc. So, a need was felt to find some

alternative sources of fuel, which can substitute the chemical fuel, which are renewable and ecofriendly. Many researchers did extensive work in this area to find the best alternative source of energy. Since the past decade, much attention was drawn by bio-fuels as renewable liquid fuel. As bio-fuels are prepared from bio-degradable raw materials, it is said to be ecofriendly. Bio-fuels or bio-diesel matches with the norms of emission set by several agencies. After its worldwide acceptance, now several companies and agencies are working seriously in the production

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and distribution of bio-diesel.

USA has discovered bio-diesel as the most usable biofuel. Being environment friendly, renewable and clean burning fuel, biofuel has substituted the excess use of chemical diesel, also reduced the expense incurred in diesel import from other countries.

Bio-diesel is used in practice by mixing the varied fractions of the bio-diesel with petrol or diesel (Kaushik and Singh, 2016). Its preparation includes the oil extracted from agricultural waste, recycled cooking oil and animal fat (oil extracted from vegetable and animal origin). Various mixtures are named according to the percentage of biodiesel like B100 represents purest form of bio-diesel. More often, bio-diesel is used in the blended form with chemical diesel. Most commonly used blends are B2 (2% bio-diesel), B5 (5% bio-diesel) and B20 (20% bio-diesel). Many of the manufacturing companies have approved the B5 blend for usage.

Other than USA, many countries are also endowed in the similar kind of practices. It is worthwhile to mention that in UAE, waste oil from approximately hundred restaurants was harvested through green fuel equipment. After a few months of set up of equipment, the production of bio-diesel was started. The waste oil was totally converted to bio-diesel with significant yield. The product was able to meet out the requirement of entire fleet of trucks. France is currently the largest producer of bio-diesel.

Bio-mass also serves as the energy source in many developing countries viz. African countries like Uganda, Rwanda and Tanzania. These countries get 90% of their energy from bio-mass whereas in India and China 45% of country's total energy comes from bio-mass. In Brazil, about 30% and about 10-15% fraction of total energy comes from biomass in countries like Mexico and South Africa.

Bio-diesel can directly substitute the petroleum diesel in the vehicles without any design change. Approximately 75% of the emission of the diesel engine can be minimized by the use of bio-diesel. As natural oils possess high grade lubrication tendency, so the use of bio-diesel also minimizes the wear and tear of engine and reduces the maintenance cost.

Advantages of using Bio-diesel over diesel

- **It is Healthier:** Lower emissions of-
- Carbon monoxide: 38% lower
- Unburned HC: 83% lower
- Particulates: 49% lower
- Smoke and odour are much better

- PAH & air toxics lower
- **It Contributes less to Greenhouse Gases**

### Indian Scenario of Biofuels

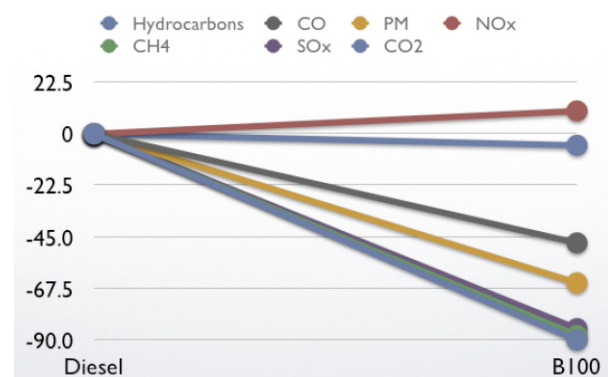
Like many other countries, India has also shown its interest in this important sector. Establishment of many research labs, initiatives taken by state and central government for the development of wastelands for oil-seeds cultivation, financial and technical supports from various organizations and determining certain policies and guidelines for the use of bio-fuels are some of the steps taken in this direction. But still this sector is deprived of many facilities and proper execution mechanism and mass acceptance, but the future is bright enough that in the upcoming years, we will be able to come out of all the hurdles and bio-fuels will take the India towards new heights.

### [I] Planning and Implementation

As stated earlier, in India around 800 million people, especially natives of villages and tribal areas make use of bio-fuels as the primary source of fuel in the form of forest wood cut either legally or illegally, leading to massive deforestation and development of waste lands. These waste lands can be utilized for the plantation of energy giving plants. A well-structured plan is required for the production of bio-fuels using waste lands.

### Four categories of plantation have been identified in this approach

1. Short Rotation Trees: *Acacia tortilis*, *Albizialebeck*, *Acacia nilotica* (Babul), *Prosopis cineraria* (Khejri), *Cassia siamea* (Siamese)
2. Plants giving hydrocarbons: *Euphorbia lathyris* (Caper spurge), *Calotropis procera* (Aak)
3. Plants providing non-edible oil: *Jatropha curcas* (Ratanjot), *Simmondsiachinensis*



4. Plants giving hydrocarbons with high molecular weight: *Partheniummarginatum* (guayule)

Many organizations in India like CSIR labs and IITs namely Council of Scientific and Industrial Research-National Botanical Research Institute, Lucknow; Central Salt and Marine Chemicals Research Institute, Bhavnagar; Biomass Research Centre, Madurai; Garhwal University, Srinagar; IIT Delhi, IIT Kanpur are actively engaged in the research and production work of bio-fuels and had taken many initiatives for its development.

Residues from agricultural sites, food and vegetable waste and residue of biomass have been converted to ethyl alcohol, methyl alcohol and their respective ester derivatives via fermentation reactions in the projects driven by Govt. of India. The significant source of biomass is *Calotropisprocera* possessing 38 % cellulose. The process of chemical hydrolysis followed by the treatment with enzymes led to the preparation of ethanol.

National policy for bio-fuels was sanctioned by Government of India in December, 2009, which proposed the use of alternate fuels especially renewable energy resources as supplement of conventional chemical fuels like petrol and diesel (transport fuels). National Bio-diesel Mission (NBM) declared tree-borne oil-seeds of *Jatropha curcas* as the best source for the production of bio-diesel<sup>2-4</sup>. A target was set in the 11<sup>th</sup> five-year plan by the Planning Commission of India to cultivate *Jatropha* on the 11.2-13.4-million-hectare waste lands. Currently, financial support is also granted for the cultivation of *Jatropha* along with many more non-edible oil seeds from the central and state governments. Other than government, many private institutes, organizations, NGOs, state bio-fuel boards, corporate and co-operative sectors, various agricultural universities are also in line for promotion of research and development activities related to bio-fuels production.

*Jatropha curcas* belongs to spurge family, *Euphorbiaceae* grows well in arid and semiarid climate and requires lesser amount of water for growth and can also be grown on the poor quality land known as waste land. Each fruit of plant contains 2-3 seeds which contains 46.2 % oil. The oil of *Jatropha* seeds is enriched with many fatty acids like oleic, linoleic, palmitic and stearic acid. Viscosity of oil around 8.2 centistokes makes it closer to that of diesel, that's why their properties show very much similarity with each other and can be used as a substitute of diesel as a fuel<sup>5-8</sup>. By a chemical reaction,

called transesterification the oil can be converted to biodiesel.

#### Advantages of making Bio-diesel from *Jatropha*

- 1 million hectares of waste land is brought under *Jatropha* cultivation
- Can yield 0.8-1 million tons of oil
- 13 MMT bio diesel for 20% blend
- 11 million hectares land required
- 11 million jobs can be created

At present, in India 2% ethanol mixing in petrol and 0.1% biodiesel blending in diesel are in practice. Government of India has planned to raise this blending percentage by 20% ethanol in petrol and 5% bio-diesel in diesel till the end of this decade. In 2017, Indian government permitted the manufacture and sale of bio-diesel for commercial purpose and also released certain guidelines of blending bio-diesel in high speed diesel for public.

#### [III] Challenges

Diesel is used as a primary fuel source in many industries, transportation and power sector and as per consumption criteria. Its demand is five times higher than petrol and increasing day by day. The conventional sources of diesel production are not sufficient to meet out increasing requirements. The increased use of diesel consumption is increasing the CO<sub>2</sub> emission significantly. So a need was developed to search out for substitute of diesel, which can serve two purposes, first to reduce CO<sub>2</sub> emission and being environmental friendly and second to share the increasing load of diesel demand.

Although many agencies have been working in this direction but still in India this industry is in its infant state. It seems totally unrealistic to achieve the ambitious targets of 20% blending upto 2030. The industry is facing many hurdles for the accomplishment of success. Due to lack of appropriate research and development in the *Jatropha* cultivation process, there comes major obstacle in the achievement of desired goal. In addition, high-yielding drought resistant *Jatropha* seeds are not available in adequate number. A large scale production of *Jatropha* on waste land of 6 lakh km<sup>2</sup> does not seem feasible, as it has to face problems related to irrigation, issues from authorities and natives of that area, some legal and ownership problems and many more. The seed distribution system is also not properly channelized. If the raw materials like seeds of *Jatropha* will not be available, then it would not be possible to set up

plants for trans-esterification, which leads to the production of bio-diesel.

Other than cultivation, yet another issue is the developing of the processing industries, which can extract the oil from *Jatropha* seeds and can further convert to useful bio-diesel form. In addition to cultivation and production of bio-diesel, yet another barrier which comes in front of bio-diesel industry is its limited distribution. Mostly the usage of bio-diesel is confined at the companies producing it, which are using for their own purpose and by a few transportation organizations. Two companies based in Andhra Pradesh namely "Naturol Bioenergy Limited" and "Southern On-line Biotechnologies" are the only two ventures in India that are endowed in the bio-diesel projects running at commercial level.

### Future

"The bio-fuels used for the energy purpose should be extracted from non-edible seed oils and these crops like *Jatropha* should be cultivated only on the waste lands, which are not suitable for the food crop production", as stated in National Biofuels Policy.

Prime Minister Mr. Narendra Modi in his speech on World Environment Day declared to reach at the goal of 20% blending by 2025, in place of 2030. This project will not only improve the quality of life of farmers but also will take the country towards the next generation of energy production. The production of bio-fuels will definitely contribute for the environmental sustainability.

In the country, only 1.5% of ethanol could be blended till 2014, this average has now improved up to 8.5%. This rise has surely given profits to the farmers endowed in the sugarcane cultivation. S & P Global Platts had reported that in the states where sugarcane cultivation is promoted, ethanol producing plants can be established.

Research is also being done in the field of ethanol manufacturing from waste of farming land and also in the process of establishment of grain based distilleries.

Bharat Renewable Energy (Set up by collaboration of Bharat Petroleum Corp, NandanBiomatrix and Shapoorji and Company Limited) has invested approximately 2,131 crore Rupees in Uttar Pradesh for the bio-diesel project. Mainly five places of Uttar Pradesh state, Kanpur, Chitrakoot, Jhansi, Laltpur and Sultanpur are identified, where the plant has been installed. The company will constitute 200 oil extraction units along with 10 refineries for bio-die-

sel. The company is accepting the annual production of bio-diesel around 270 million gallons out of these ventures wherein *Jatropha* oil-seeds to be used as source of bio-diesel.

### Conclusion

India is progressively working in this direction and in last five to six years, country's dependency on renewable energy sources has increased by more than 250% leading India as one of the top 5 countries that had researched, worked, installed and developed the renewable energy sources. India is in the line to lead the world by the vision of 100% replacement of chemical fuels by renewable energy sources and contribute for the quality of the environment and improved health of its residents.

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