

Status and Policy of Biodiesel Development in India

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Abstract- There is rapid rise in energy consumption in the country results in shortage of fossil fuels such as oil, coal and petroleum products. Recession in country economy lead to concern about the availability of energy requirement for sustaining the economic growth. In view of the fast depletion of petroleum products, the search for alternative fuels has become necessary, looking at huge demand of diesel for all sectors of economy, the biodiesel is being viewed a substitute of diesel. The vegetable oils, animal fats and grease are the main feed stocks for the biodiesel production. Biodiesel fuel properties are quite comparable to diesel. In India, National Biodiesel mission is started in year 2003 which promotes the growth and development of alternate fuel in India. This paper provides the current status of biodiesel development by various organizations and states in India. The study shows that policy implementation is consuming lot of time which should be minimized for the rapid development of alternative fuel in India.

Keywords- Biodiesel, Energy, India, Policy

1. Introduction

Energy is needed for human development. The positive correlation between human development indicated by the human development index, which measures life expectancy, literacy, education, and standards of living for countries worldwide and energy consumption India ranks sixth in the world in terms of energy demand accounting for 3.5% of world commercial energy demand in 2001. During 2004-05, the country imported 95.86 million tonnes (MT) of crude oil valued at 26 billion U.S dollar.

The Indian economy is expected to grow at the rate of more than 6% per annum which will necessitate energy demand to rise to 166 MT by 2019 and 622 MT by 2047. Currently, 70% of the fossil fuel requirements are imported placing a heavy burden on country's balance of payments. The continuous increase of crude oil price together with the ambiguity in price trends caused by the limited crude oil production has forced India to move towards renewable energy (Teddy, 2011). The fig 1 shows the trend analysis of crude oil in India.

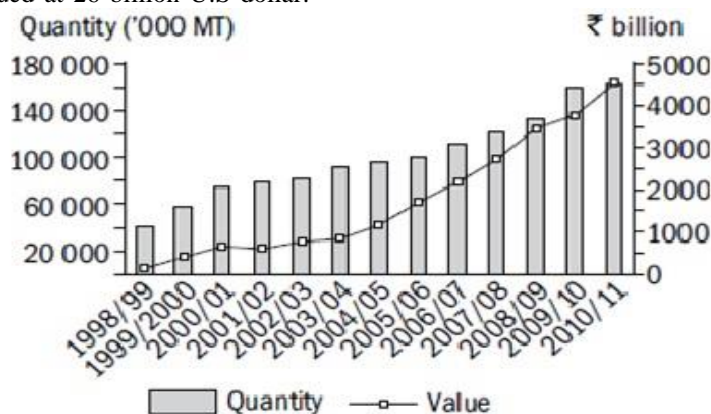


Fig. 1. Trend and Quantity Of Crude oil Import in India. Source: [1]

2. Status of Renewable Energy in India

India, being located in the tropical region, is endowed with the vast potential of renewable energy. It is at the forefront of harnessing renewable energy and is one of the largest programmes in the world [2]. The goal of the Eleventh Five-year Plan is to achieve at least 10% of grid-interactive power generation capacity from Renewable Energy Systems (RES) by the end of the plan period. As on 31 December 2010, grid-interactive renewable power contributed about 15,691.43 megawatts (MW) of electricity, i.e., about 10% of the total installed capacity in the country at that time.

Today, India has a significant potential for generation of power from renewable energy sources like wind, small hydro, biomass, solar energy. India is 5th country in the world in terms of exploitation of wind power after Denmark, Germany, Spain and USA with estimated total wind potential

of 45195 MW. The country has an estimated SHP potential of about 15000MW along with other renewable energy technologies, including solar photovoltaic, solar thermal and biomass power also spreading. The bio power (agro residue) is estimated around 16900 MW and co- generation from bagasse and waste to energy is about 5000MW and 2700MW respectively. After wind and solar energy, biomass energy has the third largest potential for power generation through renewable energy sources with a total potential of 24,600MW (including agro residue, co- generation from bagasse and waste to energy) and only 3526.87 MW is harvested till now, therefore, there is a wide scope to tap the biomass potential to full fill the needs of society through renewable energy sources. For overcome the dependancy on the imported fuel we have to look through other sources of energy like biomass, solar, hydro, geothermal, wind and others. The table 1 shows the estmiated potential of various renewable energy sources in India. [3]

Table 1. Renewable Energy in India at Glance [4]

S.No.	Source/system	Estimated potential	Installed capacity
1-	Wind power	45000MW	3595MW
2-	Biomass power	16000MW	302.53MW
3-	Bagasse cogeneration	3500MW	447.00MW
4-	Small hydro(upto 25MW)	15000MW	1705.63MW
5-	Waste to energy		
	Municipal solid waste	1700MW	17MW
	Industrial waste	1000MW	29.50MW
	Family-size biogas plant	12million	3.71million
	Improved chullas	120million	35.20million
6-	Solar street lighting system	-	54795
7-	Home lighting system	-	342607
8-	Solar lanterns	-	560295
9-	SPV power plants	-	1566kWp
10-	Solar water heating system	140 million m ² of collector area	1 million m ² of collector area
11-	Box type solar cooker	-	575000
12-	SPV pumps	-	6818
13-	Wind pumps	-	1087
14-	Biomass gasifiers	-	66.35MW

3. Biodiesel Alternative to Diesel

Biodiesel is the name of a clean burning mono-alkyl ester based oxygenated fuel made from natural, renewable sources such as new/used vegetable oils and animal fats. The resulting biodiesel is quite similar to conventional diesel in its main characteristics. Biodiesel contains no petroleum products, but it is compatible with conventional diesel and can be blended in any proportion with mineral diesel to create a stable biodiesel blend. The level of blending with petroleum diesel is referred as Bxx, where xx indicates the amount of biodiesel in the blend i.e. B10 blend is 10% biodiesel and 90% diesel [5]. Biodiesel is an alternative to diesel. Biodiesel from *Jatropha* and *Pongamia*, assume significance and are considered as the best option to substitute petroleum diesel there by reducing

the dependence on import of crude. In addition to provide energy security and a reduced dependency on oil imports, biodiesel offers several other significant benefits such as reduced GHG emission , good fuel properties for vehicles, increased employment in the agricultural sector and conversion of wasteland into productive land. [6] Trans-esterified vegetable oil, or biodiesel, is produced by the reaction between vegetable oil and alcohol. It can be used as a partial or complete petro-diesel replacement in unmodified diesel engines. It is biodegradable, and can burn up to 70% cleaner with 93% lower total hydrocarbon, 50% lower CO, and 45% lower particulate matter in comparison with conventional diesel fuel. Liquid bio fuels are generally classified into first and second generations

based on the feedstock used in production. First-generation bio fuels are manufactured from feed stocks such as corn and sugarcane, in case of ethanol, and vegetable oils such as soybean oil and palm oil, in case of biodiesel. However, use of these feed stocks has been controversial, as they have value as human food, and increase in the prices of these commodities have been blamed on their use in bio fuel manufacture. Second-generation bio fuels aim at rectifying the problems associated with first-generation bio fuels. So use of no edible oil like *Jatropha* and *Pongamia* are used as feedstock for biodiesel production. [7]

4. Oil Crops in India

The various oil sources are classified as edible and non edible the edible sources like groundnut, peanut etc are primarily used to meet the food requirement. India is not using vegetable oils derived from rapeseed & mustard, soybean or oil palm for the production of biodiesel. It is because; India is not self-sufficient in edible oils production and depends upon imports of palm oil and other vegetable oils in large quantities to meet the domestic demand. However, utilization of non-edible seed oils extracted from trees and forest sources does not interfere with food security directly if the trees are grown on marginal/waste land that does not compete with food

production. Every year around 1.2 million tonnes of tree borne non-edible seed oils are produced in the country [8]. In India, biodiesel is produced mostly from the non-edible oils extracted from the seeds of plants like *Jatropha*, *Pongamia*, *Mahua*, *Neem* etc. Depending on climate and soil conditions, different nations are looking for different vegetable oils as substitute of diesel fuel for example soybean oil in USA, rapeseed and sunflower oils in Europe, palm oil in south East Asia and coconut oil in Philippines are being considered as substitutes for diesel. In India *Jatropha* and *Pongamia* being non edible source are being viewed as the only future hope for biodiesel production. [9] Table 2 overviews the non-edible oil producing plants that can be cultivated for oil production on suitable land and consequently the oil can be used for biodiesel production. [10] The non edible oil seed plant given in the above table has potential to produce oil and subsequent conversion to biodiesel apart from their uses for illumination, burning, soap making, candle making etc. It is estimated that the potential availability of such oils in India is about 2 million tons per year. The most abundant oil sources are *Sal*, *Mahua*, *Neem*, *Pongamia* and *Jatropha* oil. Based on extensive research, *Jatropha* and *Pongamia* have been identified as the potential feed stocks for biodiesel production in India.

Table 2: Production of Non-Edible oils in India [10]

S. No.	Botanical Name	Local Name	Annual Productivity (Tons)
1.	<i>Jatropha curcas</i>	Ratanjyot	45,000
2.	<i>PongamiaPinnata</i>	Karanja	135,000
3.	<i>Schleicheraoleosa</i>	Kusum	25,000
4.	<i>Azadirachtaindica</i>	Neem	1,00,000
5.	<i>Shorearobusta</i>	Sal	1,80,000
6.	<i>Modhucaindica</i>	Mahua	1,80,000

5. National Bio fuel Policy of India

The government of India has undertaken several policy measures to enhance the production and use of bio fuels during the past one decade. The launching of National Bio fuel Mission (NBM) in the year 2003 under the direction of Planning Commission, Government of India, is the frontrunner of such efforts in the country. The NBM laid special focus on phased expansion of area under bio fuel feedstock crops like *jatropha*, *pongamia*, etc. It has included several small missions covering promotion of large-scale plantation of feedstock crops in forests and wastelands, procurement of seeds and oil extraction, blending, trade and R&D. The ethanol blended petrol programme and biodiesel blending programme are the integral parts of NBM and are aimed to initiate blending of bio fuels with transport fuels like petrol and high speed diesel on a commercial scale. In order to make bio fuel blending Natural Gas, Government of India, in the year 2003 made 5 per cent ethanol blending in petrol mandatory across in 9 states and 5 union territories. It was

implemented only partially due to the unavailability of ethanol due to low sugarcane production in 2003-04 and 2004-05. The blending mandate was further extended to cover 20 states and 8 union territories in the year 2006. This direction could also be partially implemented due to the inability of Oil Marketing Companies (OMCs) 1 to procure sufficient ethanol at the prevailing support price. Subsequently, ‘The National Bio fuel Policy’ formulated by the Ministry of New and Renewable Energy (MNRE) was approved by the Cabinet Committee in September, 2008 and was released in December, 2009. The policy foresees bio fuels as a potential means to stimulate rural development and generate employment opportunities, as well as aspires to reap environmental and economic benefits arising out of their large-scale use. It outlines research and development, capacity building, purchase policy and registration for enabling bio fuel use, including second generation2 bio fuels. The policy envisages utilization of a wide range of crops such as sugarcane,

sweet sorghum, cassava, maize and tree-borne oilseeds like *Jatropha* and *Pongamia* for production of bio fuels. It also envisages the setting up of a 'National Bio fuels Development Board' (NBDB) to develop a road map for the use of bio fuels in petrol and diesel engines in a time bound manner, besides taking appropriate policy measures. The national indicative target of 5 per cent blending by 2012, 10 per cent by 2017 and 20 per cent after 2017 has been recommended in the policy. [11]

Biodiesel plantation by community/government on waste/degraded/marginal lands would be encouraged, while the plantation in fertile irrigated lands would not be supported. Minimum Support Price with the provision of periodic revision for biodiesel oilseeds would be announced to provide a fair price to the growers. The details of the minimum support mechanism will be worked out subsequently and considered by the steering committee. The Minimum Purchase Price for the purchase of bio ethanol by the oil marketing companies would be based on the actual cost of production and import price of bio ethanol. In the case of biodiesel, the Minimum Purchase Price should be linked to the prevailing retail diesel price. The Policy envisages that bio fuels, namely, biodiesel and bio ethanol may be brought under the ambit of "Declared Goods" 3 by the Government to ensure unrestricted movement of bio fuels within and outside the states. It is also stated in the Policy that no taxes and duties should be levied on biodiesel. Further, it is recommended

to set-up an Inter-Ministerial National Bio fuel Coordination Committee under the Chairmanship of the Prime Minister and a Bio fuel Steering Committee under the Chairmanship of the Cabinet Secretary, Government of India, for high level coordination and policy guidance or reviewing of various aspects of bio fuels development in India. The Government is considering creation of a National Bio fuel Fund for providing financial incentives like subsidies and grants for new and second generation feed stocks; advanced technologies and conversion processes; and production units based on new and second generation feed stocks. Besides, the bio fuel technologies and projects would be allowed 100 per cent foreign equity through automatic approval routes to attract Foreign Direct Investment (FDI), provided such bio fuels produced are put only to domestic use. [12] The future demand for biodiesel in India is given in Table 3. The above table indicates that by the year 2020–2021, about 24.61 MT of diesel could be saved if B20 blend is utilized. This will ensure sustainable fuel availability with secured environmental conditions. As per the report of the committee on Bio fuel, the estimated demand of diesel in 2011–2012 was 64.19 MT, requiring 12.84MT of biodiesel and plantation of *Jatropha curcas* over about 13.69 million hectare of land. As per Government of India survey, out of total land area, 124.7 million hectare is classified as waste and degraded land. The table 4 show the estimation of waste land in India.

Table 3. Projections of biodiesel demand and corresponding *Jatropha* area required for meeting the blending targets in India (Area in Mha, Demand in Mt) [13]

Year	Diesel demand	For 5 % blending		For 10 % blending		For 20 % blending	
		Biodiesel demand	<i>Jatropha</i> area	Biodiesel demand	<i>Jatropha</i> area	Biodiesel demand	<i>Jatropha</i> area
2011-12	64.19	3.21	3.42	6.42	6.85	12.84	13.69
2016-17	92.15	4.61	4.91	9.21	9.83	18.43	19.66
2020-21	123.06	6.15	6.56	12.31	13.13	24.61	26.25

Table 4. Various estimates of wastelands in India. [14]

S.No.	Source	Area (M ha)
1-	National Commission on Agriculture (NCA-1976)	175
2-	Directorate of Economics and Statistics, Department of Agriculture and Cooperation	38.4
3-	Ministry of Agriculture (1982)	175
4-	Department of Environment and Forests (B.B. Vohra)	95
5-	National Wasteland Development Board	123
6-	National Bureau of Soil Survey and Land Use Planning	187
7-	Society for Promotion of Wasteland Development	129
8-	National Remote Sensing Agency	75.5
Average Waste land area		124.7

India has third largest road network in Asia having length about 3 million km the sides of which can be used for growing the *Jatropha* and *Pongamia* crops and oil can be converted into biodiesel. India has railway network of 63,140 km and land along the track can be easily used for cultivation of *Jatropha curcas* to check the soil erosion and to improve fertility in addition to oil production.[7]

6. Research and Development

Understanding research and development on bio fuel crops is a major mandate of the National Bio fuel policy. It is stated in the policy that research and development efforts would be focused on plantations, production and

processing technologies of bio fuels, as well as maximizing efficiencies of different end-use applications and utilization of by-products. The policy envisages to accord high priority on indigenous R&D and technology development based on the local feed stocks and needs, which would be benchmarked with international efforts. The specific areas identified in the policy framework on R&D are production and development of quality planting materials and high sugar containing varieties of sugarcane, sweet sorghum, sugar beet and cassava; advanced conversion technologies for first and second generation bio fuels including conversion of ligno-cellulosic materials; technologies for end-use applications; utilization of by-products, etc. When the national biodiesel mission was launched in 2003, several above-mentioned R&D efforts were initiated along with its other mandated activities. The NOVOD Board established a "National Network on Jatropha and Karanja" in 2004 by involving Indian Council of Agricultural Research (ICAR), State

Agricultural Universities (SAUs), Council of Scientific and Industrial Research (CSIR), Indian Council of Forestry Research and Education (ICFRE), Central Food Technological Research Institute (CFTRI), Indian Institute of Technology (IIT, Delhi) and The Energy Research Institute (TERI). Research is mainly focused on issues such as identification of elite planting material, tree improvement to develop HYVs with better quality of reliable seed source, intercropping trials, developing suitable package of practices, post-harvest tools and technology and detoxification of oil meal of important TBOs. The Central Soil Salinity Research Institute (CSSRI) under ICAR is conducting field trials on various cultivars of *jatropha* and *pongamia* for developing site-specific genotypes that can tolerate adverse climatic conditions. The Central Research Institute for Dry land Agriculture (CRIDA), undertaking the studies on genetic diversity, variability and other biotechnological traits on *jatropha*. [15]

Table 5. Role of Govt Organization in development of biodiesel in India [16]

S.No	Organization	Work In Area Of Development of Bio fuel
1-	Planning Commission	Coordination, Overseeing, Hosting cell to serve committees
2-	Environment & Forest Division	Coordination, Overseeing, Hosting cell to serve committees
3-	Petroleum Division	Coordination with Ministry of Petroleum and Natural gas
4-	Ministry of Petroleum & Natural Gas	Ensure implementation of responsibility given to it, its institutions & monitor progress
5-	Indian Oil Corporation (R&D):	Carry out studies, Collection of data
6-	Petroleum Conservation Research Association (PCRA)	Carry out studies, Collection of data & Mass Awareness Programmes
7-	Diesel Marketing Oil Companies	Ensure facilities for transesterification, blending & marketing, monitor performance of automobile engines
8-	Ministry of Environment & Forests	Ensure implementation of plantations, Monitor environment and health effects, Carry out decision of Coordination Committee
9-	Director General- Forests	Plantation, seed collection and oil expelling activities
10-	Central Pollution Control Board (CPCB)	Monitor environment & health effects of emissions of bio-diesel.
11-	Ministry of Non-Conventional Energy Sources	Support studies related to bio-diesel Development of appliances to run on Jatropha oil
12-	Indian Renewable Energy Development Agency Ltd.(IREDA)	Support entrepreneurs wishing to establish seed centres Development of esterification units and plantation
13-	Ministry of Road Transport & Highways	Plantation along highways Use biodiesel blended fuels.
14-	National Highways Authority of India (NHAI)	Plantation along highways Use biodiesel blended fuels.
15-	Ministry of Rural Development	Fix targets for plantation other poverty alleviation programmes
16-	Department of Land Resources (DLR) Plantation	Seed collection and oil expelling.
17-	Council for advancement of people's action & Rural Technology (CAPART)	Nurseries/Plantation, Seed collection, Oil extraction through Voluntary organizations.
18-	Ministry of Agriculture	Monitoring the progress of various Institution in the agriculture and bio fuel development area

S.No	Organization	Work In Area Of Development of Bio fuel
19-	Indian Council of Agriculture Research (ICAR)	Research in all aspects of Jatropha plantation
20-	Indian Agricultural Research Institute (IARI)	Research in all aspects of Jatropha plantation
21-	Department of Agriculture & Cooperation (DAC)	Ensure implementation of responsibility given to it
22-	National Oilseeds & Vegetable Oils Development Board (NOVOD)	Plantation on non-forest lands Help seed collection.
23-	Ministry of Science & Technology	Monitoring the progress of various Institution
24-	Department of Bio-Technology (DBT)	Make available elite planting material at cheaper prices.
25-	Council for Science & Industrial Research (CSIR)	Organize studies on aspects of bio fuel.
26-	Indian Institute of Petroleum (IIP)	Carry out research and development in alternate fuel
27-	Indian Institute of Chemical Technology (IICT)	Carry out research and development in alternate fuel
28-	Indian Toxicology Research Centre (ITRC)	Carry out research and development in alternate fuel
29-	Ministry of Law & Justice	Advise on Legal aspects of bio-fuel programme
30-	Ministry of Water Resources	To ensure availability of water for irrigation of plantations.
31-	Ministry of Finance & Company Affairs	Review taxation Make available resources Arrange external funding
32-	National Bank for Agriculture & Rural Development(NABARD)	Support plantation Seed centres Oil expelling units
33-	Small Industries Development Bank of India (SIDBI)	Support plantation. Seed centres Oil expelling units
34-	Ministry of Railways	Plantation along railway tracks Use biodiesel blended fuels
35-	Ministry of Consumer Affairs, Food & Public Distribution	Ensure framing of standard specifications as needed
36-	Bureau of Indian Standards (BIS)	Formulate Standard Specifications for Bio-fuels.
37-	Ministry of Small Scale Industries & Agro & Rural Industries	Seed collection and oil expelling centres.
38-	Khadi & Village Industries Commission (KVIC)	Seed collection Oil expelling centres
39-	Ministry of Industry	Monitoring the progress of various Institution
40-	Automotive Research Assn. of India (ARAI)	Carry out studies on use of bio-fuels in engines and emissions thereof
41-	Ministry of Tribal Affairs	Collection of seed from tribal areas
42-	Tribal Cooperative Marketing Development Federation .of India (TRIFED)	Collection of seed from tribal areas.
43-	Ministry of Information & Broadcasting	Information, Education and Communication programme
44-	Society of Indian Automobile Manufacturers	Carrying out of required tests for engine performance and vehicle manufacturer's agreement and guarantees to use bio fuels.

7. State-specific Policies

In concurrence with the larger bio fuel promotion programme undertaken by the central government at the national level, various state governments are also pursuing

policies and programmes in support of bio fuels production and use in their respective constituencies. Some states have drafted their own policy documents and vision statements which though distinct are in line with the broad spirits of the National Bio fuel Policy. An account of various state-specific bio fuel policies is presented below.

Table 6. State Specific Policies [17-21]

S.No	State	Policy and Work
1-	Andhra Pradesh	The Government of Andhra Pradesh introduced a draft biodiesel policy in the year 2005 to facilitate investors and farmers to plant oil bearing trees, mainly <i>Jatropha</i> , <i>Pongamia</i> and <i>Simaruba</i> . The Policy has proposed a partnership among government, industry and farmers, wherein the provision of buy-back arrangements for seeds and credit disbursement for farmers routed through industry are the major highlights. There is also a proposal to constitute a Biodiesel Board, which would be an autonomous body for the promotion of cultivation of bio fuel crops and biodiesel production in the state.
2-	Chhattisgarh	Chhattisgarh has sufficient land resources and favourable climatic conditions for the cultivation of bio fuel crops like <i>Jatropha</i> and <i>Pongamia</i> . The bio fuel programme in Chhattisgarh was launched in the year 2005 with the creation of Chhattisgarh bio fuel development authority (CBDA) under the aegis of Chhattisgarh Renewal Energy Development Authority (CREDA). Minimum support price of Rs 6.50/kg for <i>Jatropha</i> seeds and of Rs 6.00/kg for <i>Pongamia</i> seeds has been announced by the government to ensure fair prices for the farmers. There are also plans for setting up a state-of-the art laboratory with a capital outlay of about Rs. 1.5 crores for testing oils, biodiesel, etc.
3-	Karnataka	The Government of Karnataka has identified non-edible oil bearing crops like <i>Jatropha</i> , <i>Pongamia</i> , <i>Simaruba</i> , <i>Neem</i> and <i>Mahua</i> as feed stocks for bio fuel production in the state. Being a sugarcane surplus state, Karnataka also plans to expand its distillation capacity for enhancing ethanol production by setting up new processing units. The State bio fuel Policy released in the year 2009, Sufficient incentives like tax concessions on feedstock, machinery, products, raw materials, etc. would be extended to them in addition to other concessions already available as per the industrial policy of the state. Growers will be organized on contract farming basis and community mobilization, trading and capacity building activities will be undertaken simultaneously. The Government of Karnataka has already set up a Bio fuel Park in the Hassan district and plans to establish more such parks.
4-	Rajasthan	In the state of Rajasthan, a Bio fuel Authority of Rajasthan (BFA) was established and entrusted with the responsibility of promoting bio fuels in the state. The primary focus of the state's bio fuel programme is on <i>Jatropha curcas</i> with a target of covering over 21 lakh hectares of wastelands with the crop. Centrally sponsored Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). This serves the dual purpose of employment generation and bio fuel promotion.
5-	Odisha	The Odisha Biofuel Policy aims to utilize 30 per cent of the state's wastelands (0.6 million hectares) and expects to generate 10 million person-days of work through bio fuel production in the state. The potential of biodiesel production has been estimated at 1000 kl per annum. The policy identifies <i>Jatropha</i> and <i>Pongamia</i> as the most suitable oil-bearing species which can be chosen for bio fuel production.
6-	Uttarakhand	In Uttarakhand, van Panchayat committees and small house groups are the grass root level actors involved in bio fuel promotion. A partnership amongst state government, Forest Development Corporation (FDC) and entrepreneurs in Uttarakhand ensures a steady supply of feedstock to the private processing plant that produces biodiesel. The Uttarakhand biofuel board (UBB) was established as the nodal agency to coordinate various bio fuel development programmes in the state. It has a mandate of covering an area of 2 lakh hectares with <i>jatropha</i> by the year 2012. It has established a <i>Jatropha</i> gene bank to preserve high-yielding varieties. The Board in collaboration with MNRE is also involved in bio fuel-based rural electrification of remote villages in the state.
7-	Tamil Nadu	The official bio fuel Policy of Tamil Nadu was released in the year 2007-08 with a target of promoting 100,000 ha of <i>Jatropha</i> plantations over a period of five years.

S.No	State	Policy and Work
8-	Punjab (Sardar Swarn Institute,Govt Of India)	Technology development for the production of bio-ethanol using lingo-cellulosic materials, especially the agricultural crop residues and its application. Technology development for production of Bio-oil/lignoil, bio-crude production and integrated bio-refinery development. Study on the growth characteristics of different varieties of oil bearing plants such as Jatropha Curcus and others. Development of Bio-diesel production parameters using non-edible and waste oils, different types of catalyst, feed stocks and the use of bio-diesel as fuel in diesel engines.
9-	Harayana	Farmers in Haryana have formed NGOs and cooperatives for promotion of Jatropha plantation. These NGOs and cooperatives are raising nurseries for Jatropha plantation and supplying saplings to others for further cultivation. They have been blending directly Jatropha Oil into diesel fuel and successfully using this blend in their tractors and diesel engines without any problems. These NGOs and cooperatives are also organizing the practical demonstration of this usage in their demonstration workshops. They are organizing local seminars, workshops and conferences etc. to promote the usage of Jatropha oil. NGOs have also printed some booklets on Jatropha plantation.

8. Current usages of bio-diesel / Trials & testing of bio-diesel

Usages of bio-diesel are similar to that of petro-diesel and its present status in India is as follows:

- 1- Shatabadi Express was run on 5% blend of bio-diesel from Delhi to Amritsar on 31st Dec. 2002 in association with IOC.
- 2- Field trials of 10% bio-diesel blend were also done on Lucknow-Allahabad Jan Shatabdi Express also through association with IOC
- 3- HPCL is also carrying out field trials in association with BEST
- 4- Bio-Diesel blend from IOC (R&D) is being used in buses in Mumbai as well as in Rewari, in Haryana on trial basis.
- 5- CSIR and Daimler Chrysler have jointly undertaken a successful 5000 km trial run of Mercedes cars using bio-diesel as fuel.
- 6- NOVOD has initiated test run by blending 10% bio diesel in collaboration with IIT Delhi in Tata Sumo & Swaraj Mazda vehicles

9. Conclusion

The increasing industrialization and motorization of the India has led to a steep rise for the demand of petroleum products. It is therefore necessary to look for alternative fuels, which can be produced from indigenous, renewable in the country that is biodiesel from non edible oil like Jatropha and Pongamia. India has launched national bio fuel policy in 2003 which is right path for the development for alternative fuel. Several organizations are doing research for the development of alternate fuel. Many trial runs are completed but the process for these developments consuming lot of time. The above study shows that India is moving in the right direction but the speed of process and policy implementation should be increased so that desired goal of replacing diesel with biodiesel can be achieved.

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