A Fundamental study of Indian Biofuel

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Abstract

The objective of this study shows the impact of using biofuels in the modern world. Biofuel initiatives have gained thrust with the Indian biofuel policy targeting 20% to 25% blending of both petrol and diesel by 2020. Most of India's biofuel plans spin around using sugarcane for bioethanol and jatropha for biodiesel production. Study, taking the southern Indian states as an example, aims at estimating the probable to attain policy targets. Study spatially analyses land-use change outstanding to biofuel expansion and its possessions on food production. In India, there are two modeling frameworks are assigned. i.e., simulate land-use change and bioenergy production – Industrial Economy (IE) and Agricultural Economy (AE). Several research works was carried based on the substitute fuel for diesel engine as biofuel. This study shows the preparation of biofuel, biofuel plants and the energy circumstances in India, also study about research work based on a biofuel as alternative fuel for IC Engines.

Keywords: Biofuel, Jatropha, Ethanol Production, Biofuel Plants, Environment Policy, Research Study

Introduction

In the world of development, there are several theories and practices that plan to finish world economic condition and encourage growth. One approach is to develop sustainable industries through non-public sector development to encourage entrepreneurship, gross domestic product growth and employment generation. The chance of developing a biofuel industry in world would ensure the creation of those factors within the geographical region, decreasing the economic condition that afflicts thousands of subsistence farmers whereas providing renewable sources of energies for the country. Biofuels are fuels consequent from biomass. Biomass is organic matter in use from or formed by plants and animals. It comprises mostly wood, agricultural crops and products, hydrophytes, forestry products, wastes and residues, domestic and animal wastes. In it's the greater part; biofuels are all types of solid, gaseous and liquid fuels to facilitate can be derived from biomass. Examples of solid biofuels are wood, charcoal and bagasse. Wood and charcoal are generally used as fuel for domestic purposes such as cooking in the rural areas of most developing and developed countries. Waste bagasse, the fibrous material produced from sugar cane processing, is expansively used for steam and electrical power generation in raw sugar mills. For example, Gaseous biofuels include methane gas and producer gas. Methane gas is produced based on the anaerobic fermentation process of animal wastes, waste water treatment sludge and municipal wastes in landfills. On the other hand, producer gas can be prepared from the pyrolysis or gasification of wood and agricultural wastes. Examples of liquid biofuels such as, methanol, ethanol, plant oils and the methyl esters produced from these oils commonly referred to as biodiesel [1].

Biofuels Milestones

B.C.E. (Before Common Era)

4000 Sumerians discover the process of fermentation. 10th century Assyrians use biogas for heating bathing water.

C.E. (Common Era)

17th century Helmont observes that organic matter emits flammable gases.

1808 Davy discovers methane as the end product of anaerobic digestion.

Mid-1800s Transesterification of plant oils is used to distill glycerin during soap production.

1858-1864 French biologist Antoine Bechamp experiments with fermentation and concludes that ferments are living organisms.

1864 French chemist Louis Pasteur describes the process of fermentation scientifically.

1876 First successful internal combustion engine is produced.

1880s First successful internal combustion engine using producer gas is produced.

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1892-1893 Rudolf Diesel files a patent for a "Working Method and Design for Combustion Engines ... a new efficient, thermal engine."
1895 Biogas is used to fuel street lamps in Exeter, Great Britain.
1897 First diesel engine suitable for practical use operates at an efficiency of 75 percent.
1908 Henry Ford's Model T is designed to run on ethanol.
1920s-1930s Attempts to promote ethanol as motor fuel are made. Anaerobic bacteria responsible for methane production are identified.
1940s First U.S. ethanol plant opens.
1939-1945 Extensive use of biogas to replace gasoline occurs.
1979 Commercial alcohol-blended fuels are marketed.
1984 Number of ethanol plants peaks at 163 in the United States, producing over 2.2 billion liters of ethanol during the year.
1988 Ethanol is used for first time as an oxygenate to lower pollution caused by burning gasoline.
1990 Ethanol plants begin to switch from coal to natural gas and to adopt other cost-reducing technologies. Ethanol plants are subsidized by the U.S. government to support farmers. Gasohol becomes commonly available in the U.S. Midwest.
1997-2002 Three million U.S. cars and light trucks that could run on E85, a blend of 85 percent ethanol and 15 percent gasoline, are produced but few gas stations sell the fuel. Concerns about climate change because leading alternative energies such as biofuel, solar and wind to expand by 20 to 30 percent yearly.

2003 California becomes the first state to start replacing the oxygenate MTBE with ethanol. Several other states start switching soon afterward. California consumes 3.4 billion liters of ethanol a year – about a third of all ethanol produced in the United States.
2004 Crude oil prices rise by 80 per cent, gasoline prices rise by 30 per cent in the United States and diesel fuel prices rise by almost 50 per cent. The U.S. ethanol industry makes 225,000 barrels per day in August, an all-time record. Oil companies invest heavily in alcohol fuel.
2005 E85 sells for less than gasoline on average in the United States. More than four million flexible-fuel vehicles (vehicles that run on E85 and gasoline) exist in the United States. About 400 filling stations that sell E85 fuel exist in the United States, mostly in the Midwest. Gasoline prices rise as ethanol prices stay the same, due to rapidly growing ethanol supply and federal tax subsidies for ethanol.
2006 Indy Racing League switches to a 10 percent ethanol, 90 percent methanol fuel mixture.

{**Source: Issue Brief: Biofuels, North Carolina Association for Biomedical Research, October 2006.**}

Ethanol Preparations

Ethanol can be formed by the fermentation of carbohydrates from different feedstocks. The feedstock's collapse under three major categories: (a) sugar bearing feedstocks such as sugar cane; (b) starchy feedstock's such as cassava or corn; and (c) cellulosic feedstocks such as wood and agricultural residue such as bagasse.

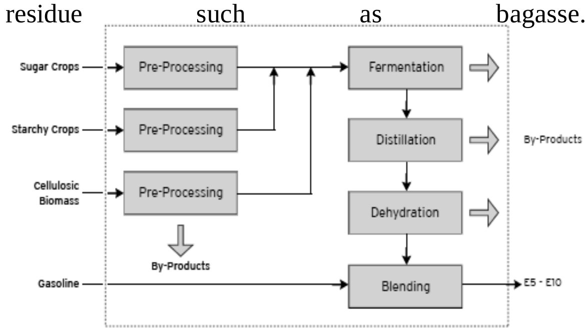

Figure 1 Flow Diagram – Ethanol Production

The production technologies for the first two types of feedstocks are fully mature and well-developed and are commercially available from various suppliers. On the other hand, the processing of cellulosic materials into ethanol using either acid or enzymatic hydrolysis is not yet fully developed commercially but is rapidly becoming technically and economically viable. Figure 1 shows schematically a simplified flow diagram for the production of ethanol from these three different feedstocks.

Methodology

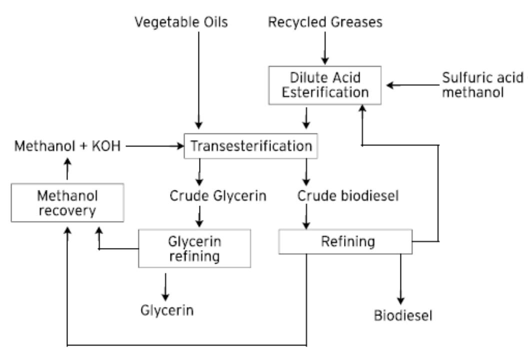

Figure 2 Production Methodology

The complete process for the production of methyl ester from plant oil and other feedstocks therefore involves basically five steps: acid esterification, transesterification, methanol recovery, biodiesel refining, and glycerin refining. The simplified process flow diagram is shown in Figure 2.

Figure 3 Biofuel Plants

The oil from oil-bearing and oil-producing plants is regularly concentrated primarily in the fruits and seeds. The roots, stalks, branches, and leaves may also contain some oil but, in general, the quantity is very much lower. The oil content of some seeds and fruits can be as high as 35%. For example, in dried coconut meat (commonly termed copra) the oil content can be as much as 60 to 65%. In several seeds the oil is mainly found in the germ or embryo, which generally constitutes only a small part of the seed. In the case of the olive, however, a major portion of the oil is found in the pulp surrounding the kernel and only a small portion in the kernel itself. But in the case of the oil palm, both the pulp and the kernel include large amounts of oil. In general, the oil from the pulp may have characteristics somewhat different from the fat from the kernel.

Policy & Potential in India

Appropriate conditions in our country wants to improved energy demand, India must import energy to meet current demand. There is possible for biofuels to leverage indigenous source of input, potentially increasing income and opportunities in rural areas. However the development of a biofuel sector could increase staple food prices and increase food insecurity for poor consumers. At present, biofuel production is minimal, accounting for only 1% of worldwide production. Supporting a future bioenergy sector will likely require policy support (such as incentive packages), community and local interest, scientific breakthroughs, and cost-effective feedstock preparation.

Important of biofuel conversation

Biofuels are potentially important to India for the reason that the significant number of lives they could impact and the financial changes they could cause. Now India is the second most populous nation in the world with an increasing population of more than 1.147 billion people. As of August 2008, the Indian supervision and the World Bank both estimated that 26% of India's population was classified as poor despite efforts made to improve the problem. However, there are possibilities to modernize poverty through economic growth. According to the International financial Fund, the Indian wealth is growing at over 7% per year, which means there are opportunities to invest in fresh industries such as biofuels that could help determine some of India's economic problems.

As the 5th largest energy consumer in the world, India is also provides a good market for biofuels. 70% of its crude oil is imported from the order of the world and experts think likely that over 94% of its crude oil will be purchased from abroad by 2030 if energy trends continue on their current route. Biofuels offer potential opportunities to decrease the nation's faith on foreign energy imports.

In India, biofuels are an alternative energy selection due to the availability of feedstock crops. In view of the fact that the sugar industry is one of India's largest industries, sugar cane and its processing derivative are available for bioethanol production. Additional feedstocks such as oil-seeds for biodiesel are not yet widely available, but it is predicted that trees such as jatropha curcas that fabricate these seeds will thrive in India's climate and environment.

Biofuel preference in India

The term biofuels refers to several different types of fuels, includes bioethanol and biodiesel, which are both feasible options in India. Bioethanol is the most familiar form of biofuel. It is likely that India would use molasses, a by-product of its sugar processing industries, to force ethanol production.

On the other hand, there are most important impediments to larger-scale production and use of bioethanol in India including price competitiveness and production restrictions. The price of bioethanol must be competitive with oil or other current energy sources in order to be successful. Though, current production technologies force biofuel prices higher than those of traditional fuels. Individual way to lower prices is to couple India's sugar production with its bioethanol production so that the sugar industry absorbs some of the costs. However, it is likely that extra costs from biofuel production would cause the price of sugar products to rise for the general residents. Additionally, bioethanol production from molasses might be hindered by the fact that the sugar industry is volatile as a result of its dependence on monsoons. More particularly, when monsoons are fragile, less sugarcane grows and consequently, less molasses is obtainable for bioethanol production. This effect was evident in 2003 and 2004 when monsoons were more subdued than normal and, as a result, mutually sugar production and bioethanol production decreased dramatically.

Biodiesel from oil seed plants are also an option for India's biofuel industry. Newly, Indian scientists, economists, and politicians have become progressively more involved in jatropha, a plant that grows in arid or semi-arid tropical regions, and produces seeds contains anywhere between 21% to 48% oil. It is speculated that jatropha could be the answer to the food-versus-fuel debate because it grows on marginal land or around crops as a protective barriers without competing with them for natural resources. In addition humans, and animals for that matter, do not on average eat jatropha, and thus there is little anxiety that jatropha will be diverted from food markets to fuel the energy industry. There remain numerous questions about the likelihood of commercial jatropha production, because the idea to use the crop for biodiesel is somewhat new. Initial studies show that the oil from jatropha might support a good fuel economy because its production is cost-effectively competitive with diesel when fuel prices are high. In 2006, jatropha production was $0.47/liter while oil production was $0.46/liter. More over the past few years, biofuel critics have argued that investments in biofuels will decrease food security in developing nations where there are already several people who cannot pay for to buy food at current prices. It is projected that if grains and other affix foods are diverted from food markets into energy markets to produce biofuels, food prices will increase. As a result, basic nutrition will be less accessible to the poor around the globe.

In India is specifically exposed to food security issues. Because of 2008, the United Nations Development Programme estimated that over twenty seven percent of Indians live below the poverty line and lack access to enough calories per day to carry on a healthy routine lifestyle. As recently as 2006, India imported 2.2 million tons of wheat in order to guarantee food availability. If more food is siphoned inedible from the food markets into the energy market to grow the biofuel industry, it is likely that the food-versus-fuel divergence will come into play.

Sugar cane and edible vegetable oils such as palm oil are two of the most common feedstocks for biofuel production just about the world. However, there are concerns that India must wrestle clear of these two feedstock sources in order to stay away from serious problems of food insecurity. India is already, one of the largest consumers of the sugar in the world. If sugar be then additionally diverted to the biofuel industry, the food industry would be less capable to meet its original demand. UN and other part of this world, a lot of researchers suggest that sorghum and tropical sugar beets would be better suited to drive India's bioethanol production. In the same way, India's demand for vegetable oil already outstrips its supply. Still, non-edible oils could be used instead to produce biodiesel. Pro-biofuels experts claim that the impacts of biofuels can be mitigated through two principal types of technological novelty. First, nations can focus on cellulosic biofuel technologies that use byproducts or waste products of food and different crops to create biofuels. Technologies needed for this option to be feasible are just starting to become available but are relatively expensive. Similarly, initial investments in existing technologies that increase agricultural productivity could soften the impact of biofuels especially when coupled with technologies for cellulosic biofuel production. The selection does not necessarily need to be between food and fuel. However, the eradication of this difference is highly dependent on India's willingness to invest in new technologies over the biofuels view.

Biofuels crash in India

The biofuel industry could have considerable positive impacts on the health, education, and yield of the rural poor people in India. A few predict that the biofuel industry will create new jobs for the poorest communities in India because biofuel production requires mostly inexperienced labor, which is widely available in rural areas. Even though many people worry that biofuels decrease food security, others oppose that the opposite is true. Their dispute is that food security is determined by one's ability to purchase food at the market price fairly than by the plenty or shortage of food. If this condition, higher incomes effect from increased job opportunities, the rural poor will have more access to food even if prices rise. In addition, biofuel production has the potential to increase access of rural communities to neat and cleaner, more reliable energy.

Although biofuel production has the potential to promote India's rural poor, it is also the possibility of causing damage. If land is transferred from its current use for biofuel production, the poor people will benefit from employment but may risk losing feed for their livestock or materials for their houses and additional structures. The Indian government cited that there were over 30 million hectares of wasteland is presently available, i.e., used for jatropha production around the nation. However, a bunch of this wasteland is also considered Common Property Resources (CPR), land that is jointly owned by rural villages and communities. This land is commonly a source of food, fuel, fodder and timber for the poorest in India. One of the research studies sows that 12-25% of poor household incomes depend on CPR.

The welfare of the urban poor could be particularly endangered by the biofuels, in dissimilarity with the rural poor who may have some opportunities to profit. Although the urban poor do not risk down their land to biofuel production, they don't get employment opportunities or income increases from an expanded biofuel industry also. If India produces biofuels from food commodities on a large-scale or if other countries around the world decide to do so, worldwide food prices will likely increase. The rural poor may possibly be less affected by increased food prices as a result of their ability to produce their own food and live outside the global food market or due to their increased income as a result of biofuel production in rural areas. The urban poor have more at risk because their food security is more tightly linked to fluctuations in the global food market and because they are unlikely to reap any benefits or additional income from the biofuels industry.

There are also numerous questions concerning exactly who will benefit from the biofuel industry — small farmers or large corporations. Seeing that a result of the fact that so little is known about jatropha, small farmers are dubious to risk planting jatropha, which will not collect any profits for 2 to 3 years, if at all. They are more expected to plant more conventional crops such as sugarcane, which can improved guarantee benefits but potentially endanger the food security of the entire poor population. For these reasons, superior companies might become the larger stakeholders in the biofuel industry, which could direct to greater losses but also greater gains. The question was raised, whether biofuels expand or narrow the inequality gap? At final the Indian strategy says 'Biofuels are act in the major role in today's fuel requirements'.

Biofuels Role

Some have call jatropha as the answer to India's energy challenge. According to many sources, jatropha has long been used as a small-scale energy source. Its origin is Central America; their people often use the plant to form lamp oil. Proponents anticipate this small shrub-like plant to fuel the biofuels industries, supporting energy security and independence of the future.

Jatropha has numerous advantages over other feedstocks, which supports the concept that jatropha could be used as the primary feedstock for Indian biodiesel. The plant varieties grow on wastelands with minimal water or nutrients, and have a comparatively high oil yield per plant. From the basis of general estimates, one hectare of jatropha could give up about 1,892 liters of oil. In addition, the plants produce seeds for a predicted thirty years. Jatropha was contributes negligibly to the "Fuel vs. Food" debate because it is not edible for humans or other animals. Therefore growing jatropha for biofuel production neither pulls away nutrients from the food market nor requires valuable croplands due to its preference for arid soils. Although jatropha comes with a host of encouraging attributes, it is important to keep in mind that decision-makers lack crucial information about jatropha, which is still essentially an undomesticated plant. A lot of questions still remain about how much water the plant requires in its first years of growth and whether plant density changes its growth prospective. In view of the fact, that jatropha has never been fully domesticated; it is more complicated to predict its yield year after year. Moreover, it still remains to be seen whether or not jatropha will actually the poor. Experimental results representing low yields and financial returns have shed doubts on the pro-poor jatropha miracle. As a result, it is compulsory to study the plant in depth in order to better understand its optimal growing environment and growth potential. Experts are therefore tentative to recommend heavy investment in jatropha for commercial use before the plant is fully domesticated. A various jatropha varieties need to be explored in the future before it is planted and harvested like a conventional crop. However, in the interim, jatropha can be used as a good fallow crop because it stops ground erosion and increases water storage in the soil.

Environment Policies

Much support for Indian biofuels has come directly from the Indian national government. Its basic biofuels policy agenda emphasizes an optimistic point of view of biofuels, indicating that these alternative fuels will bring greater energy security and independence to the Indian nation. The growth of a domestic biofuel market is anticipated to improve lives of the poor by creating more rural employment opportunities. When the employment rates are improved in rural area, it was based on the potential to have cascading effects that will contribute to the overall improvement of the health and wellbeing of the population. Lastly, the government anticipates biofuels will be more environmentally friendly than other current energy sources by decreasing air pollution and possibly greenhouse gas emissions.

The government started moving its agenda on biofuels in 2003 with the introduction of the National Mission on Biofuels and the Ethanol Blending Programme (EBP). Under the National Mission, jatropha would be planted on 500,000 hectares of Indian government land, and later on it was expanded onto more land. At the same time, the government hoped to begin privatizing the biodiesel industry to become completely separate from the government by 2012. However, these ideas did not come to execution as a result of limited financial and policy support. Environmental Biodiesel Policy also encountered major barriers. The program consented that oil companies produce fuel with 5% ethanol in certain regions of the Indian nation. This schedule almost immediately grinded to a halt because there were there wasn't enough ethanol to meet this mandate between 2003 and 2004. Entertainingly, the National Mission on Biofuels and EBP demonstrated to private investors that the Indian government is serious about testing the possibility of biofuels. Generous sources report that jatropha planting and other biofuel development has started despite unsuccessful government programs.

In September 2008, the Indian government announced the National Biofuels Policy. These policies aim to blend conventional fuels with 20% bioethanol or biodiesel by 2017. The Indian government suggests that biodiesel be produced only from non-edible oil seeds, if possible those grown on marginal lands so as to minimize the food-vs-fuel dispute. Emphasis is placed on developing the domestic growth and production of non-edible feedstocks and their resulting oils by creating a Minimum Support Price and Minimum Purchase Price, as well as by eliminating all taxes and duties levied on domestic biofuels.

Barriers to the Biofuel Industry in India

Although biofuels may be a fine energy alternative option in the future expectations, there are a lot of obstruction that keep the Indian biofuel industry from receiving off the ground in the present. Specialists from all over the world have a range of opinions about the most important barriers that avoid the biofuel industry from growing rapidly. The following are a few major tentative blocks.

From a logistical point of view, India is not ready to invest heavily in fuels because the political and physical infrastructure essential to support the industry currently does not survive. Even though the Indian government proposed the National Mission on Biofuels in 2003, the Indian government still needs the political backing to realistically implement a program of that magnitude. The Mission offers governmental suggestion on developing the biofuel industries. But, there is little policy to make sure these guidelines are followed. Additionally the physical infrastructure to support a proposed biofuel industry of that size is missing. While there are a important number of industrial plants that can process bioethanol, there are very few proficient of producing biodiesel. In India the requirement for diesel is over five times higher than the demand for petrol. Therefore if India is serious about biodiesel from jatropha or other oil seed plants, it should invest significantly in acquiring additional and advanced technologies in oil mining, transesterification, and luggage compartment for biodiesel oil. An example, prior to 2006, here no transesterification plants capable of producing profitable biodiesel. At present there are only a handful of transesterification plants in operation and they do not operate at full facility. India wants to scale up its efforts drastically if it hopes to produces fuels with 20% biofuel by 2017. here are environmental barriers and anxiety to large- scale biofuel production and use in India. The accessibility of both land and already scarce water resources may greatly limit biofuels. At this time, it takes 3,500 liters of irrigation water to produce one liter of ethanol from sugarcane. Many researchers say that as a result, India must seem to drought challenging crops such as jatropha to avoid enormous water shortages as a result of biofuels. On the other hand, it is undecided how much water jatropha requires producing its highest yield. If jatropha requires a considerable amount of irrigation to reach its potential, it is almost confident that water scarcity will increase in occurrence. It is also probable that the biofuel industry's demand for water would take water away from food production, which could more over intensify food insecurity in India. Furthermore, it is still blurred whether or not biodiesel from jatropha will help decrease India's greenhouse gas emissions. Jatropha can be a source or a sink for greenhouse gases depending on numerous factors such as its efficiency in taking up carbon dioxide (which still remains unknown) and the amount of fossil fuels burned to process jatropha into biodiesel (which will depend on the technology and processes used).

On a more local level, the biofuel industry is hindered by Indian farmers' lack of assurance in biofuels. In order to expand the biofuel industry at a significant rate, the Indian government wants to find a way to show that it is serious about the biofuel industry and that it is ready to support small and large farmers' initial investments. The government has started to do so by establishing Minimum Support Prices and Minimum Purchase prices. However, it needs to carry on finding new ways to convince farmers to invest a basic.

Biofuel Research – Study

Different research work was carried through the usage of biodiesel as a substitute fuel for internal combustion engines. Iman K. Reksowardojo et al, says, from his research methodology focused that coconut oil and its blend with diesel fuel gives higher BSFC than diesel fuel and worse emissions because poor atomization due to high viscosity and heating value of coconut oil is lower than diesel fuel. High viscosity of coconut oil impacts on better fuel system components lubrication. On the other hand, engine oil degradation is greater when operate diesel engine with coconut oil. So, it reduces period of engine oil utilization. Coconut oil gives less deposit in combustion chamber but more deposit in piston land, piston ring, and piston grooves. It happens because it's high penetration due to high viscosity of coconut oil.

L. Ranganathan, et al., was experienced in the bio fuel for is research, his research analysis, he can be concluded that cotton seed oil and its blends are a potential substitute for diesel oil. They produce minor emissions than petroleum diesel and have satisfactory combustion and emission characteristics. B.K. Highina.et.al., says that the overall analysis has shown that biodiesel has potential as an alternative fuel in conventional internal combustion engines.

Sejal Narendra Patel.et al., was focused, when his Performance and emission test analysis, it was found that when compression ratio increases brake thermal efficiency (BTHE) increases and brake specific fuel consumption (BSFC) decreases. The results of brake power remains unaffected by changing compression ratio. In emission parameters with the increment in compression ratio emission of carbon monoxide (CO), unburned hydrocarbons (HC) and carbon dioxide (CO2) was found to be decrease. Emission of nitrogen oxide (NOx) was increases considerably with the compression ratio increases. S. Savariraj, et al., predicts that the carbon monoxide emissions are doubled with neat Mahua biodiesel operation when compared to diesel mode at full load condition. At
20% load, HC emissions for Mahua biodiesel and blends are quite high. At higher loads, as the amount of Mahua biodiesel in the mixture increases HC emissions decreases.

Conclusions

This study has been represents to clarify the BDF
(biodiesel fuel) production reaction to optimize the reaction conditions for maximizing the yield of BDF by using plant oil as raw material. In light of the fact that commercial biofuel production and use is a comparatively new idea, all stakeholders – including the Indian government, diminutive farmers, investors, scientists, researchers — have an array of possible actions and stances regarding biofuels. There are abundant opinions about what the logical next steps are. A good deal with this research is undoubtedly major sums into biofuel development policy particularly those policies based around jatropha. Others have specified that India must work to improve its agricultural practices before it moves forward with the rest of its biofuel agenda. There are improvements the government could start making in order to give the biofuel industry a solid support system from which it can grow. Advances in agriculture during water save methods, intercropping, cyclic planting, and crop rotation could produce more efficiency in the agricultural sector and therefore increase yields. These improvements may possibly create a mixture of positive effects downstream in the biofuel industry and the rest of Indian society. Investing time and money studying and domesticating jatropha also has potential settlement.

The Indian government has pointed toward through its policies and public statements that it hopes to make jatropha a central part of the biofuel industries. Unluckily, however, there still is not adequate information about jatropha to ensure that the Indian government would get a substantial return on its investment. At final, biofuel will act as the major role in today's engines alternative fuel requirements.

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