IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 2 Ver. V (Mar - Apr. 2015), PP 01-07
www.iosrjournals.org

Research Analysis on Sustainability Opportunities and Challenges of Bio-Fuels Industry in India

Neha singh parihar
samundra institute of maritime studies lonavala maharashtra

Abstract: *Substantial measures for a reasonable biofuels industry include: collaboration among all stakeholders utilizing a frameworks methodology focused around sustainable biofuels certification; strategic sustainable development, and government policies to stimulate research into new innovations and feedstock, and additionally to decrease consumption and expand efficiency.*
The major aim of this paper endeavors to answer three fundamental questions, with a limited scope to bioethanol and biodiesel production in India. First, what are some significant sustainability opportunities and difficulties of the biofuels business? Second, what is the current condition of biofuel operations in India, and third, what initial moves to sustainable biofuel development can be distinguished? The reaction to these inquiries was researched into utilizing devices incorporating a strategic sustainable development approach, as conceived by The Natural Step Framework.
Keywords: *Sustainable Biofuels Certification; Strategic Sustainable Development, Government Policies, Feedstock and Natural Step Framework.*

I. Introduction

Bioenergy is defined as the energy created through biofuels that are delivered from renewable sources of plant base [1]. All the more specifically, bioethanol delivered from sugar or starch got from grains/biomass and biodiesel acquired from the treatment of consumable and non-edible vegetable oils can be utilized as fuel for fueling automobiles. Aside from this absolutely specialized edge, the growing consideration on biofuels recently can be ascribed to different reasons also. Biofuels offer various environmental, social and financial inclinations. The utilization of biofuels may prompt diminishment in vehicular contamination and greenhouse gas discharges as it is made that the release of sulfur dioxide (SO_2), particulate matter and carbon monoxide (CO), and so forth, are less from biofuels [2]. The monetary and social benefits emerging out of the improvement of biofuel division through expanded income and business opportunities for the country groups is likewise highlighted [3], [4]. The greening of wastelands and recovery of debased backwoods arrives through development of biofuel yields is an alternate included playing point [5].

A. Types of Biofuels

For some, biofuels are still generally obscure. Either in liquid form, for example, biodiesel or fuel ethanol or vaporous form, for example, biogas or hydrogen, biofuels are basically transportation fuels got from organic (horticultural) sources. There are two sorts of biofuels:

- **First Generation Biofuels:**

First generation biofuels are produced using biomass comprising of sugars, vegetable oils, starch, biodegradable yield or animal starch squanders from agribusiness, ranger service, industry, and family units utilizing ordinary innovations.
– Cereals like sweet sorghum, maize, and sugar harvests like sugar beet, sugarcane, and so forth., get reasonably effortlessly matured to produce ethanol, which can be utilized either as an engine fuel in pure structure or as a mixing part in gas.
– Oil seed harvests (edible: soybean, rapeseed, oil palm, sunflower, and non-eatable: pongomia, jatropha, neem, and so on.) can be changed over into a liquid fuel which can be mixed with ordinary diesel fuel or burnt as pure biodiesel.

- **Second Generation Biofuels:**

Second era biofuel advances are gathering up significance on the grounds that first era biofuels produce has got significant limits. The first one is that, they can't be delivered beyond a limit level without devastating sustenance security. They are likewise not taken a cost concentrated with existing fossil fuels. The second era fuels are more manageable, moderate and have more prominent environmental benefits. Then again, they have not ended up mainstream on the grounds that the innovation for producing these is not yet institutionalized. Further;

– Ligno-cellulosic materials, including vegetative trees, grasses, and different waste items from yields can be changed over to alcohol. At the same time the methodology is more difficult in respect to transforming sugars and grains. Systems are being produced, on the other hand, to all the more viably change over cellulosic products and product squanders to ethanol.
– Organic waste material changed over into energy forms which can be utilized as an automobile fuel: waste oil (e g, cooking oil) into biodiesel; animal dung into biogas; and exceptional strains of algae, rural and forestry waste items into ethanol.

II. Economic Sustainability Of Biomass

The basic of sustainability obliges that we obviously consider these criteria in both the short and long term. Three of the most critical criteria for commercial sustainability are productivity (the cost of the biofuel go beyond the production costs), effectiveness (the greatest measure of yield is acquired with a given amount of assets) and value (dissemination of profits or worth included among performers along a biomass-biofuel quality chain or across generations). Subsequently, from the viewpoint of sustainability, the first target is to secure the long term financial feasibility of the profitable framework.

A. Profitability and efficiency

The main model for long term reasonability of a production framework using assets to make marketable profit is that it indicates monetary gainfulness: makers might be eager to seek after biofuel generation if it is financially gainful. Key elements that can influence benefit incorporate optional destructive works of the feedstock and energy costs.

To be beneficial and focused with fossil fuels, biofuel production expenses need to stay beneath the cost of the oil identical. Accordingly, oil costs set a price ceiling at the cost of biofuels. If expenses surpass this value, the biofuels will be consequently valued out of the business sector (Schmidhuber, 2007). The creation of sugar is financially reasonable as long as the production costs are secured. By and by, when oil costs hike and sugar costs fall, ethanol may be the more effective decision. The line of impassion demonstrates the equality cost of ethanol – the circumstances in which farmers will be apathetic regarding delivering ethanol or sugar. Likewise, a circumstance where both oil and sugar costs stay low at the same the time is very conceivable, as was the situation in May 1999, when not ethanol or sugar generation was earning back the original investment.

For instance, in 2000 when sugar costs arrived at practically USD 0.24 every kg, the opportunity expenses of delivering ethanol made it less expensive for India to import ethanol from the United States, though certainly the expense inclination of Indian ethanol generation (Gallagher et al., 2006). Though new developments have empowered more adaptability to respond to market signals, a wide number of components still utmost point the adaptability of the industry participants. For instance, there is no perfect substitution of biofuels for fossil fuels, since vehicles, plants and fuel stations are liable to specific advances. Comparing total production expenses of the diverse biofuel-nation mixes in Table I, rapeseed-based biodiesel in the EU is indicated to be the most extravagant (USD 3.29 every gallon) while sugar stick inferred ethanol in India is the least expensive (at USD 0.25 every liter).

Table I - Cost of production of biofuels from selected feedstock

Biofuel/ Country	Feedstock	Feedstock (% of total)	Total production costs ($/l)
Biodiesel			
USA	Soyabean oil	80-85	.64
Malaysia	Palm oil	80-85	.52
EU	Rapeseed	80-85	.84
India	Jatropha	80-85	.51
Diesel			
USA	Diesel	75	.38
Ethanol			
USA	Corn	39-50	.38
USA	Cellulosic sources	90	.69
India	Sugarcane	37	.25
EU	Wheat	68	.57
EU	Sugarbeet	34	.74
Gasoline			
USA	Gasoline	73	.33

B. Economic equity

The idea of intra-generational value, indicating to reasonableness in distribution of assets between concurrent competing interests, has gotten generally less consideration than between generational value (in the middle of present and future eras). It suggests social and financial equity, personal satisfaction, demacratic system, public investment and strengthening; the occurrence and size of unsustainable practices begin from power disparity. It is in this situation that the environmental furthest reaches of supporting biological communities are characterized [6].

The government of India, for example, through its National Mission on Biofuels, intended to bring around 400 000 hectares of peripheral lands under development of nonedible oil seed products (for the most part Jatropha) for biodiesel creation. On the other hand, the major share of these grounds, common property resources (CPRs) in India, give key subsistence works and present an indispensable section of the employment of the local poor, supplying nourishment, food, fuel wood and building materials. They help between 12 percent and 25 percent of the wage to poor families. [7]

III. Economic Sustainability Assessments

A. Cost-benefits analyses (CBA)

Cost-benefit analysis (CBA) is a standard financial device connected to assess a venture's monetary and economic benefit, an essential for its reasonability. Commonly, in CBA, a net present value (NPV) is figured, considering the normal in- and out-streams and variables, for example, time and risk inclination of influenced stakeholders. If the NPV is definite, the venture ought to be done unless capital is an important compulsion. For the particular instance of biofuels, CBA varies from conventional economic or business computation in that it likewise endeavors to measure cost and profits that don't fundamentally have a business cost. These are regularly called external expenses or external advantages, and for this situation, the relevant ones are:

- Employment advantages;
- Environmental profits;
- Security of supply advantages.

Ecological profits of the different biofuel sorts and their alternatives have been assessed to a great extent through the measurement of their life cycle GHG production values, which is determined primarily by the "cost of carbon," given that it would be inappropriate to distinguishing a higher advantage than the expense at which comparable decreases in emission gasses can be accomplished. Cost benefit analysis obliges making forecasts of the future. The choices brought regarding biofuels will have a monetary and money related effect for a long time to come, and will include expenses and create profits, after quite a long time. Thus leaders need to know the expected outcomes of the options they consider.

B. Full-cost pricing

Estimating policies are a central component in the move towards a greener economy. Full-cost valuing implies that the cost of an exchange not just reflects facts about its individual expenses and profits, as well about the external expense it forces on society through ecological harms. Valuing is especially securing in the region of environmental change, where instruments can adequately and proficiently decrease carbon discharges. Besides the application of full-cost valuing goes well beyond carbon and may cover regions, for example, immediate pollution, agriculture, waste, and fishery.

Full-cost estimating also gets for eliminating unsafe subsidies. Today, numerous nations use subsidies on fossil fuels and agricultural business to give poor families access to fundamental needs or to shield certain divisions from competition to ensure existing employments.

IV. Environmental Sustainability Of Biomass-Biofuels

A. Energy balance

The vital stimulation for bioenergy strategies is to expand energy security. Fossil fuels are limited and costs are required to hike significantly in future. Renewable bioenergy is seen as an approach to expand the vitality sources. The assurance of any biofuel to energy supply depends both on the fossil energy going into its formation and on the energy substance of the biofuel. This incorporates energy needed to develop (manures, irrigating innovation, pesticides, and culturing) and to process the feedstock into biofuel, harvest the feedstock, and to transport the feedstock and the ensuing biofuel through the different periods of generation and appropriation.

Fossil energy balance, characterized as the degree between renewable energy yield of the resultant biofuel and fossil energy information required in its production, is a key variable in judging the requirement of biomass-determined biofuel: this idea measures to what degree biomass is qualified to supplant fossil fuels. Fig. 1 shows reported hypothetical scopes of fossil energy similarities of liquid biofuels as indicated by fuel and feedstock. An energy parity of 1.0 shows that the energy necessity for the bioenergy formation is equivalent to the energy it contains [8]. As such, the biofuel gives no net energy loss or gain. A fossil fuel energy equalization of 2.0 implies that a liter of biofuel contains double the measure of energy as was needed for its formation.

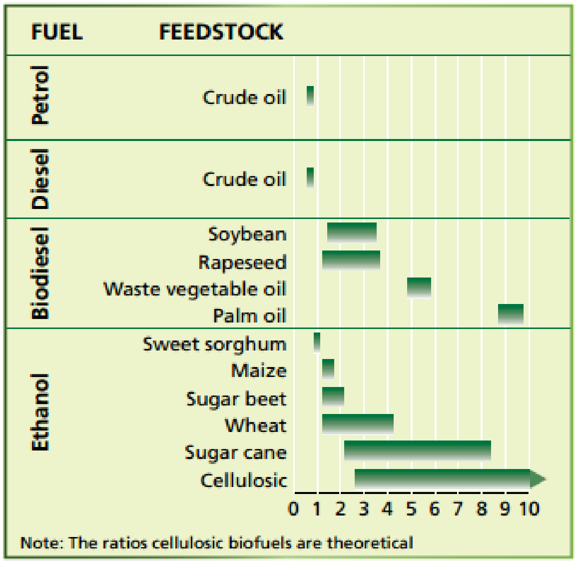

Fig.1: Fossil energy balances for liquid biofuels

B. Greenhouse gas and other air pollutants

Tackling global warming and the likelihood of decreasing greenhouse gas (GHG) releases is the second fundamental driver for biofuel improvement. The negative impacts of GHG releases on atmosphere have been known for a long time. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change [9] examined that GHG releases need to be reduced by 50-85 percent by 2050 to balance out the concentration of GHGs in the air. Given that fossil fuels utilized as a part of transport and cooling and heating frameworks are the biggest supporters to a global warming (around 75 percent of aggregate CO_2 discharges); a standout amongst the most vital targets will be to cut depletions here.

GHG production evaluations normally incorporate those of CO_2, nitrous oxide (N_2O), methane (CH_4), and halocarbons. The gasses are discharged amid the complete element life-cycle of the biofuel relying upon the agricultural works on (counting fertilizer and pesticides use, harvesting and so on.), the change and transportation process, and the last consumption and utilization of substances.

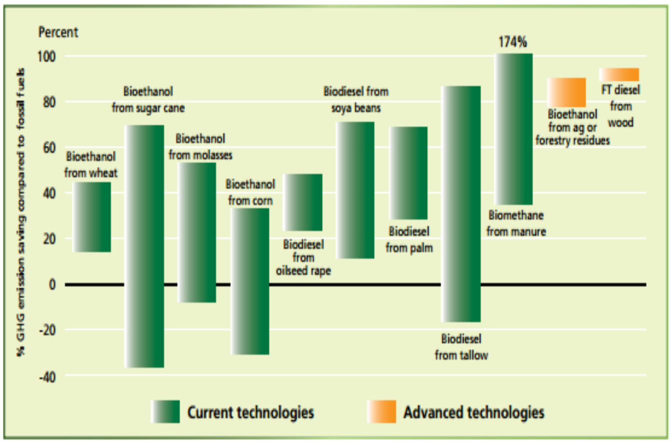

Fig.2: Life-cycle GHG balance of different conventional and advanced biofuels

Among biofuels use in transport, various pollutants are discharged, for example, CO, total hydrocarbons (THC), particulate matter (PM), sulfur fusions, volatile organic compounds (VOC), and dioxins. These gasses can be risky both for the earth and human wellbeing. Although, considered to fossil fuels, biodiesel and ethanol radiate less pollution, with the exception of NO, which are higher under biofuel

C. Life cycle assessments

To estimate if a biomass biofuel framework brings about a net decrease in GHG productions or an enhanced energy balance (input-output energy ratio); a Life-Cycle Assessment (LCA) is generally utilized. As per ISO 14040, a LCA is an "assemblage and assessment of the inputs, outputs and the potential ecological effects of an item framework for the duration of its life cycle."

The choice of distinctive parameters can change the results. There is a subtlety and variability of GHG balance to the unpredictability of biomass vitality frameworks (e.g. product, area, and energy transporter) and the affectability of an extensive variety of parameters. Some key methodological issues identify with estimation of GHG equality, including:

- Reference area utilization
- Indirect area utilization;
- Allocation;
- Data (particular information, default values);
- Time scale issues; and
- Uncertainties in system.

V. Issues In Implementing Ebpp

A. Taxation Issue:

There is a delay in the acquirement of ethanol in specific parts of the nation because of the taxation policy and procedural measures contained by the state governments, for example, excise duty,sales tax procedure, duty of import/export, and issues of permits, and so forth (Table II).

B. Availability of Ethanol:

Ethanol supplies are not in accordance with the demands set on the ethanol suppliers in all the states where EBP usage is in development. Ethanol supplies are influenced because of unusual feedstock supplies and high cost of crude material. The Indian sugar industry pounds around 70-80% of the sugar cane for sugar manufacture, with the remaining utilized for nearby sweeteners (jaggery and khandsari), seed, sustain and cane juice and waste. The by-result of the sugar business, sugar molasses, is utilized for creation of liquor and ethanol. The accessibility of molasses in sufficient amounts to make the expected demand for ethanol relies on upon cane manufacture and therefore sugar production and government policy on use of molasses, and so on (70% liquor for industrial and consumable reason and 30% of alcohol made accessible for fuel reason).

C. Pricing Issue:

As respects fixing of the basic purchasing price of ethanol, two years earlier, the government and sugar industry consented to fix the cost of ethanol at the rate of Rs. 21.50/liter. Despite that, now estimates demonstrate that, the expense of ethanol manufacture in the nation is around Rs 30/liter [10], [11]. This has left the manufacturers in a dubious position, wherein they are not able to offer to government organizations at the purchase cost. Besides, the final cost of ethanol relies upon sugar manufacture and the cost of molasses, which has been fluctuating notably through the years (Rs 2,000-Rs 5,000/ton), prompting extensive variety in ethanol production costs.

Table II: Ethanol Tax Structure in Different States of India

State	Sales Tax (%)	Import Fee (Rs/kl)
Punjab	20+2%SC on ST	1000
Haryana and Chandigarh	20	2000
Uttar Pradesh		1500
Gujarat, Daman and Diu, Dadra and Nagar Haveli	4	3000
Maharashtra	4	1500
Goa	19	190/tank lorry
Andhra Pradesh	12.5	
Tamil Nadu	8+5%SC on ST	1000

SC: surcharge; ST: sales tax. Source: MoPNG

Table III: Projected Demand for Diesel and Biodiesel Requirement, India (Million tonnes) [12]

Year	Diesel Demand	Diesel Blending	Requirement
		@5%	@10%
2009-10	60.07	3.00	6.00
2011-12	66.90	3.35	6.69
2016-17	83.58	4.18	8.36
2018-19	111.92	5.60	11.19
2019-20	202.84	10.14	20.28

VI. Implications Of Biofuels On Food Security, Social Welfare And Environment

A. Food Security and Poverty:

In India, about 70% of the populace live in rural areas and depend on agricultural and related exercises to acquire their living. Additionally, in rural India, around 28.3% individuals are still underneath poverty line. Despite the fact that India is food self-sufficient as far as food creation, very nearly half of children and the same number of women experience the effects of protein calorie malnutrition as judged by anthropometric parameters [13]. Consequently, any large scale biofuel program needs to guarantee that it doesn't reduce with the country's food and nutritive security. In a push to grow the biofuel area in the nation, it ought to be guaranteed that the land under food products must not be redirected for the reason.

B. Appropriate Technology and Feedstock:

Given the current yield yields, feedstock accessibility and transformation technology, the ethanol production in the nation is to be just cost-effective. At present, ethanol production is absolutely on sugar cane molasses, and there is an ominous necessity to seek out substitute feedstock to upgrade ethanol supply. Sweet sorghum is one choice; although, purposeful exploration exertion ought to be concentrated on delivering ethanol from second era biofuels like lingo-cellulosic materials [14].

C. Socio-economic Development:

The advancement of biofuel improvement is interesting for a nation like India due to its potential for making job opportunities for the rural poor and additionally offering opportunities for advancing regional level enterprise and upgrade of women's interest. The accessibility of developments for decentralized manufacture of bio-fuels offers opportunities for the advancement of region level enterprise. Zonal organizations like panchayats, self-help groups (SHGs) and Joint Forest Management (JFM) councils can assume an essential part in including town groups in bio-fuel programs.

D. Environmental Sustainability:

India to improve carbon credits beneath the Kyoto Protocol's Clean Development Mechanism (CDM) must be verified appropriately. It is likewise demonstrated that biodiesel has positive energy equalization and life cycle carbon dioxide (CO_2) release from biodiesel is around 78% lesser than that of outmoded diesel [15]. On the other hand, during a time when the world is getting progressively concerned about an global warming, in-depth studies on the accompanying viewpoints are greatly essential before further extending the area:

a) Crop perceptive, area specific effects on essential vitality utilization and emanations over complete manufacture cycle;
b) Impact on biodiversity;
c) Effects on shore and water assets as a consequence of progress in border example; and
d) Cost-sustainability of accomplishing release diminishments through biofuels.

E. Reduction of Greenhouse Gas Emissions

Substituting fossil fuels with biofuels has obviously been indicated to decrease man-made Greenhouse Gas (GHG) productions. Nonetheless, the examination between GHG productions of fossil fuels and biofuels is not straight forward. For instance, the energy needed to deliver, prepare and transport feedstock and after that change over them into fluid fuels additionally must be considered. Regular systems have been produced to harmonize calculations of greenhouse gas releases from bioenergy in Europe and focus the "GHG balance" of creating distinctive biofuels from diverse feedstock.

VII. Conclusion

The paper concluded the research analysis on sustainability opportunities and challenges of bio-fuels industry in India. Scientific studies about on the ecological sustainability of biofuels have been fairly constrained in India. Substituting fossil fuels with biofuels has distinctly been indicated to diminish man-made Greenhouse Gas (GHG) discharges.

Recently debates over hiking food costs and the related results as an effect of large scale movement of zone from food yields to biofuel feedstock crops have made concerns among the policymakers in both developing and developed nations. This is basically on the grounds that the business sector feedback of a movement against food crops at the worldwide level may influence the agricultural part, as well as different areas of economy, regardless of the level of investment of a nation in biofuel production.

References

[1]. Rao, P P and M C S Bantilan (2007): "Emerging Biofuel Industry: A Case for Pro-Poor Agenda with Special Reference to India", ICRISAT Strategic Assessment and Development Pathways for Agriculture in the Semi-Arid Tropics, Policy Brief, No 12.

[2]. Subramanian, K A, S K Singal, M Saxena and S Singhal (2005): "Utilization of Liquid Bio-fuels in Automotive Diesel Engines: An Indian Perspective", Biomass and Bioenergy, 29, 65-72.
[3]. UNCTAD (2006): "An Assessment of the Biofuels Industry in India" (Geneva: United Nations Conference on Trade and Development)
[4]. Deepak, Rajgopal (2008): Rethinking Current Strategies for Biofuel Production in India, Energy and Resources Group (Berkley: University of California).
[5]. Mandal R and P Mithra (2004): "Biofuels: Indian Scenario and Policy Issues", proceedings of the "International Conference on Biofuels: Perspectives and Prospects", organized by Winrock International India, 16-17 September.
[6]. Jabareen, Y. (2004). A knowledge map for describing variegated and conflict domains of sustainable development. Journal of Environmental Planning and Management, 47(4), 623–642.
[7]. Pagliaro M, Rossi M M (2008), "The Future of Glycerol- New Uses of a versatile raw Material", Cambridge: RSC Pbulishing.
[8]. Armstrong, A.P. et al (2002). Energy and Greenhouse Gas Balance of Biofuels for Europe- an Update, CONCAWE Report No. 2/02, Brussels.
[9]. IPCC 1990. Climate Change: The IPCC Scientific Assessment. Editors Houghton J.T, Jenkins G.J and Ephraums J.J. Cambridge University Press. Cambridge.
[10]. Biofuels International (2009): Regional Focus: Biofuels in Asia, 2(6): 30-32.
[11]. GoI (2003): Report of the Committee on Development of Biofuels, Planning Commission, Government of India.
[12]. MoPNG (2009): Ministry of Petroleum and Natural Gas, www.petroleum.nic.in, accessed on June2009.
[13]. Bamji, S M (2007): "Nutrition Secure India – How Do We Get There? Nutrition Conclave Discusses the Way Forward", Current Science, Vol. 93 (11), December.
[14]. TERI (2005): "Liquid Biofuels for Transportation: India Country Study on Potential and Implications for Sustainable Agriculture and Energy", Report submitted to German Technical Cooperation.
[15]. Paramathma, M, P Venkatachalam and A Sampath Raja(2007): "Jatropha Improvement, Management and Production of Biodiesel", Centre of Excellence in Biofuels (Coimbathur: Agricultural Engineering College and Research Institute).

Table IV: Planning Commission Estimates on Potential Land Availability for Jatropha Plantation [12]

Types of Land	Total Area (m ha)	Area estimated for Jatropha Plantation (m ha)	Assumptions
Forest cover	69	3	14m ha of forests are under the scheme of Joint Forest Management out of which 20% would be easily available for jatropha plantation
Agriculture land	142	3	It is assumed that farmers will like to put a hedge around 30m ha for protection of their crops
Agro-forestry		2	Considerable land is held by absentee landlords who will be attracted to jatropha plantation as it does not require looking after
Cultivate fallow lands	24	2.4	10% of the total area is expected to come under jatropha plantation
Wastelands under integrated watershed development and other poverty alleviation programs of MoRD		2	
Public lands along railway tracks, roads and canals		1	