SUSTAINABLE ENERGY FINANCE INITIATIVE

SEFI

UNEP

Catalysing Financing Market for Bio-fuel Oils in South India

Biofuel Oil Promotion and Credit Facility

Approach Paper

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1. BACKGROUND

Background

1.1. About 70% of India's population lives in villages, a majority of which has practically remained outside the reach of the economic development that has transformed lifestyles of a small segment of urban population to the levels comparable to developed countries. A majority of population in rural areas does not have adequate income generating opportunities, and also, either do not have access to adequate energy for their livelihood or have to rely on polluting energy sources to the detriment of the environment, and to their own social and economic development. Scarcity of energy for productive and income generating activities has perpetuated poverty in rural areas, kept villages under developed, resulting in exodus of youth to slums in metropolises. Even in the so-called 'electrified villages', 70% of the households have no access to electricity since they cannot afford to pay for connectivity from the pole. The rest 30%, who have been connected to the grid, also suffer due to bad quality as well as chronic shortages of electricity, which at times can be just 4 to 6 hrs in the night when they may not need it. The challenge therefore is to provide affordable, reliable and quality energy in the rural areas, especially for income generating activities, which can transform the life of the poor. One solution to this challenge is to shift the energy paradigm away from centralised fossil-fuelled power plants towards clean and cost-effective solutions based on decentralised renewable energy sources available locally. Oil from plants such as Pongamia and Jatropa, that can run diesel engines to provide power for a range of income generating activities such as rice milling, water pumping, operation of agricultural equipments and transport, is one such energy form that may hold the key to such a transformation. Using this clean renewable energy technology in place of fossil fuels also eliminates carbon dioxide emissions, the main source of global warming.

1.2. Technology for use of oils as bio-fuels to power diesel engines is old and well proven. It gained momentum world over due to increasing environmental concerns related to fossil fuels with several initiatives in EU and US countries to increase use of bio-diesel (name given to vegetable oils that are processed and used to substitute diesel). Although a variety of oils are being considered as diesel substitutes in EU and US programmes, the focus in India is on non-edible oils due to high demand for and price of edible oils. Several varieties of oil-bearing seed trees are found in India but experts have zeroed in on to a few species for producing oil. This includes Pongamia, Jatropa, Mahua and Neem.

1.3. Although technology is well proven and demonstrated, access to credit is still a major problem for the rural poor, who otherwise could turn into entrepreneurs raising plantations, setting up oil extraction facilities, generating power and running small-scale industries in villages. Although India has a well developed rural banking infrastructure, the link between the renewable energy and banking sectors is yet to be consolidated. Banks still perceive lending to this sector risky. This initial phase of the proposed project is intended to design, in partnership with

a few (2 to 4) identified Indian banks and finance institutions, a rural finance facility to loan money for raising bio-fuel oil plantations, set-up oil extraction and use facilities and equipments, using United Nations Foundation ("UNF") resources to buy down the initial risks of lending to this sector. The resource requirement for the Phase 2 is expected to be of the order of $ 2 million for implementing the credit facility. The full project under Phase 2 targets at leveraging UNF and other resources by 4 to 6. It is expected to result in the setting up of several bio-fuel plantations, small businesses, and electrification of rural households, benefiting a large number of poor in rural areas in the process. Indirect benefits as a result of these income-generating activities are expected to be multifold.

1.4. With replication, this project will help India lower its projected carbon emissions[1] and thus address the climate change challenge.

1.5. The project is a short-term intervention designed to kick-start a large-scale market for rural credit finance of the bio-fuel oils usage in India. It will therefore require terms of concessional finance and/or guarantees that will no longer be required once barriers to mainstream financing – such as risk perceptions – have been addressed and the credit-worthiness of the rural entrepreneurs and intermediaries trying to promote use of bio-fuel oils is proven.

1.6. Some initial discussions were held with banking partners in the UNF/ Shell foundation-funded Photo Voltaic Solar Credit Facility Project in South India, and their initial response to United Nations Environment Programme ("UNEP") initiative was positive. The bank partners have developed sufficient confidence in working with UNEP in the course of the above project, and hence their approach is positive to this idea.

1.7. Bio-fuel oil is a renewable energy resource that has not been popular due to cheap and easy availability of fossil fuels till recently. Interest in use of bio-fuel oils has revived recently all over the world with targets in EU and US to increase its usage. In India also, the government has launched an initiative making use of 5% ethanol-blended gasoline mandatory from January 1, 2003 in 9 major states and 4 union (federally governed) territories. The entire nation is to be covered in the second phase and the blending will be increased from 5% to 10% starting 2005. The government also announced that the blending of bio-diesel with diesel up to 20% would be targeted by the year 2011-12. The government programme however focuses on bio-diesel on account of its strategic importance and is yet to cover bio-fuel oil use for usage in rural and semi-urban areas.

1.8. However, more than 20 demonstration projects have been set up by the Sustainable Transformation Of Rural Areas ("SUTRA"), a project set up by Indian Institute of Science Bangalore, a premier science institute of the country[2]. The bio-fuel oil can be used to generate power and provide electricity to villagers, run pumps to provide potable as well as irrigation water, and run diesel engines in

[1] The project will look to monetise this emissions reduction through the bulk sale of CO_2 credits to a third party. Emissions reduction value could cover a part of the project costs.

[2] For details see web sites http://www.apdap.com/sutra/index.htm; http://www.goodnewsindia.com/Pages/content/discovery/svo.html; http://agni.csa.iisc.ernet.in/sutra/conf/presentation.html:

several other income generating applications such as oil mills, rice mills, food processing, etc. It can thus help improve quality of life in rural areas. The project has achieved tremendous success and created awareness among several NGOs and local governments, who are eager to take this initiative further. More than 0.27 million litres of bio-fuel oil from Pongamia has been successfully used by SUTRA in their projects. The confidence of international community can be seen from the fact that the World Bank and a German environmental group, 500ppm, have bought carbon credits from two of these projects (www.profor.info/docs/PressReleasePowerguda.doc). BBC covered the project in detail in their broadcasts, and details can be found at http://www.tve.org/ho/doc.cfm?aid=1433&lang=English. However, commercialisation cannot occur unless financial institutions come forward to provide money for investment. They still appear to be largely unaware of the opportunities and consider it risky to lend to new initiatives. During exploratory discussions, Canara Bank and Syndicate Bank, partner banks in the PV Solar Project in India did show some interest. Canara Bank expressed interest in coming forward if UNEP provided some initial support in this area. After 2 years of partnership with UNEP in India PV Solar Project, they have confidence that UNEP can design and implement the programme in a manner that would address the issue of risk to them.

1.9. Rural populations are yet to benefit from this promising technology which has tremendous potential to make a significant contribution to their economic well-being. In fact, this technology combines two important objectives of governments and international donors - providing income generating opportunities to the poor and access to clean energy (including electricity) with a view to reduce emissions and improve the environment. Since the bio-fuel oil substitutes potential fossil fuel use (mainly diesel), greenhouse gas emissions savings can be large. The CO2 saved can be sold and improve project viability. In addition, green cover will also increase substantially, depending on type of plants chosen for bio-fuel oil production. Additional benefits is through availability of organic manure (oil cakes) as a result of processing, as almost 75% of the yield from seeds is organic waste in the form of oil cakes. Some experts suggest that oil cake can also be processed through bio digesters to get additional energy and processed organic fertiliser.

1.10. A lack of access to credit is now the largest impediment to the growth of this technology. Rural customers, a gestation period of 3 to 5 years, and a new application of the technology - all these means higher risks for the financial institutions. India has a well-developed rural banking infrastructure, particularly in Southern India. Commercial, cooperative, retail and rural development banks are all represented in various forms, as are non-banking finance institutions, such as micro-credit organisations. With availability of entrepreneurs and Self Help Groups[3] in rural areas with their good credit track record, initial technical support from

[3] A Self-Help Group ("SHG") brings together 20 to 30 poor families, mostly in rural areas, to jointly access a group loan from a bank or other financial institution. There has been tremendous growth of SHGs in India and associating with SHGs would help reach out to poor households, who may find it difficult to access bank financing individually. Lending to SHGs has been a good experience in India and many banks now prefer to lend through SHGs as they also help reduce transaction costs.

organisations like SUTRA (who have over 4 years of technical experience of running projects based on bio-fuel oils) and willingness of some banks to come forward with support from UNEP, the obstacles to growth of the technology can be easily removed. A successfully designed rural finance facility, with the support of a technical partner, can improve access to credit.

1.11. The proposed project will have replicability not only at rural level but also on a wider scale. Nurseries for plants, seed gathering, plantations in small holdings for villagers as well as on a large scale for corporates and local governments, oil extraction and processing facilities by entrepreneurs point to the possible future potential. One important feature of the project would be the participation of rural poor and women directly as well as through Self Help Groups. There is also a good possibility that commercialisation would be sustained through sale of CO2 in the post-project period.

1.12. Crestar Capital India Private Limited, Mumbai, India ("Crestar") and UNEP RISØ Centre, Denmark representatives first met stakeholders across India in July 2004 to understand the problems facing the budding Bio fuels industry in India. Crestar subsequently carried forward the process and met various stakeholders during 2004-05. This Approach Paper reflects the findings from the discussions held with the various stakeholders..

2. EXECUTIVE SUMMARY

2.1. Government Mission: The Government has launched an ambitious programme to blend Diesel with Bio Diesel in the coming years. To implement Government targets and policies, several government-owned bodies, research organisations and petroproduct companies are working with farmers and entrepreneurs to cultivate/ collect oil seeds, extract oil and produce Bio Diesel. Jatropha has been identified as the ideal plant for production of Bio Diesel and large-scale farming is being encouraged across the country. A few large plants for production of Bio Diesel have been established and petroproduct companies have started supplying small quantities of Bio Diesel to a small set of big buyers.

2.2. Endorsement for use of Bio Diesel: Countrywide research has confirmed that the use of Bio Diesel is compatible with existing engine technologies although large-scale commercialisation of the use of Bio Diesel is yet to take place. Straight Vegetable Oils have also been found to be a suitable diesel substitute in several engines, especially for stationary applications and small power plants in rural areas.

2.3. Supply Chain: Although over 20 different types of oil seeds are suited to the production of Straight Vegetable Oil/ Bio Diesel, their availability is scattered across different regions in the country. Moreover, there is no organised cultivation/ cultivation of the oil seeds, thereby restricting their supply at prices too high to produce Bio Diesel economically vis-à-vis Diesel. By cutting intermediation costs and organising the supply chain for oil seeds, costs of production can be reduced significantly; further, realising higher values from sale of by products can also help produce Straight Vegetable Oil/ Bio Diesel at prices lower than Diesel.

2.4. Production Infrastructure: Farmers will be encouraged to cultivate/ collect oil seeds if there is firm production off take arrangements. Direct linkages with local customers and big buyers can stimulate supply and stabilise prices. Existing oil extraction infrastructure is suitable for processing of oil seeds. Hence, Straight Vegetable Oils are best produced by small village enterprises. However, trans esterification plants for production of Bio Diesel will have to be established afresh. It is likely that large companies will dominate these production activities.

2.5. Transforming rural economies: Use of Straight Vegetable Oil in the local areas where they are produced can transform rural energy access and economics; the oil is suitable for use in multiple rural applications, including generation of power at a lower cost and higher levels of efficiency.

2.6. Access to credit: In order to seed commercial conditions, access to credit is crucial – village enterprises need funds to carry on operations, build direct market linkages and improve their financial capacity to invest in downstream activities and develop more uses for the Straight Vegetable Oils. Banks are reluctant to fund businesses that they are not familiar with and their confidence to do business in the Bio Diesel industry has to be improved. Building an organised market for the oil seeds and the use of the oils is necessary to improve the feasibility of the Bio Diesel businesses.

2.7. Need for intervention: Despite the Government's intensive efforts, they are focussed on cultivation of Jatropha and blending of Bio Diesel with Diesel; complementing its efforts by collecting a wide variety of oil seeds across different regions through the year and popularising the use of the oils in rural applications can help realise the goal of cheap localised energy solutions for rural India. Access to commercial credit can result in a sustainable market for vegetable oils.

2.8. Project Areas: 3 South Indian States of Andhra Pradesh, Karnataka and Tamil Nadu, have the right commercial business environment for the UNEP's proposed Bio Diesel Project – enabling Government policy framework, vibrant village enterprises, good banking networks and ready markets for use of the oils.

2.9. Project Strategy: UNEP can play a large facilitation role in bringing together bank partnerships to help finance village enterprises engaged in Bio Diesel-related businesses. This involves the organisation of the supply chain to produce the oils in the cheapest and orderly manner and encouraging its use locally.

3. SUMMARY OF CONSULTATIONS

Consultations were held during the period November 2004 – March 2005 with government, vendors, research institutions, engine manufacturers, NGOs, capacity building organisations and banks to poll their views on the state of the market and chart the way forward.

Conclusions from the consultations are summarised below:

3.1. Favourable Policy Framework: Bio Diesel is engaging the attention of various State Governments; it could reduce dependence on fossil fuels, encourage farming in wasteland areas and generate rural employment. Some States have formulated policies and specific plans of action to encourage farming and entrepreneurship in the Bio Diesel industry.

3.2. Reasons for Demand: Use of vegetable oils is known in rural areas; Bio Diesel will be preferred if it is cheaper than Diesel and other similar petrofuels. Power shortages are strong demand-drivers for alternative fuels. Using Straight Vegetable Oils/ Bio Diesel to run generators to produce power for captive power and local grids could be a source of demand.

3.3. Engine-friendly: On extensive testing and use, Bio Diesel has been found to substitute or blend with Diesel for use in both stationary and automotive engines without any major modifications or effect on performance.

3.4. Bio Diesel vs. Straight Vegetable Oils: Although Government policy and private initiative focuses on use of Bio Diesel, Straight Vegetable Oils are also found to be equally attractive substitute fuels, cheaper and suited for use in various rural applications and for power generation.

3.5. Price advantage: To compete with Diesel, Straight Vegetable Oils and Bio Diesel have to be priced lower. Currently, limited supply of oil seeds results in price volatility; streamlining the supply of oil seeds can reduce cost of production and Bio Diesel will enjoy a cost advantage over Diesel. Production costs can be reduced further by maximising revenues from sale of by products.

3.6. Increasing supply of oil seeds: The focus of stakeholders is on encouraging use of Jatropha; however, existing resources of several other oil seeds including Pongamia that are available in the wild need to be tapped.

3.7. Production Model: Village enterprises are the most cost-effective business platforms for cultivation/ collection of oil seeds, oil extraction, trans esterification and marketing of bio fuels. Production technologies are either well known or available within India. Existing business infrastructure can be used, reducing the investments required.

3.8. Market Linkages: Firm tie-ups for sale of oils and by products will encourage cultivation/ collection of oil seeds and downstream activities, besides reducing transaction costs.

3.9. Regional variations: The South Indian States of Andhra Pradesh, Tamil Nadu and Karnataka appear to have favourable government policies, supply of oil seeds and entrepreneurship synergies to produce Bio Diesel. They also have a wide network of banks to increase access to credit for entrepreneurs.

3.10. Commercial financing: Although the existing policy and product framework facilitates financing, the confidence of banks needs to be increased to lend to the Bio Diesel industry.

List of stakeholders consulted is annexed as Annex 1.

4. BIOFUEL OILS- INDIAN CONTEXT

GOVERNMENT POLICY AND EFFORTS

4.1. Big initiative: A National Mission on Bio Diesel was launched in April 2003 based on the recommendations of a report submitted to the Planning Commission of India[4]:

- Jatropha Curcas ("Jatropha") was identified as the energy crop that could be grown in over 5 million hectares of waste lands across India
- By the Year 2006, all diesel sold was to be blended with 2.6 million tones of Bio Diesel[5]
- Year 2012 Bio Diesel production target is 13 million tones to blend 20% of all diesel
- Specific wasteland and forest regions have been identified to cultivate Jatropha

4.2. Focus on Jatropha: Although there are over 20 different types of oil seeds[6] that could be used to produce Bio Diesel, of which several already grow in the wild abundantly, Government prefers cultivation of Jatropha, one major reason being its potential for rural employment and wasteland farming.

4.3. Limited Progress: 2 years later, there is uncertainty over good species, crop practices, etc. Despite some States enacting specific polices and action plans, the acreage under cultivation is very small. Farmers are unsure about the marketability of the oil seeds in the absence of any organised marketing infrastructure or assured market linkages.

4.4. Big Oil Company buyers: Petro product companies[7] are likely to be the biggest buyers of Bio Diesel[8], which is intended to be blended with Diesel:

- None of them are directly involved with farming; they have *not* made any commitments to buy Jatropha produced by farmers
- They do not advocate use of Straight Vegetable Oil[9] ("SVO"); their direct business interest lies in procuring only Bio Diesel for blending with Diesel and sale through their outlets
- The consumer is unlikely to see any significant price advantage even after Bio Diesel becomes available

4.5. Financial incentive mechanism: With the help of Government funding, the National Oilseeds & Vegetable Oils Development Board ("NOVOD") has launched a grant-based financial support mechanism linked to bank financing for farming and post-harvest activities. However, the National Bank for Agriculture and Rural Development[10] ("NABARD") is yet to announce a concise policy of lending by the banks. Banks[11] are unsure about the feasibility of Bio Diesel-related businesses.

[4] One of the most influential policy-making bodies that allocates funds for various programmes run by Government
[5] A substitute for Diesel, based on vegetable oils
[6] Indian Institute of Science has identified 83 varieties of oil seeds
[7] Indian Oil Corporation, Bharat Petroleum, Hindustan Petroleum, etc., who refine and retail petrol, diesel and other petroleum products
[8] The supply of Bio Diesel will not be adequate to completely replace Diesel, hence blending
[9] Oil seeds are crushed to extract SVO, which is further trans esterified to produce Bio Diesel; SVO itself is a diesel substitute although it has limited applications in view of its higher viscosity
[10] Influences bank lending policies and provides financial support
[11] Almost all Banks in India have extensive rural branch networks and a range of rural loan products

4.6. Validation of use of Bio Diesel: Various research institutions in India have conducted lab and field studies to test whether use of Bio Diesel is suitable for stationary and automotive engines. Results are satisfactory. There is limited use of Bio Diesel in various applications and by some potential big buyers, such as the Indian Railways and the bus transport companies, but no sustainable long-term uses have emerged till date. The Sustainable Transformation Of Rural Areas ("SUTRA") Project implemented by the Indian Institute of Science, Bangalore, has established several demonstration rural projects using SVO[12].

4.7. Bad precedents: A similar plan to blend Ethanol in petrol, which went on stream last year, has been unsuccessful primarily due to non-availability of Ethanol. Shortage of oil seeds could also hamper the ambitious plan to produce Bio Diesel by the year 2006-07.

4.8. Need for Government intervention: Progressive Government policies and enabling regulatory and business environment can encourage farming and post-harvest activities around the production of Bio Diesel. Government controls use of forest resources, viz. collection of oil seeds from trees situated in forest areas. Further, present regulatory controls over use of chemicals such as Methanol need to be relaxed in order to facilitate establishment of trans esterification plants[13]. Government's involvement will increase the commitments of other stakeholders and catalyse the development of the Bio Diesel industry.

[12] In the project areas, village communities have been mobilised to collect oil seeds grown in the world, extract oil through local crushing facilities and use the SVO in small engines that pump water, run automobiles and generate power. In all cases, SVO has been produced using *Pongamia Pinnata* oil seeds

[13] SVO has to be trans esterified to produce Bio Diesel

4.9. **ENVIRONMENTAL DIMENSION**

ENVIRONMENTAL IMPACT OF ONGOING BIO DIESEL INITIATIVES IN INDIA[14]

India ranks 5th in carbon emissions in the world. Carbon emissions are forecast to grow by about 3.3% annually through 2020. Developing a rural infrastructure for oil-based fuels means:

- Watershed management
- Increased tree cover and control of soil erosion
- Generation of leaf litter as mulch and feedstock for bio-gas
- Production of seed cake as organic fertiliser
- Creation of a rural economy/livelihoods around collection of seeds, processing and storage of oil

Due to the high rate of deforestation in most farms in rural India, the available tree cover is giving way to non-sustainable high-energy farming systems. With 1/3rd of agricultural lands degraded and another 50-150 million ha of wastelands that are underused and degraded due to overuse, deforestation, drought and erosion, the land available for plantations of Jatropha, Pongamia and other tree-borne oils is high.

The capacity of Jatropha to rehabilitate degraded or dry lands by improving their water retention capacity makes it an instrument for upgradation of land resources. Thus grown on a significant scale, Jatropha can clean the air and green the country, add to the capital stock of farmers and promote crop diversification. Pongamia flourishes in dry areas where agriculture is unproductive and in poor or saline soils. Around 60 million hectares are under forests and 24 million hectares fallow lands (compared with 142 million hectares under agriculture). Some of this land could be used for growing Pongamia. The plantations sequester carbon in the biomass throughout their rotation and abate carbon emissions through replacement of fossil fuels when converted to energy.

The non-edible oil extracted from the oil seeds is used as fuel, and the deoiled cake is also an environmentally friendly insecticide and pesticide rich in nitrogen when compared to other commonly available organic manures. The tree itself is nitrogen fixing and will improve the soil where it grows.

As a diesel substitute, Bio Diesel eliminates carbon dioxide emissions. When compared to Diesel, it reduces emission of particulate matter by 40%, unburned hydrocarbons by 68%, carbon monoxide by 44%, sulphates by 100%, polycyclic aromatic hydrocarbons (PAHs) by 80%, and the carcinogenic nitrated PAHs by 90% on an average. However, use of Biodiesel results in higher emissions of NOx. Intensive agriculture practices in cultivation of Jatropha (unlikley in Indian conditions where there is limited mechanisation and organic farming methods are practiced) and other oil-bearing crops can partly reduce the CO2 savings because of the fossil fuels used to produce and distribute it.

Transport sector is the biggest contributor to carbon emissions in India, especially from use of Diesel, whose carbon content is 86%.

[14] From various published sources including the Planning Commission Report, Phytotron Agro India and SUTRA

4.10. ENVIRONMENT IMPACT ASSESSMENT: COMPARISON WITH GLOBAL BIO DIESEL INITIATIVES AND EVALUATION IN INDIAN CONTEXT

#1 Reduction In Carbon Emissions: Use of Bio Diesel reduces carbon emissions, and life cycle analyses show reductions of up to 80% compared to Diesel.

#2 Reduction in Sulphur: Life cycle emissions of Sulphur Dioxide are lower for Bio Diesel.

#3 Increased NOx: Use of biodiesel increases emissions of Nitrous Oxide. This partly counters the CO2 emission savings and can lead to eutrophication of the environment.

#4: CO Emissions: Use of Bio Diesel reduces Carbon Monoxide by 20 – 40%.

#5: Green Fuel: Bio Diesel is biodegradable, non-toxic and free from sulphur and aromatics.

#6: Effect on Engine Life: Use of Bio Diesel lengthens engine life and can reduce the gap between engine overhauls, saving on energy to produce new engines and maintain them.

#7: Comparisons with other alternative fuels: Fuels such as CNG/ LPG may be cleaner compared to Bio Diesel.

- Diesel contributes most of India's carbon emissions and use of Bio Diesel may be the most cost-effective compared to other alternative fuels such as CNG/ LPG that are not available easily.

#8: Relative production efficiency: A U.S. Government full lifecycle emissions study found that for every unit of fossil energy needed to make Bio Diesel, 3.2 units of energy are gained. In contrast, it takes 1.2 units of fossil resources to produce 1 unit of Diesel.

#9: The emissions during the respective production cycles of Diesel and Bio Diesel – g/km

	Diesel		**Bio Diesel**
Extraction	16	Fertiliser Production	15
Transport	3	Fertiliser application	10
Refining	14	Agricultural Machinery	25
Distribution	1	Oil Extraction	3
Vehicle Emissions	245	Processing – Straw	1
		Processing – Gas	17
		Transport	5
		Vehicle Emissions	0
Total	**279**	**Total – Straw Processing**	**59**
		Total – Gas Processing	**75**

Source: ECOTEC Research and Consulting Limited (ECOTEC) study for the British Association for Bio Fuels and Oils

#10: Diversion of Food production: In Europe and North America, food crops such as Soya, Rape and Sunflower are cultivated to produce Bio Diesel, thereby diverting food production.

- In India, only non-edible oil seeds will be used, thereby sparing food production.

#11: Better uses for land: Land requirements for energy crop and forest plantations will compete with land used for the traditional production of food and fibre products. It could also encourage further clearing of indigenous forests.

- Oil seeds will be harvested mostly from Jatropha Curcas grown in wastelands and wild Pongamia and Mahua trees. The trees will help add to the forest cover.

#12: Impact on Bio Diversity: Cultivation of Energy crops could result in either high intensity (intensive arable/ grassland) or low intensity (e.g, set aside) land uses, leading to environmental change. Indicators are biodiversity, water quality (affected by inputs of agrochemicals), soil quality/ erosion, landscape character. Species used must consume lower inputs and support higher levels of biodiversity. Monocultural production of energy crops (possible if Jatropha curcas is grown to the exclusion of other crops) is environmentally unacceptable.

- Jatropha Curcas will be grown in Indian wastelands lands where no other crops are being grown at present, thereby increasing the green cover. Jatropha Curcas will also be fencing or inter crop in existing fields. In view of the shortage of water, organic farming methods will be practiced with minimal use of fertilisers.

- 22 species have been identified for cultivation of energy crops, keeping in mind differing agro-climatic conditions across the country and the need for biodiversity. Oil-bearing trees like Pongamia and Mahua have been selected under agro-forestry plans in order to increase biodiversity.

#13: Foreign crops: Growing non-native species of plants can have undesirable consequences on bio diversity and environment.

- Jatropha Curcas, Pongamia and Mahua are native to India and grow extensively in the wild. Jatropha Curcas is a common plant in most parts of South and Central India, but this is the first time that organised cultivation is undertaken on a mass scale.

#14: Intensive cultivation: Cultivation of energy crops increases consumption of fossil fuels to produce fertilisers/ pesticides and run agricultural vehicles/ equipment such as tractors, their use can have detrimental effects on soil, groundwater and ecosystems. Typically, rape, sunflower and soya are intensively farmed with high chemical inputs.

- Non-chemical manpower-intensive agricultural methods are practiced in India. As per the Soil Association, UK, organic farming methods reduce energy consumption by 50% and do not contribute to increased N2O emissions resulting from use of fertilisers.

- The requirement of fossil fuels for producing Bio Diesel are significantly less than in the Western world where the production costs of biodiesel are often 2-3 times higher. In India, production processes are less energy-intensive.

- Jatropha Curcas has been specifically selected because it uses almost no or minimal fertilisers or pesticides. Traditionally, organic farming methods are employed in wasteland areas. Thereby, nitrous oxide emissions associated with the use of fertilisers will be absent.

- Jatropha Curcas will be cultivated in rain-fed areas, requiring almost no irrigation facilities, obviating the need to use fossil fuels. Water pumps are likely to run on Bio Diesel instead of depending on grid power or Diesel.

- Tractors, wherever used, are likely to use Bio Diesel to run their engines.

- Energy trees such as Pongamia or Mahua will be grown under agro forestry programmes – there will be no plantations using chemical and fossil inputs.

- Growing of energy crops is being seen as a solution to solving massive rural unemployment problems and increasing the income of farmers.

- Growing energy crops will add to the water retention capacity of the soil and help in the nitrogen fixation process to enrich it.

#15: Transport of oil seeds: Fossil fuels are used to transport oil seeds from the field to the oil extraction plant.

- In India, oil extraction is a common decentralised village-level industry and plants are located near the source of oil seeds, minimising transport emissions. Typically, oil seeds are collected using farm labour and despatched to the nearest oil extraction plant.

#16: Use of fossil fuels in downstream processing: Oil extraction facilities use grid power or burn fossil fuels.

- Oil extraction facilities are likely to use Bio Diesel in their engines. Village power plants running on vegetable oils are expected to supply power for local needs.

#17: Use of base oils: Straight Vegetable Oils themselves can be used in most stationary engine applications. SVO has many advantages over Bio Diesel in terms of energy usage and pollution and fuel stability. Production of Bio Diesel requires additional processing.

- In India, SVO could be used widely in stationary engines in the local area where they are produced, establishing an energy-efficient localized production and delivery supply chain.

#18: Production of Bio Diesel: Production of Bio Diesel requires chemicals such as methanol and sulphuric acid, and the trans esterification process itself requires energy to heat and mix the chemicals and large-scale industrial plants for cost effectiveness. There are additional transport costs to carry the fuel from the fields to the factory, and then back to the end user.

- In the interests of keeping costs down in India, it is unlikely that Bio Diesel plants will be located far away from the where the base oils are produced. Further, after blending with Diesel, Bio Diesel will be distributed in the same region.

- SVO can fuel small power plants for villages that currently suffer severe power shortages, reducing dependence on fossil fuels, curtailing transmission & distribution losses and increasing energy self-sufficiency and security.

- Several employment opportunities will be generated thanks to (a) cultivation of energy crops, (b) collection and processing of oil seeds, and (c) various downstream activities including storage, transport, retailing, etc.

#19: Dependence on Subsidies: In Europe, farmers earn heavy subsidies for cultivating energy crops in set-aside lands. Further, since the cost of Bio Diesel is uneconomic, prices are also too high compared to Diesel.

- Barring minor subsidies in some States to help farmers defray the initial cost of seedlings, no special subsidy support is envisaged. As per current cost estimates, the cost of Bio Diesel will be lower than that of Diesel, which is sold at subsidised prices, thereby actually saving Government money, and mitigating the inflationary impact of Diesel prices, while generating higher incomes for the villages.

5. SUPPLY OF OIL SEEDS

SOURCES OF SUPPLY

5.1. Several types of oil seeds: There are over 20 different non-edible oil seeds[15] that could be used to produce Bio Diesel; almost all of them grow abundantly in the wild. Most of the organised cultivation efforts centre on Jatropha. There is tremendous scope for improvement in crop productivity, depending on the crop species used and the agricultural practices employed. Unlike in West Europe and North America, edible oil seeds are not available for production of Bio Diesel.

5.2. Shortage of oil seeds: At present, cultivation is inadequate[16] and hardly any collection of oil seeds from the wild to support the Government's ambitious production targets for Bio Diesel.

5.3. Regional availability: Different types of oil seeds are available across various regions in India. The 3 South Indian states of Karnataka, Andhra Pradesh and Tamil Nadu have significant resources[17]; there are also concentrated efforts on cultivating Jatropha in view of favourable agro-climatic conditions and need to generate employment in their rural waste lands. This calls for region-specific approaches to use of Bio Diesel.

5.4. Seasonal availability: Oils seeds are available only during certain periods in a year. To ensure uninterrupted supply of oil seeds for production of Bio Diesel, various types of oil seeds should be used depending on their availability. For example, as per the Karnataka State Land Use Board, the seasonal cycle for oil seeds in Karnataka State is as follows:

Type of Oil Seed	When available
Pongamia[18]	Jan-Apr
Neem	May-Jul
Mahua	Jul-Sep
Jatropha	Oct-Dec

5.5. Skewed Government Policy: Government policy is biased towards Jatropha; a single-seed policy could be adverse:

- Over-dependence on one oil seed would mean exposure to risks of crop failures
- Seasonal availability brings problems associated with seasonal occupations, shortages, storage, deterioration in yields and higher costs
- Prices could be difficult to control

5.6. Need to use different seeds: A multiple-oil seed use strategy is crucial to ensuring that:

- Various oil seeds are available throughout the year, depending on seeding cycles,
- Price volatility is controlled by switching over to cheaper oil seeds
- Area-specific strategies can be adopted to suit region-wise availability of seeds

[15] Among them Jatropha, Pongamia Pinnata, Neem, Mahua and Rubber Seed
[16] Jatropha is being grown in an organised manner for the first time in India
[17] Karnataka State alone has 34 million trees of Pongamia Pinnata
[18] Pongamia Pinnata

5.7. Geographical considerations: The scattered geographical location of oil seeds-growing areas and varying levels of market demand for Bio Diesel necessitates a broad-based decentralised approach to establishment of production infrastructure. Further, to maximise the price advantage over Diesel, production of oil should be ideally close to the source of supply of oil seeds. A skewed production and distribution infrastructure may have to be appropriate in some places – for example, oil seeds may be bought from the Central Indian State of Chattisgarh[19], but the oil used in Karnataka State.

5.8. Forms of Oil: Different oil seeds can be used to produce oil that has almost the same specifications. Engines can use different forms of oil – Straight Vegetable Oils, Degummed Oil and Bio Diesel; SVO costs the least and Bio Diesel is the closest in characteristics to Diesel. User can maximize their cost advantage by using the oil most suited to their engines.

5.9. State of the market: Government policy intervention and facilitation of free market enterprise will trigger off interest amongst village communities and marshall their collective resources to mapping resource areas, collecting oil seeds, organising and running village enterprises, reaching produce to the open markets, stabilising prices, etc. In most Indian States, export of forest resources[20] is restricted and controlled collection of oil seeds may be required till Bio Diesel can compete effectively against Diesel. For example, in 2 districts of Tamil Nadu[21], the Government Forest Office controls access to forest areas for collection of Pongamia seeds, and facilitate their sale at predetermined prices – around Rs. 3 per kg – making it possible to produce Bio Diesel at around Rs 20 per litre[22]. On the other hand, in Tumkur District of Karnataka State, the same Pongamia oil seeds are sold at Rs 10 per kg to oil extraction facilities, making the Bio Diesel too expensive vis-à-vis Diesel.

ANALYSES OF VARIOUS OIL SEEDS

Jatropha Curcas

5.10. Attention on cultivation of Jatropha: Government policy favours Bio Diesel based on oil produced from Jatropha seeds:

- It grows well in less fertile, poorly-watered soils
- Cost of cultivation is low compared to other cultivated crops
- It has the fastest growing cycle
- Both crop productivity and oil yield are high
- Technical expertise for growing this crop is available and most research around use of Bio Diesel is based on Jatropha

5.11. Limited Availability: Currently, there is very little organised farming and oil seeds are collected from the wild across a few states in India, mainly Tamil Nadu, Karnataka, Madhya Pradesh, Maharastra and Chattisgarh. However, despite intensive efforts made by Governments in some States, farmers have not responded in a big way, mainly because they are unsure of crop productivity/ oil yields and assured off take by buyers.

[19] Mahua and Jatropha grow extensively in its forests
[20] Such as collection of oil seeds from Pongamia trees in forests
[21] Krishnagiri and Dharmapuri Districts
[22] Diesel retails currently at around Rs. 32 per litre In Tamil Nadu State

Apart from organised farming of Jatropha, encouraging the growing of this plant as fencing crop and in watershed programmes is another way of propagating this crop.

5.12. Mixed responses: Several research institutions have done extensive work around this crop and oil, and almost all petro product companies favour the use of Jatropha-based oil. There exists reasonable level of expertise and technical resources across the country. However, Banks remain unconvinced about the business viability of Jatropha farming and are weighing their options as events unfold.

5.13. No price stability: Presently, the supply chain for sale of oil seeds and the oil is neither organized nor well developed. Prices are erratic and range from Rs 10-35 per kg, at which prices Bio Diesel cannot compete with the price of diesel.

Pongamia Pinnata

5.14. Not a cultivated crop: The Pongamia tree has a long growing cycle, but is ideal to propagate through watershed and afforestation programmes. It is the cheapest of the oil seeds to cultivate; however, a lot of effort is involved in collecting them from the wild.

5.15. Abundant availability: Pongamia trees grow wild in select pockets in the South Indian peninsula, with States like Karnataka alone reporting a resource base of 34 million trees[23]. This means an estimated oil production of over 61,000 tons or 72 million litres of SVO[24]. In some areas, Pongamia is being planted under afforestation programmes. If existing resources are tapped, they are likely to yield significant quantities of oil. The oil seeds are available only during a fixed season of 2-3 months every year and collection has to be concentrated during those months. The oil seeds are not collected, except in some areas such as the Tumkur region of Karnataka State.

5.16. Price variations: Wherever collected, the oil is in great demand from the soap-making, pharmaceutical and a few other industries, thus driving up its prices. Thanks to the limited supply of seeds and the high transaction costs, oil prices are skewed – at prevailing levels of around Rs 40 per kg[25], Bio Diesel will be too expensive. Nonetheless, in parts of Tamil Nadu[26] and Andhra Pradesh[27] States, oil is available at ¼ th the prices prevailing in Karnataka State.

5.17. Successful use of Oil: SUTRA[28] has conducted extensive field studies and testing of Pongamia oil in various rural engine applications – water pumping, generators, tractors, etc – and the results are satisfactory.

[23] In addition, Karnataka State has 28 million Neem Trees and over 1 million other oil-bearing trees
[24] Assumed that 0.85 kgs of oil is equivalent to 1 litre of oil
[25] Prevailing price in Karnataka's Tumkur District, one of the largest producers and markets for Pongamia oil seeds and oil
[26] Under the initiative of the State Government's Forest Office in Krishnagiri and Dharmapuri Districts
[27] In Adilabad District under supervision of the Government's Integrated Tribal Development Authority
[28] Please refer *Para* 4.6 in *Page* 11

Other non-edible oils

5.18. Unutilised resources: The most important of the other non-edible oils are Mahua and Neem, both of them grown extensively in Central India and the South Indian peninsular region. However, there is limited collection of oil seeds. Trees such as Mahua grow extensively in the poorer districts in Karnataka State and in tribal-populated areas of Madhya Pradesh and Chattisgarh – cost of labour being a major cost, in such districts, collection costs are also lower. There are others such as Rubber Seeds who may also be suitable for the Bio Diesel project – they are abundantly available in some regions in Kerala State – and apparently neither collected nor used at present.

5.19. Cheaper source of seeds: It may be possible to procure these seeds at prices lower than those for either Jatropha or Pongamia. For example, in the same regions in Karnataka State where Pongamia is sold at Rs 5 per kg, Neem seeds are available at Rs 3 per kg. This depends on what value the oil seeds command in the market for other uses.

Edible Oils: Palm Oil

5.20. Imported Palm Oil could be one of the input oils for Bio Diesel production, particularly in view of the fact that the supply chain for the oil is well established. Moreover, Palm Oil prices compare favourably with all other oils available in India.

5.21. Price benchmark: Southern Bio Technologies Limited proposes to use imported Palm Oil to produce Bio Diesel in the event it is unable to source local oil seeds such as Jatropha and Pongamia. The price of Palm Oil[29] could set the benchmark for the maximum price for SVO extracted from local oil seeds.

Other Edible Oils

5.22. Not available: India being a high consumer of edible oils, there is very little edible oil available for non-edible use such as for Bio Diesel production. Moreover, the prices of all oils are far higher than what would be a viable price for processing and sale as Bio Diesel.

[29] Currently [Rs. 18-22 per kg in the case of Palm Oil imported from Malaysia

6. PRICING

6.1. Lower cost incentive to switch fuels: SVO or Bio Diesel has to have a significant price advantage over Diesel in order to win over customers across various applications. Prices of diesel vary, depending on the place where it is sold[30] and accessibility to petrol stations. For example, in most villages, diesel is procured from the petrol station in the nearest big town, whereby landed costs are up to Rs 5 per litre higher than the retail price at the petrol station. Therefore, area-specific price dynamics will determine the popularity of SVO or Bio Diesel. A decentralized production infrastructure is critical to reducing costs.

6.2. Substitute for residual petro fuels: Several large engines run on Furnace Oil or LSHS which are the cheapest of petro products - this large customer segment could also be weaned away to use SVO, assuming that its selling price is lower.

6.3. Production costs for SVO/ Bio Diesel: The major cost components are:

- Seedlings and other farming costs, in the case of organized farming
- Labour costs, where seeds are collected from the wild
- Cost of storage space, for oil seeds since it is a seasonal product
- Transport costs to reach the oil extraction facility
- Oil extraction costs, offset by revenue from Sale of by products
- Cost of storage space for SVO
- Transport costs to reach the Bio Diesel production facility
- Trans esterification[31] costs, offset by revenue from Sale of by products

6.4. Reducing costs: The main area for cost control in the supply chain is the price of oil seeds that accounts for most of the cost of the fuel. The price at which SVO/ Bio Diesel can be sold in the open market will depend primarily on:

- Type of oil seeds used, whether it is Jatropha, Pongamia Pinnata, Palm Oil or any other oil seed
- Price of the oil seeds by the time it reaches the oil extraction facilities
- Whether SVO or Bio Diesel is sold
- Value realizations from sale of by products

6.5. Low-cost farming model: In order to kick start the market, various Government agencies sponsor the supply of seedlings (mainly for Jatropha) at no or low costs. Despite such largesse, at this stage, thanks to uncertainties about crop yields, fears of crop failures and inadequate crop off take arrangements have stymied its efforts and failed to encourage large-scale cultivation of any of the energy crops amongst small farmers in the target areas.

6.6. Seed procurement economics: Availability of non-edible oil seeds is restricted, region-specific and season-specific; their costs also vary depending on whether they are

[30] The price of Diesel depends on the taxes and imposts levied in each State. For example, there could be a significant difference of up to Rs 3 per litre in selling price of Diesel in the State of Delhi compared to Karnataka State

[31] The production process required to convert SVO into Bio Diesel

cultivated (such as Jatropha) or collected from the wild (such as Pongamia, Neem and Mahua), and whether they have more valuable alternative uses. On the other hand, in the case of Edible Oil seeds, the huge domestic demand for cooking purposes means that very little is available for non-edible purposes. In any case, they are too expensive to be used as bio fuel. Hence, oil seed procurement strategies have to be multiple-seed based and dynamic in order to take advantage of lower prices.

6.7. Projected cost of production: There are varying estimates for oil seed prices and fuel production costs. One assessment[32] pegs earnings of a Jatropha farmer at Rs 4 per kg, after having spent over Rs 24,000 per hectare in the first 5 years. The Planning Commission Report[33] portrays a scenario wherein Jatropha seeds will be available at Rs 5 per kg, and assuming that 3.28 kgs of seed will yield 1 litre of oil, the cost of Bio Diesel could be as low as Rs 15 per litre; however, this requires an additional income earnings of around Rs. 50 per kg from the sale of by product glycerol[34]. If these production economics are achieved, the price of SVO/ Bio Diesel will compare favourably with the prevailing price of Diesel[35]. Despite the promising cost estimations, the present cost structures are unfavourable, because of the volatility in oil seed prices that characterize an undeveloped market.

6.8. Poor market access for producers: Transaction costs – primarily intermediation costs - are very high; the oil seed reaching the oil extraction facility has already passed from producer/ cultivator to traders – in some parts of Tumkur District, farmers/ collectors were paid Rs 2-3 per kg for Pongamia seeds, but by the time they reached the oil crushing stage, their cost had already been jacked up to Rs 10 per kg without any value addition. Traders cream off profits from the actual producer or collector of oil seeds[36].

6.9. Financial capacity for stocking seasonal produce: Oil seeds are available only certain months in a year (usually not more than 2-3 months at a stretch) and long-term storage costs[37] are high. In the event that the seeding coincides with the busy agricultural season, the intensity of collection will be low. Different types of oil seeds may have to be collected from various regions to ensure year-round supply of oil seeds. The individual farmer or collector has to be empowered with financial capacity to stock up and sell at optimal prices.

6.10. Managing collection costs: Back-of-envelope calculations based on statutory minimum wages payable to farm labourers indicate that a collection cost of around Rs 3 per kg appears to be fair. For farm labour, collecting oil seeds from the wild could supplement their incomes during slack agricultural season.

6.11. Existing market for the oils: Most of these oils are being produced locally typically for medicinal and industrial use. For example, Pongamia oil is in demand for soap-making,

[32] By a company that proposes to source oil seeds from the open market and produce Bio Diesel
[33] Report referred to in *Para* 4.1 in *Page* 11
[34] Glycerol is produced during the trans esterification process
[35] Retail selling prices of diesel is around Rs 30 per litre, although it varies depending on location and State, since tax structures are different from State to State.
[36] This is a problem afflicting trade in most agricultural commodities, and this has been blamed on a variety of factors, including crop failures, lack of market transparency and limited market access
[37] Costs are not merely financial costs of storage, but also those resulting from deterioration in oil yields

both in local markets as well as from up-market buyers. This has skewed pricing of the oils wherever strong market linkages exist with big buyers. However, with increased production of the oils for use as Bio Diesel, prices are likely to stabilise.

6.12. Way forward to reduce costs: The biggest challenge is to streamline supplies and ensure price stability, simultaneously addressing concerns relating to high intermediation costs and improvement of financial capacity of the farmer/ collector. Increased demand-supply facilitated by direct market linkages - with the help of producer societies and direct buyer contracts – can help reduce the price inequities.

6.13. Significant revenues from sale of by products: Oil extraction and Bio Diesel production[38] costs are not significant, and both manufacturing processes yield valuable by products whose sales realizations impact the final cost of the product considerably, sometimes being over 50% of the total sales realizations:

- Seed husk has high calorific value and can be used as fuel to run biomass gasifiers
- Deoiled cake is good organic fertilizer, saleable at Rs 8-10 per kg
- If detoxified[39], deoiled cake can sell at Rs 10-12 per kg as animal feed
- Glycerol[40] selling prices are around Rs 50 per kg

Development of market linkages is the key to achieving optimal production cost economics. However, sudden increase in supply of by products such as Glycerol can be detrimental to pricing – there may be no demand for such large quantities and its prices could crash.

6.14. Total Cost Estimates: The Karnataka State Land Use Board has estimated the cost of SVO at Rs 12 per litre, assuming Pongamia oil seeds are available at Rs 5 per kg, extraction costs at Rs 4 and realisations from sale of deoiled cake Rs 12 per kg. Even after adding a handsome trade margin of 30%, and taking into account other costs, SVO can retail at a little over Rs 16 per litre[41].

6.15. Pricing pressures by Farm Lobbies: Government helps subsidise agricultural production in various crops. Although in the short-term it catalyses cultivation, a soft support regime is not conducive for long-term growth and creates political pressures by farmer lobbies for unsustainable “minimum off take” and “minimum support price” business environments.

6.16. Unclear Tax Policy: At the moment, Government policy is unclear about the tax and regulatory structure for production and use of SVO and Bio Diesel. This can impose additional regulatory and financial costs on the producer and retailer.

[38] Trans esterification
[39] Research is underway to detoxify deoiled Jatropha cake
[40] Produced during the trans esterification process
[41] Conversion factor 0.85 kg = 1 litre

7. PRODUCT & TECHNOLOGY

WHAT DRIVES DEMAND FOR THE PRODUCT

7.1. Policy Drivers: Government policy towards bio fuels is driven by the following factors:
- Dependence on fossil fuels, especially imported crude oil, can be reduced
- Waste lands can be better used and more people employed if Jatropha is cultivated
- Kyoto Protocol emission control commitments can be fulfilled

7.2. Pricing is key: There is no shortage of petro products in India. Therefore, consumer fuel switching will hinge solely on economics – can Bio fuels be sold at lower prices than Diesel?

7.3. Quest for cheaper fuels: Presently, the rising cost of petro products is wreaking havoc on economic life and fuelling an inflationary economy. Prices of Diesel have risen over 4 times in the last 10 years; expectations are that they will continue to rise in coming years in an unbridled fashion. Cheaper fuel substitutes such as Bio Diesel could infuse price stability. Moreover, costs can be managed locally since bio fuel supply chain is decentralized and depends on a variety of regional factors.

7.4. Impending price hikes: Thanks to controlled pricing mechanisms, the price of Diesel is subsidized and with increasing liberalization, steep increases in prices of Diesel are inevitable over the next 2 years. In view of the increasing costs of Diesel and grid power tariffs, SVO/ Bio Diesel has the brightest potential to take over as the preferred substitute.

7.5. Potential Market: SVO/ Bio Diesel has to have a significant price advantage over Diesel in order to convince buyers. If low enough:
- Automobiles would progressively start using Bio Diesel
- Agricultural pump sets and miscellaneous engines in rural areas will use SVO
- SVO could be a product used seasonally in back-up power generator engines whenever power situation becomes grim in summer.
- Engines running on Furnace Oil/ LSHS may switch fuels
- Remote village communities away from the grid or suffering severe power shortages, whether seasonally or round the year, may run power plants fuelled by SVO produced locally

7.6. Non-financial reasons for switching fuels: Lab research and field tests point to other reasons why the switch over to use of SVO/ Bio Diesel could be rapid:
- Fuel efficiency of engines improves by up to 10%
- Long-term maintenance costs could be less
- The fuel's eco-friendliness could appeal to customers in specific customer segments such as 5 star hotels who currently use Diesel in their back-up power generator facilities

7.7. Technical compatibility: Present Government policy favours the use of Bio Diesel and most research and engineering efforts are directed at production and use of Bio Diesel. Extensive lab and field testing has been done across India by different research institutions such as IITs, Indian Railways, petro product companies like Indian Oil

Corporation, SUTRA, engine manufacturers such as Wartsila, etc. There is general unanimity on the following issues:

- Several types of oil seeds can be used to produce SVO/ Bio Diesel, without any significant change in operating characteristics of the engines
- Use of bio fuels reduces engine performance marginally but reduces emissions significantly
- Standard specifications for Bio Diesel have been formulated and a 20% blend is recommended
- Engines do not require any major modification to run on Bio Diesel
- Engine life has been found to improve with use of SVO/ Bio Diesel
- Bio Diesel stored for a long period of time deteriorates, for which solutions are being evolved
- Research is underway to develop more cost-effective manufacturing processes and earn more revenues from sale of by products

7.8. Responses from Engine Manufacturers:

- *Mahindra & Mahindra*, India's largest automobile company in tractors and rural utility vehicles, has no reservations with use of Bio Diesel in their engines.

- *Kirloskar Oil Engines Limited*, one of India's largest small engine manufacturing companies, is yet to confirm the use of SVO/ Bio Diesel in their engines primarily because their fuel injector supplier Mico Bosch has not yet endorsed its use. Unless Mico Bosch, being the dominant supplier of fuel injection equipment in India, accepts use of SVO/ Bio Diesel, several engine companies will find it difficult to accept switch over to diesel substitutes. From the user point of view, any such use would invalidate manufacturer warranties. Nonetheless, some small engine manufacturers such as Landmaster permit use of SVO/ Bio Diesel in their engines. However, Kirloskar engines have been tested extensively by SUTRA and other research institutions in India and use of SVO/ Bio Diesel is found to have no negative implications.

- *Wartsila India Limited*, a large engine manufacturer (engine sizes capable of generating power 1 MW upwards) now endorses use of SVO in its engines in lieu of Furnace Oil, LSHS and Diesel.

ANALYSES OF DIFFERENT OILS & THEIR USE

Straight Vegetable Oil

7.9. Producing a Diesel Substitute: The oil extracted from the oil seeds is SVO and itself is a Diesel substitute. Oil crushing technology is known widely and is one of the most common rural enterprises in India. Oil extraction machineries are designed to crush different types of oil seeds[42]. Typically, these plants have a capacity of 75 kgs per hour upwards and can be as high as 1-5 tons per hour; either electric motors or oil engines power them.

7.10. Ready-made manufacturing base: To optimise on transport costs, extraction of oil has to be close to source of oil seeds, ideally located at the local market for the oil seeds, whether cultivated or collected. Typically, small entrepreneurs own the facilities. In most parts of India, the SVO/ Bio Diesel supply chain can utilize the existing infrastructure of

[42] This is because all oil seeds are available only during specific seasons

oil extraction plants avoiding the need to establish brand-new manufacturing facilities. Most facilities work only during certain months in the year depending on availability of oil seeds, and there is considerable unutilised capacity. In the case of Jatropha, Pongamia, etc, the availability of oil seeds is restricted to certain months in a year, not more than 2-3 months at a stretch. This provides an opportunity for existing facilities to take on additional work during their slack period, reducing both infrastructure as well as processing costs. Further, establishment of facilities dedicated to SVO production may not be a viable business proposition, and can only drive up costs of manufacture. Existing entrepreneurs should be sensitised to the new business opportunities in dealing with SVO. Further, since these facilities are also open to crush oil seeds on contract basis[43], they can mitigate the higher risks of seed procurement and oil marketing.

7.11. No additional technologies required: Oil extraction technologies are well established and no additional technical support is required. There are several vendors of oil extraction machinery, with good sales and service networks across regional conventional oil markets. Banks have a good deal of experience in funding this market. Some technical reengineering may be needed to process certain types of seeds such as Rubber seed[44], although in general the plants are designed to crush different types of oils and are the same, barring minor modifications in equipment and processes. This technical reengineering is within the capabilities of the vendors and the entrepreneurs.

7.12. Market access: Forging market linkages between cultivators/ collectors and oil extraction facilities on one side, and between the oil extraction facilities and the users/ big buyers on the other, is crucial to building a complete supply chain. Typically, oil extraction facilities procure oil seeds from local markets, crush oil and sell it in the retail market or to big buyers through a well-established chain of traders and intermediaries. A similar structure has to be built up before a sustainable market for SVO/ Bio Diesel can work.

7.13. Need for intervention: Of paramount importance is to set technical specifications, norms and good practices for the industry. The focus of policy-makers is concentrated on Bio Diesel and there has been very little effort to tackle technical, business and regulatory issues in the post-harvest upstream industries of seed procurement and oil extraction. Another looming threat is the prospect of adulteration of diesel with SVO, and it is yet unclear whether Government plans to regulate the production and use of SVO, which is the base oil for production of Bio Diesel.

7.14. Business Structure:

- Decentralise production around pockets or markets where oil seeds are cultivated/ collected
- Tap existing oil extraction facilities and entrepreneurs, besides establishing small-capacity plants locally
- Develop market linkages for sale of the SVO and by products

[43] They merely crush seeds on someone's behalf for a fee

[44] Rubber Seed is being considered as one of the oil seeds suitable for Bio Diesel production, although there has been very little research. The seeds are available abundantly in rubber plantations, mainly in Kerala State, and are largely unutilised.

Market for SVO

7.15. Demonstration of the use of SVO: SUTRA has demonstrated the successful use of SVO[45] in stationary and automotive engines across 3 states in South India – in agricultural pump sets, power generators, railway locomotives and tractors/ utility vehicles. Their decentralized production prototype can be emulated in most rural areas, wherever oil seeds are available. However, the SUTRA projects have (a) not looked beyond the immediate local market for sale of SVO, and (b) relied on grants and subsidies and have not passed the test of commercial viability[46].

7.16. Direct uses for SVO in stationary engines: Stationary engines can use SVO without any major modification[47], although theoretically, SVO can fuel any type of engines. Rural areas[48] use stationary engines in several applications and they can save considerably on running costs by switching over from expensive Diesel to SVO since they also control the production costs. Each region needs to be mapped for possible uses for SVO.

7.17. Grim power situation: Small business enterprises and domestic households in most rural areas[49] suffer either severe power shortages or lack of grid connectivity. Government power tariff policies in most States is skewed in favour of low or no power tariffs for agricultural consumers, but quality of power supply is bad. Facing severe resource constraints to build new power stations and expand distribution infrastructure, it is unlikely that the power situation in rural areas will improve dramatically in the coming years. On the other hand, the distribution infrastructure for petro goods is generally good, although petrol stations tend to be concentrated around the small market towns that would normally serve a hinterland in a radius of 25-40 kms, and Diesel prices continue to rise.

7.18. Pumping of water: Agricultural water pump sets can substitute Diesel with SVO. In recent years, electric pump sets have become popular because of unrealistic power tariffs, but this scenario is likely to change - several States are threatening to stop free power and increase tariffs – and alternative power solutions will progressively become attractive. Grid power continues to be rationed out in rural areas, resulting in tremendous inconvenience[50]. In this context, the biggest advantage that SVO commands is that the local community has control over the sources of fuel and its costs, unlike both electricity and petro goods.

7.19. Miscellaneous agricultural implements and equipment used by small businesses in rural areas can now run unhindered by the erratic power supply and the rising cost of diesel. Alternative fuel solutions could not only help run such equipment but the uninterrupted and cheap availability of Bio fuels can transform the face of rural industry.

[45] Produced using Pongamia
[46] None of the Projects have borrowed money from commercial financial institutions
[47] Minor modifications may be
[48] Especially where SVO is produced
[49] Almost 85,000 villages do not have grid power
[50] In most States in India, power for agricultural use is made available at only non-peak hours, typically in the night, and the frequency of irregular power shutdowns is very high

7.20. Small Rural Power Plants: Small Power plants can be established by small village communities who – (a) are not yet connected to the grid, (b) face power shortages during certain periods of the year[51], and (c) generate power to supply to the grid. Even in villages that claim to be electrified, there are hamlets that are not wired. Establishing small power plants – starting from a small 10 HP motor to 1 MW power plants – that use bio fuels could be one of the solutions to mitigating the power crisis. Being more cost-effective than diesel[52], it guarantees the village communities supply of uninterrupted power at their will with the help of local resources, the cost of which is controlled by them. Power Plants, having size of 1 MW and above, will need a larger footprint of a cluster of villages, with suitable linkages to sell excess power to the State power utility. The biggest challenges are (a) overcoming the regulatory obstacles for establishment and operation, and (b) to convince rural populations to pay cost-linked tariffs. The ambitious Government Village Energy Security Programme intends to make each village self-sufficient in energy and encourage use of local resources. Power generation using SVO/ Bio Diesel is one of the viable options in this direction.

OUTLINE PLAN FOR VILLAGE ENERGY SECURITY PROGRAMME[53]

- Use of locally available biomass resources can provide a sustainable solution for meeting total energy needs of villages
- Technologies such as biogas production, biomass gasification and biofuels can be deployed in the village in an efficient, reliable and cost effective manner
- Focus on utilisation of existing biomass resources and production through plantations by the local community
- Energy security plan to be funded through a one-time Government grant[54] and a soft loan scheme
- Initial plan is to cover 2000,000 villages located near forests and in remote areas

7.21. Back-up power generation: Industrial units and small businesses use generators for back-up power during power shortages in most parts of South India, especially during the summer season when most small towns/ villages face scheduled/ unscheduled power cuts for uncertain periods of time. Small generators use Kerosene and Diesel, but the larger ones use Furnace Oil/ LSHS, all of whom can switch to using SVO. The local market itself can consume most of the SVO produced by the oil extraction facilities in the locality, the balance being sold for similar purposes in urban markets in the neighbourhood. Although Furnace Oil/ LSHS may be cheaper than SVO, better access to SVO may attract several users to switch fuels. Demand from large buyers can create a sustainable demand for the oil. Demand for back-up power generation is normally concentrated around summer time and there is perfect synergy between the availability of Pongamia oil seeds (during Jan-Feb) and the demand for SVO (Apr-Jun), such that even if production of SVO is a seasonal industry, there will be no shortage of buyers.

7.22. Automobiles: Use of SVO is not recommended for automobile engines; Bio Diesel is a better fuel. Nonetheless, if a low-cost diesel substitute is available locally, it is likely to

[51] During Peak Load - early evening hours and summer season – rural areas face severe power cuts
[52] May be more expensive than grid power, which in case may not be available
[53] Ministry of Non-Conventional Energy Sources, Government of India
[54] 70-100% in grant support is also envisaged

trigger a switch over to use of bio diesel in local automobile engines, further enlarging the market for the SVO.

7.23. Bio Diesel Producers: One of the biggest buyers of SVO will be the producers of Bio Diesel who trans esterify SVO to produce Bio Diesel for sale to the large petro product companies like Indian Oil Corporation and other large users. There are likely to be many such companies and, considering the shortage of oil seeds, producers of SVO should have no difficulty in selling their output through long-term contracts with these companies. All petro product companies have ambitious targets for production of Diesel blended with Bio Diesel over the next 5 years, and if these plans take off, there is likely to be tremendous demand for SVO and Bio Diesel. However, the large petro product companies are unwilling to enter into any firm buy back arrangements with producers.

Degummed Oil

7.24. Cheaper than Bio Diesel: The biggest problem associated with the use of SVO is that it leaves residues inside engines that could cause performance problems and increase maintenance costs[55]. Degumming SVO is one of the solutions to reducing the viscosity of SVO and ridding engines of such deposits. The Degumming process is very simple and machinery for this purpose is available in the market. Degumming is one-third the cost of trans esterification, although during the latter process the value of by products is higher. Degummed Oil is better than SVO but cheaper than Bio Diesel. However, there has been limited testing of engines using Degummed Oil. Southern Railways has carried out experiments using Degummed Oil in their railway locomotives.

Bio Diesel

7.25. Preferred fuel option: When trans esterified, SVO is transformed into Bio Diesel. Government policy is biased in favour of blending of Bio Diesel with Diesel by the petro product companies. Most research centres on use of Bio Diesel in engines - findings are that its use (a) affects engine performance marginally, (b) reduces emissions, and (c) could extend engine life. However, most engine manufacturers are unprepared for use of Bio Diesel in their engines. Unfortunately, Mico Bosch, the dominant supplier of fuel injection equipment for diesel engines, has not yet endorsed the use of Bio Diesel.

7.26. Benefit the user? It is not clear whether the blending of Bio Diesel with Diesel by the petro product companies will result in any price benefits to the consumer. On the other hand, if SVO or Bio Diesel is produced and used locally, users are likely to pay less for their fuel; therefore, open market sale of Bio Diesel would be welcome and possibly directly benefit the user. However, it is unclear whether regulations will constrain producers of SVO and Bio Diesel to sell only to the petro product companies, or whether they will have the freedom to sell their produce directly to users.

7.27. Brand-new production infrastructure: Bio Diesel production facilities[56] range from small capacities of 250 litres per day to 30 tonnes per day and larger. They are single-

[55] Minor retrofits and suitable maintenance protocols can help overcome most of the problems
[56] Trans esterification plants

purpose plants[57] and unlike oil extraction facilities, the production infrastructure has to be set up from scratch. Ideally, one trans esterification plant will be the hub for several village oil extraction facilities to match capacities and minimize investments. Although global technology leaders such as Lurgi sell large-capacity plants, villages need smaller plants that have been designed and engineered by several research institutions[58] and vendors to operate in Indian conditions. Smaller plants can be located closer to the source of oil supply. The large-scale plants, of which many are being planned or built, may have the advantage of financial ability and big-buyer tie-ups over the smaller plants.

7.28. Problems faced by a sunrise industry: Unlike oil extraction, which is a well-established business in India, the regulatory issues relating to Bio Diesel plants are yet to be evolved. Bio Diesel Plants require either ethanol or methanol – both restricted commodities, the procurement, use and storage of which licenses are required and cumbersome regulations complied with. Unless Government liberalises its use for trans esterification, village-level plants will have start-up bureaucratic problems.

7.29. Bio Diesel plant business strategies: The business model that seems to be gaining acceptance is for large Bio Diesel Plants[59] to source SVO in the open market/ through tie-ups and negotiate off take contracts with large buyers, both in India and abroad; ultimately, they will have a limited role in cultivation/ collection of oil seeds and extraction of oil. However, in the preliminary stages, they are likely to play a pro-active catalyst role by assisting farmers with inputs and firm buy back offers. In Karnataka State, Phytotron Agro Products India Private Limited is working on a contract farming model for Jatropha; in Andhra Pradesh State, Southern Online Bio Technologies Limited plans to buy Pongamia oil wherever available, besides tying up with a Malaysian company for import of Palm Oil; and in Tamil Nadu State, Bannari Amman Sugars is adopting the sugarcane farming model and supports cultivation of Jatropha. In all cases, large-capacity Bio Diesel plants will procure SVO from the villages and produce Bio Diesel.

7.30. Reducing production costs: The key to controlling costs in the trans esterification process is the realization of value from sale of by products, mostly Glycerol. Besides developing suitable market linkages – new applications and regular buyers - for by products, the risk of over-supply adversely affecting prices is a distinct possibility. With appropriate market linkages, it may be possible to produce Bio Diesel at almost the same cost as SVO, making it a viable business proposition for even small-capacity village-level plants to make large investments in trans esterification plants and produce Bio Diesel locally.

Market for Bio Diesel

7.31. Big Oil Company Buyers: Petroproduct companies prefer Bio Diesel produced from Jatropha despite that there are no significant advantages of one oil to the other. Further, although it is apparent that the actual output of Jatropha will be inadequate to meet the short-term blending targets, existing resources such as Pongamia are not being

[57] Capable of producing only Bio Diesel
[58] Indian Oil Corporation, IIT-Delhi, Indian Institute of Petroleum and Tamil Nadu Agricultural University, to name a few
[59] 30 tons per day upwards

considered. Moreover, manufacturing standards, product technical specifications and quality parameters for Bio Diesel are not yet in place.

7.32. Is there a free market for Bio Diesel? It is not clear whether there will be restrictions on the sale of Bio Diesel in the open market, in which case the regulations may favour large-capacity Bio Diesel plants. Large petro product buyers will bargain for low prices, putting smaller units under pressure. Government policy favours blending of Bio Diesel with Diesel for sale through existing petro product company outlets. Assuming that there is a free market for sale and distribution of Bio Diesel, producers may have to (a) set up blending plants, (b) develop their own retail outlets or (c) sell to large buyers such as industrial users, bus transport companies, etc. Keeping in mind the regulatory environment for petro product marketing, independent retailing of Bio Diesel seems unlikely; further, competition between petro product companies and Bio Diesel producers may not be permitted. In these circumstances, finding an alternative buyer market for 100% Bio Diesel will be a challenge for the producers.

7.33. Large urban markets: Large urban areas offer ready markets for producers in adjoining rural areas for use of SVO/ Bio Diesel by big buyers and for miscellaneous engine applications, especially captive power generation. Large engine makers such as Wartsila endorse use of bio fuel substitutes in lieu of Furnace Oil/ LSHS/ Bio Diesel for captive power generation; users will look to substantial cost advantages to switch fuels. Large-scale conversions in a few urban hubs could help grow the supply chain in the surrounding rural areas. For example, the city of Bangalore has several captive power installations using either Furnace Oil or Diesel; the city and its neighbourhood districts (including adjoining districts in Tamil Nadu State) have substantial resources of Pongamia trees – if collection of oil seeds is stepped up in these areas, accompanied by a commensurate manufacturing infrastructure, there would be good demand-supply match and operational synergies.

7.34. Automobiles: Rural transport vehicles – tractors, public transport and cars – are another high-potential market for Bio Diesel. Apart from being cheaper than other petro products, Bio Diesel produced locally could also be sold through easily accessible outlets and at flexible prices unlike petro products that are subject to uniform administered pricing.

7.35. Railways: Indian Railways is the largest user of Diesel in the country; and they have started running rail locomotives[60] on Bio Diesel and have set themselves targets to progressively use eco-friendly fuels. Already, there have been several successful initiatives to use Bio Diesel. They have both the financial resources and collective buying clout to procure Bio Diesel from producers.

7.36. Bus Transport: One of the most promising large markets for Bio Diesel is for use by bus transport companies. In many States, Government-run bus public transport systems are switching over to using Bio Diesel in their bus fleets, many in collaboration with petro product companies. Already, a couple of States[61] have already created exclusive bus depots that use Bio Diesel. Through their many depots scattered across various regions

[60] Off Delhi, one of the country's most prestigious trains Shatabdi Express has used Bio Diesel; in South India, regional Southern Railways regularly runs 2 freight trains on Bio Diesel

[61] Road transport corporations in Haryana and Gujarat

of each State, the bus transport companies offer a ready market for decentralized procurement through tie-ups with producers in the vicinity where they are located

CLEAN DEVELOPMENT MECHANISM – Impact on Bio Diesel Initiatives

- Large-scale plantation of trees having oil-bearing seeds like Jatropha and Pongamia will fix atmospheric carbon dioxide by photosynthesis. Further, when the oil derived from these seeds is burnt, same amount of carbon dioxide is emitted as was sequestered.

- Each ton of Bio Diesel produced or consumed leads to a reduction of Green House Gases by about 3 times, i.e. it avoids 3 tonnes of carbon dioxide. Assuming market price of carbon credits at USD 5 per ton of Carbon Emission Reduction, this means additional revenue of Rs 690 per tonne of Bio Diesel produced (or Rs. 0.75 per litre)[62].

- There is also another side to cultivation of energy crops[63] - clearing of natural forests for palm oil tree plantations in Indonesia continues at an alarming rate, with devastating effects on biodiversity! Therefore, any contemplated use of Palm Oil (or any other crop in the above circumstances) for production of Bio Diesel will have to combat the negative consequences in reducing forest cover.

- The energy plantations of Jatropha would be eligible for bundling of CDM projects[64]. If Energy Plantations are bundled, farmers and low income communities can gain from returns on carbon mitigation in tree biomass; there is additional incentive in the initial years so that investment made into Jatropha planting pays off from this income. Producing biomass through involvement of low-income communities ensures that the criteria for bundling of Small Scale Projects are fulfilled. Thus substituting biomass for fossil fuels by establishing Energy plantations within the framework of CDM has clear advantages over using it solely as a means to sequester carbon. Rural communities gain jobs rather than removing land from productive use to sequester carbon.

[62] *Bio Fuels India* magazine, December 2004
[63] World Wildlife Fund Report of 2002
[64] *Role of Bio-Energy plantations for carbon-dioxide mitigation with special reference to India*, Dr.N.Hooda and Mr.V.R.S.Rawat, Biodiversity,Climate Change and Policy Research Division, Indian Council of Forestry Research and Education,Dehradun, India

8. BUSINESS MODELS

8.1. Price-competitiveness: The *first* challenge is to build the supply chain for production of SVO and Bio Diesel. But the *bigger* challenge is to produce oil that can compete with Diesel, at a price advantage to convince users to switch fuels. Key areas for cost control are in Oil seed procurement and higher value realizations from sale of by products, both during oil extraction and trans esterification.

8.2. Sensitisation to business opportunities: Individual farmers and villager groups (such as Self-Help Groups[65]) need to see a viable business proposition before venturing out to start and run SVO-centric business enterprises – cultivation, collection, storage of oil seeds, oil extraction, storage of oil, marketing of oil, power generation, etc. Village entrepreneurship initiatives have to be promoted around clear-cut business goals and sustainability. Capacity building themes are village energy self-sufficiency, additional employment opportunities, afforestation and easy access to energy.

8.3. Encouraging farming: Some State Governments, including Tamil Nadu, Andhra Pradesh and Karnataka, are encouraging cultivation of Jatropha, both by individuals and on contract, with financial and non-financial support in the form of supply of seedlings and technical assistance. Expectations are that Jatropha oil seeds will be available at around Rs 5 per kg. In the case of Pongamia and other tree-borne oils, there are some isolated initiatives to grow them under afforestation and watershed programmes in both public and private lands[66].

8.4. Organisation of collection of oil seeds: In respect of trees that grow in the wild, collection costs have to be minimized. Typically, oil seeds are available only during a specific season of the year. It is unlikely that the same region has several types of trees[67] – i.e. some regions have Pongamia trees, others may have Neem Trees, and more others Mahua trees, and so on, and hence this business cannot provide employment round the year. Hence, collection activity is a supplementary employment opportunity and if seeds are available during times of busy agricultural activity, there are chances that they may not be collected at all. Typically, Self-Help Groups ("SHGs") of women can serve as ideal business entities for this purpose. Village Forest Management Committees[68] will facilitate the collection activities in an organized manner.

8.5. Unique village business models: Non-cash business models can be very effective in village environments, as was demonstrated in the SVO-based power generation projects in Adilabad District in Andhra Pradesh State[69]. Pongamia oil seeds are collected by village women and children from the jungles, oil extracted and used to run a small engine linked to a generator. The collectors are not paid cash for their efforts; a family collecting

[65] Self-Help Groups are discussed in *Para* 1.11 in *Page* 6

[66] NOVOD's view is that existing oil seeds are not being utlised fully due to lack of awareness of their uses, collection, marketing, lack of proper facility for storage, seed collection, long gestation, fruiting/ maturity season coinciding with rains, etc.

[67] Usually, Pongamia growing areas are not the same as those growing Neem and Mahua and so on

[68] Set up in villages to manage afforestation and other forestry-related activities

[69] Villages Powerguda and Kommaguda, where the power plants were established by SUTRA

at least 300 kgs per year can swap it for free power supply throughout the year. On the other hand, households who do not collect or meet the target, pay cash for their power.

8.6. Advantage of using existing production infrastructure: Oil extraction is a common rural small business concentrated around oil seed production areas. Oil extraction machineries are designed to crush various types of oil seeds depending on their seasonal availability. In the slack season, the prospect of additional revenue streams from production of SVO will be welcome. Existing production infrastructure may be utilized effectively, saving on the capital expenditure and effort involved in establishment of dedicated manufacturing facilities. Oil extraction facilities are part of a well-established local supply chain, which includes storage facilities and selling arrangements. They employ different business models – (a) buy oil seed and crush them for oil, and sell them in the open market or to large buyers, or (b) crush oilseeds on contract for farmers and other large buyers.

8.7. Reducing transaction costs: The most significant initiative to reduce costs is to minimise the tiers of intermediation – the trader, not the producer often makes more money dealing in the oil seeds and the prices of oil seeds is unreasonably high by the time it reaches the oil extraction stage[70]. Creating direct links between the producer (either the cultivator or the collector) and the user (in this case, the oil extraction unit) helps reduce the price gap significantly, also improving respective profit margins.

8.8. Producer-User direct linkage models have been very successful in the Indian context, across various types of rural industry and regions:

- Gujarat State pioneered what is now referred to as the *Amul Model*, whereby groups of farmers sold milk and other dairy produce to big buyers though their own cooperatives and federations
- In Karnataka State, the *HOPCOMS Model* is a similar initiative for selling horticultural produce, cutting out the trader-financiers who held the producer-communities under their bondage.
- In Tamil Nadu State, producer companies or *Kalanjams* aggregate producer from their members and employ collective selling/ buying mechanisms to obtain remunerative prices.
- Under the auspices of the *District Forest Office* in Krishnagiri District of Tamil Nadu, licensed collectors sold Pongamia oil seeds at remunerative prices to a central procurement agency; the cost of seeds was the lowest and made production of Bio Diesel very cost-competitive vis-à-vis Diesel.
- Federations of *SHGs* and *Village Forest Management Committees* in Andhra Pradesh State transact business with big buyers for a variety of agricultural produce.
- The *contract farming model* being adopted by some companies in Tamil Nadu for cultivation of Jatropha ensures that farmers follow standardized cropping practices and obtain technical and financial support and reach their produce to a single buyer. This is again similar to successful contract farming models prevalent elsewhere in India – tomato farmers and PepsiCo in Punjab State, cocoa farmers and Cadbury in Karnataka State, tobacco farmers and cigarette major ITC in Andhra Pradesh State and of course, the most popular sugarcane procurement process.

[70] For example, in Tumkur District of Karnataka State, oil seeds sold by collectors at Rs 3 per kg are priced at Rs 10 by the time they reach the oil extraction facility

8.9. Scope for several small rural businesses: The production infrastructure can be built in several tiers, depending on the extent of involvement of the village communities in downstream businesses beyond cultivation/ collection - transport/ storage of oil seeds, establishment of oil extraction of facilities, extraction of oil, transport/ storage of oil, marketing of SVO, establishment of degumming/ trans esterification facilities, degumming, trans esterification into Bio Diesel, transport/ storage of Bio Diesel, marketing of Bio Diesel and use of both SVO/ Bio Diesel in rural applications, including generation, distribution and sale of power. To establish and operate these businesses, the financial capacity of the village community needs to be enhanced and so should their access to the market.

8.10. Doing away with intermediaries: Conventionally, traders and other middlemen offer complete services to farmers – credit, agricultural inputs and market access. SHGs, cooperative societies[71] and similar groupings can bring their collective clout to reducing oil seed procurement prices and costs relating stocking and oil extraction, besides realizing more remunerative margins on sale, leading to an organised market. SHGs and producer federations enjoy credit linkages with Banks, enabling them to source finance on reasonable terms.

8.11. Development of market linkages is a crucial task to enable a streamlining of disorderly sources of supplies, stabilising prices and tapping demand:

- Selling oil seeds procured by cultivators/ collectors
- Marketing SVO to users and Bio Diesel producers
- Selling by products – such as deoiled cake, husk and Glycerol – in the open market
- Distribution of power generated by local power plants within the local area itself and to the grid

8.12. Sale of oils: Marketing and distribution of SVO/ Bio Diesel is a specialized task that can be best discharged by a business entity operating on sound commercial principles, and be capable of maintaining high quality and customer service standards, especially for big buyers.

- In Karnataka State, Phytotron Agro Products India Private Limited is establishing a 10,000 TPA Bio Diesel facility. It is collaborating with farmers to directly buy Jatropha oil seeds on a firm basis at prices linked to diesel price indices. Bio Diesel will be sold to large petro product companies and in overseas markets.
- In Andhra Pradesh State, Southern Online Bio Technologies Limited is establishing a 30TPD plant near Hyderabad to produce Bio Diesel using Jatropha and Pongamia seeds. Additionally, it has contracted to import palm oil. It plans to sell Bio Diesel to petro product companies and other large buyers in India and abroad. Their business strategy is to optimise oil seed procurement costs by switching between different types of oil seeds.
- In Tamil Nadu State, Bannari Amman Sugars is employing the time-tested sugarcane business model - contract farming to support several farmers grow and market their produce to it on a firm buyback basis. On the cards are a decentralized oil extraction facilities linked to a centralised Bio Diesel facility.

[71] collective bodies that are treated as separate business entities, and are common in India

BUSINESS MODEL *Illustration 1* – Producer Co-operatives

- Cultivators and collectors of oil seeds are organised as cooperative bodies to maximise supply chain efficiency and optimise earnings. There may be one or more cooperative for each activity in the supply chain – cultivation, collection, transport, storage, oil extraction, etc. The oils produced is either used locally or sold to downstream Bio Diesel production units.

BUSINESS MODEL *Illustration 2* – Big Buyers

- Large buyers for SVO/ Bio Diesel[72] place procurement contracts with cultivators/ collectors of oil seeds, and produce SVO and Bio Diesel, either directly or by means of outsourcing. This model is characterised by assured offtake contracts by the big buyers.

BUSINESS MODEL *Illustration 3* – Local Use

- Villages establish their own energy security plans by achieving energy self-sufficiency. Oil seeds are grow/ collected, oil extracted and used in local applications, typically in all types of engines, including generation of power locally. Excess power may be sold to the State utility company for supply to the grid.

BUSINESS MODEL *Illustration 4* – Non-cash

- Small village communities generate their own power using small engines. Oil seeds are cultivated/ collected and bartered for regular power supply in a typical non-cash model. Capital investments are small and export of oil seeds/ power limited to the local area.

[72] such as captive power plants, transport utilities, etc

9. BANK FINANCE

9.1. Credit, means of reducing costs: As in the case of most agricultural commodities, producers have limited financial capacity that results in their obtaining less prices for their produce, ultimately leading to higher transaction costs and widening the price gap between the producers and the users. Unless the number of intermediaries is reduced, it is unlikely that SVO/ Bio Diesel can be sold at competitive prices vis-à-vis Diesel. Access to credit is a powerful tool to breaking the grip of traders and lessening the distance between the producer and the user.

9.2. Financial needs: Small businesses involved in the production of SVO/ Bio Diesel require financing for several activities, some of it to buy machineries, but most the working capital to run it:

- Cultivation/ Collection of Oil Seeds
- Extraction of oil
- Trans esterification of SVO into Bio Diesel
- Other downstream activities

9.3. Response of Banks: Thanks to Government encouragement, the National Bank for Agriculture and Rural Development ("NABARD") and the Banks are looking at starting loan programmes for financing cultivation of Jatropha. Although such crops can be financed within the framework of existing bank policies, Banks retrain themselves from doing so till they are convinced about yields and marketability of the produce. Once their concerns are resolved, Banks are expected to lend to farmers engaged in cultivation of Jatropha[73].

9.4. Limited financing for long growth-cycle crops: Unlike Jatropha, it will be more difficult to seek financing for cultivation of Pongamia and other tree-borne oils since banks prefer short-growth cycle crops.

9.5. Financing for collection activities: With more financial capacity, collectors of oil seeds will be able to stock their produce and sell them in the markets at best possible prices. Being in the nature of small businesses, bank financing will be available for collection activities provided they are convinced about the techno-economic feasibility. It will be easier to access bank finance if the collectors are organized as SHGs and producer cooperatives. Further, they obtain loans at concessional rates of interest[74], further reducing the cost of production of SVO.

9.6. Financing for oil extraction: Oil extraction facilities need both long and short-term capital – to buy machinery and run the business. Banks are accustomed to lending to this business segment – since they deal in a variety of oil seeds and operate in regional pockets, and buy machinery from established manufacturers. These entrepreneurs can easily obtain bank assistance in the normal course, and no special support may be needed. However, an oil extraction facility dedicated to dealing only in bio fuel oil seeds[75]

[73] Banks lend only for organised farming, they do not normally finance forestry activities
[74] Banks lend at rates below normal to SHGs
[75] Unlikely, normally process different oil seeds to increase capacity utilisation

may find it more difficult to convince bankers to extend finance to it since it would be very difficult for the business to run only 2-3 months a year – which would be the case were it to depend on only one oil seed and one industry.

9.7. Apprehensions about support for Bio Diesel plants: Banks are unfamiliar with the trans esterification business and not confident enough about its business prospects – the availability of sufficient oil, the cost competitiveness of the Bio Diesel vis-à-vis Diesel, acceptability to users, marketing tie-ups. Corporate entities with large-capacity plants have easier access to Banks in the ordinary course of business; however, this is not the case with small businesses that may face an uphill task in convincing bankers about their ability to compete effectively with the larger entities. Moreover, since the business is new, suitable technologies/ good practices will have to be identified and vendors qualified before lending can take off in a sustainable manner.

9.8. Commitment to lend to rural small businesses: Banks in India set targets for lending in rural areas and small businesses, referred to as "priority sector" loans. Such loans are sometimes eligible for concessional finance and special support mechanisms. Banks have a vast network of branches in rural areas[76] and have a wide range of rural loan products. In recent years, Banks route most of their rural micro-credit through SHGs, which are entities formed by a group of individuals and engaged in income-generation activities. Credit recovery rates in this sector are good. Banks also lend to cooperatives and other producer groups. They also work closely with Government and NGOs in encouraging specific businesses and directing credit to chosen segments of society.

9.9. Questions of feasibility: At present, thanks to the unorganised nature of the market for bio fuels, Banks lack confidence in the technology and the prospects for marketing the fuel. Typical of any new business, banks are likely to be unconvinced about lending for Bio Diesel production unless several questions relating to the business feasibility are answered, particularly:

- Will there be adequate supply of oil seeds?
- Will big buyers honour their contracts for off take of the Bio Diesel?
- Can Bio Diesel be cost-competitive vis-à-vis Diesel?
- How can production cost economics change if prices of by products fall?
- Will government policy changes adversely affect business?

Apart from sensitising bankers to this new lending opportunity, key credit concerns to be addressed include mitigation of risks relating to pricing and off take. Successful demonstrations of the business model in different regions and operating conditions, besides user acceptability of SVO/ Bio Diesel will assure lenders about the safety in lending to the industry. Fortunately, current Government policy towards rural lending and Bio fuels is positive; nonetheless, only a stable business structure can convince Banks to start lending to this industry.

9.10. Borrowing limitations: Village communities have strong credit linkages to local Banks directly and through SHGs, producer cooperatives and other collective entities. They need to access finance from banks to build up their financial capacity. Conventionally, banks extend finance to only their existing customers with whom they already have relationships and credit experience. This limits credit availability in any specific area since the business entities may have relationships with Banks who may not be interested

[76] Nearly 70% of branches are located in rural areas

in lending for Bio fuel industries, thereby stifling their business expansion plans. In order to broad base lending operations, bank lending may have to be innovatively structured to facilitate financing of SHGs and other business entities that have no prior experience with it.

9.11. Liberalisation in lending policy: By offering special terms of lending, accessibility to credit can be improved by offering loan products where (a) interest rates are lower than normal, (b) borrowers are required to put in less up-front monies[77], (c) technologies are streamlined, (d) good business practices are followed, (e) longer duration of loans helps ease cash flows in the initial years of establishment of the business, and (f) security and loan documentation requirements are less rigorous. Loan products should be designed to ensure that they are sustainable beyond the initial period of support and can be easily replicated by other banks. To the maximum extent possible, loan products should be in conformity with conventional bank policy and procedures.

9.12. Support to Banks: Partnerships with Banks have to be both financial and non-financial – financial support could include interest subsidies, credit default guarantees, etc, and non-financial support could be in the form of qualification of technologies and vendors, stipulation of good practices, facilitation of market linkages, price stabilization, etc.

9.13. Existing Government-sponsored loan programme: With support from the Government, NOVOD[78] is collaborating with Indian banks to extend capital grants and other forms of support to cultivation and post-harvest activities in the Bio Diesel sector. However, the scheme may not effectively address the capacity building and business structural issues adequately in order to build a sustainable commercial business environment. Other Government-sponsored schemes have suffered from funding constraints, bureaucratic hurdles and the perils of standardisation.

NOVOD's CREDIT-LINKED SUBSIDY PROGRAMME FOR PROMOTION OF TREE BORNE OIL SEEDS

- 30% back-ended capital investment subsidy linked to credit
- Entrepreneurs have to contribute 20% of the capital investment costs, but this can be monetisation of labour, land cost, watch & ward, etc.
- Limited quantum of financial assistance available for establishment of nurseries, seed procurement centres and oil extraction facilities
- Centralised approval through NOVOD offices in Delhi, loan availability through Banks

9.14. Banks best credit delivery platforms: The Indian banking sector is very effective in reaching out to rural entrepreneurs and small businesses. They have a wealth of experience in credit assessment, financing and loan administration in Indian conditions, and have strong customer relationships in the areas that they serve. Further, they have focused on capacity building and do banking with a strong sense of social responsibility.

[77] Margins, in banking parlance – means the amount of money that will have to be brought in by the borrower, usually 25% in conventional bank lending products

[78] National Oilseeds & Vegetable Oils Development Board

Canara and Syndicate Bank are possible Bank partners along with Regional Rural Banks[79] sponsored by them. They are national banks with extensive network of bank branches across most of India, especially in rural areas of South India.

9.15. Collaboration with many Banks: Restricting support to only 2 banks may be inadequate and partnerships with several banks may be required to broad base and scale up credit access to more businesses across various regions. Banks limit their lending to their existing customers and in order to break these shackles, building bridges with more Banks is essential. This will help infuse a degree of competition between the Banks.

[79] Also known as Grameen Banks

10. PROJECT AREAS

10.1. Focus States: The Planning Commission Report[80] identified various States where cultivation of Jatropha is to be encouraged, keeping in mind the extent of forest and wastelands available in these States, and after assessing their agro-climatic conditions:

Top 8 States	Forest - Lakh[81] Ha	Wastelands - Districts
Madhya Pradesh	2.3	21
Rajasthan	2.2	13
Maharastra	2.0	15
Jharkhand	2.0	19
Tamil Nadu	1.5	9
Andhra Pradesh	1.0	12
Karnataka	1.0	15
Chattisgarh	1.0	15

10.2. No collections from the wild: Government policy is skewed heavily in favour of cultivation of Jatropha; there does not appear to be any specific plan of action to exploit existing resources of oil-bearing trees[82] such as Pongamia, Neem and Mahua.

10.3. State Government policies for Jatropha cultivation: Various States are in the process of formulating detailed agricultural polices and action plans to implement the Government's ambitious cultivation targets. 3 South Indian States, viz. Andhra Pradesh, Tamil Nadu and Karnataka, appear to be ahead. The respective State Governments have started implementing various programmes – distribution of seedlings, provision of farm extension services, contract farming, etc. However, at this stage, there is no significant increase in lands under Jatropha cultivation and farmers are believed to be generally reluctant to switch over to new crops unless they have assurances on marketability of their produce. Nevertheless, these pioneering initiatives are likely to result is sizeable production of Jatropha oil seeds in the States.

10.4. Using other oil seeds: All 3 South Indian States have abundant unutilised resources of Pongamia, Mahua, Neem and other tree-borne oil seeds. Organised collection of oil seeds from the wild can help kick start the Bio Diesel industry, generating multiple employment opportunities and catalysing fuel switching in rural areas. Besides tapping a ready source of supply of oil seeds, such efforts will help build a production base and demand for SVO/ Bio Diesel even as more lands come under cultivation of Jatropha.

10.5. Inter-regional commerce: To ensure balanced supply of oil seeds throughout the year and stabilize prices, supply oil seeds could come from states such as Madhya Pradesh and Chattisgarh[83] to regions of demand in the South Indian States that have an enabling business environment. Till internal demand in these Central Indian States picks up, they may be in a position to export their produce to other regions in the country. This will also help build up a national market for the oil seeds. Similarly, in Kerala State, organized

[80] Please refer *Para* 4.1 in *Page* 11
[81] 10 Lakhs = 1 million
[82] NOVOD's assessment is that hardly 20% of the existing potential is being crushed and utilised
[83] Both these States have plentiful reserves of Jatropha and Mahua

collection of Rubber Seeds can be one more source of oil seeds for production of Bio Diesel.

10.6. Demand-supply equations: The 3 South Indian States suffer chronic power shortages[84], especially during peak demand summer season. Rural areas suffer the most and in the absence of any tangible solutions, the dismal power supply situation is expected to continue in the years to come. Reliance on captive power is high. There is tremendous demand for energy and alternative energy solutions have gained fast acceptance. There is likely to be good demand for SVO/ Bio Diesel in a variety of stationary and automobile engine applications, including local generation of power.

10.7. Business environment: All 3 South Indian States have a business environment, a vibrant entrepreneurship culture and a traditional oil extraction industry, conducive for a quick take off of the Bio Diesel industry and optimal utilisation of existing resources. Not surprisingly, private sector enterprises are being established in these States – companies such as Phytotron Agro, Southern Bio Technologies, Bannari Amman Sugars, Mohan Breweries, Renu Lakshmi Agro, etc. – are already in business. SUTRA has successfully demonstrated the use of Pongamia-based SVO in rural engine applications in all these States. Commercial finance is easily available; Banks have strong networks and credit culture is well entrenched in this contiguous region. States like Andhra Pradesh have the highest population of SHGs that are credit-linked to the banking systems and in promoting rural business enterprises.

10.8. Encouraging developments in the States: A snapshot of recent happenings in the 3 South Indian States serve to highlight the lead they have over the rest of India:

- Announcement of specific policies for the Bio Diesel industry
- Mapping of resources
- Fixing district-wise performance targets for cultivation of Jatropha
- Windows for technical and financial assistance to farmers
- Political pressures to offer minimum price support for produce[85]
- Facilitating partnerships between private companies and farmers[86]
- Action Plan by Forest Offices to collect oil seeds from the wild
- Demonstration of use of Bio Diesel
- Initiatives to influence and satisfy user demand
- Mobilisation of village communities to generate power for supply to local grids
- Sensitisation of banks to financing Bio Diesel supply chain

[84] Although currently there is no power shortages in Tamil Nadu State
[85] In Andhra Pradesh State
[86] Contract farming in Tamil Nadu State, facilitation in Karnataka State

11. CAPACITY BUILDING

11.1. Key Issues: Use of SVO/ Bio Diesel is not popular because it is either not available or there is inadequate data on its successful use in diesel engines across various applications. Government policy is biased in favour of cultivation of Jatropha and does not give enough importance to other tree-borne oil seeds. Further, by focusing on blending Diesel with Bio Diesel, it bypasses the opportunities or using SVO/ Bio Diesel in various rural applications that can transform rural production economics and improve their access to energy. If village communities are sensitised to business opportunities in the Bio Diesel industry and are mobilized to do so, with suitable market and bank credit linkages, the switch over to eco-friendly Bio fuels will be rapid.

OPPORTUNITIES AND SOLUTIONS

11.2. Opportunity 1: Governments in some States, notably Tamil Nadu, Andhra Pradesh and Madhya Pradesh, are encouraging growth of oil-bearing plants such as *Jatropha* to increase oil seed availability for production of Bio Diesel.

- *Action Plan*: Integrate Bio Diesel Project goals to complement ongoing efforts of Government, and supplement with suitable market linkages – focus on same geographical clusters, facilitate establishment of commensurate bio diesel facilities, etc.
    - *Target group*: Government – agricultural departments, vegetable oil industry regulators, forest offices, local governments, etc

11.3. Opportunity 2: Initiatives relating to environmental protection and watershed development emphasis agro-forestry, including planting of useful income-generating plant species.

- *Action Plan*: Network with organizations –governmental, agriculture extension organizations (such as agricultural universities) as well as NGOs to popularise growing of oil-bearing crops as fencing and bund crops
    - *Target group*: Government departments, NGOs, Agricultural Universities

11.4. Opportunity 3: There has to be widespread cultivation of oil-bearing trees and collection of oil seeds to make available oil seeds on a continual basis for production of Bio Diesel.

- *Action Plan*: Farmers have to be encouraged to grow various oil-bearing plants in both their own used/unused lands and also in public lands.
    - *Target group*: Village Farm Committees, Government's forest offices, local governments, individual farmers, etc.

11.5. Opportunity 4: Existing edible and non-edible oil industry business infrastructure can provide ready-made manufacturing infrastructure, help build market linkages and ensure sustainability.

- *Action Plan*: Convince vegetable oil extraction entrepreneurs to diversify into Bio Diesel business areas
    - *Target group*: Existing vegetable oil entrepreneurs, traders and vendors

11.6. Opportunity 5: Processing of SVO into Bio Diesel requires relaxation of current regulation over use of catalysts such as Methanol[87] – if not, establishing new trans esterification plants could be a cumbersome task.

- *Action Plan*: Work closely with policy-makers and regulatory bodies to ease procedures for permitting establishment of trans esterification plants
    - *Target group*: Regulatory bodies, vendors, entrepreneurs, etc

11.7. Opportunity 6: Several engine manufacturers have not yet recognized the potential for using SVO/ Bio Diesel.

- *Action Plan*: Reach out to engine manufacturers to evaluate existing evidence and conduct their own research and convince their users to use SVO/ Bio Diesel, besides extending suitable product warranties and after-sales support.
    - *Target group*: Research organizations (such as IIT), engine and component manufacturers, dealers of engines, etc.

11.8. Opportunity 7: Users of diesel are not aware of diesel-substitutes.

- *Action Plan*: Confidence in use of alternative fuels should be increased; information relating to its successful use in different engines should be disseminated
    - *Target group*: Large customer groups such as road transporters, Small customers such as agriculturists, power generators, etc

11.9. Opportunity 8: Commercial financing is required to fund crop cultivation and post-harvest processing activities such as oil extraction, trans esterification, etc.

- *Action Plan*: Bankers need to be sensitised to the new business opportunities in the Bio Diesel industry and have a positive outlook to its feasibility.
    - *Target group*: Commercial banks, apex bank organizations such as NABARD, etc.

EXCERPT FROM THE SPEECH OF THE PRESIDENT OF INDIA ON January 26, 2005

Bio-Fuel Generation

We have nearly 63 million hectares of wasteland available in the country, out of which 33 million hectares have been allotted for tree plantation. Certain multi-purpose bio-fuel plants can grow well in wastelands with very minimum input. Once cultivated, the crop has fifty years of life. Fruiting can take place in two years. Bio-fuel plants grown in parts of wastelands, for example, 11 million hectares can yield a revenue of approximately Rs. 20,000 crore a year and provide employment to over 12 million people both for plantation and running of extraction plants. It will reduce foreign exchange outflow for import of crude oil, cost of which is continuously rising in the international market. Bio-fuel is Carbon mono-oxide emission free. The oil can also be used for soap and in the candle industry. De-oiled cake is a raw material for composting and the plantation is also good for honey production. We should absorb the best of technologies available worldwide and start commercial operations immediately. One time investment needed for bio-fuel plantation to production in 11 million hectares will be approximately Rs. 27,000 crore. Capital equipment and investment in plant and machinery can come from bank loans and private sector entrepreneurs. I have seen the progress in bio-fuel plant cultivation, preparation of seedlings, tissue culture and development of non-toxic hybrid varieties in the Tamil Nadu Agricultural University in Coimbatore. They have also worked from processing of seeds to bio-fuel production by indigenous design and development of bio-fuel plants. Anand Agriculture University at Anand in Gujarat has also made progress in bio-fuel cultivation and processing in Gujarat. Bio-fuel plants can be grown in a number of states in the Southern, Western and Central parts of the country.

[87] Please see *Para* 7.28 in *Page* 26 – use of Methanol is restricted

12. PLAN OF ACTION

PURPOSE OF INTERVENTION

12.1. The Bio Diesel Industry in India is gaining momentum. There are several agencies engaged in promoting use of Bio Diesel and building a sustainable supply chain. The overall facilitation and financial assistance strategy calls for intensive engagement of stakeholders across various regions, disciplines and objectives. The key tasks are to (a) produce and sell SVO/ Bio Diesel at prices low enough to convince users of Diesel, Furnace Oil and LSHS to switch fuels, (b) improve access to credit for village communities, and (c) develop a local market for SVO/ Bio Diesel

PROJECT AREAS

12.2. Intensively source oil seeds and produce/ use of oils in 3 South Indian States of Andhra Pradesh, Karnataka and Tamil Nadu

12.3. Procure tree-borne oil seeds in Madhya Pradesh and Chattisgarh States and Rubber Seeds in Kerala State for inter-regional use in areas of demand

FACILITATION ROLE

12.4. Extend Technical support[88] in collaboration with research institutions, vendors, government and others

12.5. Research in use of oil seeds and higher value realizations from sale of by products

12.6. Mobilise village communities[89] to collect oil seeds, run production facilities and sell oils for local use

12.7. Procure different types of oil seeds[90] to be used in Project Areas

12.8. Reduce intermediation and build direct market linkages for producers

12.9. Establish model projects[91] in different areas

12.10. Build market linkages for oil seeds, oils and by products locally and with big buyers

12.11. Forge tie-ups with big buyers to use SVO/ Bio Diesel, and establish demand in large urban markets

[88] Agricultural inputs, Manufacturing processes & equipment
[89] Through Self-Help Groups, Producer Cooperatives, Local Governments and NGOs
[90] Without any bias for any type of oil seeds
[91] With the help of commercial finance and by village communities

12.12. Prototype model procurement organizations for oil seeds and a selling organization for marketing of SVO/ Bio Diesel

12.13. Qualify vendors and standardise technical specifications of machineries and eligibility for bank financing[92]

12.14. Introduce good technical, sales and service practices

12.15. Engage engine manufacturers in adapting engines to use SVO/ Bio Diesel

12.16. Tap existing manufacturing infrastructure to minimize capital investments and maximise existing supply chain synergies and entrepreneurship

12.17. Bundle and sell Carbon Emission Reduction credits

CAPACITY BUILDING

12.18. Map existing oil seed resources[93], production infrastructure and demand in specific areas[94]

12.19. Complement ongoing Government and private programmes

12.20. Accelerate local use of SVO

12.21. Cut transaction costs by reducing the number of intermediation channels[95]

FINANCIAL SUPPORT AND BANK PARTNERSHIPS

12.22. Launch a Loan Programme to improve access to credit[96]

12.23. Use interest subsidization as an incentive tool to catalyse lending

12.24. Forge partnerships with several banks to replicate Loan Programmes to cover a wider population of prospective entrepreneurs

12.25. Sensitise bankers to lending opportunities in the Bio Diesel industry and infuse confidence in feasibility of the businesses

12.26. Innovate financial solutions for lending to new customers[97] of Partner-banks

[92] Guide Banks in lending for Bio Diesel-related businesses
[93] Including identification of more varieties of oil seeds
[94] Initially, in areas where model projects are to be established
[95] Build direct linkages between producer and buyer
[96] Structure a Bio Diesel industry loan product with liberalised terms
[97] To broad base lending beyond Banks' own customers

PARTNERSHIPS

12.27. Enter into flexible partnerships[98] with several Banks, NGOs, Vendors and Government organizations

12.27.1. **Wartsila and other engine manufacturers**: Support their customers switch fuels; help build supply chain for their village power plant and urban captive power customers

12.27.2. **Government's Forest/ Agriculture Offices and Agro corporations**[*99*]: Encourage and regulate collection of oil seeds from areas under their control

12.27.3. **Environmental activists**[*100*]: Convince Village Forest Committees to include energy plants/ trees as part of ongoing afforestation programmes

12.27.4. **Dhaan and other NGOs**[*101*]: Mobilise village communities to establish supply chain for Bio Diesel industry

12.27.5. **Tamil Nadu Agricultural University and other agricultural research institutions**[*102*]: Propagate high-yielding plant species and crop practices, and research higher realizations from by products

12.27.6. **Indian Institute of Science's SUTRA and other engineering research institutions**[*103*]: Disseminate research findings on use of SVO/ Bio Diesel in engine, research into reduction of production costs and increase in value realizations from sale of by products,

12.27.7. **Indian Railways, Road Transport Corporations and other big buyers:** Develop market linkages for sale of SVO/ Bio Diesel produced by village enterprises

12.27.8. **Phytotron Agro and other corporates**[*104*]: Support their efforts to build a supply chain for production of Bio Diesel

12.27.9. **Canara Bank, Syndicate Bank & other Banks**: Launch loan product with soft terms with some financial support from UNEP

[98] May be project-specific, task-specific or complementary to their existing efforts or other projects
[99] Since these entities often control supply of oil seeds, being either forest or agricultural produce
[100] Having grassroots contacts with village communities, to include Bio Diesel within their causes
[101] BAIF, Development Alternatives, ITC's *echoupal*, etc
[102] Anand University, Punjab Agricultural University, CIPET, etc
[103] Including Indian Oil Corporation, IIT, etc
[104] Renu Lakshmi Agro, Bannari Amman Sugars, etc

Annex 1

STAKEHOLDERS

Government & Regulators

1. Biomass Energy for Rural India Project, Bangalore
2. Khadi & Village Industries Commission, Bangalore
3. Ministry of Non-Conventional Energy Sources, Secunderabad
4. Society for Elimination of Rural Poverty, Hyderabad
5. Directorate of Agriculture, Madhya Pradesh, Bhopal
6. Integrated Tribal Development Authority, Utnoor, Adilabad District, Andhra Pradesh State
7. District Forest Office, Krishnagiri District, Tamil Nadu State
8. Zilla Panchayat, Tumkur District, Karnataka State
9. Directorate of Agriculture, Karnataka State
10. Directorate of Horticulture, Karnataka State
11. Directorate of Agriculture, Tamil Nadu State
12. Office of the Chief Conservator of Forests, Andhra Pradesh

Engine Manufacturers

13. Mahindra & Mahindra Limited, Mumbai
14. Kirloskar Oil Engines Limited, Pune
15. Wartsila India Limited, Chennai

Research Institutions

16. Indian Institute of Science, Bangalore
17. University of Agricultural Sciences, Bangalore
18. Tamil Nadu Agricultural University, Coimbatore
19. Forest College & Research Institute, Mettupalayam, Tamil Nadu State
20. Petroleum Conservation Research Association, Hyderabad
21. Indian Institute of Petroleum, Dehradun, Uttaranchal State
22. Central Arid Zone Research Institute, Jodhpur, Rajasthan State
23. Sardar Patel renewable Energy Research Institute, Anand, Gujarat State
24. Central Farm Machinery Training & Testing Institute, Budhni, Madhya Pradesh State
25. Indian Institute of Technology, Kanpur, Uttar Pradesh State
26. Indian Institute of Technology, Delhi
27. Mr. Syamsunder Joshi, Bangalore

Technologists, Vendors & Users

28. Mr. Satish Lele, Mumbai
29. Bannari Amman Sugars Limited, Coimbatore
30. The Federation of Andhra Pradesh Chambers of Commerce & Industry, Hyderabad
31. Indian Oil Corporation Limited, Delhi
32. Southern Railways, Chennai
33. Bharat Petroleum Corporation Limited, Delhi
34. MP State Agro Industries Corporation, Bhopal
35. Mr. Paneer Selvam, Chennai
36. Equipment Engineers, Chennai
37. Kumar Industrial Works, Salem, Tamil Nadu State
38. Chemical Construction International Private Limited, New Delhi

39. Phytotron Agro Products India Private Limited, Bangalore
40. Renulakshmi Agro Industries India Limited, Coimbatore, Tamil Nadu State

NGOs

41. Dhan Foundation, Madurai, Tamil Nadu State
42. Development Alternatives, Delhi
43. BAIF Institute for Rural Development-Karnataka, Kabbigere, Karnataka State
44. BAIF Institute for Rural Development-Karnataka, Lakkihalli, Karnataka State
45. Laksha Vruksha Andolana, Sirsi, Karnataka State
46. International Society for Krishna Consciousness, Belgaum, Karnataka State

Consultants & Capacity Building organisations

47. Mr. Chaturvedi, Hyderabad
48. Centre for Resource Education, Secunderabad
49. Dr MCR HRD Institute of Andhra Pradesh, Hyderabad
50. Winrock International India, Delhi

Banks

51. National Bank for Agriculture & Rural Development, Head Office, Mumbai
52. National Bank for Agriculture & Rural Development, Regional Office, Bangalore
53. Canara Bank, Head Office, Bangalore
54. Syndicate Bank, Corporate Office, Bangalore
55. Andhra Bank, Head Office, Hyderabad
56. Canara Bank, Circle Office, Hyderabad

Site Visits

57. SUTRA Straight Vegetable Oil Plant, Ketahalli, Karnataka State
58. Powerguda Village, Adilabad District, Andhra Pradesh
59. Kommaguda Village, Adilabad District, Andhra Pradesh
60. Beemangattu Village, Krishnagiri District, Tamil Nadu
61. Oil Extraction facility, Tiptur, Karnataka State
62. Oil Retail Outlet, Tiptur, Karnataka State

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