Project Report

Analysis of Bio-diesel Programs from Socio-Economic and Agronomic Perspectives: Case Study on Rajasthan and Orissa

Prepared For
Ministry of New and Renewable Energy (MNRE)
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Integrated Research and Action for Development (IRADe),
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Ministry of New and Renewable Energy,
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Analysis of Bio-diesel Programs from Socio-Economic and Agronomic Perspectives:

Case Study on Rajasthan and Orissa

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Thanks are also due to the respondents for giving their precious time and answering the questions very patiently.

We hope that this report will be useful in further action regarding the Jatropa program.

Dr. Jyoti Parikh
(Executive Director)

Executive Summary

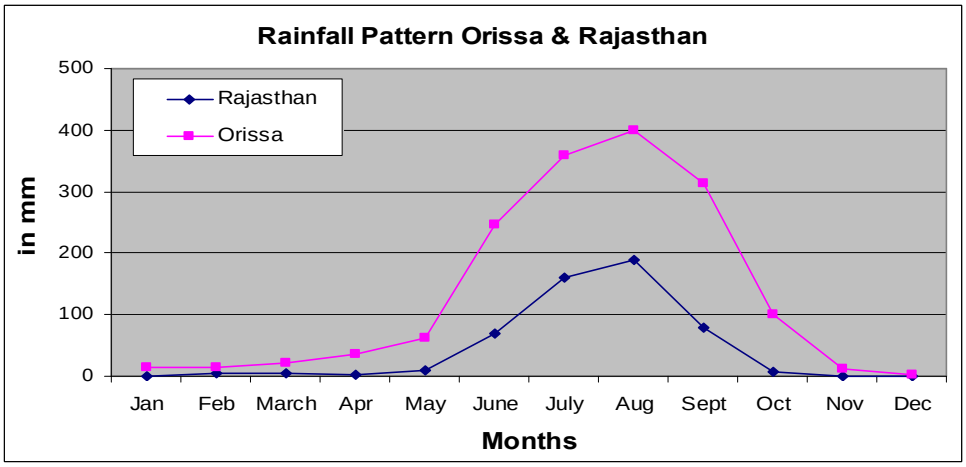
The objective of this project was to capture the current status, barriers and success of Jatropha based bio-diesel production and consumption in the states of Orissa and Rajasthan. The surveys carried out generate information to outline the future agenda to address key demands from the community for targeted information on Jatropha cultivation in Orissa and Rajasthan and draw lessons for national policies as well. We attempt to identify and fill critical knowledge gaps, which currently inhibit effective policy on bio diesel in India to delineate the key challenges in the Jatropha cultivation in consonance to find ways to scale up scale up the outreach of services to the poor and vulnerable. The study analyzes various socio economic parameters and other multi stakeholders consisting of oilseeds cultivators, with regard to Jatropha based bio-diesel cultivation and production. The study focuses on the viability, costs and prices alternatives that each stakeholder has to do other things with their resources. Thus, stakeholder profile, dynamics, interdependence, and role of government are analyzed in the study. In doing so, the project identifies the primary barriers of Jatropha plantation, bio-diesel production in India, addresses demand, supply gaps, and analyzes socio-economic feasibility of a multi-stakeholder system with a focus on rural population. It also finds out gaps in each subsequent step from land use, seed availability, and Jatropha plantations to the finished product, marketing and supply of bio-diesel to the end consumer.

For collection of data, survey, empirical observations, and expert judgment methods are used to study the social structure of rural India, wasteland profile, compatibility of Jatropha Plantation to wasteland, profile of farmers and marketing of seeds in respective states. Both quantitative and qualitative surveys were carried out among the beneficiary population of the selected villages in Rajasthan and Orissa. The quantitative data was collected for the existing levels of the impact, outcome and output indicators of Jatropha based farmers and their socio-economic conditions. The qualitative information are collected through meeting of and interacting local stakeholders, NGOs, Government administration, and social

Scientists to understand challenges for Jatropha plantation and selling of seeds. The obtained data was analyzed to detail the above process to draw inference for policy framework for Jatropha plantation and bio-diesel production.

Biofuel promotion is a very complex issue dependent on knowledge, infrastructure support, policy issues, political environment, intersectoral cooperation and national and international linkages for the cooperation and technology promotion and transfer. Feedstock supply and management chain emerge as a major issue to be addressed considering local circumstances such as climatic, agronomic, economic, and social conditions. Study covered 41 villages and the jatropha cultivators in these villages in the two states Rajasthan and Orissa to understand the ground realities of the jatropha plantation. . Following table highlights comparison of the two states,

	RAJASTHAN	ORISSA
LAND & CLIMATE		
Land	Total wasteland available in Rajasthan is 1014.5 lakh ha, of which only 52 lakh hectares are considered as cultivable wasteland Wide variation in soil types. In the western Rajasthan they are mainly desert, sand dunes, red desert soils and in southern Rajasthan mostly red soils, alluvial in depression of foot hills Texture varies from sandy, Coarse sand, sandy loam, to gravel	In Orissa 18 lakh hectare of wasteland are available where no cropping is possible due to degradation, undulating, eroding and less fertility. The soil offers wide range of variation from Lateritic, Red & Yellow, and Mixed Red & Black. These soils are either acidic or alkaline in nature where there is a less possibility to raise any normal agriculture crops.

<table>
<tr><td>Rainfall</td><td colspan="2"> 
</td></tr>
<tr><td></td><td>The average rainfall varies across Rajasthan. The desert receives an annual rainfall of 100 mm. The southeastern region gets annually 650 mm. Maximum rainfall received is during July to September and almost dry for rest of the year.

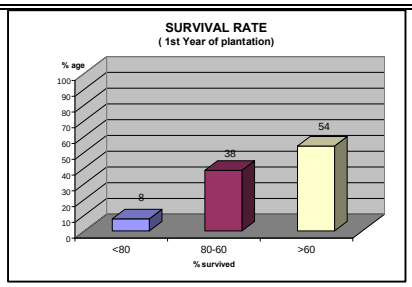
Though Jatropha can grow under such conditions, pays heavily on the growth due to scarcity of water.</td><td>Receives fairly good rainfall 1500 mm

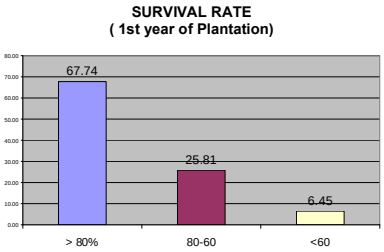
Even the Summer months receives some rainfall

These climatic factors are quite suitable for the jatropha plantation.</td></tr>
<tr><td>Temperature</td><td>Wide variation in temperature observed in Rajasthan. In North western -2 (Churu) to 45 0c to that of 8 to 45 ^{0}c in south eastern region.

Low temperature is not suitable for the jatropha crop</td><td>Temperature in all the agro-climatic regions ranges between 12 to 40 ^{0}c, which is ideal for the growth of Jatropha except in Eastern Ghat High Land (Major parts of Koraput, Nabarangpur) where especially in winters temperature drops down to 7.5^{0}c.</td></tr>
<tr><td colspan="3">• Climatic conditions are far better for the Jatropha plantation in Orissa than Rajasthan.
• Availability of water plays critical role for the growth of jatropha during its early</td></tr>
</table>

stages of growth		
JATROPHA PLANTATION		
Plantation	• Jatropha plantation was initiated as early as 2001in the state. But actual large scale plantation was started from 2006 onwards • There is no specific figure on actual area under plantation in the state. Number of private players and government agencies are independently involved in plantation activity. • Mostly grown on the waste land under rainfed conditions. Under contact farming some farmers are cultivating on agriculture land also • Growth of the plants is slow compared to Orissa because of the climatic, edaphic and water scarcity.	• Large scale plantation activity in the state was initiated in 2007-08 • Similar is the case with Orissa. State government has plans to cultivate more than 15000 acres and Organisations like ONCC has plans to cover one lakh acres by 2013. • Mainly grown on the wasteland under rainfed conditions • Good growth was observed. Climatic conditions are better suitable than Rajasthan. Rainfall is good and even received during off monsoon season helped in better growth & survival during early stages of the development.
		

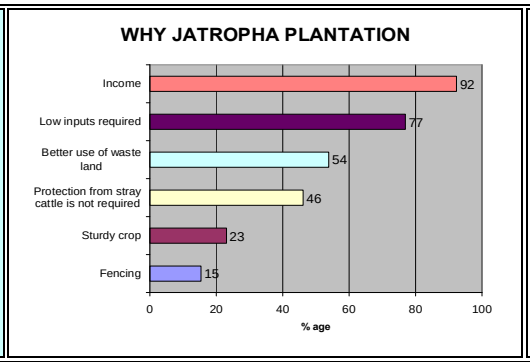


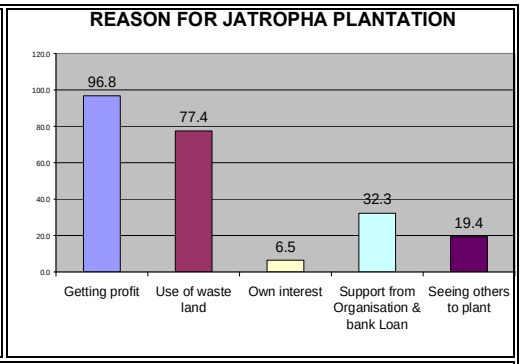


- *It is very important to have good planting material to get better results. Wide variations in the yields were observed during field trails in the different parts of country. Since the economic benefits are spread over 40 years, it becomes utmost important to select proper planting material. Needs good R &D inputs for improvement of the planting material*
- *Timely supply of good saplings is important*
- *Anything free is often misused, therefore supply of free sapling should be restricted*
- *Yields are very low ranging from 250-400 gms per plant even after more than 4 years of plantation in Rajasthan. While at Orissa, it is too early to comment on the yield but given the good growth, better yields are expected compared to Rajasthan*
- *Jatropha though survives in the extreme conditions but, performs badly with water scarcity in early stages of growth*

CULTIVATORS

Farmers	Enthusiastic participation of farmers for jatropha plantation was observed in the state. The state government through various programmes also supports Plantation activity. Many of the private sector companies are also promoting plantation through contact farming mode. Some of the farmers cultivating Jatropha on agriculture land and private players are encouraging them.	ñSeeing is believingò holds well in Orissa. Given the good growth performance of the demonstrative plantation, many farmers have taken up cultivation of Jatropha on their waste/ fallow lands. Performance is quite encouraging and could match to the expectations of the farmers, However, it is too early to comment on exact yield





- *The major driving factor in both the sates was additional **economic benefits** from the use of available wastelands. However, the other reasons like low input cost, support from the local organisations, sturdy crop, no protection required from stray cattle were also played important role in adoption of jatropha plantation.*
- *Orissa has setup the unique model of Self Help Group (SHGs) based Jatropha plantation.*
- *It was observed that, proper institutional support system is needed for establishing linkages with financial institutions, Government and market. ONCC from Orissa has setup unique model for promotion of Jatropha plantation.*

Others (Private sector & NGOs)	There are number of players involved in this plantation like IKF, who has acquire land from the sate government and also in contract farming mode with the farmers and has plans to grow Jatropha on 50000 ha. Rajasthan State Mines and Minerals is also involved in in-house plantation and use of biodiesel Other organisations like *Centre for Jatropha Promotion & Biodiesel* (CJP) is implementing its ambitious plan for planting 50 million trees under their New Biodiesel Tree Plantation (NBTP) programme to produce 10 million ton Biodiesel per annum	Organisation like Orissa Nature Care Council Action (ONCC) is quite active in the promotion of jatropha and planning to cover 150500 acres of area under Jatropha plantation by year 2013. Corporate like, Mission New energy has also announced to take up jatropha plantation in a big way. The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery in the state
Number of private players are showing interest in the promotion of Jatropha plantation and processing in both the states. However, the scales on which plantation have been promoted remains questionable.		
Government	ñBio Fuel Missionò was constituted to promote biofuel in 2005-06. Government has declared the Bio Fuel Policy and has constituted the Bio Fuel Authority.	Government prepared elaborate policy guidelines for ñRaising of Energy Plantation and Bio-diesel Productionò
PROCESSING (EXTRACTION & TRANS-ESTRIFICATION) INDUSTRIES		

Government	Government has assured support for promotion of the processing units. However, not much is yet achieved Maharana Pratap University of Agriculture and Technology has established two Jatropha oil processing plants in Dungarpur and Udaipur	Not much has been achieved so far. The Orissa Forest Development Corporation has installed one integrated Biodiesel plant starting from extraction to trans-esterification at Satyanagar, Bhubaneswar in year 2007 to demonstrate complete process. Government has planned to establish 20 pilot projects during 2008-09 in 20 districts.
Private	There are number of small edible oil extraction unit. At present, some these expellers are extracting jatropha oil. This oil is used for lamps and other non-edible usage. IKF Technologies Ltd. Has established a small Bio-fuel refinery in Udaipur and planning to expand the capacity to 100MT. Rajasthan State Mines and Minerals has set up pilot unit in year 2006	There are number of small oil extraction units, which could be effectively jatropha oil extraction. Recently number of private players like Mission New energy, The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery in the state.

Most Jatropha plantations are far from biodiesel producing units. Therefore, it is advisable to establish decentralised processing units for extraction of oil. This would provide better value addition to the farmers for their produce, create local employment and reduce the cost of production. Trans-esterification shall be

further carried out at larger plants. *For better extraction, good quality expellers could be promoted.*		
MARKETING		
Local	Though the plantation is older than the Orissa, but production levels are not up to the mark to achieve sizable trading. Seeds are mainly sold in the local market and traded by traders with price ranging from Rs 3- 10 /kg of the seeds even though government has assured minimum support price of Rs 7/ kg.	Since the plantation is new no significant market landings for the jatropha seeds was not observed in the local market. It will take another 2 years to establish trade linkages. ONCC, local organisation has ensured buyback at the rate of Rs 5/ kg to the farmers
Regional	No such arrangement exists for trading seeds or oil/ diesel at present	No such arrangement exists for trading seeds or oil/ diesel at present
End Users	Only used on the experimental basis by institutes. Not available in the market for general public use as biodiesel	Since the supply side has not established, the end users are yet to get benefits from the same. Some of the research institutes are using oil on experimental basis.
• *Since the production is limited, market networks are not yet established. Product is mostly traded locally. Within next 2-3 years when volumes were traded, suitable networks shall be established.* • *Government should focus on establishing proper marketing linkages at village level for procurement at the rate fixed by the government.*		
INSTITUTIONAL SUPPORT		

Government	**National Oilseeds And Vegetable Oils Development Board (NAVBOD) : Back-ended Credit linked subsidy program for development of Tree Borne Oilseeds** Provides 30 percent back-ended capital investment subsidy by which the subsidy is linked up with credit (50%) from the institutional finance. The remaining 20% margin money is to be contributed by the beneficiaries. The margin money is monetized in the form of labour, land cost, watch & ward etc. The schemes have been made broad based, decentralized, entrepreneur driven and result oriented. The subsidy is for Establishment of seed procurement , Installation of multi-purpose pre-processing and processing facility, Installation of oil expeller, Nursery raising and Commercial Plantation of TBOs More information on: http://www.novodboard.com/GUIDELINES-BACKENDED.pdf	
Others	There of number of players who support for Jatropha plantation in the state. One of the notable examples is Centre for Jatropha Promotion & Biodiesel (CJP) at Churu provides support for scientific commercialization of Jatropha. IKF, private limited has also supporting jatropha plantation.	There are not many private players at present though number of corporate has shown interest. ONCC (Orissa Natural Care Council Pvt. Ltd.)

Observations & suggestions:

- Although Jatropha plants can survive in wastelands/degraded lands, the fruiting and seed yield of the plant is highly dependent on availability of water (rain or irrigation) during critical stages. Soil characteristics also play important role in the growth. Therefore, it is observed that the growth performance is better in Orissa than Rajasthan
- Jatropha plantations in its early stage of development in both the state, actual results on the production are awaited. There is a need to record time series

- performancesò of various plantations in the state to understand impact of various influencing factors the production.
- It may be difficult at this stage to understand weather jatropha plantation is economically viable, but many farmers are convinced that this is the best use of their unproductive waste and fallow lands.
- Timely availability of the quality planting material is very much important for the promotion of jatropha, Proper quality control mechanism shall be established and R & D efforts should be initiated to provide best planting material. Nursery establishment should be given priority.
- The support system for the training, resource mobilisation (both inputs & financial), information exchange to the farmers needs considerable strengthening and necessitates building of suitable institutional support mechanism with the support of NGOs and private institutions. Formation of SHGs and tie-ups with the financial institutions will create positive impact in promotion of this activity.
- Even though the area under Jatropha plantation has increased, has not achieved the critical production levels to establish large processing units. However, this could be right time to establish the oil expellers of small and medium capacity.
- At present most of the seeds purchased are processed at the local expellers. Network of the good expellers is necessary and if possible, the ñexpeller SHGò could be formed at village or cluster level for value addition at grass root level.
- Government should focus on establishing proper marketing linkages at village level for procurement of the produce at the rate fixed by the government.
- Concerns about the possibilities of the impact of the jatropha cultivation on the grazing land could be matter of concern. The transfer of commons and grazing lands which provides fodder to livestock in the local economy could be restricted
- Mix model of Jatropha cultivation: With other oil seed crops like caster and fruit trees could be ideal solution to maintain the diversity and ecological stability.

- Private players who are involved in the plantation activity require proper monitoring. Proper agreement between the promotional parties (Companies) and farmers should be carried out to gain confidence among the growers.
- Detailed impact assessment study of the activity on the long-term impact on agro-ecological balance is necessary.

Chapter 1
Introduction

Meeting the energy requirements in a sustainable manner continues to be a major challenge for most of the countries across the world. Technological advancements, increasing global crude prices, opportunities to reduce local and global environmental emissions and achieving targets have been the major drivers for promotion of bio-diesel as an energy source in both developed and developing countries. While these are generic drivers for adoption of bio-diesel as alternative energy source the specific contextual drivers differ widely across countries.

For developing countries like India specific drivers, include diversifying energy sources as well as augmenting domestic supply sources from the energy security point of view, reducing local emissions such as SOx, contributions towards reduction of foreign exchange outflow and improving the livelihood and income generation opportunities in rural areas especially the semi-arid regions of the country.

Decreasing dependence on imported oil through inter-fuel substitution has been stated as one of the objectives of the energy policy of the Planning Commission of India (Planning Commission, 2006).

Both qualitative and quantitative methods of inquiry can be used to understand the perspectives of different players across the different component of value chain i.e. cultivation, bio-diesel production, distribution and consumption.

Tools such as value chain analysis, technology mapping and institutional analysis can be used to evaluate the critical gaps that impede sustainable progression in adoption of bio-diesel as alternative energy source.

1.1 Objectives of the study

The broad objective of the project was to formulate a multi-stakeholder analysis that examines feasibility ranges for various parameters that determine socio-economic viability of the bio-diesel system & complete survey in two states (Orissa & Rajasthan) of India to collect data on various parameters of socio-economic status, agro-ecological condition for Jatropha seed cultivation, bio-diesel production, remuneration of farmers and use it to identify barriers and gaps for bio-diesel development in India for the formation of future strategies and policy framework.

Objectives

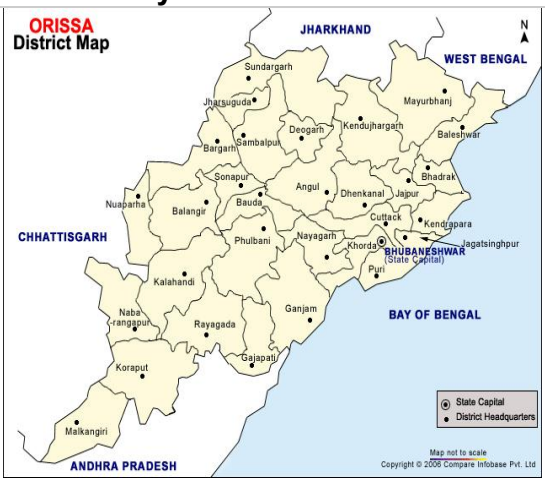
Main objective of the study to give recommendations and road map for each components of bio-diesel system for National Policy on Bio-diesel are as follows:

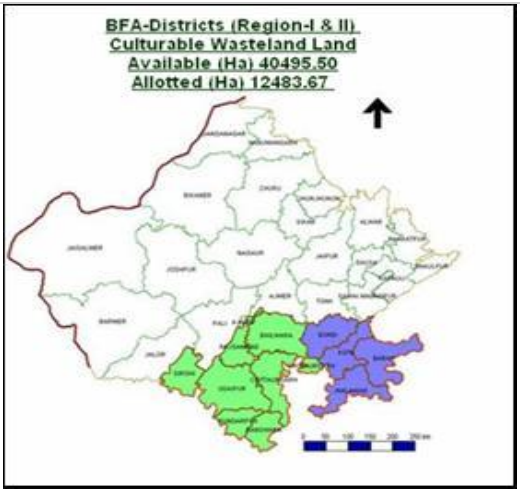
- Conduct field study and collect comparable and consistent dataset on various parameters of Bio-diesel production.
- Analyze the economic feasibility of each stakeholder and complete value chain and computation of proportionate effect of various factors influencing the feasibility of value chain.
- Find out technical, social and economic gaps in the interlinking of various components of bio-diesel system.
- Carry out socio-economic analysis of bio-diesel production under various scenarios.
- Conduct field based study, consulting with multi-stakeholders & farmers and collect ground level information on bio-diesel production, cultivation, marketing etc.
- Feedback from Nodal agency and suppliers for their experience and problems
- To give recommendations and road map for each component of bio-diesel system and for National Policy on Bio-diesel

1.2 Scope of Project:

The study of Bio-diesel project was carried in the states of Orissa and Rajasthan As stated in the proposal the study covered 18 villages in Orissa and 23 Villages in Rajasthan.

1.3 Study Area





ORISSA STATE	RAJASTHAN STATE
District: Ganjam	**District: Udaipur**
Tahori	Rana
Kulada	Kachna
Sana gopalpur	Ghata
Talpada	Jogiyo Ka Guda
K. Nuapally	Jolabas
Kanchana	Devro Ka Kheda
Haripur	Mokhal
Tamanda	Senwada
Nabagacha	Surajgarh
District : Kalahandi	Naal
Manikera	Chotiyakhedi
M. Rampur	Mokhi
Nuagaon	Majam
Sindhiguda	**District: Banswara**
Penjikupa	Bhooradood
Bajamunda	Mandli Choti
Gandapadar	Mandli Moti
District: Raigada	Godawara Narang
Suri	Jeeva Khoonta
Senpadia	Bhelkuwa
Total Numbers of village covered: 18	Semel Kheda
	Motiya
	Bejelpur Bhaliya
	Bejalpur Haliya
	Total village covered: 23

1.4 Approaches and Methodology:

The following methodology was adopted for conducting stakeholdersô consultations

- The Stakeholders consultation process was carried out in a systematic manner to cover all relevant information
- Consultations were conducted with the important State government functionaries, academics, NGOs, officials and village functionaries at all levels.
- The meetings were participatory in nature with due representation from all sections.

The stakeholdersô consultation was carried out in the State of Orissa and Rajasthan**,** to collect data on various parameters of seed cultivation, agro-ecological, bio-diesel production and find out various technical, social and economic gaps in the interlinking of various components of bio-diesel system.

The key objective of the project is to give recommendations and road map for each component of bio-diesel system for National Policy on Bio-diesel.

Consultations with farmers and multi-stakeholders consultation is a prerequisite for designing modifications in projects.

1.5 The Current Study:

The present study was conducted in Udaipur, & Banswara district of Rajasthan and Ganjam, Raigada and Kalhandi district of Orissa. 23 Villages were selected from the two districts, and 18 villages were selected from the Rajasthan and Orissa respectively for this study. To select respondents from each identified village in consultation with farmers. Data were collected by IRADe team members with the help of, designed questionnaire for study purpose. Thereafter, data were analyzed, tabulated and interpreted.

- Literature Survey of Social Structure of Rural India, Wasteland profile (distance from mother village), compatibility of Jatropha Plantation to wasteland etc in **Orissa** and **Rajasthan.**
- Preliminary concept development on Jatropha plantation by different profile of farmers and marketing of seeds (focus on Orissa and Rajasthan)
- Field surveys (according to structured format) for data collection on a consistent basis in the two leading states of India, which are active in bio-diesel, namely Orissa, Rajasthan. It would comprise of meeting and interacting local stakeholders, NGOs, Government administration, and social scientists to understand challenges for Jatropha plantation and selling of seeds. The quantitative and qualitative insights obtained from these viz. land availability, factors that determine yield, by-product management and marketing, flexibility and constraints of each stakeholder etc. was used to do a quantitative study.
- Detailing of social Structure. Analysis will be carried out for following issues;
  - Jatropha plantation by whom? (Analysis based on profile of farmers in the rural area.
  - What is the nature of wasteland? (Saline / ravines / alkaline etc.)
  - What are the problems of plantation?
  - What kind of network exists for procurement of seeds?
  - Analysis of processing of seeds at village level / block level / Industry.
  - What is the expected revenue from the value chain and how it benefits the rural economy?

The project will analyze, all the four components of the bio-diesel system namely, oilseeds production, extraction & processing of seeds oil, marketing and end uses. The obtained data was analyzed to detail the above process to draw inference for policy framework for Jatropha plantation and bio-diesel production Compilation of data and analysis.

Final report preparation with observation and recommendation for future programme.

- Consultation and briefing with the concerned officials of the MNRE to determine the Performance Measurement Indicators.
- Preparation of a structured questionnaire to evaluate the performance of the bio-diesel plant and its production capacity.
- Meeting with the state nodal agency and the project officer/ in-charge of the project, to understand the implementation mechanism and the shortcomings/difficulties in implementation of the Program.
- Visit to different villages for the collection and verification of micro level information on installed system performance, and maintenance and satisfaction level of beneficiaries.
- Compilation of data and analysis.
- Observation & recommendation for both states & future program.

Chapter 2
Bio-diesel

2.1 Introduction

Bio-fuels are defined as energy carriers derived from the conversion of biomass to provide sustainable inputs for heat, power, and transport applications. Bio-fuels can be liquid, solid or gaseous. The principle sources of biomass are agriculture and forestry.

Currently, world over only about 10 percent of the biomass is used as bio-fuels. Forecasts show that in the most optimistic scenarios, bio-energy could provide for more than twice the current global energy demand, without competing with food production, forest protection efforts, and biodiversity.

Concerning economic competitiveness of bio-fuels, already today, heating applications based on modern bio-fuels can compete with oil and gas, and electricity generation with biogas from residues, landfills, or waste-water treatment undercuts costs of oil- and gas-fired power plants. Ethanol from sugarcane in Brazil is competitive without subsidies at 35-50 US$/bbl oil (WB 2005), while most other liquid bio-fuels for transport need further development before becoming economically attractive at oil prices 100 US$/bbl range. Yet, volatility in oil prices could also endanger investments in market introduction of bio-fuels.

Solid Bio-fuels

The conversion of solid bio-fuels to energy is quite a traditional human activity ï from the fire used in pre-historic times to modern cooking stoves, and electricity generation from biogenic residues burnt to generate steam for high-pressure-turbine power plants. Biomass gasification technology based on solid bio-fuels has become commercially viable in recent times for both - power generation and process heat applications in industry. Realizing the potential of gasification

technology to meet the distributed power energy and industrial applications for process heat in Small and Medium Enterprises (SMEs), a number of large projects are under implementation in several countries. Interestingly, the market introduction of such technologies in developing countries is far more rapid such as India than in industrialized ones.

Medium-to-large cogeneration using bio-fuels is already in the market, and could benefit from gasification developments, especially for industrial process heat, and on-site cogeneration. With ñhybridò schemes and ñbio-refineriesò for multiple outputs becoming available in the next decade, power and fuel markets might well overlap or even merge, allowing the bio-energy industry to optimize their outputs according to market development, and revenue opportunities. With the emerging bio- and thermo chemical conversion systems for bio-energy, the bio-energy power and heat sector will be coupled more closely to the transport sector. Indirectly, this will also couple the commodity prices for traditional agricultural and forestry products with the energy sector. This development would mean that the agro and forestry product industries will have to consider the developments in the bio-fuel markets far more closely, and then decide whether to become active in those markets. For this, there is a clear need of support for the decision making process, especially for SMEs.

Liquid Bio-fuels

Bio-ethanol and bio-diesel have emerged as dominating liquid bio-fuels on the global scale in replacing fossil fuels (i.e. gasoline and diesel) not only in the transport sector, but also with huge potential for heat and electricity generation. Bio-ethanol from biomass as a substitute for gasoline is currently the main bio-fuel globally as it has proven efficiencies, and established economics. Suitable biogenic feedstock contains high shares of sugar, or starch, which is catalyzed into simple sugars, and then fermented into ethanol. Sugar cane in particular stands as the feedstock that already provides a large amount of ethanol in Brazil. Other crops, which can be converted into ethanol, are cassava, maize, potatoes,

sorghum, sugar beet and wheat. The conversion of their starch content into sugar has a high process energy demand, so that the cost of the product is quite high.

Bio-diesel is an another important liquid bio-fuel: oilseed-yielding plants like castor, cotton, jatropha, palm, rape, soy, etc. offer a feedstock from which **S**traight **V**egetable **O**ils (SVO) can be derived by physical and chemical treatment (milling/refining). The SVO can then be processed further into **F**atty **A**cid **M**ethyl **E**sters (FAME), also known as bio-diesel. With respect to future market potentials, smaller-scale bio-fuel cogeneration systems with diesel engines using liquid bio-fuels (SVO or FAME) as inputs become attractive additional options, especially for stand-alone and mini-grid applications in developing countries as well as for ñgreenò electricity generation in industrialized nations. For developing countries, it is potentially valuable that bio-diesel can also be derived from plants such as Jatropha, which show comparatively low yields, but need only minor inputs so that their overall costs might be moderate if land and labour costs are low. Jatropha can also be grown on marginal and even degraded land, and needs only little irrigation during the first years.

Gaseous Bio-fuels

Development of Biogas has reached far beyond the mere fermentation of biomass residues like dung, liquid manure, or organic household wastes: nowadays, it can be derived from ñmodernò bio-energy crops such as maize (or corn), wheat, and even more interestingly from industrial wastes as well as from mixed or double cropping farming systems which can integrate various ñoldò plant varieties into their rotation, and give net energy yields comparable to the best palm oil, or sugarcane plantations. High rate bio-methanation process has been applied in many countries to obtain biogas from industrial wastes as well as from liquid municipal wastes for use on a commercial basis to generate power or process heat. India through its nation wide programme of biogas installations proved success of their technology

2.2 Bio-diesel: Indian Scenario

The country's energy demand is expected to grow at an annual rate of 4.8 per cent over the next couple of decades. Most of the energy requirements are currently satisfied by fossil fuels ï coal, petroleum-based products and natural gas. Since the beginning of this decade, India's oil import bill has grown tremendously. The total crude oil import in India grew from 74.09 Million Tons at a total cost of $ 12.9 Billion in 2000-2001 to 120.01 Million tons at the cost of $ 61.72 billion in 2007-2008. Currently India's imports are more than three quarters of the total oil consumed domestically, which also reflects the fact that the energy bill of the nation is growing alarmingly. Since oil prices are an important determinant of the economic performance of an import dependent county, the impact of growing prices are manifold. The bigger the oil-price increase and the longer and higher prices are sustained, the bigger the macroeconomic impact on the country.

To reduce the dependence on the imports of crude oil, India is aggressively promoting renewable energy. Renewable power has already contributed about 15000 MW to the power capacity in the country, which accounts for about 8% of the total installed capacity (Akshy *Urja, May-June 2009, MNES*). It is estimated that total capacity achievable from the renewable is over 85000 MW.

Bio-fuels are going to play an extremely important role in meeting Indiaôs energy needs. ñNational Mission on Biodieselò was launched in 2003 to address socioeconomic and environmental concerns. The launch was proposed in two phases: By 2006-07, Phase 1- Demonstration project. By 2011-12, Phase 2-Self sustaining expansion. At present biodiesel production is negligible and the results of this ambitious plans area waited.

Bio-diesel production efforts are focused on using non-edible oils from plants (*Jatropha curcas*, *Pongamia pinnata* and other tree borne oilseeds) and animal fats like fish oil. The focus is to encourage the use of wastelands and other unproductive land for the cultivation of these relatively hardy bio-fuel crops. The GOI wishes to avoid bio-fuel feedstock crop cultivation to compete with food

crops for scarce agricultural land and water. An estimated 55.3 million hectares are considered wasteland in India, which could be brought into productive use by raising bio-diesel crops. The GOI policy is also driven by the fact that bio-fuel crop cultivation in wastelands would provide additional employment to the vast rural population in India. Though there is some question as to the definition of ñwastelands" as some grazing or less intensive dry land farming may be considered brought under this category. According to the Economic Survey of Government of India, out of the total land area, about 175 million hectares of land is classified as waste and degraded land.

2.3 Advantages of Bio-diesel

Biofuels are seen as a more sustainable alternative to conventional petrol and diesel derived from fossil fuels because they come from renewable sources, which also absorb carbon dioxide (CO_2), although CO_2 will be emitted because of energy used in the harvesting and production process. Studies indicate that the overall CO_2 savings from biofuels compared to conventional petrol and diesel vary between 20% to 70% depending on the type of crop and the energy consumed in growing, harvesting, transporting and processing the crop into a fuel.

- Biodiesel is the comparatively very clean and environmentally friendly only alternative fuel
- Biodiesel runs in any conventional unmodified diesel engine. It can be stored anywhere that petroleum diesel fuel is stored.
- Biodiesel can be used alone or mixed in any ratio with petroleum diesel fuel.
- Studies have found that the lifecycle production and use of biodiesel produces approximately between 80-100% less carbon dioxide and almost 100% less sulphur dioxide emissions.
- Combustion of biodiesel alone provides over a 90% reduction in total unburned hydrocarbons and a 75-90% reduction in aromatic hydrocarbons.

- Biodiesel further provides significant reductions in particulates and carbon monoxide than petroleum diesel fuel.
- Based on Ames Mutagenicity tests, biodiesel provides a 90% reduction in cancer risks.
- Biodiesel is 11% oxygen by weight and contains no sulphur. The use of biodiesel can extend the life of diesel engines because it is more lubricating than petroleum diesel fuel while fuel consumption, ignition, power output and engine torque are unaffected.
- Biodiesel is safe to handle and transport because it is as biodegradable as sugar, 10 times less toxic than table salt and has a high flashpoint of about 125C compared to petroleum diesel fuel, which has a flash point of 55C.
- Biodiesel can be made from renewable oilseed crops such as soybeans, rapeseed, cottonseed and mustard seed and non-edible oilseeds.

Biofuels offers flexibility in use and decentralized production

2.4 Feedstock

There are many options for feedstock options for PPO/ SVO and biodiesel production. Besides dedicated oilseed crops such as e.g. mustered, rapeseed and soybean, also microalgae, animal fats and waste oil provide viable feedstock opportunities for fuel production. The choice for a dedicated feedstock is pre-determined by agricultural, geographical and climatic conditions. But it also has to be considered, that different feedstock types are characterized by different properties. For instance, the oil saturation and the fatty acid content of different oilseed species vary considerably. Biodiesel from highly saturated oils is characterized by superior oxidative stability and high cetane number, but performs poorly at low temperatures. Therefore, pure plant oil (PPO) with a high degree of saturation is more suitable as feedstock in warmer climates1.

1 WWI 2006 p. 26 (WWI (WORLDWATCH INSTITUTE) (2006): *Biofuels for Transportation, Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century).*

In India National Biodiesel Mission, formulated by the Planning Commission of the Government of India is the centrepiece of Indiaûs plans for biodiesel development and commercialization. The implementation of the project has two phases. In Phase I a demonstration project that was carried out between 2003-2007. The project was involved in the development of Jatropha oilseed nurseries, the cultivation of 400,000 hectares with Jatropha, the setting up of seed collection and Jatropha oil expression centres, and the installation of an 80,000 Mt/year transesterification to produce biodiesel from Jatropha oil. Phase II will consist of a self sustaining expansion of the programme leading to the production of biodiesel to meet 20 per cent of the countryûs diesel requirements by 2011-12.

2.5 Non-edible oil cops

India is home to more than 300 different tree species that produce oil-bearing seeds. It is estimated that the potential availability of non-edible oils amounts to about one million tons per year including *sal oil* (180 000 t), *mahua oil* (180 000 t), *neem oil* (100 000 t) and *karanja/ pongamia oil* (55 000 t) as the most abundant oil sources2 . These oil sources from non-edible plants are of special interest due to not directly concurring with vegetable oil for human food use and due to the fact that many plants can be grown in arid to semi-arid regions poorly suited for food crops. Non-edible oilseeds are not currently utilized on a large scale, but such oils can be an important component of local economies.

However, the present study focuses mainly on the **Jatropha Curcas**

2 KUMAR et al. 2003 in MITTELBACH & REMSCHMIDT 2004 p. 24

Chapter 3

Jatropha Curcas: Overview

Jatropha
Major cultivation regions: India, Myanmar, Mali, Philippines
Worldwide production in 2006: not known
Formerly used to make soap and candles, experts have identified this hardy plant from Central America as an efficient source of biofuel. Jatropha seeds contain up to 40 percent oil that can be burnt in a conventional diesel engine after extraction. The plant grows in difficult terrains, needs relatively little water, generates topsoil, and helps to stall erosion. A Jatropha bush lives for up to 50 years.

Jatropha or physic nut (Jatropha curcas) is one of 150 Jatropha species in the family of the Euphorbiaceae. It is an oilseed crop that grows well on marginal and semi-arid lands. The bushes can be harvested twice annually, are rarely browsed by livestock, and remain productive for decades. Jatropha has been identified as one of the most promising feedstock for large-scale biodiesel production in India, where nearly 64 million hectares of land is classified as wasteland or uncultivated land. It is also particularly well suited for fuel use at the small-scale or village level (WWI 2006).

The economic viability of biodiesel from jatropha depends largely on the seed yields. To date, there has been a substantial amount of variability in yield data for the plant, which can be attributed to differences in germplasm quality, plantation practices, and climatic conditions. In addition, due to absence of data from block plantations, several yield estimates are based on extrapolation of yields obtained from individual plants or small demonstration plots.

Several agencies promoting jatropha are projecting significantly improved yields as the crop is developed. In India, researchers estimate that by 2012, as much as 15 billion litres of biodiesel could be produced by cultivating the crop on 11 million hectares of wastelands. Further development and demonstration work is needed, however, to determine whether these levels of productivity are feasible.

3.1 Characteristics of Jatropha

Physical Characteristics	
Maturity fruiting	3 years onwards
Plants/hectare	2500
Seed/tree	2 kg avg (1 ï 4 kg)
Seed yield /hectare	1500- 5000 kg
Oil yield/hectare	500-1750 kg (30-40%)
Tree height	2 metre
Fruit Shell	Too thin(easy de shelling)
Physico chemical characteristics	
Sp. Gravity (15 °C)	0.918 ï 0.923 kg/l
Flash Point	191 ° C
Cetane Index	62 56.2
Sulphur %	0.014
FFA %	5.8 ï 7.5
Source: R. Mandal (2005): ñEnergy ï alternate solutions for Indiaõs needs: biodieselò, Adviser for the Planning Commission, Government of India, 2005	

3.2 Advantages of Jatropha:

- Easy to establish, grows quickly, hardy and require little care.
- It can grow in poor soils, in wastelands except flood prone and waterlogged areas.
- Reclamation of wasteland and degraded land is possible through its plantation. In fertile land it gives higher yields
- Plantation of Jatropha, oil extraction and nursery rising, can be rural based, hence promoter of rural economy besides ensuring energy security.
- It is suitable for preventing soil erosion including *Jhum fallows*.
- Jatropha is not a competitor of any crop rather it increases the yield.
- Due to *mycorrhizal* value in Jatropha roots, it helps in getting phosphate from soil boon for acid soil.
- Improves the soil fertility throughout their life cycle.
- Possesses medicinal as well as other multiple uses all parts of the shrub are used in traditional medicine and as raw material for pharmaceutical and cosmetic industries. The use of Jatropha oil in the production of soap in rural areas gives direct benefit, where as indirectly this will help to save edible vegetable oil.

- Generate net income for 30-35 years @ approx. Rs. 10,000 / ac/year from 4th year.
- Providing local jobs, lessening the need for local villagers to migrate to cities to find employment.
- Use of bio-diesel at the village level for operating oil engines for pumping water and operating small machinery are another good opportunity, which will be a boon to the farmers.

In India, *Jatropha curcas* is found in almost all the state and is generally grown, as a live fence for protection of agricultural fields from damage by livestock as cattle or goat does not eat it.

3.3 Agronomy

Soil and climate	• It is a tropical species and grows well in subtropical conditions. It can tolerate extremes of temperature but not the frost and water stagnation. It grows almost everywhere- even on gravely, sandy, acidic and alkaline soils having pH ranging from 5.5 to 8.5. It can thrive in poorest stony soils. The plant is undemanding in soil type and even does not require tillage.
Propagation	• Jatropha is usually propagated on mass scale by both seed as well as stem cuttings. For commercial cultivation, normally it is propagated by seeds. Well-developed plumpy seeds are selected for sowing. Before sowing, seeds are soaked in cow-dung solution for 12 hours and kept under the wet gunny bags for 12 hours. Hot and humid weather is preferred for good germination of seed. Germinated seeds are sown in poly bags of 15 x 25 cm size filled with soil, sand and farm yard manure in the ratio of 1:1:1 respectively. • Seeds or cuttings can be directly planted in main field. However, pre-rooted cuttings in poly bags and then transplanted in the main field give better results.
Seed rate	• For one-hectare plantation about 5 -- 7.5 kg seeds are required. Fruiting starts from 2nd year if propagated by stem cutting but it takes one year more while raised by seed.

Planting in field	• The land should be ploughed once or twice depending upon the nature of soil. In direct planting system, the seed/cuttings should be planted in the main field with onset of monsoon as a spacing of 3m x 2m. • In hilly areas where ploughing is not possible, after clearing jungles, pits of size 30 cm x 30 cm x 30 cm is dug at required spacing, refilled with top soil and organic manures (500 g FYM + 100 g Neem cake or Jatropha oil cake + 100 g super phosphate) and then planted. • Actual spacing will be determined based on end-use, soil quality / condition, humidity, rainfall, intercropping, etc.
Aftercare	• Two to three weeding are necessary; it does not require supplementary irrigation if planted in onset of rain. Jatropha is deciduous in nature and the fallen leaves during winter months form mulch around the base of the plant. The organic matter from fallen leaves enhances earthworm activity in the soil around the root zone of the plants, which improves the fertility of the soil. • Light harrowing is beneficial during early growth stage. Pinching the terminal is essential at six months age to induce laterals. Application of GA @ 100-PPM spray induces early flowering and capsule development
Canopy management (Pruning and trimming)	• To give a bushy shape the plant should be trimmed during spring (Feb-March) up to 5 years including one pruning when the plants attains 1.5 m height. • The terminal-growing twig is to be pinched to induce secondary branches. Likewise, the secondary and tertiary branches are to be pinched or pruned at the end of first year to induce a minimum of 25 branches at the end of second year. Once in ten years, the plant may be cut leaving one foot height from ground level for rejuvenation. The growth is quick and the plant will start yielding in about a year period. This will be useful to induce new growth and yield stabilization there on.

Manuring	• At the time of planting compost @ 2 kg /pit should be applied. Afterwards depending on soil type manuring @ 3-5 kg/plant along with and NPK should be applied near the crown following ring method before monsoon. • In general application of super phosphate @ 150kg/ha and alternate with one dose of 20 : 120 : 60 kg NPK/year from second year improves yield. From 4th year onwards, 150 kg super phosphate should be added to the above dose.
Diseases	• Collar rot may be the problem in the beginning that can be controlled with 0.2% COC or by application of 1 % Bordeaux mixture drenching.
Harvesting	• The flowering is induced in rainy season and bears fruits and matures in winter. Pods are collected when they are turned yellowish and after drying seeds are separated mechanically or manually. • Economic yield starts from third year-end. • The dried pods are collected and seeds are separated either manually or mechanically. Seeds are dried for 4-5 days to reduce moisture level 10% before packing.
Economic life	• The economic life of Jatropha is 35-40 years. The plant survives up to 50 years if root zone does not come in contact with rising water table and continues for longer time.
Yield	• There will be about 1675 plants /ha at 3m x 2m spacing. Grown up Jatropha from 6th year onwards yield 3-6 kg per plant under good management. The average productivity can be projected between 1500- 6500 kgs/ ha

Source: from various published information on Agronomic practices for Jatropha cultivation http://www.svlele.com/jatropha_plant.htm, http://www.jatrophaworld.org, http://www.tnau.ac.in/tech/swc/evjatropha.pdf

JATROPHA CROP- CALENDAR	
Propagation	
Nursery raising	FEB - MARCH, SEP - OCTOBER
Direct seedlings	After Good Rainfall
Transplanting of pre-cultivated saplings	FEB - APRIL, In Monsoon Months
Direct Planting by Stem- Cuttings	2 Months before Monsoon
Manuring	On transplantation and after a year
Pruning	In March- May
Flowering	May / Sept.

Fruiting	July- November
Harvesting	Aug- December(N. India)
Seeds Storage	15 Months

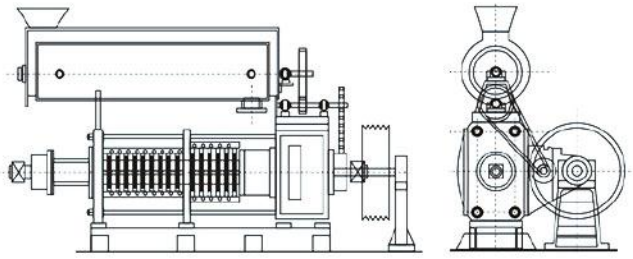
3.4 Bio diesel production process from Jatropha Oil

Today, mainly oil from plant sources, which are exclusively harvested, for biofuels production (oil crops) is used for biodiesel processing. Following steps are involved in the biodiesel production.

⬇ **Harvesting:**

Pods are harvested manually from the plant. These pods are then sun dried for 2-4 days to reduce the moisture content. The pods are then thrashed to remove the outer coating and remove the seeds. These seed are then cleaned, sorted and bagged. The seeds are either transported directly to the oil mill or stored first. The first process step of biofuel production then is the oil extraction, which can be done by several means.

⬇ **Oil Extraction**



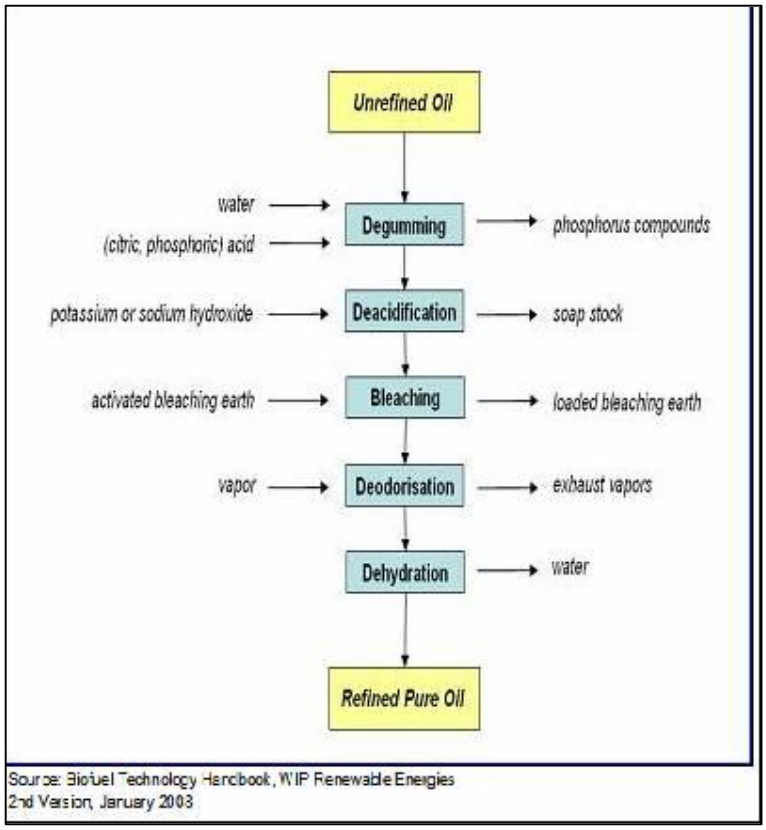
The oil extraction of the feedstock is the first process step of both PPO and biodiesel processing. Regarding the scale of production and the infrastructure, there are two fundamental production process types for vegetable oils:

- **Industrial**: centralized production by refining in large industrial plants
- **Small scale pressing**: decentralized cold pressing directly on farms or in cooperatives

In **small scale, cold pressing** facilities the cleaned oil seeds are exclusively mechanically pressed at maximum temperatures of 40 ºC. Suspended solids are removed by filtration or sedimentation. As a co-product, the press cake is left with a remaining oil content of usually over 10 %, which is used as a protein-rich fodder

Industrial **large-scale plants t**he process of oil extraction for other oilseed crops is similar. Some process steps are added or modified. Nevertheless, the final product is always unrefined oil. After refining, which is described below, the plant oil can be directly used as PPO and to be used as biodiesel it has to be transesterificated.

⬇ Oil Refining



Source: Biofuel Technology Handbook, WIP Renewable Energies 2nd Version, January 2003

The refining process is an important treatment of creating PPO and of preparing vegetable oil for the transesterification process of biodiesel. It is important in order to remove undesirable substances, such as phosphatides, free fatty acids, waxes, to copherols and colorants. These substances can alter oil storage life and hamper further processing. During this first refining step, the oil mass (4 to 8 %) and the solvent contents are reduced.

Since the refining process depends on the vegetable oil quality, the refining steps depend on the feedstock source. There also exist alternatives of refining and some refining steps are merging. Simplified process chart is shown in the chart.

- **Degumming**: The first purification step of oil refining is the removal of phosphatides, also known as **degumming**. This is necessary as phosphatides make the oil become turbid during storage and as they promote the accumulation of water

- **Deacidification** The second refining step is the **deacidification**. It is an important step for edible oils as the development of rancid flavours of free fatty acids (FFA) are prevented. The content of these FFAs in unrefined pure oil is between 0.3 and 6 %. In this step also phenol, oxidized fatty compounds, heavy metals and phosphatides are removed. The purification of all these substances is not only important to edible oils, but also to fuel production as these compounds alter storage life and influence transesterification in the biodiesel process.

- **Bleaching**: In the third step **bleaching**, colorants are removed. This process step enhances storage life of the biofuel. Bleaching is mainly conducted by adsorbing substances, such as bleaching earth, silica gel or activated carbon. In addition, oxygen, ozone, hydrogen peroxide and heat (200°C) can be used for bleaching.

- **Deodorization:** In the forth step **deodorization** odorous substances (ketone, aldehyde) are removed by steam distillation.

- **Dehydration:** Finally, a **dehydration** step has to be conducted, as traces of water may decrease conversion in the transesterification process of biodiesel production. The removal of water is either accomplished by distillation under reduced pressure or by passing a stream of nitrogen through the fatty material

⬇ Transesterification:

This process changes the molecular structure of lipid molecules and thus the physical properties. Although even refined pure plant oil (PPO) can be directly used in refitted diesel engines, biodiesel, which is created by a transesterification step, is very similar to fossil diesel and thus can be consumed in common diesel engines which are refitted with only small efforts.

Transesterification is also called **alcoholysis**, is the process by which the refined oil molecule is ñcrackedò and the glycerine is removed, resulting in glycerine soap and methyl or ethyl esters (biodiesel). Organic fats and oils are triglycerides which are three hydrocarbon chains connected by glycerol. The bonds are broken by hydrolyzing them to form free fatty acids. These fatty acids are then mixed or reacted with methanol or ethanol forming methyl or ethyl fatty acid esters (monocarbon acid esters).

The mixture separates and settles out leaving the glycerine on the bottom and the biodiesel (methyl-, ethyl ester) on the top. Now the separation of these two substances has to be conducted completely and quickly to avoid a reversed reaction. These transesterification reactions are often catalyzed by the addition of an acid or base.

For the transesterification process, mainly the alcohols methanol and ethanol are used. Theoretically, transesterification can be also processed with higher or secondary alcohols.

Considering wide variety of oils and fats that can be used to produce biodiesel, there is a greater range in the characteristics of biodiesel fuels than for ethanol fuel. Ethanol is actually one very specific molecule, whereas biodiesel is a mix of molecules that varies somewhat, depending on the initial oil or fat source used to produce the fuel.

Chapter 4

Bio-diesel Orissa

4.1 Socio-Economic Background:

Orissa is one of the poorest State of India. It is located between the parallels of 17.49N and 22.34N latitudes and meridians of 81.27E and 87.29E longitudes. It is bounded by the Bay of Bengal on the east, Chhatishgarh on the west and Andhra Pradesh on the south. It has a coastline of about 450 kms. It extends over an area of 155,707 square kms., accounting about 4.87 of the total area of India. According to the census of 2001, the total population of Orissa is 36,706,920 persons, comprising of 18,612,340 males and 18,094,580 females

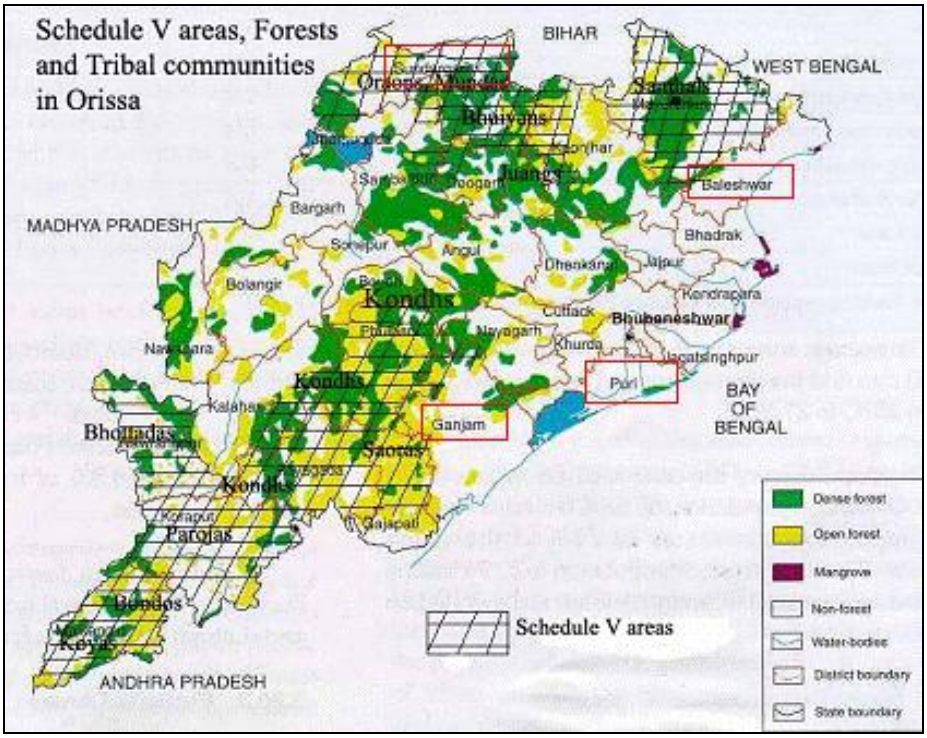


Figure 4.1 Socio-economic backgrounds

Tribal areas in Orissa are some of the most backward and poverty ridden areas in the country. It is also extremely resource rich state. 71% of the tribal households in Orissa live beneath poverty line. Scheduled Tribes, which constitute 22% of Orissaôs population are the most marginalized and poor social

group in the state, with over 72% living under the poverty line. Though land & land based resources are central to the livelihood of the tribal people, they have poor access to land and forests.

4.2 Agro-climate & Wastelands:

Orissa has 10 agro-climatic zones: North Western Plateau, North Eastern Plateau, North Eastern Coastal Plain, North Eastern Ghat, Eastern Ghat Highland, South Eastern Ghat, Western Undulating Zone, Western Central Table land, Mid Central Table Land.

Table 4.1 Characteristic of Agro-Climatic Zones of Orissa

S.No.	Agro-climatic Zone	Agricultural Districts	Climate	Mean Annual Rainfall (mm)	Temp (°C) Max	Temp (°C) Min	Broad Soil groups
1	North Western Plateau	Sundargarh, parts of Deogarh, Sambalpur & Jharsuguda	Hot & moist sub-humid	1600	38	15	Red, Brown forest, Red & Yellow, Mixed Red & Black
2	North Central Plateau	Mayurbhanj, major parts of Keonjhar, (except Anandapur & Ghasipura block)	Hot & moist sub-humid	1534	36.6	11.1	Lateritic, Red & Yellow, Mixed Red & Black
3	North Eastern Coastal Plain	Balasore, Bhadrak, parts of Jajpur & Hatdihi block of Keonjhar	Moist sub-humid	1568	36	14.8	Red, Lateritic, Deltalc alluvial, Coastal alluvial & Saline
4	East & South Eastern Coastal Plain	Kendrapara, Khurda, Jagatsinghpur, part of Cuttack , Puri, Nayagarh & part of Ganjam	Hot & Humid	1577	39	11.5	Saline, Lateritic, Alluvial, Red & Mixed red & Black
5	North Eastern Ghat	Phulbani, Rayagada, Gajapati, part of Ganjam & small patches of Koraput	Hot & moist, sub-humid	1597	37	10.4	Brown forest, Lateritic Alluvial, Red, Mixed Red & Black
6	Eastern Ghat High	Major parts of Koraput,	Warm & humid	1522	34.1	7.5	Red, Mixed Red & Black,

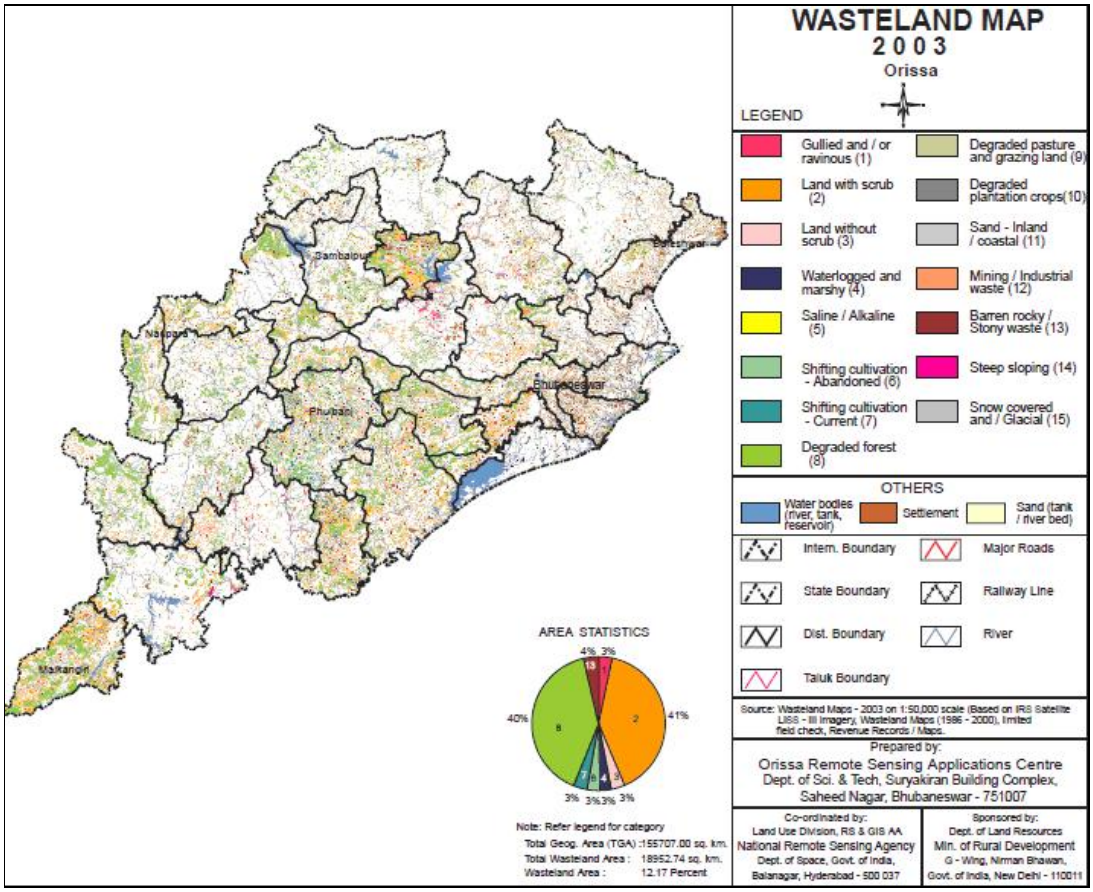
	Land	Nabarangpur					Mixed Red & Yellow
7	South Eastern Ghat	Malkangiri & part of Keonjhar	Warm & humid	1710	34.1	13.2	Red, Lateritic, Black
8	Western Undulating Zone	Kalahandi & Nuapada	Hot & moist sub-humid	1352	37.8	11.9	Red, Mixed Red & Black and Black
9	Western Central Table Land	Bargarh, Bolangir, Boudh, Sonepur, parts of Sambalpur & Jharsuguda	Hot & moist sub-humid	1614	40	12.4	Red & Yellow, Red & Black, Black, Brown forest, Lateritic
10	Mid Central Table Land	Angul, Dhenkanal, parts of Cuttack & Jajpur	Hot & moist sub-humid	1421	38.7	14	Alluvial, Red, Lateritic, Mixed Red & Black
Source: Agriculture Statistics Orissa							

It is evident from the above table that all these agro-climatic zones are suitable for the cultivation of the Jatropha. Temperature in the entire region is between 12 to 40 ^{0}c, which is ideal for the growth of Jatropha except in Eastern Ghat High Land (Major parts of Koraput, Nabarangpur) where especially in winters temperature drops down to 7.5^{0}c. Rainfall is very adequate as well, the soils are well-drained helps further to suitability for the jatropha plantation. Jatropha (locally called *sabun butta* plant / Soap plant) is traditionally grown as hedge in field or abundantly found growing particularly in barren and wastelands, etc. in Orissa.

Orissa has over 2 million ha of land categorised as waste / barren land, which accounts 13.1 % of states geographical area. This land could be effectively brought under Jatropha cultivation. Following table 4.2 gives details of the districts wise wasteland availability for the cultivation of the Jatropha.

Table 4.2 Geographical Area & Wasteland Profile of Orissa				
S.N.	**District**	**Geographical Area (sq Km)**	**Total Wasteland (sq Km)**	**% of total geographic area**
1	Keonjhar	8303	1246.04	15.0
2	Cuttack	11142	768.53	6.9
3	Puri	10188.75	1751.85	17.2
4	Sambalpur	17516	941.58	5.4
5	Sayurbhanj	10418	779.21	7.5
6	Dhenkanal	10834.47	1535.41	14.2
7	Sundirgarh	9675	1148	11.9
8	Balasore	6311	218.42	3.5
9	Balangir	8915.52	1278.42	14.3
10	Kalahandil	11772	1241.47	10.5
11	Ganjam	12531	4310.84	34.4
	Total	**117606.74**	**15416.81**	**13.1**

Apart from the identified wastelands, huge areas under degraded forests can also be brought under plantation of oil seed bearing plants are also available in the State where such cultivation can be taken up. As per Orissa Remote Sensing Application Centre, of the total wastelands in the state 40% is considered as a degraded forest land and 41% as land with shrubs (see map below).



In addition, it is possible to cultivate oil seed bearing trees in JFM mode on field boundaries, tank bunds, fences etc.

4.3 Potential of Bio-diesel Production

Government of Orissa has chalked out detail plan for the energy plantation and bio diesel production. According to the Department of Science & Technology, Government of Orissa, it has been estimated that

- The current bio-diesel production potential of the State has been estimated at approximately 1000 Kilo Litres (KL) per annum.
- With further utilization of about 30%, wasteland of the State the production is likely to increase up to 14000 KL per annum.

To achieve this, state government plans to target about 2 million hectares of land available under the categories of barren and uncultivated land and fallow lands

and areas of degraded forests available in the State. Moreover, farmers will be encouraged to raise energy plantations along the fence of cultivated lands, and on marginal and degraded lands coming under common land, wasteland, canal and tank bunds, degraded forests, along the railway tracks, highways.

State government also planned for allocation of land will be made as per prevailing Acts of the Revenue Department under Orissa Land Reforms/Orissa Prevention of Land Encroachment Act/Orissa Government Land Settlement Act to self-help groups and others. *Van Suraksha Samittees* may also raise energy plantations in forest and degraded forest land as per their approved JFM plans.

Quantification of Benefits of Bio-diesel production:

- Total expected production: 14000 KL per annum
- Utilization of wasteland: 0.6 Million Hectares
- Employment generation: 100 million man days
- Additional organic manure: 42,000 tones

Government bodies like WORLP, OTELP, Water shed Mission, DRDAs, ITDAs etc, will be given priority to take-up promote various promotional activities for plantation.

4.4 Feasibility and Potential of Jatropha

Bio-diesel has the potential to provide a reliable and a cost effective alternative to Indiaôs increasing future energy concerns. India is the world most populous country and with economic development on full throttle, meeting energy requirement in a sustainable manner is a major challenge for the country. India produce only about 30% of its annual crude requirement while for the remaining 70%, the country is dependent on imports. There is an immense potential for Jatropha cultivation in the country. At the national level, producing more bio-fuels will generate new industries, new technologies, new jobs and new markets. At the same time, producing more bio-fuels will reduce energy expenditures and allow developing countries to put more of their resources into health, education and other services for their neediest citizens.

Bio-diesel system is a multi-stakeholder system, consisting of oilseeds cultivators, processing (extraction & trans-estrification) industries, bio-diesel

marketing companies and end-users. All these have to be in balance in terms of viability, costs and prices alternatives that each stakeholder has to do other things with their resources.

The output of each stakeholder should meet requirement of the next stakeholder in the value chain on a sustainable basis in a timely and socially viable manner. This is the key to feasibility and success of Jatropha based Bio-diesel production and consumption. Thus stakeholder profile, dynamics and interdependence and role of government will be analyzes in the study.

Land: If the soil water holding capacity is high, if the drainage is poor, if the water is lying in the land for a long time in any season it will works negatively on Jatropha growth. It flourishes well in the soils where water holding is very less. It is estimated that there is wasteland of about 18 lakh hectare in Orissa where no cropping is possible due to degradation, undulating, eroding and less fertility status of the land. The soil characteristics of the wastelands indicate that these are either acidic or alkaline in nature, with less humus, course, and low water holding capacity where there is a less possibility to raise any crops. Topography is undulating offers restrictions for the cultivation of the normal agriculture operations and the cultivation of the crops.

Apart from the types of land, sizeable lands are belong to landlords and high profile persons who are not mindful to take up any type of seasonal cropping due to various reasons. Apart from other category of farmers, the lands are also belonging to tribal small and marginal farmers who are mostly engaged in collection of forest produce and paddy cultivation. They have also little interest to have seasonal cropping in those lands. All these lands are suitable for Jatropha plantation

Climate: The rainfall pattern of Orissa indicates that the rain in erratic and inadequate in many parts of the state discourages normal agriculture activity. Jatropha needs warm and dry climate therefore; such climatic

factors are quite suitable for the jatropha plantation given its sturdy nature and adoptability in wide range of soil types.

4.5 Government Initiatives[3]:

Orissa State Government has decided to take up jatropha plantation on a massive scale under the National Rural Employment Guarantee Scheme (NREGS). The Panchayati Raj Department, the nodal agency for implementation of the NREGS, has been asked to prepare an action plan on jatropha plantation in consultation with the Science and Technology Department and issue necessary instructions to the district rural development agencies (DRDAs) for chalking out district level plans. Whether jatropha plantation can be taken up in private land under NREGS will be known once modalities of the programme are finalised, said a senior Government officer. Even though Government had approved Rs 5 crore proposal of the Science and Technology Department for jatropha plantation and bio-diesel production in KBK region, the project is yet to take off.

The Government had targeted a plantation over 1,500 hectares during 2007-08. However, the programme did not materialise due to lack of response from commercial financial institutions. Commercial banks are still not forthcoming to finance jatropha cultivation, as they consider the project not economically viable, official sources said[4].

Orissa Renewable Energy Development Agency (OREDA) also announced ñThe Energy Plantation and Bio-diesel Productionò (EPBP) Program during 2007-08 following announcement of relevant policy guidelines by the State government. A total financial provision of Rs 498 lakhs (200 lakhs under RLTAP, 100 Lakh under State Plan and 198 lakhs under MoRD, GOI funds) was made during the year for implementation of various components of the program covering,

3 Policy Guidelines for raising of Energy Plantations and Bio-diesel Production, The Orissa Gazette, extraordinary published by authority no. 1487 Cuttack, Government of Orissa Science & Technology Department

4 source: Express Buzz, Jatropha cultivation under NREGS planned Express News Service, 05 May 2009 http://www.expressbuzz.com

4.5.1 **Information, Education and Communication (IEC) activities:**

This is primarily a confidence building exercise under which District and Block level workshops are being organized to make different government functionaries, NGOs/ CBOs, leading farmers as well as public aware about the program, its objectives, implementation methodologies, policy framework, support services etc. So far, 16 District level and 120 Block level workshops have been organised in 16 different districts and proposed to organise 4-district level and 40 Block level workshop in the newly adopted districts of Jharsuguda, Bargarh, Dhenkanal and Puri

4.5.2 **Allocation of wasteland:**

Waste land in suitable agro-climatic zones will be identified by concerned Government functionaries and allotted for the purpose of cultivation of oil seed bearing trees to different categories of beneficiaries as under

- Individual farmers : 2.5 hectare per beneficiary belonging to BPL categories
- Groups: SHGs/ VSS/ Bhumi Panchayats/ Other recognised farmers groups etc. : 25 hectares per group

Allocation of land will be made as per prevailing Acts of the Revenue Department under OLR/OPLE/OGLE.

Van Suraksha Samittees with due permission of the forest Department may also raise oil seed bearing tree plantations in forest and degraded forest lands. In such cases, the quantity of land to be allocated per VSS may be decided by the forest department. The above arrangement, however, does not prevent others to grow plantation on their own land.

4.5.3 **Rising of Plantations**:

Rising of Bio-diesel crop plantations is the most tangible and important activity under the entire program. Although it is claimed by several organizations that huge plantations of Jatropha have been raised through their efforts in different parts of the State, During 2007- 08 following meticulous verification only some

312 acres of plantation would only be supported under the free seedling program of MoEF.

During the current year, it is proposed to support 15000 Acres of *Jatropha curcas* plantation under the subsidy scheme. The district wise break up of targets for raising *Jatropha curcas* plantations during FY 2008-09 (Table: 4.3).

Table 4.3: District-wise target for raising Jatropha plantations during Financial Year 2008-09.

S/N	District	Target (Acres)				Availability of funds (Rs. Lakh)		
		For coverage under State Plan	For coverage under Central Plan (RLTAP)	For coverage under SCA (RLTAP)	Total	Under State Plan	Under Central Plan	Under SCA(RLTAP)
1	Balangir	0	275	1350	1625	0	15	78.75
2	Koraput	0	275	1350	1625	0	15	78.75
3	Kalahandi	0	275	1250	1525	0	15	72
4	Malkangiri	0	170	0	170	0	9	0
5	Nuapara	0	120	0	120	0	6	0
6	Nabarangpur	0	225	1000	1225	0	12	56.25
7	Rayagada	0	250	1100	1350	0	13.5	63
8	Sonepur	0	120	580	700	0	6	33.75
9	Angul	200	0	0	200	12	0	0
10	Balasore	200	0	0	200	12	0	0
11	Ganjam	200	0	0	200	12	0	0
12	Kandhamal	200	0	0	200	12	0	0
13	Keonjar	200	0	0	200	12	0	0
14	Mayurbhanj	200	0	0	200	12	0	0
15	Sambalpur	200	0	0	200	12	0	0
16	Sundergarh	200	0	0	200	12	0	0
17	Jharsuguda	250	0	0	250	12.5	0	0
18	Bargarh	250	0	0	250	12.5	0	0
19	Dhenkanal	250	0	0	250	12.5	0	0
20	Puri	250	0	0	250	12.5	0	0
Total		**2600**	**1710**	**6630**	**10940**	**146**	**91.5**	**382.5**

Source:OREDA

4.5.4 Financial incentives:

- **Support price of oil seeds:**

  In order to facilitate farmers to sell their oil seeds, State Government shall fix up remunerative support prices for purchase of different oil seeds suitable for production of Bio-fuels.

- **Incentives for raising commercial plantations:**

For raising commercial plantations different categories of cultivators can avail financial assistance under back ended credit linked subsidy programme of National Oilseed and Vegetable Development (NOVOD) Board under the Ministry of Agriculture, Government of India. (Annex-I)

For cultivation of oil seed bearing trees at present subsidy @ 30% subject to the benchmark cost of Rs 30,000/- per hectare is available under the NOVOD guidelines. The pattern of assistance is 30% subsidy, 50% bank loan and 20% beneficiary share

Establishment of model seed procurement centre & Installation of pre-processing and processing equipments Quantum of assistance - Subsidy restricted to 30% of project cost with the ceiling as under:- i) Government/Semi Govt Organizations, Co-operative institutions, Federations, Corporations etc. : 4 projects with a ceiling of Rs.25.00 lakhs ii) NGOs/VOs/Individual ï One project with a ceiling of Rs. 6.50 lakhs

4.5.5 Setting up of pilot scale Bio-diesel production Units:

The Orissa forest development corporation has installed one integrated Biodiesel plant starting from extraction to trans-esterification at satyanagar, Bhubaneswar in year 2007 to demonstrate complete process.

Although this component was available during 07-08 not a single unit could be established due to lack of information on current availability of different tree borne oils. Now with the availability of such information it is proposed to establish 20 pilot projects during 2008-09 in 20 districts at a total financial out lay of Rs. 155.00 lakhs. Eligible entrepreneurs shall be entitled to subsidy as per the special package offered under Self Employment Programme implemented by the Industries Department. Such special package allows 15% capital subsidy and 3% interest subsidy.

4.5.6 Procurement of oil seeds:

Although funds had been apportioned during 2007-08 to procure oil seeds from farmers at the support price fixed by Government so far no seeds have been procured. During the current year 2008-9, it is proposed to procure non-edible oil seeds of various types including Jatropha curcas through the District Renewable Energy Cells of OREDA.

For such procurement, it is proposed to have a total financial out lay of Rs 15.00 lakhs for procurement of about 300 tons of seeds, which will be used for demonstration in the pilot trans-esterification units.

4.6 Private Initiatives:

Organisation like Orissa Nature Care Council Action, who is quite active in the promotion of jatropha has successfully covered over five thousand acres of Jatropha plantation across the state until the end of 2007 and planning to cover 150500 acres of area under Jatropha plantation by year 2015.

Corporate like, Mission New energy has announced to take up jatropha plantation in a big way. The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery to be established in Orissa. There are number of private players who are active in the state to raise the Jatropha plantation, but there are no confirmed figures for the actual scale of plantation.

4.7 Present status of Jatropha Plantation in the state:

It is difficult to assess the actual Jatropha plantation in the state. There are number of players in operation, like State government, Private operators and NGOs. Jatropha plantation in Orissa is very recent, most of plantation activity was initiated in late 2007. The most notable player in the promotion of Jatropha plantation in the state is The Orissa natural Care Council Pvt. Ltd (ONCC)[5]. ONCC with the support of OREDA and other governmental agencies has

5 http://onccworld.com/ot.htm

planned to promote Jatropha cultivation by over 1.5 lakh acres by year 2013. By 2009 total area planted by them is over 10000 acres.

To understand the impact of ongoing plantation activities in the state, detailed survey was conducted in three district of the state covering 18 villages. Following is the list of villages covered,

ORISSA STATE

Total Numbers of village covered: 18

District: Ganjam
Tahori
Kulada
Sana gopalpur
Talpada
K. Nuapally
Kanchana
Haripur
Tamanda
Nabagacha
District : Kalahandi
Manikera
M. Rampur
Nuagaon
Sindhiguda
Penjikupa
Bajamunda
Gandapadar
District: Raigada
Suri
Senpadia

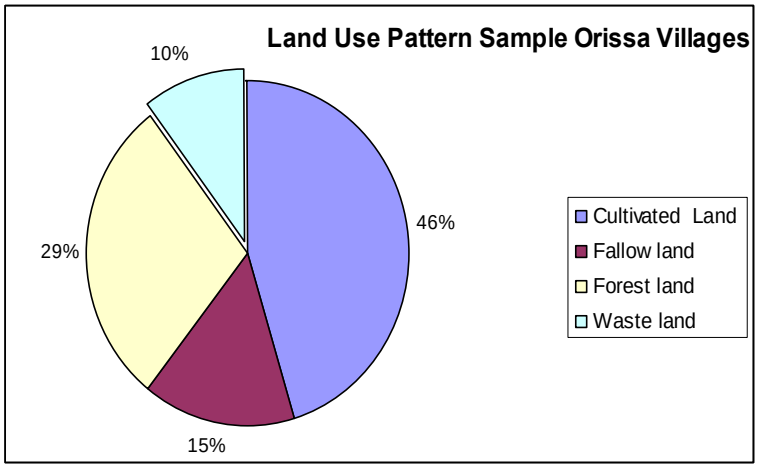
4.8 Survey Findings:

Jatropha, plantation activity is very recent in Orissa, most of the plantation has been taken place from year 2007. Following are the findings of the survey conducted to understand the ground realities of the Jatropha plantation

4.8.1 Land Use:

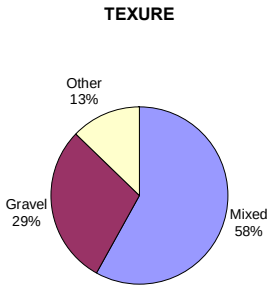
As per the survey, it was observed that around 10% of the land in most of the villages is as waste land. This land is mainly used for the jatropha plantation these villages. However, some of the farmers also used fallow land which they though not good for the agriculture. Most of these lands are located away from

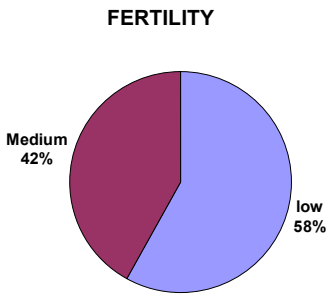
the village or near to the boundary of forest. These lands are mostly undulating. Soils of these lands were found to be of lateritic origin with less humus content and reddish in colour.

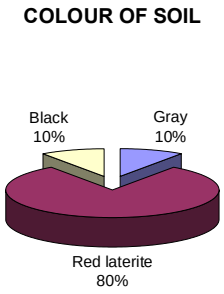


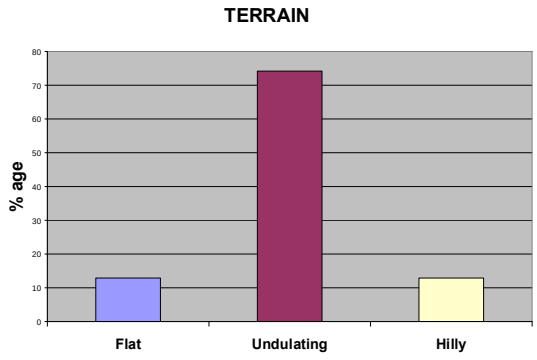
The issue of conflict of grazing lands vs. jatropha plantation need better understanding. Many of these wastelands were used for the grazing of cattle. However, after plantation these lands may not be suitable for grazing and may add pressure on the adjacent forests

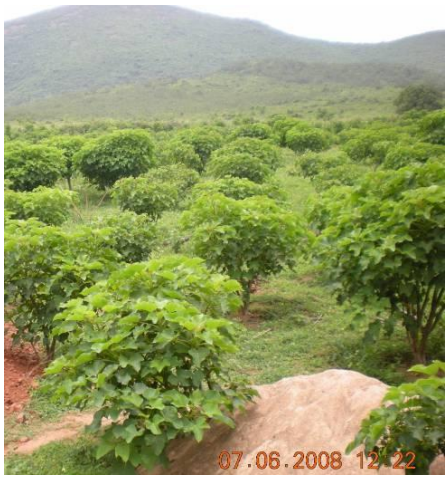
4.8.2 **Soils:**











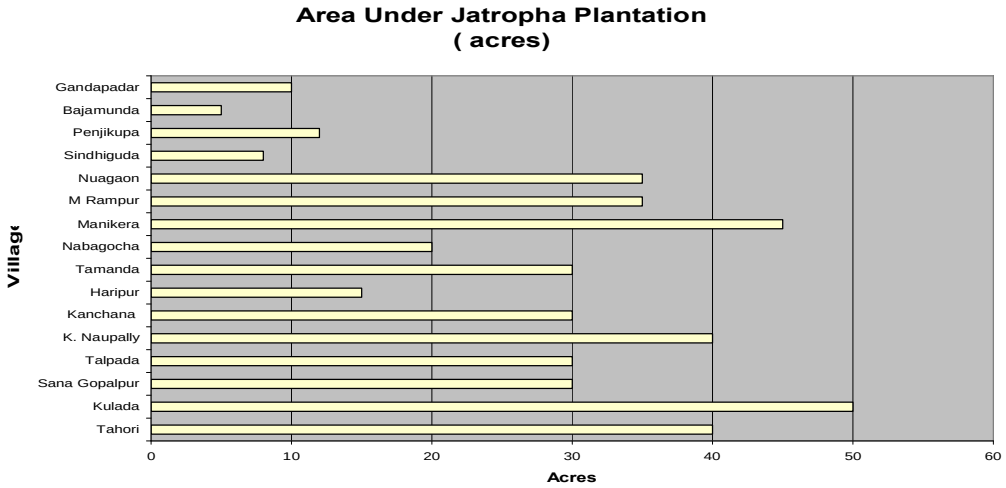
The entire plantation is on the uncultivated agriculture land or the waste land. Above graphs shows that the texture, fertility status (as viewed by farmers), colour of the soil and the terrain on the type of land Jatropha is cultivated by farmers. It is observed that these soils are quite well suited for the jatropha plantation.

4.8.3 Plantation:

Jatropha plantation is fairly new in Orissa. It was the first experience of the villagers and farmers. The entire plantation in the selected villages was carried out at the Culturable waste lands.

On an average, each farmerôs has planted around 2000 sapling, which account to around 2 acres of the land. The entire plantation was carried out in year 2008. These saplings were provided by the promoting agency. Often the problems related to timely supply was reported by farmers. The average growth recorded by year two was around 2.5-5 feet, with stem girth measuring 3-4 inches with around 4-6 branches. Some flowing and pod formation is observed but not substantial.

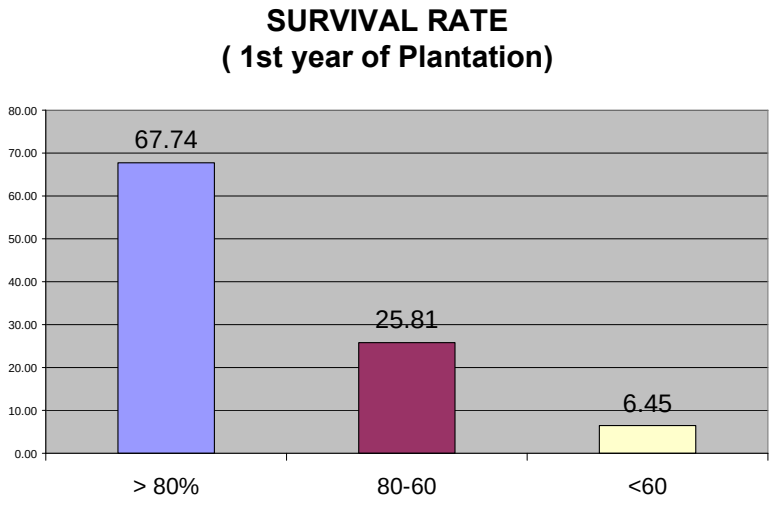
It has been observed that area planted per village varies from 5- 50 acres. Villages in the Ganjam districts have highest area under plantation average out to be around 31 acres per village for sample villages**.** Following graph shows the village wise area under jatropha plantation.



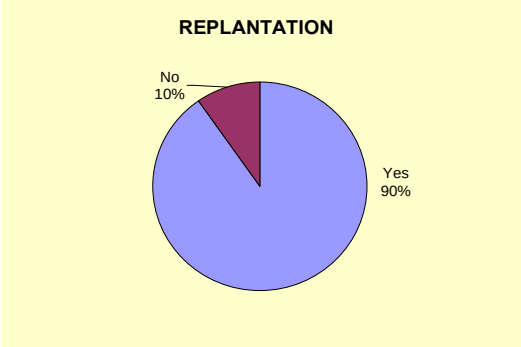
On contrary to other districts, the area per village is low. Higher plantation area in the districts Ganjam was due to the sustained efforts of ONCC who is actively promoting jatropha plantation in the state

4.8.4 Survival rate:

Survival rate during the first year of plantation was good. 68% of all the farmers reported that survival rate was above 80% for the first year of plantation , 26% farmers reported between 60- 79%, and only 6.5% of the farmers said that survival was



below 60%. The reason for the low survival (below 60%) is mainly for the plantation which was planted during the dry spell of monsoon and late plantation and those on the hilly slopes, where water retention of the soil was less. Some farmers also complained that due to poor quality of the saplings provided affected survival rate. Some of the villagers reported that some farmers kept plants long time in the bags and planted afterwards affected survival.



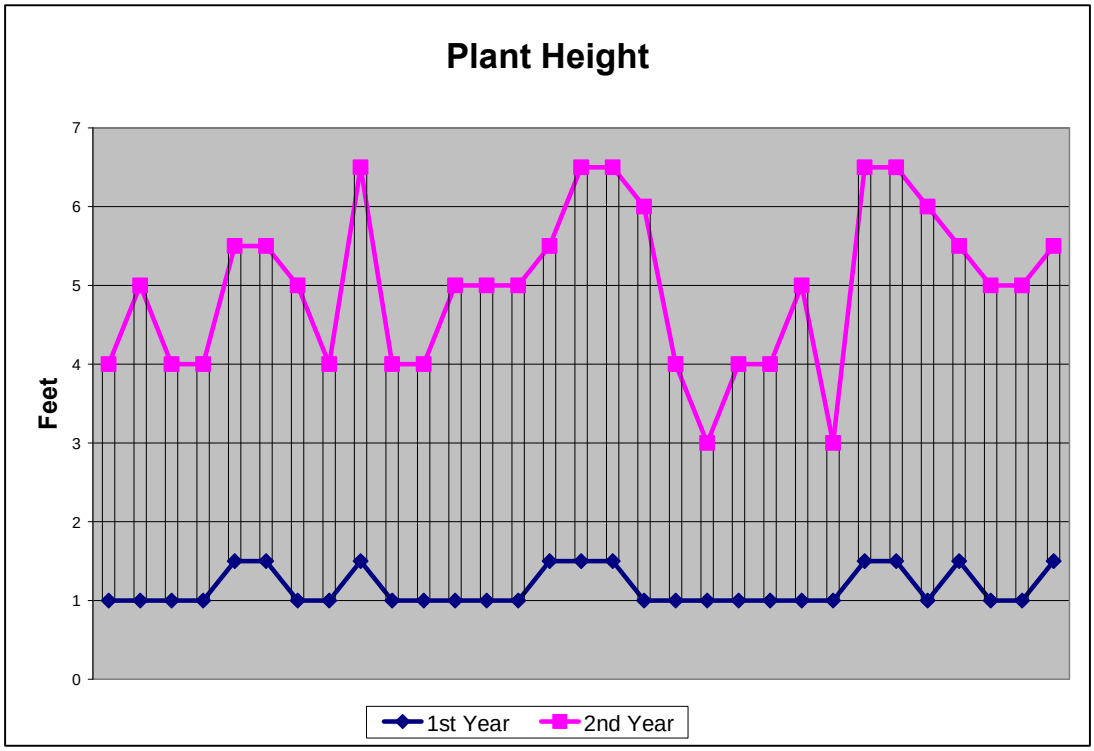
However, it was quite interesting to note that 90% of the farmers carried out re-plantation in the same year to replace the dead plants. This has ensured better utilisation of the land mass and high plant population which would help in better yield. Only, 10% of the farmers did not carry out re-plantation for varying reasons, these are

1. Low survival: Lost interest in replanting
2. Non availability of the sapling: Saplings were not available when they decided to carry out replacement of the dead plants
3. No money

The survival rate observed after 2nd year was around 75%. No gap filling was carried out in the second year. No irrigation was provided and grown as rainfed crop. Climatic conditions are quite suitable for Jatropha, even off- monsoon showers helped in growth of this crop. Soils are also suitable they are well-drained laterite soils, devoid of water logging which is deterrent for the jatropha.

4.8.5 Growth Performance:

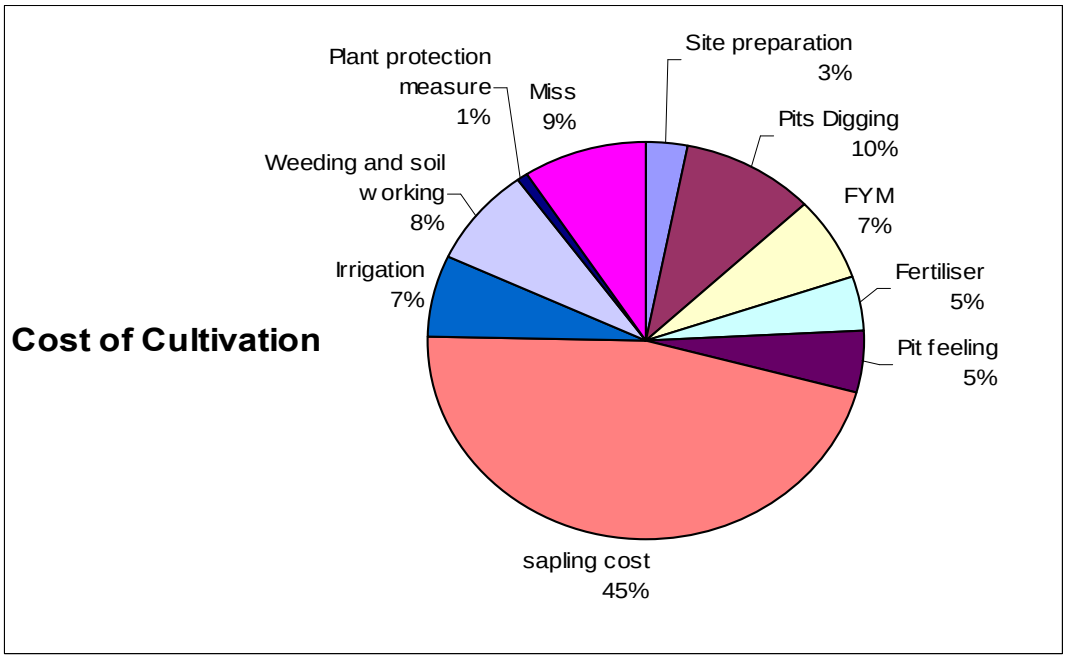
Average plant height noticed was around 1-1.5 feet, Good 2nd year growth was



observed at most of the farmers land except those planted on the low fertility and hilly lands. Some of the plants attend height of 6 feet within two years. Stem girth reported were between 3-6 inches with 3-6 major branches. Overall growth performance is satisfactory. Though flowing and pod formation was reported only few seeds were harvested. Around 10% of the farmers reported that they harvested some seeds ranging from 5 to 20 kg /acre. Since, it is early stage of growth; this could not be weighted against the yield performance. It would take another two years to estimate actual yield under this condition

4.8.6 Cost of cultivation

The cost of cultivation of Jatropha varies depending upon location, geographical area, availability of inputs etc. The cost of plantation of Jatropha is estimated to be Rs. 12000 per acre. Break-up of the cost is given below,



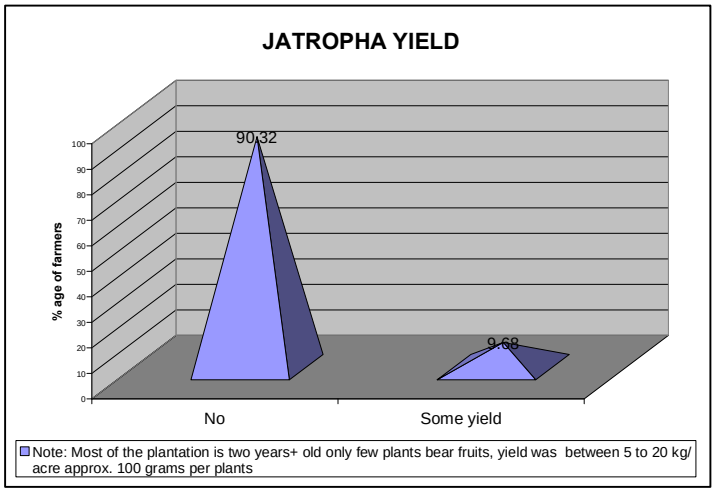
As per OREDA, estimated cost of Jatropha plantation is Rs 12000 per acre. However, during the survey conducted at various places, it was observed that farmers have not applied fertilisers except basal dose at the time of planting, no irrigation, no weeding or plant protection measures after plantation. Even in many cases hardly used any FYM. These activities have potential impact on the growth of the Jatropha. Most of these plants after plantation were kept on the mercy of nature to grow. However, due to favourable climatic conditions growth was satisfactory.

The actual cost of plantation per acre to the farmers is the cost of saplings (1000-1400) @ Rs 4 per sapling accounts to Rs. 4000 to 5600 and initial cost fertiliser Rs 800. The digging of the pits was carried by farmer himself. Thus, the actual cost varies from Rs 4800 to 6400 per acre.

As a package, Rs 12000/ acre is provided as loan, with around 50% as a back ended subsidy from the OREDA. The loan amount covers, cost of seedlings (even for gap filling), fertilizer, and the labour.

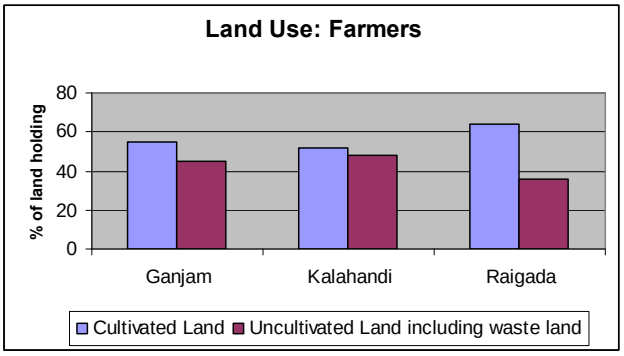
4.8.7 Yield and related aspects:

It is assumed that the jatropha plant start yielding from the year two after plantation and achieve good yield after 4th year onwards. This may be practically good for the well-irrigated and fertilised plantation, but in practice, these plantations are not irrigated and grown on the wasteland. However, initial growth parameters are not so bad and could give good results. As such, no incidences of pest and dieses were noticed that could affect the plants. Favourable climatic conditions and on and off rains helped them to grow well. Only 10 % farmers said that they could harvest some pods from the plants. However, this yield is only notional (5 to 20 kgs per acre) since very few plants were bearing pods.



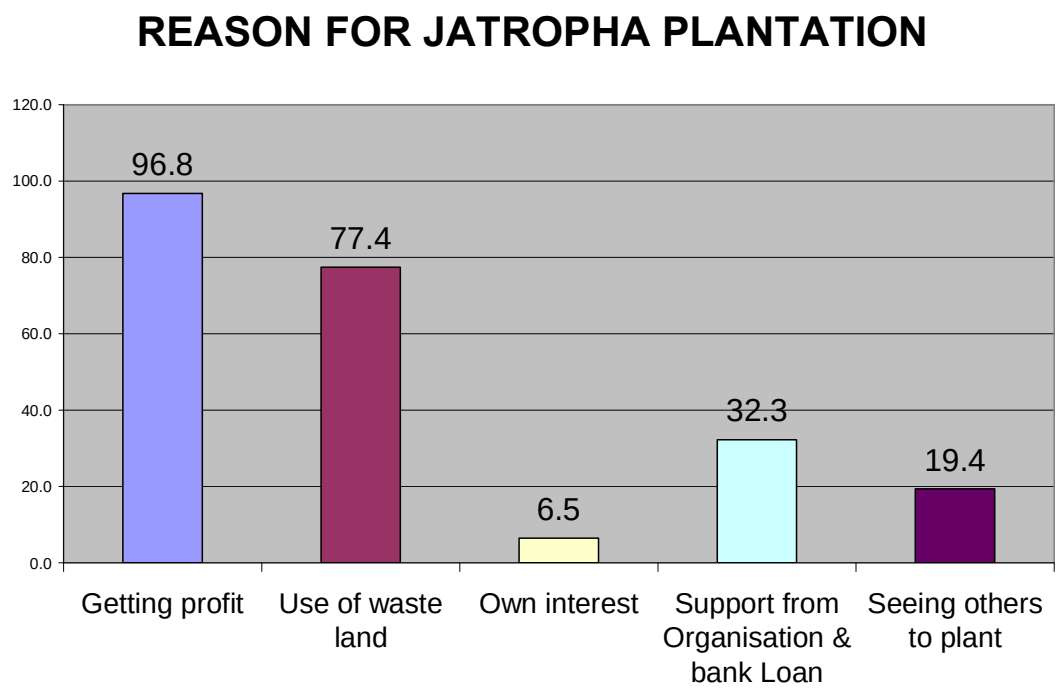
4.8.8 Farmer's perception:

Almost all the jatropha planters were farmers and they have planted the crop on either waste or the fallow agriculture lands. Average family size was of 7 people per family with 3-4 children. Wide variation in the land holding sizes were observed from the district to district. At district, Ganjam the average landholding size was 3 acres to that of 6 acres in Kalhandi district. Most of the farmers who opted for the Jatropha plantation has major portion of the land as fallow or



wasteland. It has been observed that around 40% of the land is either fallow or wasteland. Paddy is grown as a main karif crop grown. The other crops are various pulses and mustered

An income of the most of the familiesôsurveyed ranges between Rs. 48000 to 57000 per annum, with comparatively large family size (average 6), unproductive land and low income seems to be the main driving forces to find the suitable option that could help them to increase their income using the available land resources with minimum inputs. Jatropha emerged to be a good option. From the analysis of data, it is emerged that the main reason for Jatropha plantation is for **economic benefit (96%).** Apart from the economic benefit, 77% farmers thought this is the best use of their otherwise waste land. 32% farmers said that since there was support from the local organisation they adopted jatropha plantation. This emerged as an important aspect for promotion of the plantation activity. 19% farmers were motivated to adopt Jatropha plantation by seeing plantation of other farmers.



General Perception of cultivators:

- Growth and Survival is good and farmers have high expectations from the plantation.
- Almost all of the farmers thought this is the best use of their wasteland because no other crops can grow on these lands. It is also difficult to carry out agriculture operation due to unlevelled land (undulating) and difficult terrain.
- Wild and domestic animals do not damage Jatropha therefore, there is no need for surveillance and fencing. This reduces pressure on family for protection and the cost for fencing.
- Jatropha is sturdy crop because it doesn't need much aftercare and still survives
- No theft because plants cannot be used for any other purpose like timber, poles, fuel.
- Support from ONCC & OREDA and subsidy on loan taken for plantation activity. However, many farmers were not very clear about the repayment.
- Most of farmers said that they expect some production only after 4th year.

Case study of Banmali

Banmali, farmer of the Village Naupally, District Ganjam has family of 7 with 5 children. He has 3.5 cares of land of which 2 acre is good agriculture land and 1.5 acres is non-cultivable. He cultivates paddy and pulses. Most of the agriculture is rainfed. Apart from his own land, he rents in 1 to 2 acres of land from other farmers. During off-season, he works as agricultural labourer. All his efforts are to meet the ends.

He was approached by the worker of ONCC for cultivation of the Jatropha plantation on his wasteland. Initially he was reluctant, but after workshop, he understood the importance of the jatropha. ONCC provided him 1500 seedling for his 1.5 acres of wasteland. As per guidance, he dug 1500 pits at the distance of 6X 6 feet and planted seedling on onset of monsoon 2008. Initially seedling was healthy but due to dry monsoon, 30% of his plants died. He was again provided 450 seedlings by ONCC. Now, after 2 years survival is around 80%.

As per him loan of Rs 9600 per acre is given by the bank and there is about 50% subsidy. He has to repay loan amount in 8 year, repayment of about Rs 1000/ acre per year. He is hopeful that after another 2 years he will get regular income from the plantation. Though, he is not very clear about exact yield, his estimate is around 500- 600 kgs of seed per year which is around Rs.2500 to 3000/ acre @ Rs 5/ Kg. He thinks this is good income from the land otherwise not giving any returns.

His own experience of Jatropha plantation is quite encouraging. He said he has not put much effort for raising this crop. Only initially, he removed weeds around plant and applied fertiliser as directed. But after one year, not much effort was needed. His crop is growing well. He thinks this is very sturdy crop. Also fells that if irrigation is provided, it will grow much faster.

There is hopeé hope, Jatropha fulfils it!

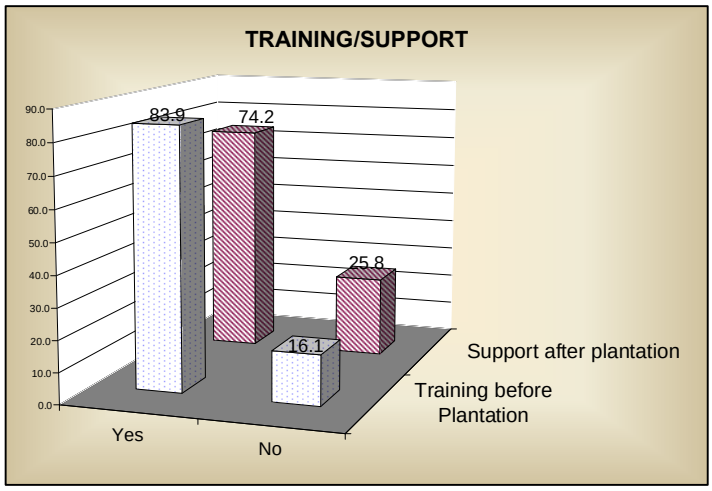
4.8.9 Market Linkages:

As such, no established marketing linkage was observed in the surveyed area. However, ONCC, who has promoted plantation has committed to buy the seed at the rate of Rs 5 per kg. ONCC also planed to establish expellers at few locations, once the critical level of production of seeds to be achieved. Orissa government also has ambitious plan to establish 20 processing units in next few year to support this activity. Private firms like Mission New energy, The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery to be established in Orissa.

As most of the jatropha plantation in the state is not more than 2 years old, therefore exact scale of operation for the processing and marketing is difficult to assess.

4.8.10 Training and support system:

All the farmers interviewed were provided initiation information and the training on the Jatropha plantation. State government has organised number of training programmes for awareness generation on Jatropha plantation with support of the local organisations.



ONCC is a leading private organisation with the support of OREDA has provided initial orientation on the Jatropha. ONCC formed the farmers SHG for the plantation of the Jatropha. ONCC has taken lead in convincing farmers on the importance of the Jatropha, imparted training, and supplied saplings, helped in finances from the banks with active support from the OREDA

However, the most striking feature is of the post plantation support, which includes inspection of plantation, discussion with the farmers on problems if any. This support helped in replanting and proper aftercare of the saplings, ensuring better survival and growth of the plants. And, where there was no post plantation support, farmers were ignorant about the aftercare and resulted into mortality of the plants. In some cases, even the support system for providing saplings for the gap filling was missing. This was in contrast to the areas were ONCC was in operation, but they also fell that frequent after care support and awareness building during the initial stages of growth of the crop is very much necessary and could drastically improve the performance.

Orissa Nature Care Council (ONCC)

Provides services to Farmers under one roof:

Acting as an interface between the farmers, the bank, and government for plantation and establishment of crude oil extractor and bio-diesel refinery

Already carried out plantation over 5000 acres and targeting for over 1.5 lakh acres of Jatropha plantation by year 2015.

- Creating awareness regarding the potential of Jatropha / Karanja (Pongamia Pinatae) and other energy plantation and biodiesel production.
- Identification of wasteland.
- Selection of interested beneficiaries.
- Collection, Verification of land documents and land site.
- Formation of societies, farmersôgroups and SHGs/JLG.
- Preparation of Detailed Project Report (DPR) as per ñPolicy Guideline for Raising Energy Plantation and Biodiesel Production-2007ò, submit to Govt.
- Providing photos for photo identification to rural and tribal farmers.
- Preparation of documents for bank loan.
- Making agreement at bank between farmers, bank and ONCC.
- Provide technical guidance and post plantation management services to the farmers.
- Liaison with insurance company to make insurance whenever required.
- 100% buyback of Jatropha/Karanja Seeds from farmers through collection centres, supply for crude oil / Bio-Diesel production and make payment of cost of seeds thereof.
- ONCC provides necessary guarantee to the bank to safeguard the interest of the farmers to get the loan from the bank for plantation of Jatropha/ Karanja.

ONCC is the only organization who has the confidence of banks and government due to the above services.

4.9 Key Observations:

- Orissa, Jatropha plantation is at very early stage of development, only few organisations are actually involved in promotion of jatropha. ONCC is leading organisation promoting plantation.

- No exact estimates for actual Jatropha plantation in the state are available.

- Soils and climatic conditions are suitable for the jatropha plantation in the state and are evident from the existing plantation.

- Plantations those supported with the initial training, follow-up support and awareness has performed well to that of without follow-up and support.

- Most of the plantation by farmers was carried out on the culturable wastelands in their possession. It has been noticed that most of the small farmers in the survey are has around 30-50% of their land not fit for cultivation of the agricultural crops. Therefore, jatropha is considered as best option to get some income from these unproductive lands.

- Jatropha is mainly grown as rainfed crop; failure of rain often affected survival. High mortality rates were observed. Healthy sapling, good mulching practices to retain soil moisture could improve the survival. Planting time also plays crucial role in establishment of the crop.

- It has been observed that good institutional support mechanism is necessary for the promotion of jatropha plantation on farmers land. Formation of SHGs and tie-ups with the financial institutions has positive impact in promotion of this activity.

- Farmers often do not care the crop after initial plantation. Jatropha though sturdy, needs good care during its initial growth.

- High input cost is deterrent for the promotion of the plantation. Proper financial tie-ups are necessary before actual plantation.

- A timely sapling supply to the farmer is an area of concern, needs establishment of nurseries at local level with proper distribution mechanism.

- Even though the area under Jatropha plantation has increased, is yet to achieve critical production levels to establish large processing units. However, this could be right time to establish the oil expellers of small and medium capacity. Value addition, through expellers could be more beneficial for the farmers. Group of SHGs could initiate such activity.

- At present, there is no established market for the jatropha seeds and neither the networks for trading.

- Conflict with jatropha plantation vs. grazing lands need retrospection.

- Orissa government has not officially announced yet support price for the jatropha seeds.

- Nurseries at cluster/ block level could help to provide good quality sapling at right time.

- It is also reported by some NGOs of the Orissa that the agricultural field of poor farmer and tribal people is used for Jatropha cultivation. This has affected their livelihood.

- Mixed farming model: Jatropha plantation + other fruit baring trees or even with caster, should be promoted this is proven to be good model elsewhere, ensures better income.

- Restriction on the transfer of commons and grazing lands, which provides fodder to livestock in the local economy, is necessary.

- More efforts on awareness generation is needed

- Research need for the colane development is essential. This requires tie-up with various national and international organisation.

- Private players who are involved in the plantation activity require proper monitoring. No proper agreement between the promotional parties (Companies) and farmers has been done; this creates insecurity among the growers.

- Detail impact assessment study of the activity to assess the long-term impact on agro-ecological balance is necessary.

Chapter- 5
Bio-Fuel in Rajasthan

5.1 Socio-Economic Background

Rajasthan is the largest state of India in terms of area, total geographical area of Rajasthan is 3, 4 2,239 square kilometres. Most of its area is occupied by the Great Indian Desert (Thar Desert). The borders of Rajasthan are shared with Pakistan in the west, Madhya Pradesh in the southeast, Gujarat in the southwest, Punjab in the north, and Haryana and Uttar Pradesh to the northeast. Total area of Rajasthan is about 3, 42,239 square kilometres, occupying 11 percent of the total geographical area of India. The main features of geography of Rajasthan include the Thar Desert and the Aravali range. The Aravali Range runs across the state from Mount Abu, which is 1,722 m in height to Khetri. The Aravalli range runs from the southwest to the northeast of the state, covering more than 850 km of area.

The main economy of Rajasthan is agrarian based. Agriculture is the leading economy of the state accounting for 22.5 per cent. The total cultivated area of the state encompasses about 20 million hectares and of which only 20% of the land is irrigated. The principal crops are Barely, Wheat, Gram, Pulses, Oil Seeds, Bajara, Pulses, Jowar, Maize, Ground Nuts, Fruits and vegetables and spices.

5.2 Agro-climate & Wastelands:

The climatic conditions of a region affect the agricultural cropping pattern and different areas, thus, produce different crops. Amongst a host of climatic factors, rainfall, temperature, humidity, wind velocity and duration of sunshine etc. affect the cropping pattern in a significant way. Annual rainfall and its distribution over the entire year, and the regimes of diurnal and annual temperatures are, by far, the prominent factors affecting agriculture and the life style of the people.

On the basis of climatic conditions and agricultural produce, Rajasthan has been divided into nine agro-climatic zones, each one having special characteristics of its own.

5.2.1 Agro- Climatic Zones of Rajasthan:

Table No: 5.1 Agro- Climatic Zones of Rajasthan

Zone	District Covered	Rainfall mm	Temp. C^0		Soils
			Max.	Min.	
1a	Barmer, part of Jodhpur	200-370	40	8	Desert, Sand dunes, Coarse sand Aeolian, calcareous
1b	Sriganganagar/ Hanumangarh	100-350	42	4.7	Alluvial calcareous, high soluble salt & exch. Na.
1c	Bikaner, Churu Jaisalmer	100-350	48	3.0	Desert, Sand dunes, Aeolian, Loamy coarse, calcareous
11a	Nagaur, Sikar, Part of Churu	300-500	39.7	5.3	Sandy loam, red soils in depression
11b	Jalore, Pali, part of Sirohi, Jodhpur	300-500	38	4.9	Red desert, Sierozems
111a	Jaipur, Ajmer, Dausa Tonk	500-700	40.6	8.3	Sierozem, Alluvial lithosol, brown, foot hills
111b	Alwar Dholpur Bharatpur, S. Madhopur	500-700	40	8.2	Alluvial, Water logged, Calcareous
IVa	Bhilwara, Sirohi Udaipur	500-900	38.6	8.1	Lithosol, foot hills, alluvial
IVb	Dungarpur, Udaipur, Chittorgarh	500-1100	39	7.2	Reddish, Medium well drained, calcareous shallow on hills
V	Kota, Jhalawar, Bundi and Baran	650-1000	42.6	10.6	Black of alluvial clay loam

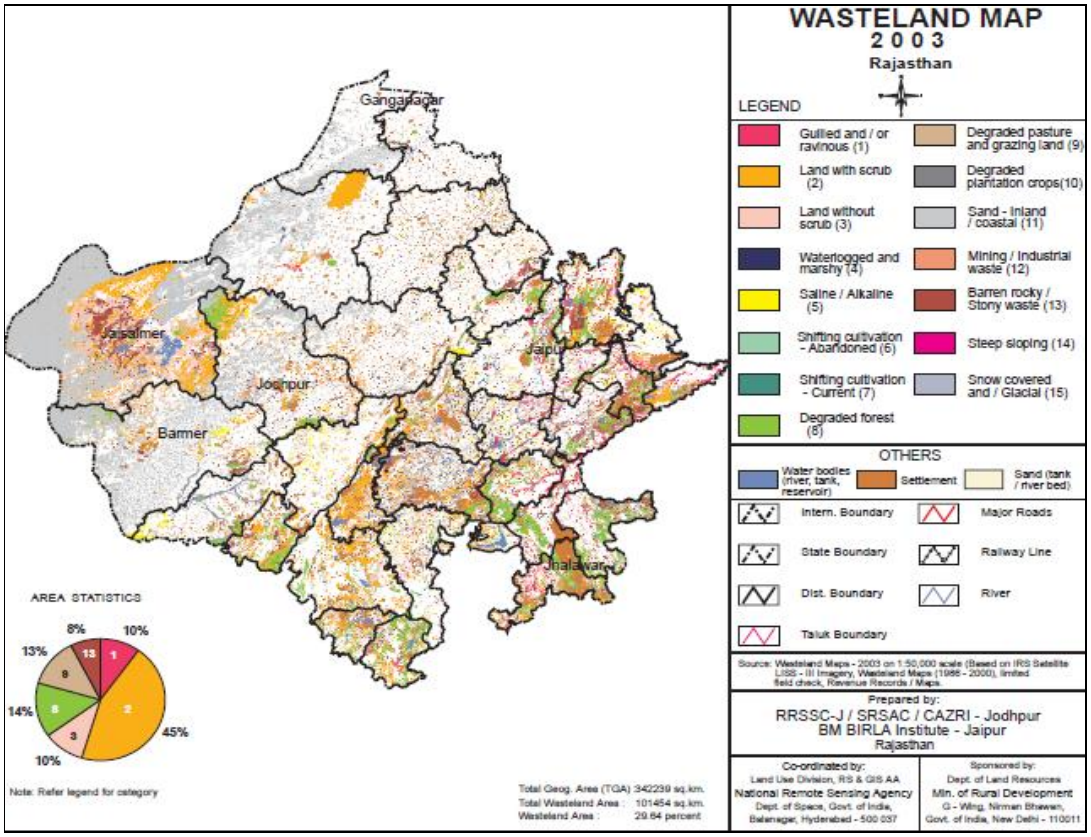
Source: http://www.rajasthankrishi.gov.in

As per table 5.1, Jatropha cultivation is possible in all the agro-climatic zones except, Arid Western Plain comprises of Bikaner, Jaisalmer, Barmer and Churu districts. This is the most arid part of the state where the annual rainfall varies from 100 to 400 mm, quite often erratic, not suitable for economically viable jatropha plantation. Also parts of the Ganganar district which are waterlogged are also not suitable for Jatropha plantation.

To avoid conflict with the food crops, Planning Commission of India suggested growing of Jatropha on the waste lands only. Rajasthan has highest area under this category. As per National Remote Sensing Agency (NRSA) about 30 % of geographical area is categorised as wasteland, which could be effectively used for the Jatropha plantation activity

5.2.2 Wasteland Profile of Rajasthan

Total wasteland available in Rajasthan is 1014.5 lakh ha covering 29.64% of the geographical area. It is 16% of the total geographical land of India. Rajasthan and Madhya Pradesh has maximum amount of wasteland available in India. Following map shows the wasteland area and spared at State of Rajasthan.



1. Rajasthan has the largest area of 52 lakh hectares of cultivable wasteland in the country
2. Western districts of Rajasthan cover around 75% of the total wasteland in the State.

3. The wasteland can be allotted to any private entrepreneur, which is interested in establishing value added agro-based projects with captive farming, plantation and horticulture preferable export-oriented projects.

As a part of the phased intervention strategy, Government of Rajasthan has identified total 40495 hectors of barren land in the 11 districts of Rajasthan (Baran, Banswara, Bhilwara, Bundi, Chittorgarh, Dungarpur, Jhalawar, Kota, Rajsamand, Sirohi, and Udaipur). Table: 5.2 shows the district wise allocation of land for Jatropha plantation by Bio-fuel authority of Rajasthan

Table 5.2: District wise allocation of land for Jatropha plantation

S.N	Districts	Culturable Wasteland (In Ha.)
1	Baran	1383
2	Banswara	2090
3	Bhilwara	8812
4	Bundi	3780.2
5	Chittorgarh	741
6	Dungarpur	1065
7	Jhalawar	3842
8	Kota	644
9	Rajsamand	6799
10	Sirohi	2547.5
11	Udaipur	8792
	Total	**40495.7**

Source: Bio-fuel Authority Rajasthan

5.3 Bio-diesel Potential Rajasthan:

Vast availability of the waste land in the state and suitable climatic conditions offers good potential for the promotion of Jatropha plantation activity. Rajasthan Government has formed, Bio-fuel Authority6 to promote the bio-fuels in the state... As per the policy it is estimated to bring around half of the wasteland under jatropha plantation for bio diesel production, estimated between 300-400 lakh kiloliters of the biodiesel production.

5.4 Feasibility and Potential of Jatropha

Jatropha is a valuable multi-purpose crop to alleviate desertification, soil degradation and deforestation. Jatropha will be a vast source of bio-fuel and a

6 http://www.biofuelraj.gov.in

key to reducing our dependence on fossil fuel and bring significant environmental benefits. The good thing about Jatropha is a tree-shrub that lives for a long time and does its job, producing oil, while it also sequesters lots of carbon dioxide from the atmosphere. Jatropha can help to increase rural incomes, self sustainability and alleviate poverty for rural communities, small farmers. It can as well help to increase income from plantations and ago based industries. There are varying estimates for the yield of jatropha per ha in Rajasthan. A study by Ray S[7] (1996) reported that Jatropha curcas maximum yield recorded in Rajasthan is 25t/ha/yr at 75% field capacity with irrigation and 1.9t/ha/yr. at 40% field capacity. Moreover under rainfed conditions also seed yield was 1.26t/ha/yr with demonstrated less water requirement for optimum yield. Recent studies however, reported yield varying from 1 tone to 4 tone/ha /year. However, it is too early to understand actual production potential for the large scale cultivation.

On other hand The Central Arid Zone Research Institute (CAZRI) in Jodhpur, is sceptical. It has two ha of its nursery under *jatropha* plantation and is yet to harvest any seeds. ñOur efforts to cultivate the seeds of *jatropha* have been quite futile in the last three years. Even with irrigation and added fertiliser, we have not been able to grow seeds on these plants,ò says L N Harsh[8], a CAZRI scientist. Harsh believes the soil and climatic conditions of only southern Rajasthan can be used to grow *jatropha*. This seems to be the right step by the state government to promote the jatropha plantation in the southern part of the state. Initial results of Centre for Jatropha Promotion & Biodiesel[9], district Churu, who is aggressively promoting Jatropha plantation, are quite encouraging. However, it may take few more years to get authentic production figures on large scale cultivation.

5.5 Government Initiatives:

Seeing the strong prospect of production of Bio Fuel on Culturable wasteland of Rajasthan through Jatropha and other such tree borne oil seeds ñBio Fuel Missionò has been constituted in 2005-06 in the Chairmanship of Hon'ble Chief

7 Roy, S. (1996) Growth and productivity of non-conventional energy sources : Jatropha curcas. In P. Chartier et al. (Eds.). Biomass for Energy and the Environment. Vol. 1, Pergamon, An imprint of Elsevier Science Publication, U.K., pp. 560-565.

8 http://www.downtoearth.org.in/full6.asp?foldername=20070315&filename=news&sec_id=4&sid=5
9 http://www.jatrophabiodiesel.org

Minister. To implementation of the objectives of the Bio Fuel Mission the State Government has declared the Bio Fuel Policy and has constituted the Bio Fuel Authority.

5.5.1 Allocation of wasteland:

- The State Government of Rajasthan decided to allotment of culturable wasteland in the identified 11 districts (Baran, Banswara, Bhilwara, Kota, Bundi, Rajsmand, Sirohi, Chittorgarh, Dungarpur, Jhalawar, and Udaipur) for the production of Jatropha and other such tree borne oil seeds for the production of Bio Fuel.
- Up to 70% of wasteland available in the districts will be allotted to SHGs of BPL families, Gram Panchayats, agriculture co-operative societies, registered societies and village Forest protection and management committees. Preference will be given to BPL families of SHG's. The remaining 30%of wasteland will be allotted to Private companies (registered under Indian company Act, 1956) and Government Enterprises.
- Allotment of land to Private companies (Registered under Indian company Act, 1956) and Government enterprises up to 1000 hector for Bio Fuel project will be made by a committee constituted under the Chairmanship of Chief Secretary. The proposals of allotment of land more then 1000 hector will be submitted to BIDI for decision. Allotment of land up to 100 hector to other categories will be done by the committee constituted under the Chairmanship of District Collector.
- Allotment of land to Government Enterprises, Private Companies and Registered societies will be done on 20% of DLC rate (The rate applicable to lowest category of Barani land), on leasehold basis for a Lease of 20 years and allotment of land will be free to other categories on Gair Khatedari basis. The ownership rights shall be retained by the State Government.
- Allottee will have to use 50% of the allotted land for plantation with in 2 years and rest in the 3rd year from the date of allotment. In case of non-fulfilment of this condition, allotment will be treated as automatically cancelled.

- Preference is given to those who are also involved in (i) Establish a processing unit,(ii) Establish trans-esterification unit/Bio diesel refinery,(iii) Take up research and development work for package of practice, (iv) Establish a nursery for developing of good quality planting material and seeds, (v) Provide employment to local people's on priority.

5.5.3 Rising of Plantations:

Under the programme for rising of Jatropha seedling, Land Resource Department of Govt. of India allotted Rs. 225 and Rs.500 in the year 2006-07 and 2007-08 respectively. In the year 2006-07, against the target of 75 lakhs of seedling raised 66 lakh seedling have been raised utilizing Rs.191.78 lakh and 61 lakh seedlings have been planted and in the year 2007-08 against the target of 174 lakh of seedling raised 147.81 lakh seedlings have been raised utilizing the Rs.298.83 lakh, and 134.03 lakh seedlings have been planted.

5.5.4 Financial incentives:

Government of Rajasthan has announced to purchase Jatropha at a minimum support price of Rs.7.00 per Kg. for the coming 3 years by the Rajasthan State Cooperative Marketing Federation (RAJFED). Finance department has exempted Jatropha, crude bio-diesel and 100% bio-diesel (B-100) from VAT. Financial incentive for jatropha nursery @ Rs.4/- plant and for jatropha plantation@ Rs.8/- plant also provided by the government.

5.6 Private Initiatives:

IKF Green fuel Limited, Noida, U.P. The company is doing Jatropha plantation in 30,000 hectare of land in Meghalaya and the company now plans to undertake this activity in Rajasthan in 50,000 hectare of landò The company already has started Jatropha plantation in 1000 hectare of land in district Udaipur. IKF Technologies Ltd. has a Bio-fuel refinery in Udaipur and the capacity of the refinery will be expanded to 100MT in future.

Centre for Jatropha Promotion & Biodiesel (CJP) is implementing its ambitious plan to plant 50 lakh saplings in the state as New Biodiesel Tree Plantation (NBTP) to produce 10 million ton biodiesel per annum to build a sustainable biodiesel industry in the state of Rajasthan, Gujarat and Madhya Pradesh.

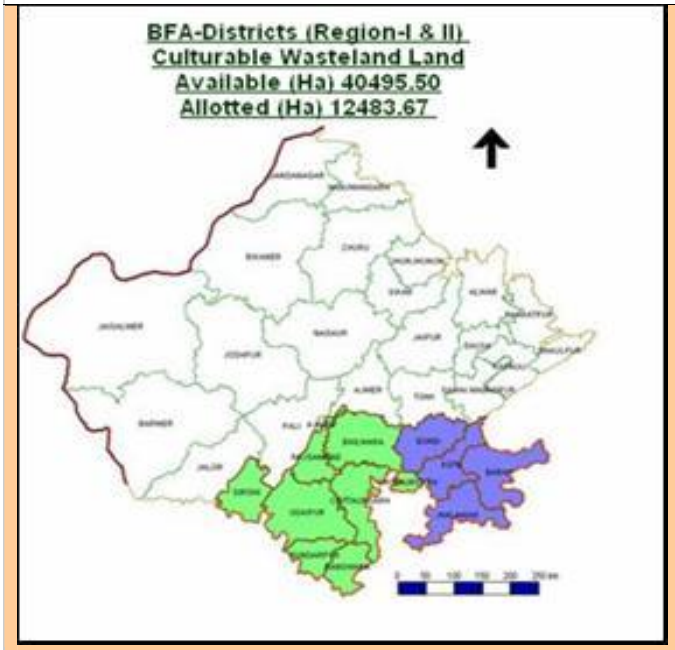
There are number of other private companies interested to promote jatropha plantation in the state.

5.7 Present status in the state:

Jatropha grows wild in south east Rajasthan which lies on south east side of Aravalli hill range which roughly divides the state in semi-arid and arid regions. Banswara, Bhilwara, Udaipur, Pali, Rajsamand, and Sirohi these districts of Rajasthan have huge strands of Jatropha growing under natural conditions.

Though, Rajasthan has huge waste land, but as a part of the phased intervention strategy, Government of Rajasthan has identified total 40495 Ha. barren land in the 11 districts of Rajasthan (Baran, Banswara, Bhilwara, Bundi, Chittorgarh, Dungarpur, Jhalawar, Kota, Rajsamand, Sirohi, Udaipur). During 2003-04, the National Oil Development Board (NOVOD), Ministry of Agriculture, Government of India, sponsored a Jatropha Development Project in Rajasthan through the state department of agriculture. Initially the programme was undertaken in Udaipur, Kota, Sikar, Banswara, Chittorgarh and Churu districts of the state. A model plantation of 7.5 lakh of Jatropha plants at a cost of Rs 75 lakh during 2004-05 was also initiated by the government. Way back 2001 then the local NGO, Sadguru Foundation has provided seeds to the farmers for the plantation. To understand the existing status of the plantation activity survey was carried out at two representative districts Udaipur and Banswara**,** covering 28 villages.

RAJASTHAN STATE



District: Udaipur
Rana
Kachna
Ghata
Jogiyo Ka Guda
Jolabas
Devro Ka Kheda
Mokhal
Senwada
Surajgarh
Naal
Chotiyakhedi
Mokhi
Majam
District: Banswara
Bhooradood
Mandli Choti
Mandli Moti
Godawara Naranj
Jeeva Khoonta
Bhelkuwa
Semel Kheda
Motiya
Bejelpur Bhaliya
Bejalpur Haliya

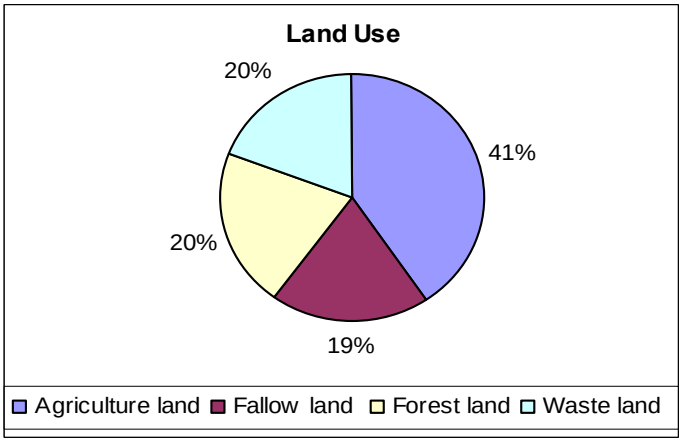
Total village covered: 23

5.8 Survey findings:

There are number of the organisations involved in the plantation activity in the state. The plantation history starts way back in 2001-02, where a NGO called Sadguru foundation, Dahod supplied seeds to the farmers free of cost and told about the planting process. However after 2006-07, more importance was given for the plantation through saplings. This was the period of proper planning for the promotion of the jatropha plantation under the state supported Biofuel mission with support of Panchayat and other local organisations.

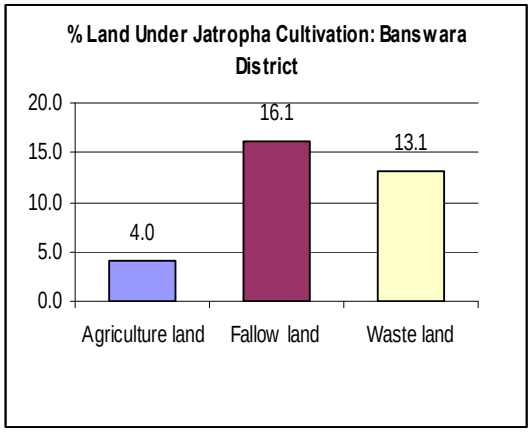
5.8.1 Land Use:

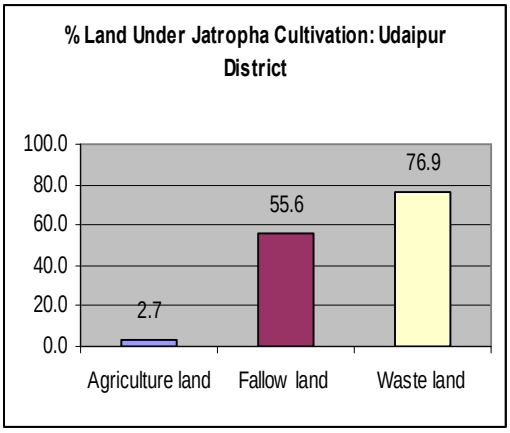
The graph shows type of land use in the surveyed areas. 41% of land is under agriculture activity. 19% of the land is kept fallow, 20 % is reported as a forest land and 20% as a designated waste



land. This waste land is mainly targeted for the cultivation of the Jatropha plantation. However, during survey it was observed that farmers used agriculture fallow land for the cultivation of the Jatropha. Maize, Pulses, wheat are the common crops grown in these districts. While in some areas, with irrigation facility paddy is also grown. Most of the cropping is rainfed. In some places supplementary irrigation is provided through open wells, check dams and the tanks.

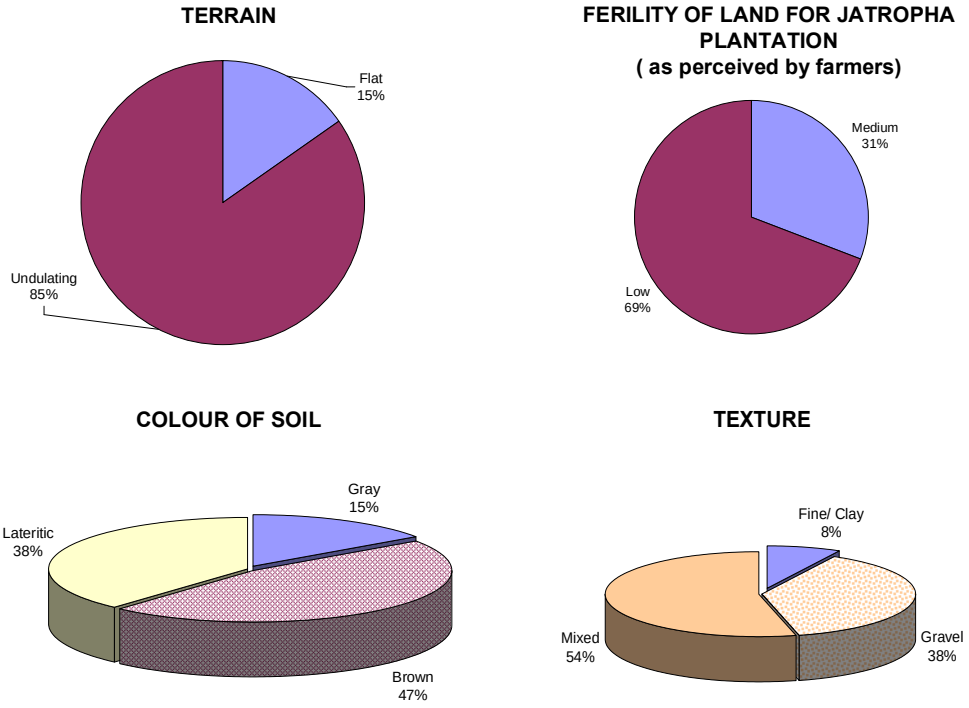
During survey it was observed that Udaipur district is more forthcoming and effectively used their waste and fallow land for the cultivation of the Jatropha crop compared to the Banswara district. It was also observed that in the district of Udaipur active participation of Panchayat and awareness of the farmers has positive impact on the promotion of the jatropha plantation.





5.8.2 Soils:

Jatropha plantation in Rajasthan is mainly targeted to utilise wasteland, which is quite substantial in the state. In few places, farmers also used their agriculture land for the cultivation of Jatropha

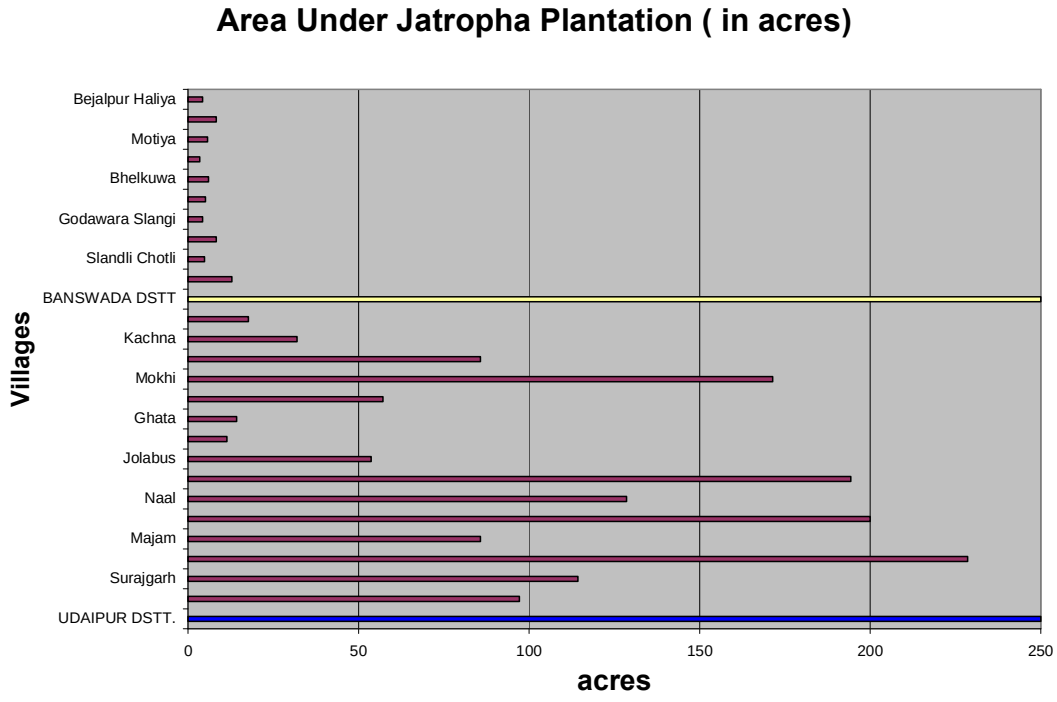


Above four graphs, show the type of land on which Jatropha plantation took place. Most of the land used is undulating and sloppy, with low fertility levels (farmerôs perception), with mixed texture and brown to greyish in colour.

5.8.3 Plantation:

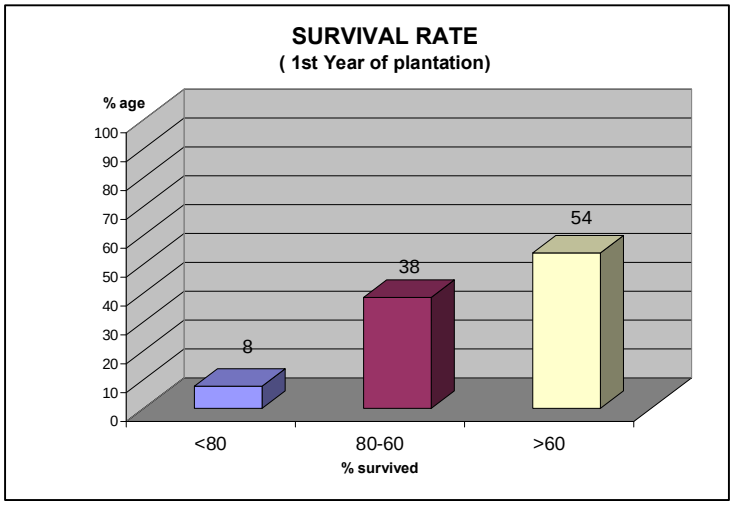
Jatropha is native crop called as *Ratanjot* in Rajasthan. Promotion of jatropha plantation was initiated in 2001-02. However, proper and large scale plantation activity was initiated only from year 2007 onwards. During survey it was observed that in Udaipur district farmers planted jatropha on 1 to 10 acres of their land while that in the Banswara district 0.5 to 2 acres of the land. In Banswara some farmers also used Jatropha for mixed plantation. Some of the farmers have brought more area under plantation after seeing the performance of the previous year. Large scale plantation at village level is observed in the Udaipur district. In many of the surveyed villages above 100 acres of land was used for the Jatropha plantation. While, in Banswara district, it was around 10 acres per village. The area under jatropha plantation from the surveyed 28 villages varies from 200 to

10 acres per village. Maximum plantation is carried out in villages from Udaipur. Following Graph gives details about the acreage under Jatropha crop.



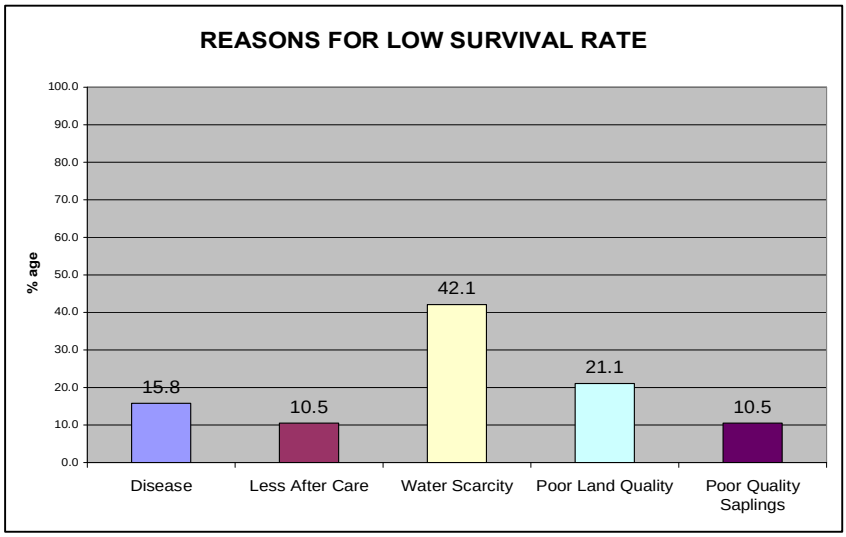
There are no specific figures about the actual jatropha plantation carried out in the state as well in the sample districts. The plantation cried out is mainly from the sapling raised at nurseries. These saplings are sold at the rate of Rs 2.5- 3/ sapling to the farmers. However, some have paid higher price for the saplings. State government also supplied free saplings to the farmers and the panchayts.

5.8.4 Survival Rate:



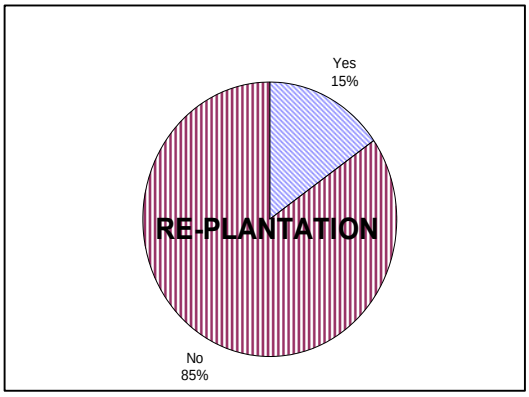
Following graph shows that 54% of the farmers reported that the survival rate was less than the 60% during the first year of plantation, while 38% reported survival rate

between 80-60% and only 8% reported survival rate above 80%. The survival rate at Rajasthan is lower than the Orissa when compared. Graph below tried to analyse the reasons for the low survival.

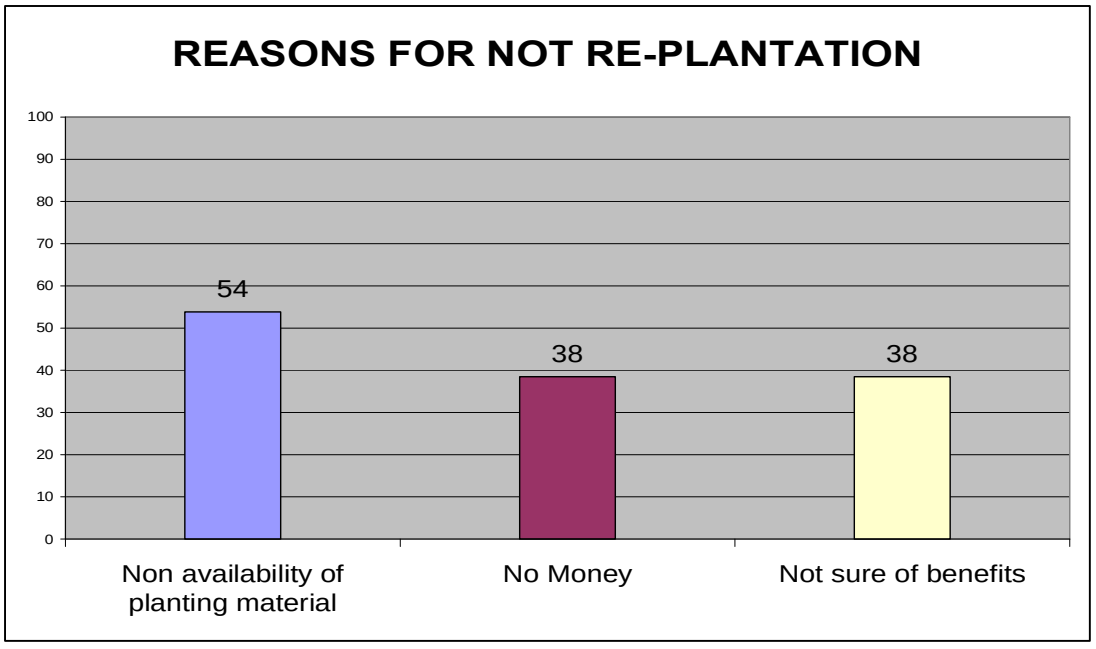


The reason for the low survival is mainly due to the scarcity of water during the initial stages of the growth, 42% respondents reported that. Apart from the scarcity of water the other important factors contributed for low survival rate were poor quality of land, saplings, dieses, low or no after care like weeding , soil amendment etc.

5.8.5 Re-plantation:



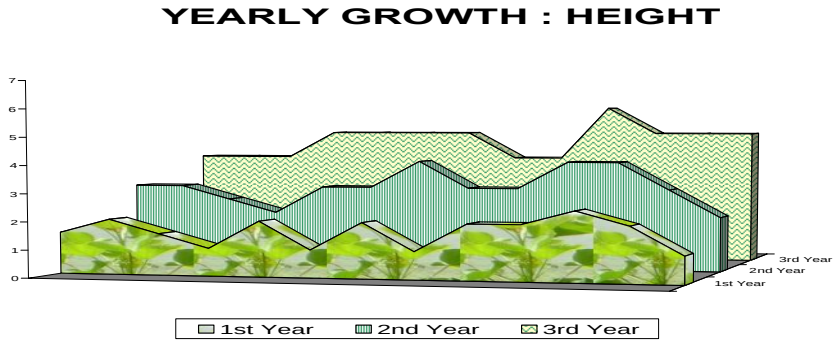
Only 15 % of the farmers in the surveyed area have carried out re-plantation / replacement of the dead sapling during the first year of the plantation. This is important activity to ensure proper utilisation of the land and maximise yield. When asked to the respondents, why they have not replanted, the first response was non availability of the planting material (54%), followed by no money to buy (38%) and some thought it is not wise to invest on seedling for replanting as the initial performance is not good and were not sure of add on expenses they will make on replanting could give them any benefits.



This has adverse impact on the productivity in long run. Most of the land mass remained unused. It is estimated from the above analysis that around 30-40% of the land on which Jatropha is planted is underutilised. Therefore, the average number of plants per acre is around 500- 600 and would affect productivity.

5.8.6 Growth Performance:

Average growth in terms of height reported was around 1.5 to 2 feet during first year and around 3-4 feet after 2 years, and 4.5 to 6 feet after 3 years. However, variation in growth is quite large because of varying soil conditions and low availability of water. Even the branching and foliage reported was not aggressive, especially for the plantations in the Banswara district. Only the plants at low-lying areas, with high soil moisture availability have performed fairly well compared to those on the slopes in the Banswara district. However, in Udaipur district performance was fairly good and uniform due to good soil conditions and well planned cultivation.



Udaipur District, Photographs curtosy, Centre for Jatropha promotion

Banswara District

Mixed model (Jatropha Plantation)

A Mixed model of Jatropha plantation has been developed in Village Godawara, located in Sajjangarh Panchayat samithi of Banswara District, Rajasthan. More than 5000 saplings of Jatropha, including fruit bearing varieties of plants (Tamarind, Black berry, Mango, Moringa etc.) have been planted in the wasteland of 11 farmers adjacent to the river bank. The land-owned farmers were keenly interested in mixed model plantation because of their additional source of income and check soil erosion during floods. This model would not only maintain biodiversity but could provide income year-round

Location

Old & New plantation

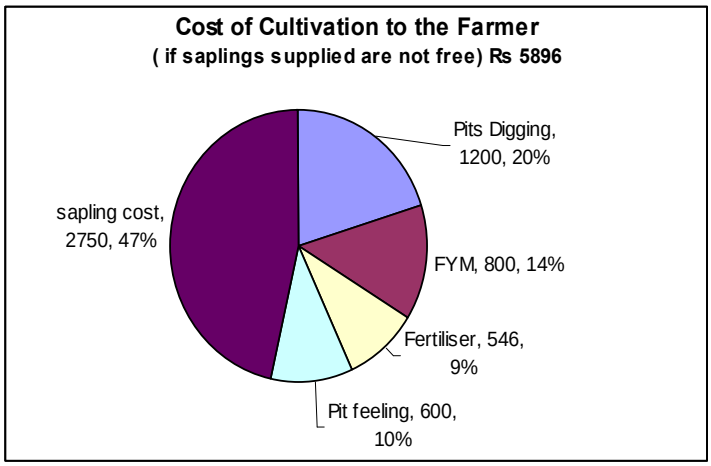
Jatropha & Castor based Model :

For setting up 400 litres per day plant, there should be a captive Jatropha / Castor Plantation of 75 Hectares (200 Acres). Jatropha trees bear seeds after 3 years. Castor crop will provide seeds for first two years. The assured supply of Jatropha / Castor oil is a key to the success of Biodiesel Plant. The approximate cost of the project is around Rs. 25 lakh

5.8.7 Cost of cultivation:

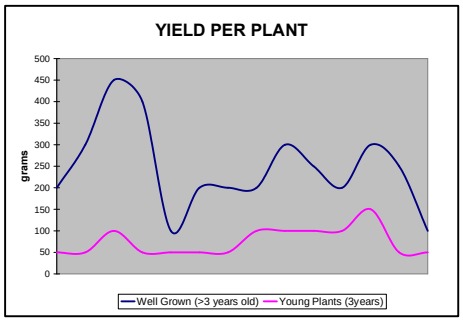
It is estimated that the cost of plantation per acre of jatropha plantation varies from Rs. 12000 to 15000 depending upon the soil condition. The major cost of the plantation is sapling cost that accounts over 50% of the cost of cultivation. Most of the Jatropha plantation in Rajasthan is rainfed therefore; the cost of irrigation is negligible.

As per the survey conducted, it was observed that the total cost of plantation to the farmer is around Rs 5000- 6000/ acre with the sapling cost of Rs. 2.5/ sapling. However, due to government initiatives many of the farmers received these saplings free of cost. Thus, the actual cost to the farmer was around Rs 2000/ acre, mainly for digging pits and manure.



5.8.8 Yield:

Proper harvest is yet to take place for all new plantations. For the older plantation, which was not systematically planted, farmer collects seeds and sells to the local traders. Seed from the new plantation is very less and averages out to be 50-150 gms/ plant, but those plants planted 5-6 years back, yielded more than 1 kilogram per plant. Graph below shows per plant yield reported by farmers. Yield varies from 50 grams to 450 grams per plant from old to new plantation. Since proper harvesting is yet to take place, based on these observations, for the old plantation more than 3 years old, yield per acre could vary from 2 quintals to 4 quintals/



acre (0.5 to 1 tone/ha) because of low survival rate (approx 500-600 plants per acre). Moreover, for new plantation, which is performing fairly well, some of the farmers reported yield around 2-4 quintals after 3 years of plantation average out to be 250 to 350 grams per plant with survival rate of around 75%. Farmers expecting to achieve 1-1.5 tone in another 2 years. However, some respondents were sceptical about the actual seed production.

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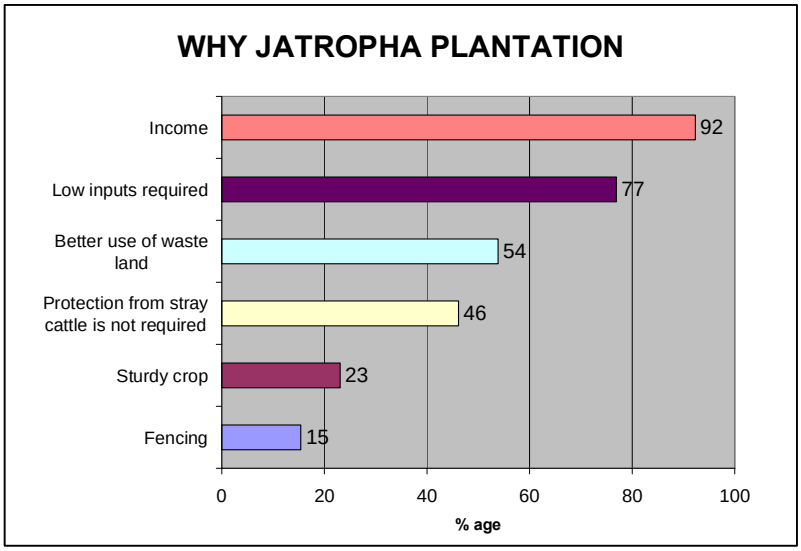
5.8.9 Farmers perception:

It is emerged for the analysis of data that the main reason for Jatropha plantation is for economic benefit. Apart from the economic benefit, 92%, Low inputs required was emerged as the important parameter for the plantation (77%), 54 % farmers thought this is the best use of their otherwise waste land. Quite interestingly, 46 % farmers reported that they planted this crop because it does not require any protection from the stray cattle (no fencing), which is a problem in Rajasthan. This is also reason for using Jatropha as fence crop.



During survey, it was observed that the farmers of the Udaipur districts were more enthusiastic and awareness about the Jatropha plantation and its benefits to them. Some of the common perceptions are,

- Jatropha is good plant for waste or degraded lands
- Survival rate is poor on the slopes

- It is good plant for fencing, Rajasthan has good population of livestock often pose problem to field crops
- Input costs are minimum, since the saplings are provided free of cost. One of respondent also suggested that since the saplings are provided free, farmers are not taking proper care of them. Therefore survival rate is poor, ñ*had some cost been attached*ò, survival & after care would have been better.
- Timely availability of good saplings was raised as a concern. Some respondents from Udaipur said that they donôt mind for paying more for quality saplings.
- Seed from the new plantation is very less average out to be 50-150 gms/ plant, and that to be from few plants. But those plants planted 5-6 years back yield per plant is around 450 grams and even more than 1 kilogram from well grown plants. However, some respondents were sceptical about the actual seed production
- There is Local market for the seeds. The seeds are sold anywhere between Rs 5 to 10 per kg. Even some farmers reported that they sold it for Rs 11/ kg. They expect to get good price if sufficient quantity of seed is produced. At present not much seed is produced.
- Almost all the respondents said that they expect some income from jatropha plantation from their waste or fallow lands, but not very clear on how much?
- Financial support for plantation is required, but difficult to get from the financial institutions.
- No systematic training was imparted except some introductory information
- No support system available for after care of the plants.

Cause of Concern

In Rajasthanôs Udaipur district farmers became hostile to jatropha after seeing their cattle die from eating the toxic leaves of the plant. ôWe were encouraged to grow jatropha by agents who sold us saplings at Rs ten (five US cents) each and extolled the virtues of jatropha,ôSukh Ram, a farmer, told IPS. ôWe were told that jatropha, being unpalatable to cattle, the saplings would stay safe. But no one told us what would happen to the cattle,ôsaid Sukh Ram. ôIn the end, we not only lost what we paid for the saplings but also possible earnings from three hectares of land, three years in a row. We are not prepared to take such risks again.ô

Source: http://www.ipsnews.net/news.asp?idnews=45949

5.8.10 Market Linkages:

At present most of the seed produced is sold in the local market. As far the rate for the jatropha seeds, it varies from place to place ranging from Rs. 5 to 10 per Kg even though Rajasthan government has announced the support price of Rs 7.0/ Kg of the seed. Hope with substantial volumes within next 2-3 years, effective marketing linkages shall be established.

5.8.11 Processing:

Since the production levels have not matched for large scale processing plant presently, existing expellers are used for the extraction of the oil. IKF, private company has established a Bio-fuel refinery in Udaipur and the capacity of the refinery will be expanded to 100MT in future. Rajasthan State Mines and Minerals has set an example by establishing a small scale refinery (see Box for more details) in 2006 and is producing bio diesel for its internal use.

Maharana Pratap University of Agriculture and Technology has established two Jatropha oil processing plants in Dungarpur and Udaipur. These processing plants can be used by any one by paying a service charge. The processing plant was run and the oil produced was used to run a tractor successfully. This initiative has created demand for cultivation of Jatropha in South Rajasthan, offers a competitive market for Jatropha seeds, and processed oil.

Rajasthan State Mines and Minerals Limited (RSMML)

Developing the vast degraded waste-land of Rajasthan as a viable resource for generating renewable energy by cultivating Jatropha curcas (Ratanjot), inspired RSMML management to explore the possibility of putting up a Jatropha based bio-diesel pilot plant in Jhamarkotra Rock Phosphate project, Udaipur, as a part of companyôs continuing quest for better environment management. The first bio-diesel pilot plant of Rajasthan was commissioned in the last week of March, 2006. Bio diesel yield obtained with respect to refined oil was 94.85%. The seeds produced oil at an average of 27%.

Since RSMML technical team has mastered production technique, scaling up in immediate future is not really a challenge. The main issue is to get high quality certified saplings in large number to take up massive plantation (75% Jatropha and 25% fruit bearing trees). RSMML has also distributed 2.5 lakhs saplings of Jatropha plant procured from Forest Department in all Panchayat Samities of district Udaipur, free of cost.

RSMML has ambitious plans to enter into large scale plantation of high yielding variety of Jatropha Curcas in association with Biodiesel Authority of Rajasthan, Forest Department and local village Panchayats. The pilot plant has given enough exposure in terms of production methods, quality of bio-diesel, its test in real time and dynamics of production economics

5.8.12 Training and support system;

The state government has mandated for the training needs and integrated the plantation activity with the rural development activities. But it is not properly implemented. Many of the farmer/ respondents showed their dissatisfaction for the training. As per their feedback, training should be more practical and also frequent to understand problems and control measures after plantation.

Supply of seedling, fertilisers, finances for plantation etc. requires considerable procedural efforts. Since the jatropha, is a new crop these mechanisms need to established?, a proper intuitional support with government departments and NGO require efforts. Which is at present not exists. Organisation like Centre for Jatropha Promotion & Bio-diesel is providing support under one roof, but they have their limitations.

Though the state has declared minimum support price for the jatropha seeds, effective mechanism for procurement is not at place. Farmers trade their product in local market through the existing trading networks.

5.9 Key Observations:

- Jatropha is native crop called as *Ratanjot* in Rajasthan

- Jatropha cultivation is mainly concentrated in the southern districts of the Rajasthan due to favourable climatic condition and the government initiatives.

- Though the Jatropha cultivation in the Rajasthan has been started way back in 2001, concentrated efforts for promotion has been initiated only after 2006.

- Exact figures on the jatropha cultivation are not available. However, as per some estimates, it is around 40,000 ha, combined by farmers, government and private.

- Although Jatropha plants can survive in wastelands/degraded lands, the fruiting and seed yield of the plant is highly dependent on availability of water (rain or irrigation) during critical stages**.** 42 % of the respondent said this is the most important factor both for survival and growth of the plant. Soil characteristics also play important role in the growth. It is observed that the growth performance is better in some districts over others. Udaipur district has better plantation compared to other districts.

- Survival rate also varies with districts. It varies from 60-80%. However, in some places it was much lower.

- Jatropha plantations in its early stage of development in the state, actual results on the production are awaited. There is need to record the

performances of various plantations in the state and understand in-depth various factors influencing the production.

- The support system for the training, resource mobilisation (both inputs & financial), information exchange to the farmers needs considerable strengthening and necessitates building of suitable institutional support mechanism with the support of NGOs and private institutions.

- It may be difficult at this stage to understand how much economical jatropha plantation would be to the farmers, but, many of the farmers are convinced that this is the best alternative to use the waste and fallow land resource, which is otherwise unproductive.

- Concerns about the possibilities of the impact of the jatropha cultivation on the grazing land could be matter of concern since Rajasthan has large population of Livestock.

- Mix model of Jatropha cultivation could be ideal solution to avoid such conflict and to maintain the diversity and ecological stability.

- Availability of the quality planting material is very much important for the promotion of jatropha, Proper quality control mechanism shall be established and R & D efforts should be initiated to provide best planting material. Nursery establishment should be given priority.

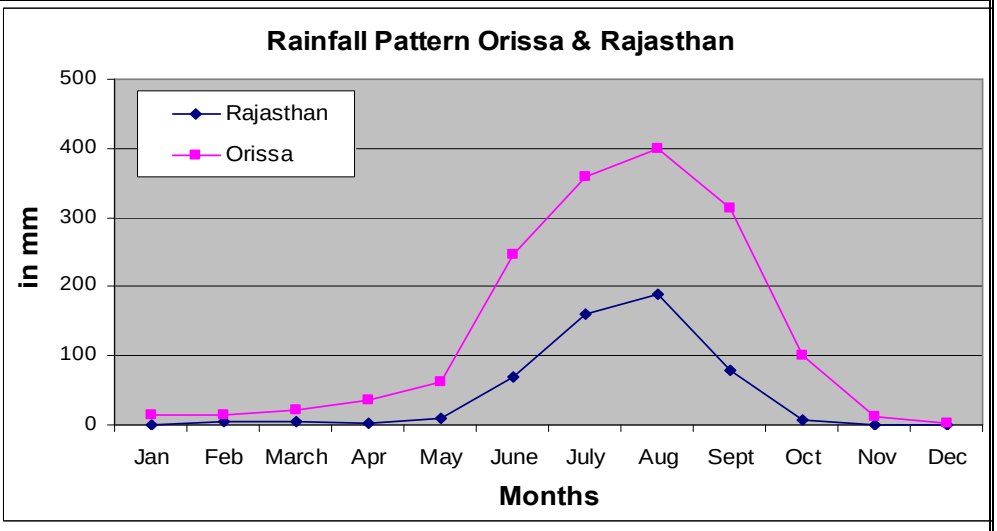
- Tissue culture based clones could be important to maintain genetic purity and quality. State should support to establish such laboratories.

- Government should focus on establishing proper marketing linkages at village level for procurement of the produce at the rate fixed by the government.

- At present most of the seed purchased is processed at the local expellers. Network of the good expellers is necessary and if possible the ñexpeller SHGò could be formed at village or cluster level for value addition at grass root level.

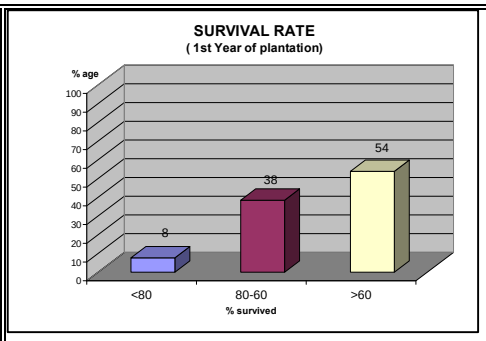
Chapter 6

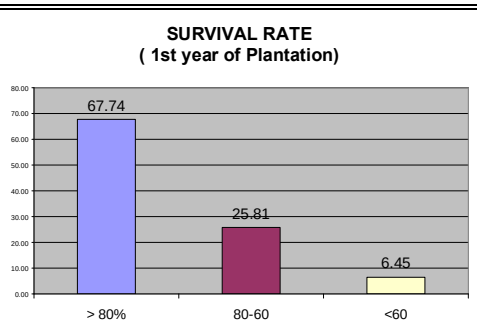
Observations Rajasthan vs. Orissa

	RAJASTHAN	ORISSA
LAND & CLIMATE		
Land	Total wasteland available in Rajasthan is 1014.5 lakh ha, of which only 52 lakh hectares are considered as cultivable wasteland Wide variation in soil types. In the western Rajasthan they are mainly desert, sand dunes, red desert soils and in southern Rajasthan mostly red soils, alluvial in depression of foot hills Texture varies from sandy, Coarse sand, sandy loam, to gravel	In Orissa 18 lakh hectare of wasteland are available where no cropping is possible due to degradation, undulating, eroding and less fertility. The soil offers wide range of variation from Lateritic, Red & Yellow, and Mixed Red & Black. These soils are either acidic or alkaline in nature where there is a less possibility to raise any normal agriculture crops.
Rainfall		

	The average rainfall varies across Rajasthan. The desert receives an annual rainfall of 100 mm. The south eastern region gets annually 650 mm. Maximum rainfall received is during July to September and almost dry for rest of the year. Though Jatropha can grow under such conditions, pays heavily on the growth due to scarcity of water.	Receives fairly good rainfall 1500 mm Even the Summer months receives some rainfall These climatic factors are quite suitable for the jatropha plantation.
Temperature	Wide variation in temperature observed in Rajasthan. In North western -2 (Churu) to 45 0c to that of 8 to 45 ^{0}c in south eastern region. Low temperature is not suitable for the jatropha crop	Temperature in all the agro-climatic regions ranges between 12 to 40 ^{0}c, which is ideal for the growth of Jatropha except in Eastern Ghat High Land (Major parts of Koraput, Nabarangpur) where especially in winters temperature drops down to 7.5^{0}c.
• *Climatic conditions are far better for the Jatropha plantation in Orissa than Rajasthan.* • *Availability of water plays critical role for the growth of jatropha during its early stages of growth*		

JATROPHA PLANTATION		
Plantation	• Jatropha plantation was initiated as early as 2001in the state. But actual large scale plantation was started from 2006 onwards • There is no specific figure on actual area under plantation in the state. Number of private players and government agencies are independently involved in plantation activity. • Mostly grown on the waste land under rainfed conditions. Under contact farming some farmers are cultivating on agriculture land also • Growth of the plants is slow compared to Orissa because of the climatic, edaphic and water scarcity.	• Large scale plantation activity in the state was initiated in 2007-08 • Similar is the case with Orissa. State government has plans to cultivate more than 15000 acres and Organisations like ONCC has plans to cover 1 lakh acres by 2013. • Mainly grown on the wasteland under rainfed conditions • Good growth was observed. Climatic conditions are better suitable than Rajasthan. Rainfall is good and even received during off monsoon season helped in better growth & survival during early stages of the development.
		

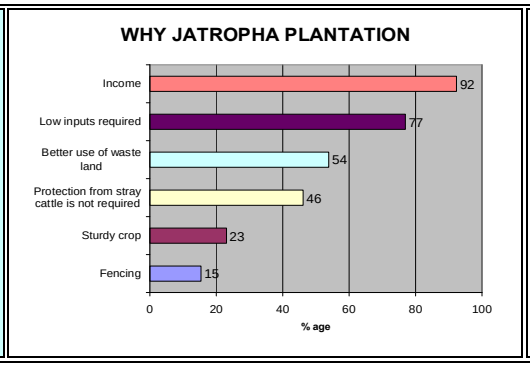


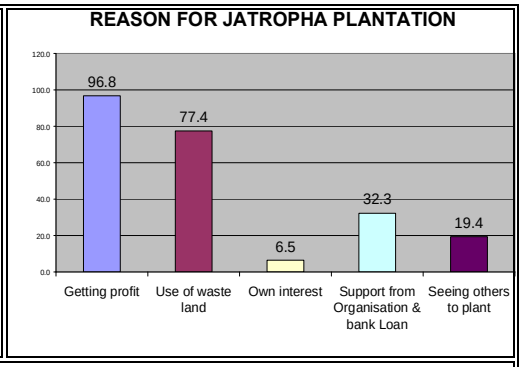


- *It is very important to have good planting material to get better results. Wide variations in the yields were observed during field trails in the different parts of country. Since the economic benefits are spread over 40 years, it becomes utmost important to select proper planting material. Needs good R &D inputs for improvement of the planting material*
- *Timely supply of good saplings is important*
- *Anything free is often misused, therefore supply of free sapling should be restricted*
- *Yields are very low ranging from 250-400 gms per plant even after more than 4 years of plantation in Rajasthan. While at Orissa, it is too early to comment on the yield but given the good growth, better yields are expected compared to Rajasthan*
- *Jatropha though survives in the extreme conditions but, performs badly with water scarcity in early stages of growth*

CULTIVATORS

Farmers	Enthusiastic participation of farmers for jatropha plantation was observed in the state. The state government through various programmes also supports Plantation activity. Many of the private sector companies are also promoting plantation through contact farming mode. Some of the farmers cultivating Jatropha on agriculture land and private players are encouraging them.	ñSeeing is believingò holds well in Orissa. Given the good growth performance of the demonstrative plantation, many farmers have taken up cultivation of Jatropha on their waste/ fallow lands. Performance is quite encouraging and could match to the expectations of the farmers, However, it is too early to comment on exact yield





- *The major driving factor in both the sates was additional **economic benefits** from the use of available wastelands. However, the other reasons like low input cost, support from the local organisations, sturdy crop, no protection required from stray cattle were also played important role in adoption of jatropha plantation.*
- *Orissa has setup the unique model of Self Help Group (SHGs) based Jatropha plantation.*
- *It was observed that, proper institutional support system is needed for establishing linkages with financial institutions, Government and market. ONCC from Orissa has setup unique model for promotion of Jatropha plantation.*

Others (Private sector & NGOs)	There are number of players involved in this plantation like IKF, who has acquire land from the sate government and also in contract farming mode with the farmers and has plans to grow Jatropha on 50000 ha. Rajasthan State Mines and Minerals is also involved in in-house plantation and use of biodiesel Other organisations like *Centre for Jatropha Promotion & Biodiesel* (CJP) is implementing its ambitious plan for planting 50 million trees under their New Biodiesel Tree Plantation (NBTP) programme to produce 10 million ton Biodiesel per annum	Organisation like Orissa Nature Care Council Action (ONCC) is quite active in the promotion of jatropha and planning to cover 150500 acres of area under Jatropha plantation by year 2013. Corporate like, Mission New energy has also announced to take up jatropha plantation in a big way. The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery in the state
Number of private players are showing interest in the promotion of Jatropha plantation and processing in both the states. However, the scales on which plantation have been promoted remains questionable.		
Government	ñBio Fuel Missionò was constituted to promote biofuels in 2005-06. Government has declared the Bio Fuel Policy and has constituted the Bio Fuel Authority.	Government prepared elaborate policy guidelines for ñRaising of Energy Plantation and Bio-diesel Productionò
PROCESSING (EXTRACTION & TRANS-ESTRIFICATION) INDUSTRIES		

Government	Government has assured support for promotion of the processing units. However, not much is yet achieved Maharana Pratap University of Agriculture and Technology has established two Jatropha oil processing plants in Dungarpur and Udaipur	Not much has been achieved so far. The Orissa Forest Development Corporation has installed one integrated Biodiesel plant starting from extraction to trans-esterification at Satyanagar, Bhubaneswar in year 2007 to demonstrate complete process. Government has planned to establish 20 pilot projects during 2008-09 in 20 districts.
Private	There are number of small edible oil extraction unit. At present, some these expellers are extracting jatropha oil. This oil is used for lamps and other non edible usage. IKF Technologies Ltd. Has established a small Bio-fuel refinery in Udaipur and planning to expand the capacity to 100MT. Rajasthan State Mines and Minerals has set up pilot unit in year 2006	There are number of small oil extraction units, which could be effectively jatropha oil extraction. Recently number of private players like Mission New energy, The Indian Oil Corporation (IOC) has announced to set up a Bio-Diesel Oil Refinery in the state.
Most Jatropha plantations are far from biodiesel producing units. Therefore, it is advisable to establish decentralised processing units for extraction of oil. This would provide better value addition to the farmers for their produce, create local employment and also reduce the cost of production. Trans-esterification shall be further carried out at larger plants.		

For better extraction, good quality expellers should be promoted.		
MARKETING		
Local	Though the plantation is older than the Orissa, but production levels are not up to the mark to achieve sizable trading. Seeds are mainly sold in the local market and traded by traders with price ranging from Rs 3- 10 /kg of the seeds even though government has assured minimum support price of Rs 7/ kg.	Since the plantation is new no significant market landings for the jatropha seeds was not observed in the local market. It will take another 2 years to establish trade linkages. ONCC, local organisation has ensured buyback at the rate of Rs 5/ kg to the farmers
Regional	No such arrangement exists for trading seeds or oil/ diesel at present	No such arrangement exists for trading seeds or oil/ diesel at present
End Users	Only used on the experimental basis by institutes. Not available in the market for general public use as biodiesel	Since the supply side has not established, the end users are yet to get benefits from the same. Some of the research institutes are using oil on experimental basis.

- *Since the scale of production is limited, market networks are not yet established. Mostly traded locally. Within next 2-3 years when volumes were traded, suitable networks shall be established.*
- *Government should focus on establishing proper marketing linkages at village level for procurement of the produce at the rate fixed by the government.*

INSTITUTIONAL SUPPORT		
Government	**National Oilseeds And Vegetable Oils Development Board (NAVBOD) : Back-ended Credit linked subsidy program for development of Tree Borne Oilseeds** Provides 30 percent back-ended capital investment subsidy by which the subsidy is linked up with credit (50%) from the institutional finance. The remaining 20% margin money is to be contributed by the beneficiaries. The margin money is monetized in the form of labour, land cost, watch & ward etc. The schemes have been made broad based, decentralized, entrepreneur driven and result oriented. The subsidy is for Establishment of seed procurement , Installation of multi-purpose pre-processing and processing facility, Installation of oil expeller, Nursery raising and Commercial Plantation of TBOs More information on: http://www.novodboard.com/GUIDELINES-BACKENDED.pdf	
Others	There of number of players who support for Jatropha plantation in the state. One of the notable examples is Centre for Jatropha Promotion & Biodiesel (CJP) at Churu provides support for scientific commercialization of Jatropha. IKF, private limited has also supporting jatropha plantation.	There are not many private players at present though number of corporate has shown interest. ONCC (Orissa Natural Care Council Pvt. Ltd.)

Chapter 7

Way Forward

The existing *Jatropha* plantations are at the very initial stage of development (1-3 years old) and not yet into full production. The new *Jatropha* plantations are expected to come into maturity in the next 3-4 years

Consequently, there should be insufficient *Jatropha* seeds to crush for biodiesel production units for sale to petroleum companies for blending purposes. However, small quantities of *Jatropha* and other non-edible oilseeds procured by traders are mostly crushed for oil, which is used for lighting lamps and other non-edible uses.

Experience from the Orissa and Rajasthan shows that even tough Jatropha is sturdy crop requires good climatic conditions, soils and water for better returns.

Some of the key observations & recommendations:

- Although Jatropha plants can survive in wastelands/degraded lands, the yields are highly dependent on availability of water (rain or irrigation) during critical stages of growth**.** Well-drained soils, with better moisture retention capacity also play important role in the growth. Therefore, it is observed that the growth performance is better in Orissa than Rajasthan

- Since, Jatropha is mainly grown as rainfed crop, failure of rain often affected its survival. Healthy sapling, good mulching practices to retain soil moisture could improve the survival. Planting time also plays crucial role in establishment of the crop.

- Farmers often noticed to be careless after initial plantation of the crop. Even though Jatropha sturdy crop, needs good initial care.

- Jatropha plantations in its early stage of development in both the state, actual results on the production are awaited. There is a need to record õtime series performancesò of various plantations in the state to understand impact of various influencing factors the production.

- It may be difficult at this stage to understand weather jatropha plantation is economically viable, but many farmers are convinced that this is the best use of their unproductive waste and fallow lands.

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- Timely availability of the quality planting material is very much important for the promotion of jatropha, Proper quality control mechanism shall be established and R & D efforts should be initiated to provide best planting material. Nursery establishment should be given priority.

- Nurseries at cluster/ block level could help to provide good quality sapling at right time. SHG should be promoted to establish such nurseries

- High input cost is deterrent for the promotion of the plantation. Proper financial tie-ups are necessary before actual plantation.

- The support system for the training, resource mobilisation (both inputs & financial), information exchange to the farmers needs considerable strengthening and necessitates building of suitable institutional support mechanism with the support of NGOs and private institutions. Formation of SHGs and tie-ups with the financial institutions will create positive impact in promotion of this activity.

- Even though the area under Jatropha plantation has increased, has not achieved the critical production levels to establish large processing units. However, this could be right time to establish the oil expellers of small and medium capacity.

- At present most of the seeds purchased are processed at the local expellers. Network of the good expellers is necessary and if possible, the ñexpeller SHGò could be formed at village or cluster level for value addition at grass root level.

- Government should focus on establishing proper marketing linkages at village level for procurement of the produce at the rate fixed by the government.

- Most Jatropha plantations are far from biodiesel producing units, and lack of efficient marketing channels result in high inefficiencies leading to high production costs. Industry sources estimate current biodiesel finished production costs at anywhere between Rs. 32 to 40 per litre, much above the government advised purchase price of Rs. 26.5 per litre.

- Concerns about the possibilities of the impact of the jatropha cultivation on the grazing land could be matter of concern. The transfer of commons and grazing lands which provides fodder to livestock in the local economy could be restricted

- Mix model of Jatropha cultivation: With other oil seed crops like caster and fruit trees could be ideal solution to maintain the diversity and ecological stability.

- Private players who are involved in the plantation activity require proper monitoring. Proper agreement between the promotional parties (Companies) and farmers should be carried out to gain confidence among the growers.

- Detailed impact assessment study of the activity on the long-term impact on agro-ecological balance is necessary.

Biofuel promotion is a very complex issue dependent on knowledge, infrastructure support, policy issues, political environment, inter-sectoral cooperation and national and international linkages for the cooperation and technology promotion and transfer. Feedstock supply and management chain

emerge as a major issue to be addressed considering local circumstances such as climatic, agronomic, economic, and social conditions.

In the following the recommended actions are summarized in tabular form, offers a framework for decision-makers is suggested which aims ñto encourage the sustainable production to achieve maximum benefits to the poor and to the environmentò

KNOWLEDGE PLATFORM	Resource base/ Feedstock Base	▪ Land assessment : with the help of surveys, mapping, and GIS to understand land capabilities and Production potential in rehabilitated marginal and degraded lands ▪ Water Resources: accessibility, conservation and optimal use ▪ Planting material quality assurance, timely supply, improvement
	Technologies	▪ Processing Technologies: Expellers; High efficiency expellers than the conventional one for removal of oil. ▪ Life-cycle analysis methodology and tools to assess biofuels systems, including their economics, energy balance, carbon flows etc.
	Stakeholders and capacities	▪ Identify the Key stakeholders ▪ Establish Knowledge/ information exchange platforms for Information generation and flow ▪ Organise training and orientation programmes for farmers to enhance the capacities& capabilities
	Economics of production and consumption	▪ Assessment of Costs across the supply chain: raw material production or gathering, processing, transport, and infrastructure modifications (if any) ▪ Values of by-products; ▪ Opportunity costs of land, labour and water used;
ACTION PLATFORM	Inter-sectoral plans and programmes	▪ Develop inter-sectoral cooperation among all sectors like Agriculture, rural development non conventional energy sources, ministry petroleum and ministry of environment and forest for effective implementation of programme ▪ Integration of the plantation activity with the various government programmes like NAREGA, Watershed development. ▪ Active participation of Panchayat Raj institution in plantation and village level processing industries ▪ Establishing policy and legislation frameworks for the land utilisation
	R&D for biofuels	▪ R & D efforts to develop good planting material and cultural practices for high yield ▪ Provide adequate financial, policy and institutional support on R&D activities ▪ Facilitating collaboration among researchers nationally and internationally

	Technologies	▪ Facilitate technology and material transfer across stakeholders (nationally & internationally) ▪ Reducing barriers for imports of technologies ▪ Tapping into modern technology information sources for expellers and transesterification
	Stakeholder Participation	▪ Organise farmers/producers, private operators for plantation; ▪ Investors and financiers for plantation and processing and marketing; ▪ Public and private sector enterprises to promote ▪ Consumers; access to biodiesel ▪ Academic and research communities for impact assessment and R &D support ▪ NGO to provide strategic support at grass root level
	Capacity building	▪ Plantation skills to the farmers ▪ Managerial skills to mange large scale plantation activity and organize local groups ▪ Technical skills for processing; ▪ Marketing and public outreach; ▪ Negotiation and investment from financial institutions
	Financial support	▪ Financial schemes at various levels, including for small-scale producers; ▪ Utilizing micro-finance and other innovative mechanisms; ▪ Insurance to the farmers ▪ Support and integration in various government schemes
POLICY PLATFORM	Biofuels and Food Security	▪ Food security Risks Assessment scenarios and possible ways to avert them ▪ Impacts of bio energy crop cultivation on agriculture, new rural infrastructure, and jobs; ▪ Present and future prices, markets, and subsidies; ▪ Potential export markets for possible surpluses;
	Energy	▪ Role of Biofuels viability as an energy option and its present role in the national energy balance; ▪ Future role of biofuels under various scenarios and technological options Knowledge and expertise available in the country. ▪ Costs and prices; ▪ Current taxation and subsidy situation in light of future biofuels scenarios.
	Support to Biofuels (incl. Fiscal)	▪ Economic and social costs and benefits of different types of support: subsidies, import tariffs and other ▪ Magnitude and types of subsidies: tax reduction, tax credits, loan guarantees, subsidized credits, ▪ Impact of a consumption mandate on domestic fuel prices in times of supply shortage due to weather or pest-related crop failures; ▪ Economic and social benefits of increased biofuels production and/or consumption as a result of government support
	Rural development	▪ Integration of biofuels development into existing rural development policies and programmes; ▪ Potential job creation under the various biofuels

		scenarios; ▪ Impact Assessment on rural development (determined by establishing baselines and indicators);
	Land use	▪ Assessing existing land-use policies in light of potential expanded biofuels use ▪ Protecting small-scale farmers from loss of land due to pressure from large-scale producers; ▪ Farmers participation in determining land-use changes
	Environment	▪ Impact assessments ▪ Emissions monitoring and reduction ▪ Biodiversity protection ▪ Water use management ▪ Soil health maintenance.
	Industry	▪ Energy industry, including established electricity and fuel providers who are central to energy distribution, as well as large-scale investors in new energy and fuel generation capacity; ▪ Small-and medium-sized enterprises, for decentralized biofuel production and distribution
	Research and Development	▪ Identifying biofuels needs in the country context; ▪ Identifying R&D institutions and their comparative advantage; ▪ Technology prioritization w.r.t environmental, social benefits and commercially competitiveness ▪ Policy research to identifying policy needs and areas of intervention

ANNEXURE

ANNEXURE-I

BIOFUEL POLICY: ORISSA

Policy Guidelines for Intensive Cultivation of Oil Seed Bearing Trees and Bio-diesel Production
GOVERNMENT OF ORISSA
Science & Technology Department
GOVERNMENT OF ORISSA
Science & Technology Department
No. /Bhubaneswar

RESOLUTION

Sub: Policy guidelines for intensive cultivation of oil seed bearing trees and bio-diesel production

Bio-diesel produced from vegetable resources is fast emerging as a viable alternative to petro-diesel, particularly in the face of its diminishing supply and the resulting steep increase in price.

Production of Bio-diesel also supplements the general economic growth by way of waste land utilization, employment generation, entrepreneurship development, augmentation of additional source of power, increasing share of organic manure in agriculture etc.

1.0 Potential of Bio-diesel Production

The current bio-diesel production potential of the State has been estimated at approximately 1000 KL per annum with further utilization of about 30% wasteland of the State the production is likely to increase up to 14000 KL per annum. At B20 this oil can be blended with 70000Kl of Diesel and at B5 the same can be blended with 280000Kl of diesel.

2.0 Quantification of Benefits of Bio-diesel production:

Total expected production: 14000 KL per annum
Utilization of wasteland: 0.6 Million Hectares
Employment generation: 100 million man days
Additional organic manure: 42,000 tons

With the above consideration in view, Government has been pleased to decide the following guidelines for implementation and promotion of Biodiesel in the State.

3.0 Objectives and strategies:

The main objective of the policy is to enhance economic growth through maximisation of production of bio-diesel in the state. Other objectives are:

3.1 To put at least 30% wasteland of the State into effective use though cultivation of oil seed bearing trees;

3.2 To enable the poor and disadvantaged people of the society to take up cultivation of oil seed bearing trees;

3.3 To fix up the minimum support price of oil seeds;

3.4 To enable interested and eligible entrepreneurs to set up bio-diesel production plants;

3.5 To provide suitable market linkage to bio-diesel producers to sell their product, and

3.6 To set up quality control facilities to guide entrepreneurs to produce BIS standard bio-diesel.

4.0 Operative period:

The scheme for promotional and fiscal incentives for intensive of cultivation of tree borne oil seeds and establishment of bio-diesel production units will come into operation with immediate effect and will remain in force for a period of TEN years.

5.0 Cultivation of Oil seed bearing trees:

5.1 Propagation of oil seeds

Although several oil bearing trees like Karanj, Mahua, Polang, Kusum, Neem, Simarauba, Sal, Linseed, Castor, Baigaba etc. are native to Orissa, systematic propagation and processing of these seeds is very important in view of large scale commercial production of bio-fuels. However, the proposed magnitude of the campaign calls for well laid out actions and well defined roles and responsibilities of different stakeholders.

5.2 Selection of Oil bearing Trees:

Except Polang which grows well in regions closer to the sea coast all other species can be grown all over the State even on marginal and degraded lands.

Oil seed bearing trees can be chosen depending upon the local agro-climatic conditions and economic feasibility for large scale bio-diesel production. Jatropha Curcas, however, is a generally accepted bio-diesel species because of its adaptability to all types of harsh conditions.

5.3 Supply of seedlings:

Government and private nurseries shall be encouraged to prepare seedlings of Bio-fuel trees and supply the same to interested farmers, co-operatives, Self Help Groups etc. at moderate prices. Financial incentives should be provided to women self help groups, grass root level Non Government Organizations/Community Based Organizations and individuals in tribal sub-plan areas for raising nurseries so as to build up a strong and continuous seedling supply chain.

5.4 Availability of land for cultivation of oilseed bearing trees:

About 2 million hectares of land is available under the categories of barren and uncultivated land and fallow lands. A major portion of this land can be utilized for cultivation of oil seed bearing trees. Besides, huge areas of degraded forest are also available in the State where such cultivation can be taken up. Cultivation of oil seed bearing trees can also be taken up on field boundaries, tank bunds, fences etc.

5.5 Distribution of land:

5.5.1 Identification of land:

While farmers have to be encouraged to cultivate Bio-fuel plants along the fencing and the bunds of cultivated lands, the very success of the programme depends on raising such plantations on marginal and degraded lands. Such areas coming under common land, wasteland, canal and tank bunds, degraded forests, along the railway tracks, highways have to be identified by designated Government Departments and given on

long term lease to interested Van Sanrakshan Samittees , Pani Panchayats, co-operatives, Self Help Groups,Tree GrowersôSocieties etc. for plantation purpose.

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5.5.2 Eligibility

Under these policy guidelines all families living below poverty line are eligible for government incentives for cultivating oil seed bearing trees.

Self Help Groups, other farmers groups, associations, consortia etc. with more than 50% members belonging to the BPL category will be preferred.

5.5.3 Allocation of wasteland:

Waste land in suitable agro-climatic zones will be identified by concerned Government functionaries and allotted for the purpose of cultivation of oil seed bearing trees to different categories of beneficiaries as under

Individual farmers : 2.5 hectare per beneficiary
belonging to BPL
categories
SHGs/ VSS/
Bhumi Panchayats/
Other recognised
farmers groups etc. : 25 hectares per group

Allocation of land will be made as per prevailing Acts of the Revenue Department under OLR/OPLE/OGLE.

Van Suraksha Samittees with due permission of the forest Department may also raise oil seed bearing tree plantations in forest and degraded forest lands. In such cases the quantity of land to be allocated per VSS may be decided by the forest department.

The above arrangement, however, does not prevent others to grow plantation on their own land.

5.6 Financial incentives:

5.6.1 Support price of oil seeds:

In order to facilitate farmers to sell their oil seeds, State Government shall fix up remunerative support prices for purchase of different oil seeds suitable for production of Bio-fuels.

5.6.2 Incentives for raising commercial plantations:

For raising commercial plantations different categories of cultivators can avail financial assistance under back ended credit linked subsidy programme of National Oilseed and Vegetable Development (NOVOD) Board under the Ministry of Agriculture, Government of India. (Annex-I)

For cultivation of oil seed bearing trees at present subsidy @ 30% subject to the benchmark cost of Rs 30,000/- per hectare is available under the NOVOD guidelines. The pattern of assistance is 30% subsidy, 50% bank loan and 20% beneficiary share.

6.0 Establishment of Seed collection centres and buy- back arrangements:

Government /private /NGO managed seed collection centres with adequate infrastructural facilities shall be established at well connected locations for collection and preservation of seeds. Such collection centres shall have facility to determine the oil content of seeds, grade and certify the seeds on the basis of their oil content and purchase the same from the farmers at support prices determined by government.

7.0 Establishment of Bio-diesel production centres

Bio-diesel production can be low tech, and is not capital intensive. Bio-diesel production does not require economy of scale. There is no minimum size for a bio-diesel facility and small decentralized bio-diesel facilities do not require dedicated technical staff support; they can be operated by locally trained non-technical staff.

Eligible entrepreneurs shall be entitled to subsidy as per the special package offered under Self Employment Programme implemented by the Industries Department. Such special package allows 15% capital subsidy and 3% interest subsidy.

Financial assistance and other incentives for setting up complete bio-diesel production units shall be given to individual entrepreneurs as well as groups as per relevant provisions of IPR, PMRY, and KVIC/KVIB.

All such incentives shall be in consonance with the Self Employment Policy of the State Government.

7.1 Selection of Entrepreneur:

Entrepreneurs for setting up bio-diesel plants shall be selected as per selection procedure in vogue of the District Industries Centres (DIC).

8.0 Preparation of Detailed Project Reports:

Standard priced DPRs for different capacities of Bio-diesel Plants shall be made available to the selected entrepreneur by OREDA. Location specific amendments to the DPR, if any, shall be incorporated by OREDA subject to verification of details and on payment of costs of such verification etc.

9.0 Establishment of Quality Control centres:

Bureau of Indian Standards (BIS) has specified standards for quality of Bio-diesel for blending with petro-diesel in India. Indian Oil Corporation has also set up certain quality standards and norms for procurement of Bio-diesel by them.

The entrepreneurs in order to sell their bio-diesel must adhere to the above standards and norms and such adherence should be monitored by suitable Quality Control Facilities created under the State Nodal Department / Agency.

Such facilities shall also duly certify the Bio-diesel following which sale to indenting buyers or consumption for one self can be affected by the respective Bio-diesel unit.

10.0 IEC Activities:

As of now, there is very little mass awareness about organized plantations of oil seed bearing trees in the State. The opportunities and potential to various beneficiaries like farmers, traders, industry and consumers have to be properly articulated. Booklets, brochures, manuals etc. have to be prepared in Oriya detailing the package of practices in plantation of bio-fuel trees , collection and preservation of seeds, buy back arrangements, economics, financial incentives, loans etc. and widely circulated among farmers. Government Departments like Agriculture, Forest, OUAT, Krishi Vigyan Kendras , PRIs, NGOs and other grass root level extension functionaries , electronic media, etc. should be adequately geared up to take up the task of awareness and education. Suitable budgetary provisions should be made by the State Government for such extensive awareness and education campaigns.

11.0 Role of OREDA

Orissa Renewable Energy Development Agency, in short OREDA, will act as the Nodal Agency for the entire programme and function as the single window for promotion and facilitation of all projects prepared under these guidelines.

ANNEXURE- II

BIOFUEL POLICY: RAJASTHAN

GOVERNMENT OF RAJASTHAN
REVENUE (Gr.6) DEPARTMENT

No. F.9(1)Rev.VI/2007 Jaipur, dated:

NOTIFICATION

In exercise of the powers conferred by sub-section (2) section 261 of the Rajasthan Land Revenue Act, 1956 (Rajasthan Act No. 15 of 1956) read with section 101 and 102 of the said Act, the State Government hereby makes the following rules; namely.-

1. Short title extent and commencement.-

(1) These rules may be called the Rajasthan Land Revenue (Allotment of waste land for bio-fuel plantation and bio-fuel based Industrial and processing unit) Rules, 2007.
(2) They shall extend to the whole of the State of Rajasthan.
(3) They shall come into force at once.

2. Definitions:- (1) In these rules, unless the subject or context otherwise requires;

(a) 'Act' means the Rajasthan Land Revenue Act, 1956 (Rajasthan Act No. 15 of 1956);

(b) 'Agriculture Co-operative Society' means the Co-operative Society of landless persons registered under the Rajasthan Co-operative Societies Act, 2001 (Act No. 16 of 2002);
(c) ôAllotting Authorityômeans the authority constituted under rule 9;
(d) ôBIDIô means the Board of Infrastructure Development & Investment constituted by the State Government from time to time.
(e) 'Bio-fuel Authority' means authority set up by the Government of Rajasthan.
(f) 'Bio-fuel based Industrial and Processing Unitô means and includes establishment of complexes or estates comprising bio-fuel processing industrial units, refineries, composite high technology agricultural projects in the areas of bio-fuel, hybrid seed production, micro propagation through tissue culture etc. and research & development activities including training;
(g) "Bio-fuel plantation" includes plantation of Jatropha, Karanj and other oil seeds plant suitable for production of bio-diesel;
(h) ôCompanyômeans Company registered under the Companies Act, 1956 (Act No. 1 of 1956);
(i) ôDistrict Level Committeeôor 'D.L.C.' means the committee constituted by the State Government for a District from time to time under clause (b) of sub-rule (1) of rule 2 of the Rajasthan Stamps Rules, 2004;
(j) 'Form' means form appended to these rules;
(k) 'Government Undertakings' means undertakings owned or controlled by the Government and shall also include Companies and Corporations owned or controlled by the Government;
(l) ôGram Panchayatô means Panchayat established under the Rajasthan Panchayat Raj Act, 1994 (Rajasthan Act No. 13 of 1994);

(m) 'Landless person' means a resident of Rajasthan who is either a bonafide agriculturist or an agricultural labourer, and is cultivating or is likely to cultivate land personally, and whose main source of livelihood is agriculture or any occupation which is subsidiary or subservient to agriculture, and such person does not hold any tenure land anywhere in Rajasthan, or the area of such land which he holds including any land which has been previously allotted to him, is less than 2 hectare of un-irrigated land:

Provided that the following categories of persons shall not be considered to be landless person, namely:-

(a) an employee of the Government, or of a commercial or industrial establishment or concern, his wife and children dependent on him. A casual or work-charged laborer shall not be treated as an employee for this purpose.

(b) a person who has sold or otherwise transferred, the whole or part of the land held by, or allotted to him and has, thereby, come to hold less than the minimum area specified above.

(c) a married person whose wife or husband, as the case may be, holds land including any land which has been previously allotted to him or her, jointly or severally, more than 2 hectare of un-irrigated land.

(n) 'Lease' means a lease executed under these rules;

(o) 'Society' means the society registered under the Rajasthan Societies Registration Act, 1958 (Act No. 28 of 1958);

(p) 'Self Help Group of B.P.L. families' means self help group (SHG) formed under the Swaranjayanti Gram Swarojgar Yojna (SGSY);

(q) 'Village Forest Security and Management Committee' means a committee constituted by the State Government in the Forest Department from time to time; and

(r) 'Wasteland'' means degraded land which can be brought under cultivation with reasonable efforts and which is currently lying unutilized and land, which is deteriorating for lack of appropriate soil and water management on account of natural causes, including ravine land.

(2) Words and expressions, not defined in these rules but defined in the Act, shall wherever used in these rules, be construed to have the same meanings as assigned to them in the Act.

3 Purpose and eligibility of allotment.- (1) Land for bio-fuel plantation, and for bio-fuel based industry and processing unit under these rules may be allotted to:

(a) Self Help Group of BPL families,
(b) Village Forest Security and Management Committee,
(c) Gram Panchayats,
(d) Agriculture Co-operative Societies,
(e) Societies,
(f) Government Undertakings, and
(g) Companies.

(2) Maximum thirty percent of total wasteland available in a district may be allotted to Government undertakings and companies and preference will be given to those Government undertakings and companies which undertake to plant Ratanjot, Karaj and other similar bio-fuel plants and to establish processing units, refineries, composite units, value addition of such bio-fuel plants and processing, establishing nursery for high quality plants and seeds including research & development and undertake to employ at least 50% of unskilled labour from local areas.

(3) The remaining land shall be allotted to the other categories of sub-rule (1) and preference will be given to self help groups of B.P.L. families amongst other categories.

4. Identification of Wasteland.- (1) The wasteland available in the District shall be identified by the committee constituted for this purpose consisting of following members:- (a) District Collector : Chairman
(b) Chief Executive Officer, Zila Parishad : Member
(c) Divisional Forest Officer : Member
(d) Concerned Sub Divisional Officer : Member
(e) Concerned Tehsildar : Member
(f) Deputy. Director, Agriculture : Member
(g) Additional Collector (Administration) Member Secretary.

(2) The identified wasteland shall comprise of all details (like - name of village/tehsil, description of land, khasra No., area of land, soil classification etc.). The land so identified shall be displayed on the web-site of the State Government/ District. The list of wastelands with all details shall be made available to Revenue Department, Rural Development & Panchayati Raj Department and Agriculture Department, Government of Rajasthan and it will be grouped into blocks of units of 10 hectare, clusters of 100 hectares and zone of 5000 hectare.

5. Wasteland not available for allotment:- The following wasteland shall not be available for allotment under these rules.

(a) Land prohibited under section 16 of the Rajasthan Tenancy Act, 1955 (Rajasthan Act No. 3 of 1955),
(b) Land situated in catchment area of any tank, river, Nala, Nadi and recorded as such in revenue record,
(c) Land reserved for allotment under any specific rules for the allotment of land within urban area,
(d) Land situated within urbanisable limit or peripheral belt as provided under section 90-B of the Act,
(e) Land falling within National Capital Region;

(f) Land situated within the limit of ï
(i) One kilometer from the central line of National Highway.
(ii) 500 meters from State Highway, Mega Highway.
(iii)500 meters from major District Roads,
(g) Land situated within the limits prescribed by the Indian Road Congress.

6. Allotment of Land .- (1) The wasteland shall be allotted to Government Undertakings, Companies and Societies on the leasehold basis on payment of premium of land referred to in rule 10.
(2) The land shall be allotted on gair khatedari basis to all persons except as mentioned in sub-rule (1).
(3) No Khatedari rights shall accrue on the land allotted under these rules.

7. Tenure of gair khatedari and of Lease.- Wasteland allotted on gair khatedari basis and on lease hold basis shall be for a period of 20 years.

8. Application for Allotment of land .- (1) Every person other than Companies and Government Undertakings shall submit an application to the District Collector and Companies and Government Undertakings shall submit an application to the State Government, in Form-'A'. alongwith following documents in triplicate duly signed by the applicant:-

(a) Site Plan of the wasteland;

(b) Project Report;

(c) Building Plan of bio-fuel based industrial purpose processing unit, if any;

(d) Copy of bye-laws, articles of association or partnership deed (wherever is applicable).

(2)Application by Companies, Public Undertakings and Societies shall be accompanied by a registration fee of Rs. 1000/- and security amount equal to Rs. 400/- per hectare. The security amount shall be adjustable on successful implementation of the project.

9. Allotment of wasteland.- On the receipt of application under rule 8, the application shall be scrutinized at appropriate level and after scrutinizing of the application, allotment of wasteland shall be made as follows:

(a) the wasteland up to 100 hectare shall be allotted (except to companies and Government Undertakings) by the District Collector on the recommendation of District Committee comprising of the following:- (i) District Collector	:Chairman
(ii) Additional Collector (Administration)	: Member Secretary
(iii) Concerned Member of Legislative Assembly	: Member
(iv) Divisional Forest Officer	:Member
(v) Joint/Deputy Director, Agriculture	:Member
(b) The wasteland upto 1000 hectare shall be allotted to Companies and Government Undertakings by the State Government on the recommendation of committee comprising of the following:- (i) Chief Secretary	: Chairman
(ii) Principal Secretary Revenue	: Member
(iii) Principal Secretary, Agriculture	: Member
(iv) Principal Secretary, Industries	: Member
(v) Commissioner, B.I.P.	: Member
(vi) Commissioner, bio fuel Authority	: Member
(vii) Deputy Secretary, Revenue(Gr.6)	: Member Secretary.

The wasteland more than 1000 hectare shall be allotted to Companies and Government Undertakings by the State Government on the recommendation of BIDI. The proposal for allotment shall be scrutinized by the Committee mentioned in clause (b).

(d) The allotment shall be made in form 'B':

(e) Only one company shall be allotted Land in a zone of 5000 hectare. If there are more than one applicants for a zone, the allotment shall be decided in favour of a company requesting for the less land.

10. Premium of Land.- (1) In case the wasteland is allotted on lease hold basis, the lessee shall pay a premium for the land equal to 20% of the DLC rate prescribed for the lowest category of barani land of the area.

(2) No premium shall be charged on the land allotted on gair khatedari basis.

11. Recovery of Premium.- The premium of wasteland allotted on lease hold basis shall be deposited by the lessee within a period of 30 days from the date of receipt of intimation for depositing the amount:

Provided that the allottee may deposit the said amount within next 60 days with interest @ 15% p.a. In case of default, allotment of land shall automatically stand cancelled.

12. Lease Rent.- (1) The annual lease rent for the wasteland allotted to Companies, Government Undertakings and Societies shall be 10 times of land revenue of lowest category of barani land in that tehsil.

(2) The State Government may revise the annual lease rent at any time, which shall be payable by the lessee.

13. Interest on late payment of lease rent.- If the lease rent is not deposited within the specified time, the interest at the rate of 12% p.a. shall be charged on the due amount.

14. Terms and Conditions of allotment of land.- The allotment of land under these rules shall be made on the following conditions:-

(a) Land allotted under these rules shall be used only for the purpose for which it is allotted. However, the allottees may utilize 2% of the allotted area or 10 hectare of land whichever is less for storage of raw material, storage of finished goods, labour quarters and factory shed.

(b) The allottee shall have to utilize 50% of the land for plantation within two years from the date on which possession was handed over and the balance shall have to be utilized for plantation within next one year otherwise the allotment shall deemed to have been cancelled automatically.

(c) The allottee shall be liable to make payment of all taxes, which may be leviable under the appropriate laws.

(d) The allottee shall abide by all the terms and conditions of these rules and other applicable laws as amended from time to time.

(e) The allottee shall give preference to the local residents of the area in employment.

(f) The alottee shall use the allotted land himself and shall not transfer/sub-lease the land.

(g) It shall be compulsory to adopt micro irrigation management system as per latest technology.

(h) The allottee shall not make any construction of permanent nature without obtaining prior approval of the allotting authority.

(i) Allottees other than Companies shall sell the produce to the Company situated in that zone at the minimum support price as fixed by the Bio-fuel authority.

(j) The Company shall purchase the produce from the other allottees situated in the zone at the minimum support price fixed by the Bio-fuel authority.

15. Execution of Lease deed.- In case where allotment is on lease hold basis, the allottee shall execute an agreement of lease in form 'C' within a period of two months from the date of deposit of premium. If the allottee fails to execute an agreement within the said period, the allotment order shall be deemed to have been revoked and the security amount shall be forfeited.

16. Conditions of mortgage.- The allottee shall be required to take permission from allotting authority for any mortgage of land for raising funds for development of land for which following conditions shall have to be fulfilled:-

(i) The land can be mortgaged only to the Nationalized Banks or the Scheduled Banks approved by the Reserve Bank of India and other Financial

Institutions approved by the Revenue Department, Government of Rajasthan.

(ii) 1% of Mortgage fee shall be remitted to the Collector.

(iii) The State Government shall have first charge on the land so mortgaged.

17. Surrender of Land.- If an allottee is unable to utilize the land allotted to him or otherwise, he may surrender the land to the allotting authority at any time but the amount deposited by him would not be refunded and no compensation in lieu of expenditure incurred by him for development of land shall be paid.

18. Cancellation of allotment.- On the recommendation of the Collector, the State Government may cancel the allotment of land if the land is not used for the specified purpose in the stipulated time by the allottee or if he violates any of the conditions prescribed under these rules and on the cancellation of allotment, the land shall revert to the State Government free from all encumbrances without payment of any compensation in lieu of expenditure incurred or any development made on the said land. The person in possession of the said land after cancellation shall be deemed to be a trespasser under section 91 of the Act and shall also be liable to pay the Rs. 1000/- per hectare per month till the vacation of the land. Any amount remaining due against the allottee shall be recoverable as areas of land revenue.

Provided that no such order shall be passed without giving an opportunity of hearing to the lessee.

19. Power of State Government to resume the wasteland.- Whenever the wasteland allotted under these rules is required by the State Government for any other special purpose in public interest, it can resume the land after giving three months notice to the allottee.

20. Interpretation of rules.- If any difficulty arises in the application or interpretation of any of these rules, it shall be decided by the State Government in the Revenue Department, whose decision thereon shall be final.

21. Repeal and Savings.- (1) The Rajasthan Land Revenue (Allotment of Land for Agro based Export Oriented Produce Purposes) Rules, 1996 are hereby repealed.

(2) All Notification, Circulars, Orders issued by the State Government from time to time in relation to matters covered by these rules shall stand superseded as from the date of the commencement of these rules.

(3) Any action taken or orders issued under repealed rules shall be deemed to have been taken or issued under these rules.

ANNEXURE- III

QUESTIONNAIRES

No: /V/_____

QUESTIONNAIRE FOR BASE LINE INFORMATION : VILLAGE

Please read all the questions carefully. Instructions are given in small letters for many questions to give you idea about expected answers…but don't force them to villagers, get their view, its very important.

The respondents are required to mark a tick (√) in the relevant box. In case more than one option apply, tick (√) more than one box.

Identification of Village

Name	
Gram Panchayat	
Block	
District	
State	

Demographic Particulars

Item	**Numbers**
Total Population	
Male	
Female	
SC population	
ST population	
No. of Households	
BPL families	

Occupational Classification

Item	**Numbers**
Cultivators	
Agricultural Labour	
Traders	
Artisan	
Others, specify	

Land Use

Item	**In acres**
Total Area	
Topography (**tick (√)**	flat/ Undulating/ Hilly
Cultivable Land (Agriculture land)	
Fallow land (cultivated some time like once in year or two)	
Forest land	
Waste land	
Gao Samaj Land **(please explain its present use**)	Present use, _____
Net Irrigated Area	
By Irrigation facilities (**should be equal or more to Net Irrigated area)**	
Canal	
Tubewells	
Open wells	
Tank	
Other	
Which are the main Crops grown in Your village **(write name of the Crop and acreages)**	
1	
2	
3	
4	

Specific for the Jatropha plantation

Area planted under Jatropha crop in your village (acres)	
From which year plantation of Jatropha is taking place?	
How much area is planted every year	Year_____ acres_____ Year_____ acres_____ Year_____ acres_____

On which type of land (**tick (√)**, give approx. acreage	Waste land ------ acres_____ Fallow land ------ acres_____ Gao samaj Land ------ acres_____ Agriculture Land ------ acres_____
Is survival is good (80% and above)	Yes/ No
IFNO,	Existing survival rate_____%, reason for low survival 1 2 3
Why Villagers are cultivating Jatropha give three main reasons ▪ **it could be give better profit, in case ask how much profit they expect** ▪ **It could be use of unused land** ▪ **Any other**	1 2 3
Who told about Jatropha plantation (Govt/ NGO/ any other)	
Who provided planting material and at what cost?	
Any training was provided to the farmers	
Any financial/ material (**fertilizers pesticides etc**) support for plantation? **If yes** how much per acre (**in Rs or material**)	
General comment on the Jatropha plantation by villagers, good or bad (**write whatever villagers say, can use back of this questioner if required**)	

List the names of farmers who planted Jatropha in this villages

Name of Farmer	Year of Plantation	Number of saplings	Area (acres)

(if required use back side of the page)

Use of Energy (tick (√)the relevant could be more than one)

Cooking & household use (write specific) mainly used in village	fuel wood/ dung/agro waste/ kerosene/ coal/ LPG
Lighting- Electricity, if yes How much time electricity available/ day)	Hours/ day____
Lighting-other source	Kerosene/ LPG lamps/
Irrigation	Diesel pumps/ electric motors

Name (s) of Respondent:

Name of interviewer: **Date:**

No: /F/_____

QUESTIONNAIRE FOR BASE LINE INFORMATION : FARMER

Please read all the questions carefully. Instructions are given in small letters for many questions to give you idea about expected answers…but don't force them to the farmers, get their view, its very important.

The respondents are required to mark a tick (√) in the relevant box. In case more than one option apply, tick (√) more than one box.

Take Photographs, wherever sing is provided

Identification of farmer

Name of farmer (M / F) **&** Telephone number if any	
Gram Panchayat/ Village	
Block	
District	
State	

Family Profile

Item	**Numbers**
Total number of family members	
Adult Male	
Adult Female	
Children	

Apart from framing what are other occupations you are involved?
___ Business man, _____ Government employee _____ Worker in a private company,

Any Others (please specify.....)

What is your annual income? (please ask for breakup.. like from agri + wage labourer + business +é this will be approx figure**): Rs……../year**

How much daily wages is paid to : Male _____ Rs/ Day & Female _____ Rs/ day in your village

Land Use

Item	In acres
Agriculture land owned	
Agriculture land on hire/rent	
Total land in possession	
Actually cultivated under crops	
How much land is kept fallow (not cultivated)	
Irrigated area if any in acres	
Source of irrigation (wells /tube well/ tank etc)	
Topography (**tick (√)**	flat/ Undulating/ Hilly/ other
Land Type (local classification like fertile/ medium/ low fertile),	
Which are the main crops grown on your land, 1 Crop_____ area_____ acre and Yield_____ quintal/care 2. Crop_____ area_____ acre and Yield_____ quintal/care 3. Crop_____ area_____ acre and Yield_____ quintal/care 4. Crop_____ area_____ acre and Yield_____ quintal/care	

Specific for the Jatropha plantation

Area planted under Jatropha crop by you?	Area_____ acres Number of sapling_____ Spacing between two plants (in feet)_____
In which year	
If planted in **again**..How much area is planted every year	Year_____ acres_____ Year_____ acres_____ Year_____ acres_____
On which type of land plantation is carried out by you (**tick (√)**, give acreage	Waste land ------ acres_____ Fallow land ------ acres_____ Agriculture Land ------ acres_____ Sandy with dunes:_____ acres_____
If waste land, who own this land (your own/ revenue department/ forest department	

any other) and who provided this land for plantation	
Any agreement was signed by you?, if yes, can you give copy of this agreement	
Type of land on which Jatropha was planted (local land classification**)** (**tick (√), - take photograph**  **of land**	Flat/ Undulating/ Hilly Fertile: High/ Medium/ Low Color of soil:_____ Texture: sandy/ clay/ mix/ gravel or any other
How you rate this land	Good Agriculture land Bad Agriculture land Not fit for agriculture at all (degraded)
How far this land is from his home	_____ kms
How many plants were planted by you (numbers)	
Who provided this plant and at what price? (it could be free also)	
Is survival is good (80% and above)	Yes/ No
IF not,	Existing survival rate_____%, reason for low survival 1 2 3
Have you **replanted** in place of dead plants	**If yes,** how many saplings**____** and at what cost _____ Rs/ plant **If NO, why? Mark (√),** Non availability of saplings:__ No money:__ Any other_____
Any Irrigation? **If yes**, How many times crop was irrigated and source of irrigation	YES/ NO Number of irrigations_____ Source of irrigation _____
Have you applied fertilizer	Yes/ NO, if yes quantity___ Kgs/ acre
Who provided fertilizer? mark **(√),**	Purchased by you? As part of subsidy?

Why you decided to Plant Jatropha on your land give three main reasons (motive could be higher profit, use of unused land, govt subsidy or any other, take his views)	1 2 3
Do you think these objectives are fulfilled**, if no,** reason?	
Who told you about Jatropha plantation (Govt/ NGO/ any other)	
Who provided planting material to you and what cost (cost per plant)	
Any training was provided, **if yes** please specify what was covered under this training	
Any financial/ material support for plantation? (Cash/ **fertilizers/ pesticides etc**) **If yes** how much per acre (**in Rs or material**)	
After plantation any support provided form that organization. **If yes** what type? Explain	
What yield is obtained (how much seed you collected) Kgs	
Approx. yield per plant (if this is difficult to explain, ask from how many plants he got this yield)	
Where you sold these seeds (mandi / local trader/ NGO/ Govt agency), **if not sold** what for they are used?	
At what price per/Kg	
Are you satisfied with the price?	Yes / NO (**if No,** ask next question)
If NO, How much minimum price he expects? (Rs/ Kg) and why ?(it could be high cost of collection, low yield)	
What for these seeds are used? (for oil that is used as bio-diesel, please ask farmers their answer and note that)	

Any oil extraction unit for these seeds nearby, **if yes,** how far **(km)**	
Are you aware of other usage of this plant	
After how many years of plantation do you think this will provide economic benefits to you **OR** It will not be beneficial at all? **WHY**?(write whatever farmer says, can use back of this questioner if required)	
After seeing your plantation how many other farmers also planted Jatropha in your village? **If NO one, reason**	

Specific Information on Jatropha plant (TAKE PHOTOGRAPH OF PLANTS)

Which variety of Jatropha was planted	
How many Plants survived first year	
What was the average height of plant in feet	1st Year- 2nd Year 3rd Year
Girth of stem (inches)	
Flowering after how many years of plantation	
Approximate seeds collected from	Well grown plant--- Small plant---
Any dieses observed, if yes, give some detail	

Cost of Cultivation of Jatropha Crop (per acre) This is very important question and read instructions carefully given in small letters in the brackets

Item	In Rs
Land Preparation (leveling/ weed removing/ Plowing etc)	
Planting material ((seedling) numbers and cost per seedling and how many they planted per acre and thus calculate cost per acre)	
Plantation cost (digging of pits and then planting ask for approx cost per pit and then calculate total cost)	
Fertilizer, if applied	

Irrigation if any (ask for the cost)	
After care	
Gap filling (re-plantation of the dead Plants), if carried out how many plant were planted again and their cost	
Total cost of plantation	
Any subsidy received, if yes how much and in which form(planting material/ fertilizer or cash)	

Use of Energy (tick (√)the relevant could be more than one)

Cooking & household use (write specific) mainly used in village	fuel wood/ dung/agro waste/ kerosene/ coal/ LPG
Lighting- Electricity, if yes How much time electricity available/ day)	Hours/ day____
Lighting-other source	Kerosene/ LPG lamps/
Irrigation	Diesel pumps/ electric motors

Name (s) of Respondent:

Name of interviewer: **Date:**