An assessment from small farmers' perspective

आरोग्य, ऊर्जा, शिक्षण आणि पालकत्व
या विषयांतील विशेष प्रयत्न

Jatropha in Horticulture Program of Employment Guarantee Scheme

Why this study?

After a long wait, the Maharashtra government declared its Jatropha plantation policy in April 2006 and included Jatropha in the Horticulture linked EGS program of the state. Generating new employment opportunities and sustainable means of development are the main objectives of the Horticulture linked Employment Guarantee Scheme (EGS) program. The scheme is targeted to attract small farmers in the state.

Considering the stakes involved of the rural economy and farmer community and the long-term implications of the policy, the Resources and Livelihood (ReLi) group of PRAYAS decided to conduct a study with an aim:

- To analyze the technical and economic factors on which the feasibility of Jatropha depends
- To review the current status of the National Mission on Bio-fuels
- To study the recently declared Jatropha-EGS policy by Maharashtra Government
- To assess the potential of Jatropha to become an economic asset and to generate employment opportunities
- To raise policy level concerns with focus on EGS

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Chapter 1

Introduction

Today, Bio-diesel and Jatropha have become buzzwords in the oil industry and horticulture sector for the business opportunities they present and in government programs for strategic reasons like natural energy security as well as poverty alleviation. Governments, multinational companies and Indian firms are investing heavily in their attempt to promote Jatropha plantation all over the country. The root of this excitement can be traced back to the year 2002 when the Government of India established a Committee on Development of Bio-fuels under the chairmanship of Member, Planning Commission.

The committee submitted its final report in July 2003 to the PMO (Prime Minister's Office) and subsequently it was decided that the Ministry of Rural Development (MoRD) would act as the nodal ministry to implement the recommendations of the committee. One of the major recommendations of the committee was to move progressively towards 20% blend of biodiesel with petro-diesel by the year 2011-12. It was therefore proposed to launch "National Mission on Biodiesel", with an aim to produce enough seed material for production of biodiesel to achieve the target of 20% blend.

The program is being implemented in phased manner. The demonstration phase (Phase I) is spread over three years (results expected by 2006-07) and aims to bring 4 lakh hectare (Ha) land under plantation (2 lakh Ha plantation each in forest and non-forest land).

The national mission and the demonstration phase is an integrated project with six different micro missions namely:

a. Plantation on Forest Lands,
b. Plantation on Non-forest Lands,
c. Plantation on Other Lands,
d. Procurement of Seed and Oil Extraction,
e. Trans-esterification, Blending and Trade,

f. Research and Development (raw material, production technology, fuel utilization)

The micro-missions of the demonstration phase are designed to lay foundation of the self-sustaining Phase II of the program and to achieve the envisaged target of 20% blending by year 2011-12.

Poverty Alleviation and National Bio-Diesel Mission

Apart from reducing country's dependence on oil imports and reducing pollution levels through use of bio-diesel, implementation of the national mission is expected to generate many benefits that can lead to economic improvement of rural India. The report of the 'Committee on Development of Bio-fuels' lists the following major benefits of the demonstration phase:

- It will act as a major pro-poor initiative, generating massive income and employment opportunities for the poor, thus, an effective instrument for poverty alleviation.
- It will act as a major step towards improving the land resources, drought proofing, greening of degraded lands, soil and moisture conservation.
- The entire project, from plantation up to primary processing stage—involving seed collection, procurement and oil extraction at the village level—will be driven by community and farmers, thus, resulting in empowerment of the poor and their community in resource poor areas.

In addition, the report suggests that MoRD may take up plantation under the Integrated Watershed Development Program (IWDP) and other poverty alleviation programs. The report assigns Department of Rural Development, Department of Land Resources and Council for Advancement of People's Action and Rural Technology (CAPART) the responsibility for plantation in degraded and wastelands in districts other than those included in the Demonstration Project, using the funds available under IWDP, Swarnajayanti Gram Rozgar Yojna (SGRY), Swarnajayanti Gram Swarozgar Yojna (SGSY) etc.

The report claims that the proposed plantation on 4 lakh Ha in the demonstration phase alone will generate 1276 lakh person days of work during the Tenth Plan. In addition, seed collection will provide sustainable employment to the tune of 80 lakh person days or 1.22 lakh person years. Thus, as per the report, bio-diesel development by itself could become a major poverty alleviation programme for the rural poor, apart from providing energy security to the country in general and to the rural areas in particular and upgrading the rural non-farm sector.

On this background, it is natural that the Maharashtra state government is thinking to make Jatropha plantation a rural development program. The Maharashtra government is planning to bring 50,000 acres (20,000 Ha) of land under Jatropha plantation through the EGS. This proposed

plantation is other than what is planned under the national mission.[1]

Why This Study?

National Mission on Bio-fuels is an ambitious program with multiple facets like energy security, pollution control, rural development, and poverty alleviation through employment generation. While the national mission is still in its nascent stage, there is no dearth of private companies and individuals that are claiming to possess quality seeds with high oil-content and high yield potential. The farmers are being enticed with prospects of huge income and benefits that would supposedly come from Jatropha plantation. On the other hand, various reports in the print media have often provided contradictory information on the economics and technical feasibility of Jatropha, the issues that are dear to any farmer. At the same time, the various state governments are busy in developing their own bio-fuels policy.

After a long wait, the Maharashtra government declared its Jatropha plantation policy in April 2006 and included Jatropha in the Horticulture program of EGS of the state. Generating new employment opportunities and sustainable means of development are the main objectives of the Horticulture program of EGS. The scheme is targeted to attract small farmers in the state.

Typically, Jatropha is expected to have biological life of 40-45 years (economic life of minimum 30 years). Naturally, any scheme involving Jatropha will have equally long term impact. Considering the stakes involved of the rural economy and farmer community and the long-term implications of the policy, the Resources and Livelihood (ReLi) group of PRAYAS decided to conduct a study with an aim:

1. To analyze the technical and economic factors on which the feasibility of Jatropha depends
2. To review the current status of the National Mission on Bio-fuels
3. To study the recently declared Jatropha-EGS policy by Maharashtra Government
4. To assess the potential of Jatropha to become an economic asset and to generate employment opportunities
5. To raise policy level concerns with focus on EGS

This was done mainly through literature search, personal discussions with government officials, agricultural scientists, and business personalities who are in some way connected with activity of Jatropha plantation. However, the present study considers data (regarding seed-yield and oil-content) available only from non commercial sources, as there is no independent mechanism to cross-check the data coming from commercial sources.

[1] Source: Marathi daily 'Sakal' 14th April, 2005.

Credits

We gratefully acknowledge Dr. M. R. Manjare for updating us on the efforts going on in Mahatma Phule Krushi Vidyapith (MPKV, Rahuri) as part of the "National Network for Integrated Development of Jatropha" and Prof. Mahesh Shelar (Nashik) for sharing the information of the techno-economic aspects of Jatropha plantations. Discussions with Mr. Aniruddha Shirke (Shirke Bio-health Care Pvt. Ltd.) and Mr. Murali Kamathe (Purandhar Agro & Biofuels) helped us to understand the opportunities and economics of Jatropha plantation. Discussions with many other individuals helped us greatly to broaden our understanding of the subject. Individual references to all these contributors have been avoided, only in order to maintain brevity.

The report presents the outcomes of the study from the perspective of small farmers and other poor sections of agrarian communities that are supposed to benefit from EGS. The ReLi group is completely responsible for all the omissions and shortcomings in this report. All suggestions and comments on this report are welcome. We hope that this report will act as a base for taking the debate on this issue further.

Chapter 2

Current Status of Technology

Jatropha curcas is found in wild in many parts of the country. It is a hardy shrub and is not browsed by cattle. The plant can grow in diverse climatic conditions and different soil-types that exist in India. It can survive in arid or semi-arid conditions, and can also face severe drought. All these features make it a plant chosen for the countrywide plantation by the Bio-diesel Mission.

However, the wide occurrence of the plant comes with variation in 'oil-content' and 'seed-yield', the two key parameters on which success of the Bio-fuel mission—as well as of the Jatropha plantations and planters—is largely dependent.

Variation in the Key Parameters

Different types of data are available on variation in these key parameters. The data available on the 'oil-content' of Jatropha seeds is only from one official source. In contrast, there is more data and information on 'seed-yield' from different sources.[2]

The survey carried out by National Oil-seeds and Vegetable Oils Development Board (henceforth referred only as NOVOD) as part of the "National Network on Jatropha" reported variation in 'oil-content' from 21% to 48%. The 'oil-content' in the seeds collected from Maharashtra ranged from 21% to 42%.[3]

While conducting this present study, it was found that the annual seed-

[2] This document is focused on data either from noncommercial, academic/ research sources or data that comes from public-owned agencies. In other words, data and information coming from commercial sources are not considered, for the want of validation or verification by reliable, independent authority.

[3] Source: NOVOD: First R& D Report on TBO's.

yield of Jatropha is highly variable and ranges from 0.4 tons/Ha to 12 tons/Ha.[4] In Maharashtra, the only publicly reported results of Jatropha plantation are from Mr. Vinayakrao Patil, a pioneer in Jatropha plantation and Chairman of Maharashtra Agro-forestry Federation (Nashik). According to him, results of Jatropha plantation raised on over 20,000 acres of land between 1986 to1994-95 are not very encouraging, with yields of 1 to 1.5 tons/Ha in the third and fourth years.[5]

A paper presenting the techno-economic analysis of Jatropha plantation, based on a field-study in the Maharashtra state, shows that the most representative figure for yield in the third year under rain-fed conditions in Maharashtra is 1 Kg/tree.[6] Very low yields of 0.8 Kg/tree were seen in some parts of Nashik under rain-fed conditions. The best scenario in the third year (i.e. 10 tons/Ha) was witnessed in few places of Solapur district, but only under irrigated condition and intensive cultivation.

Impact of Key Factors

The yield of seeds and the oil-content of seeds will be affected by either one or a combination of the following factors:

a. Genetic Variability of the Planting Material
b. Soil Type
c. Irrigation and Agro-Climatic Practices
d. Plantation Density
e. Pests and Diseases

Genetic Variation

Genetic variability is a common feature of any widely occurring bio-organism, which often is a result of climatic variations in which the species has been growing. This genetic variability is, in turn, manifested in various parameters like growth (height), water dependence, seed-yield, resistance to pests and diseases, fruiting and oil-content. The variation in these key factors due to genetic variability could be addressed by developing quality planting material that has standard benchmark values for these parameters.

Soil Type

In addition to genetic variation, the type of soil used for Jatropha plantation will also affect the seed-yield. Though, in principle, Jatropha can grow on different types of land, the seed-yield is not uniform in these different types of land.

In relatively poor soils such as those in Kutch (Gujrat), the reported seed-yields are 1 Kg/plant. In lateritic soils of Maharashtra (Nashik), the reported yields are between 0.75 to 1 Kg of seeds/tree.

[4] Source: Report of the Committee on Development of Bio-fuels, 2003.
[5] Source: NABARD Proceedings of the Meeting on Jatropha and Biodiesel, Mumbai, 3rd February 2005
[6] Source: Shelar M.N, Barhate S.D and Pethkar V.D., International Congress on Renewable Energy for Sustainable Development - ICORE, 2006.

In "suitable plantation", Jatropha yields about 2 Kg of seeds per tree.[7]

Studies done at Tamil Nadu Agriculture University (TNAU, Coimbatore) indicate that soil with medium/moderate fertility is required for greater yield.[8] While research carried out at Indira Gandhi Agricultural University (IGAU, Raipur) indicates that the growth is stunted in eroded lands, and in low fertility lands. Alkaline lands also affect growth of the plant.[9]

Thus, there is direct co-relation between soil-type and growth as well as between soil-types and seed productivity. In low quality soils on waste-lands, the seed-yield would be lower.

Cultivation Practices

Jatropha can survive in arid or semi-arid conditions and can face severe drought. As mentioned before, this low water requirement for survival is one of the reasons behind selection of Jatropha for the national mission. However, for optimum yields, standardization of agricultural or cultivation practices —such as frequency and timing of irrigation and doses of fertilizers— is vital. Some information about effect of irrigation on seed-yield is provided here, though other cultivation practices might have significant impact on seed-yield.

The report of Committee on Development of Bio-fuels mentions that it is adequate to provide three irrigations in the first year and just one from second year onwards. According to the document published by TNAU (Coimbatore), irrigation at every fortnight interval is essential to ensure year-round production and harvest of seeds. Thus, regular irrigation seems to be essential for maximizing flowering and fruiting. It is worth to note here that Andhra Pradesh, under its Jatropha Policy, is offering 90% subsidy to all farmers for installing drip irrigation system.[10]

Frequent irrigations will increase seed-yield as well as expenses. Therefore, differences in the irrigation practices will directly affect the economics of Jatropha. However, it must be highlighted here that if the planting material is of poor quality, even frequent irrigations might not prove helpful to increase the yield in a significant proportion.

Another important point to note here is that the appropriate cultivation practices will vary with the climatic conditions that prevail in different regions of the country. Further, the seed-yield seems to be significantly dependent on use of cultivation practices (including irrigation) that are adapted to local conditions.

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[7] Source: Report of Committee on Development of Bio-Fuels, 2003.

[8] See for reference abstract of the TNAU document and its link given in Appendix III.

[9] Source: "Does Jatropha Warrant Increased Scientific and Financial Inputs," a paper presented by S. Puri & S. L. Swamy in proceedings of BAIF Workshop on 'Jatropha and Other Perennial Oilseed Species'2003.

[10] Source: http://www.aponline.gov.in/Apportal/Mainpage.doc

Under "very good conditions", the seed production is reported to be as high as 5.0 Kg/tree or 12.5 metric tons per hectare.[11] But in rain-fed conditions (lack of irrigation) and poor soils, seed-yield could be as low as 0.6 Kg / tree or 1.5 metric tons/ Ha.[12] Thus, the higher seed-yield is likely to be possible only from plantations on medium quality soils using quality-planting material and after standardization and adaptation of cultivation practices (such as irrigation, fertilizers, and pruning).

Pests and Diseases

There is a strong belief that Jatropha is free from attack of pests and diseases. The First R&D Report on TBO's (by NOVOD) makes no mention of pest and disease problem. The current absence of pests and diseases may be very well due to the small sizes of existing plantations. As bigger plots are brought under monoculture plantations, the Jatropha plants may also become prone to pests and diseases.[13]

Reports of pests and diseases on Jatropha have gradually started emerging. According to Mr. S. Puri (from Department of Forestry, IGAU, Raipur), some of these pests and diseases are not yet even identified.[14]

The document published by TNAU (Coimbatore) on Jatropha reports presence of pests such as Bark Eater (*Indarbella sp*) and Capsule Borer.[15] Pests like metallic beetle as well as diseases like fungal infections are observed at the plantation site in the campus of Mahatma Phule Krushi Vidyapith (MPKV), Rahuri.[16]

'D1 Oils', a private company, has reported several pests and diseases on Jatropha plants. These include Calidea Bug, Fruit Borer, Leaf Webber, Weaver Caterpillar, Mite Infestation, and Root Rot Symptoms.[17]

Thus, there is need to acknowledge that Jatropha can be prone to diseases and pests, especially when large-sized monoculture plantations are established on a wider scale.

Plantation Density

The yield estimations made by the Committee on Development of Bio-fuels as well as by NOVOD, are based on the assumptions of plant density of 2500 plants/Ha. This plantation density proposed by the mission is also a cause of concern since the mission mainly plans to use degraded lands for Jatropha plantations.

Higher density of plantation will be more suitable for fertile land. The report of the Committee on

[11] Source: Report of the Committee on Development of Bio-fuels, 2003.
[12] In the rain-fed areas, the minimum expected rainfall is 600mm to 1500mm.
[13] This seems to have happened in the case of Chickoo plantations in northern Konkan region.
[14] Source: *Down To Earth: The New Money Plant, Page 30-39, Nov 30, 2005*
[15] See for reference abstract of the TNAU document & its link given in Appendix III.
[16] Source: Personal communication.
[17] Source: Presentation by Mark Quinn, Founder Director, D1 Oils., at 5th Global Forum on Sustainability, Vienna 11-13th May 2005.

Development of Bio-fuels mentions that, in one trial in rain-fed areas on poor soils, a plantation density of 1660 plants/Ha has been felt to be more desirable. Similarly, Dr. M. R. Manjare (Forage Breeder, MPKV, Rahuri) has also favored plantation density of 1660 and explained that the lesser density results in reduction in competition for resources and better scope for higher branching and growth after pruning.[18] Thus, the plantation density appears to be dependent on site and resources. The plantation density, in turn, will certainly affect the seed-yield per unit of land.

Efforts by the NOVOD Board

Since November 2004, the NOVOD board has undertaken an initiative named "National Network for Integrated Development of Jatropha" with the three objectives:

a. To improve quality of planting material (through selection and hybridization)

b. To produce quality planting material

c. To standardize the agricultural practices that are adapted to local conditions

Altogether thirty-two different universities and research institutes, spread across the country, are part of this national network. Two agricultural universities from Maharashtra, viz., PDKV (Dr. Panjabrao Deshmukh Krushi Vidyapeeth, Akola) and MPKV (Mahatma Phule Krushi Vidyapeeth, Rahuri) are part of the national network.

The participating research institutes and universities are trying to address the problems of variation in oil-content and seed-yield of Jatropha posed by genetic variation. In order to guide these efforts, NOVOD has set certain guidelines defining 'Quality Planting Material'. As per the NOVOD guideline, the 'Quality Planting Material' should have at least 30% of 'oil-content' and minimum seed-yield of 2 Kg of seeds/plant. Selection of quality/superior planting material is a major task for this integrated program, which will help to solve the problems created by genetic variation. Model plantations with selected superior planting material (minimum oil-content of 30% and yield of 2 Kg/plant) are being undertaken by NOVOD in total area of 10,000 Ha spread over 23 states. Of the total 10,000 Ha area under model plantation, 1130 Ha is in the state of Maharashtra. These model plantations are expected to start providing quality seeds from 2007-2008.

Besides selecting quality planting material, efforts are made to develop hybrid varieties of Jatropha with high oil-content and / or seed-yield. In a press release dated 10th May 2006, ICAR (Indian Council of Agricultural Research), reported a new variety of Jatropha (SDAUJ1), "Chatrapati", with 49.2% oil-content. Sardar-Krishinagar Dantiwada Agricultural University

[18] Source: Personal communication.

(SDAU, Gujrat), which is part of the national mission, has developed this variety.[19] The reported yields from this variety are between 1000 to 1100 Kg/Ha (Appendix V).

The Petroleum Conservation Research Association (PCRA) informs that a Jatropha variety with 1.5 times higher oil-content has been developed by NOVOD (http://pcra-biofuels.org/biodiesel.htm). Being in short supply, these improved Jatropha seeds will be supplied initially only to agricultural universities for multiplication and further development. It will take further 3-4 years to raise the stock of planting material of this improved variety. It is not clear whether the variety mentioned on the PCRA website is same as that of SDAUJ1.

In regard of the third objective, the institutions and agricultural universities involved in the demonstration phase (Phase I) of the national mission are expected to establish Jatropha specific cultivation / agricultural practices for each agro-climatic zone of the country.

Thus, efforts are being made to solve the problems created by genetic variation and other key factors affecting oil-content of seed and seed-yield. However, it is clear that such planting material will be available only after a period of at least 3 to 4 years. Similarly, experimentation and validation of suitable cultivation practices would take some time.

Summary of Findings

- There is lot of variation in two key parameters—viz., 'seed-yield' and 'oil-content'—which affect production of oil per hectare of Jatropha plantation.
- Genetic variability and different soil-types have significant impact on variation in these two key parameters.
- Standardized agricultural or cultivation practices that are locally adapted also have significant impact on improving and optimizing of two key parameters.
- There is a danger of increasing pests and diseases, with increasing monoculture or large-scale plantations, causing increase in the costs and ecological damages.[20] If not addressed in time, this problem might pose serious threat to seed-yield.
- While all these factors affect plant-level productivity, there is limitation on plantation density (the number of plants per unit area of land), especially in lower quality of soil and rain-fed plantations, putting limit on or reducing the productivity per unit area of land.
- The higher plantation density (2500 plants/Ha) is possible only if the soil quality is not poor and some irrigation is available. In other words, for rain-fed plantations on waste-lands—

[19] Source: http://www.icar.org.in/pr/10052006.htm

[20] Especially, in case of improved and hybrid varieties, increased susceptibility to pest and diseases has been observed historically.

which are going to be the conditions for most plantations in Maharashtra—the optimum plantations density would be 1660/Ha.

- The current research under the National Network for Integrated Development of Jatropha is in nascent stage. The package of adapted cultivation practices is still under development in most of the organizations participating in the program.
- The model plantations with superior planting material (2 Kg of seeds/tree, 30% oil-content) will not start providing quality planting material for other plantations before 2007-08.
- The variety developed by NOVOD with 1.5 times higher oil-content is still under testing and development. The supply of the planting material of this variety will take 3 to 4 more years.
- All these findings indicate that enhancement in the seed-yield and possibly oil-content cannot be achieved until NOVOD successfully completes its efforts for improvement in planting material and for its increased availability as well as for standardization of locally-adapted cultivation practices.
- Even after successful completion of NOVODs efforts,
  - Plantations in the rain-fed conditions are going to have significant lower production as compared to the irrigated plantations, unless varieties that are specially suited for rain-fed areas are developed.
  - Plantations in the poorer soils are going to have significantly lower production as compared to the plantations in good soils, in absence of external inputs.

Implications for the Nation-Wide Plantation

These findings also have important and wider implications for the feasibility of estimates of wide-scale efforts for plantation on the waste-lands.

The Report of Committee on Development of Bio-fuels estimates that about 134 lakh hectares of land is suitable for Jatropha cultivation. Of this, 24 lakh Ha land is fallow land and 20 lakh Ha land is wasteland, together comprising about 33% of the land estimated to be suitable for Jatropha plantation. As per NOVOD documents, the criteria for waste land is as follow:

Soil depth : 1.5 to 2 ft

Rain fall : 600 mm to 1500 mm

Soil type : All types of land including gullied, ravenous, upland with or without scrub, degraded lands under plantation, pastures, grazing lands, mining industrial waste land, hill slopes, fallow land etc.

Thus, NOVOD, under the category of waste-lands, has covered a broad spectrum of soil-types and also the lands in the rain-fed areas. The expected yield from these different soil-types and with different levels of water availability cannot be same. In some lands (with really poor soils and rain-fed conditions),

Jatropha may even yield less than 1 Kg per plant.

In the large tracts of lands categorized as waste-lands, especially under rain-fed conditions or areas with low-precipitation, Jatropha plantations can survive, but the yield-levels would be very low.

Chapter 3

Current Economics

On the background of the discussion of the technical factors involved in Jatropha plantation, this chapter discusses the economics of Jatropha plantations. The chapter begins with the discussion on key economic parameters, determining the economics of Jatropha plantations. It then engages in analysis of impact of these key parameters on two indicators of economic viability of Jatropha plantations.

Key Economic Parameters

The economics of Jatropha is largely determined by two key parameters, viz., a) the total cost of raising and maintaining the plantations, and b) total income from the plantation. The total income, in turn, depends on the total production of the seeds and the 'sale price' of the seeds. The sale-price of the seeds largely depends on the oil-content of the seeds. This section discusses the key parameters in detail.

Total Cost of Raising and Maintaining Plantations

The costs involved in raising and maintaining Jatropha plantations mainly include expenditure on three operations, viz., plantation, maintenance, and harvesting.

Plantation Cost

The estimation of costs involved in plantation and maintenance operations in the first two years (presented in Table 3.1, refer page 14) is derived on the basis of the information from NOVOD literature and the report of the Committee on Development of Bio-fuels (Year 2003). The initial costs include: the total cost of actual plantation in the first year (@ Rs. 10/plant) and the maintenance cost in the second year (@ Rs. 2/plant). The plantation cost includes costs of labour, fertilizers, plants, irrigation, weeding, and insecticides. The details of item-wise cost of

Table 3.1: Plantation and Maintenance Costs

Year	Cost Item	Cost (Rs) / Ha	
		Density 2500/Ha	Density 1660/ha
1st	Plantation	25,000	16,600
2nd	Yearly Maintenance	5,000	3,320
	Net Expenditure at End of 2nd Year	**30,000**	**19,920**

plantation are given in Appendix II. As we noted in the earlier chapter, there could be two different plantation densities depending on the soil-type. In addition to the plantation density of 2500/Ha, we will also consider plantation density of 1660/Ha for our calculations. Cost estimations for plantation density of 1660/Ha are derived from information present- ed in Appendix II on prorata basis.

The biggest variable in the plantation cost is the cost of the planting material. For this calculation, it is assumed to be Rs. 4 per plant. At present, there are various private nurseries and other agencies that supply *Jatropha curcas* planting material (seeds/saplings/cuttings). The prices of planting material range from Rs. 2 to Rs. 20 per plant. The quality of planting material will affect both the plantation cost and the subsequent yield.

Maintenance Cost

The maintenance cost in the second year (i.e. Rs. 2 per plant) is again based on information from NOVOD. The maintenance cost for subsequent years is, however, derived from the details of various factors of the maintenance cost for the second year. It is taken as Rs. 1000/- per hectare per year, irrespective of the plantation density, considering the nature of the cost factors involved in maintenance.

Harvesting Cost

The harvesting cost is again derived from the information provided by NOVOD. It is based on the 'seed-yield' per plant. The information from NOVOD says that two person-days of labour are required to collect 100 Kg of seeds. Thus, the harvesting cost for collecting 100 Kg of seed is considered as Rs. 120/- (with labour charges @ Rs. 60/- per person-day).

Total Income and Production

The final product from Jatropha plantation is Jatropha oil, or ultimately bio-diesel. However, it is assumed that the plantation owners would not sell oil, but would sell seeds that contain oil. Thus, the total income for the plantation owners depend on the total production or yield of seeds and the price that plantation owners would get for their seeds (i.e. the sale price of seeds). However, the sale price of seeds is dependent on the average oil-content of the seeds.

Average Oil Content

The survey carried out by NOVOD as part of the National Network on Jatropha reported oil-content variation from 21% to 48%. The oil-content in the seeds collected from Maharashtra ranged from 21% to 42%.[21]

Yield of Seeds

As mentioned in the previous chapter, the seed-yield figures vary widely, depending upon various factors. In this document, we are more concerned with the situation in the state of Maha- rashtra, wherein most Jatropha plantations—it is assumed—will be on waste-lands and in rain-fed conditions (without irrigation). For the plantations using the planting material available currently and raised in the conditions mentioned in the previous sentence, the yield values would be between 0.5 to 1.0 Kg per tree. This estimation is based on information presented in the previous chapter.

Sale Price of Seeds

At present, no indicative figures for the probable market price for Jatropha seeds are available from any of the government or independent agencies involved; neither has the Maharashtra state government declared any minimum support price for purchase of seeds of Jatropha. The only available indication about the price of Jatropha seeds is what could be gleaned from various cost estimations of bio-diesel that assume the seed cost to be Rs. 5/Kg for the seeds with oil-content 33%.[22]

Economic Calculations

In making calculations for assessing the economics of Jatropha plantation, we primarily depend on the assumptions made by NOVOD. However, one additional assumption is introduced here. This assumption takes into account the maintenance cost beyond the second year, which is required to carry out minimum level of maintenance of the plantation beyond the second year (refer assumption number 4). The assumptions made here are:

1. Plantation density is 2500 plants per hectare.
2. Total plantation cost for plantation on 1 hectare with density of 2500/Ha is Rs. 25,000/-.
3. The maintenance cost in the second year is Rs. 5000/Ha.
4. The maintenance cost in the subsequent years is Rs. 1000/- per hectare per year. This will include material cost component and labour cost component.
5. Continuation of maintenance from 3rd year onwards will add 8 person-days (PD) per year to the employment opportunities.

[21] Source: NOVOD: Ist R & D Report on TBO's.
[22] Here again, we are not considering the future prices promised by commercial enterprises, considering the uncertainties and risks involved.

6. The seed-yield is 1 Kg per tree for a mature tree.
7. It takes about 6 to 8 years to reach the stable seed-yield of 1Kg/tree.
8. To harvest 100 Kg of seeds, labour equivalent of 2 person-days (PD) is required.
9. At wage rate of Rs. 60/day, the cost of harvesting 100 Kg of seeds will be Rs. 120/-.
10. The sale price for seeds is Rs. 5/Kg
11. The plant is expected to give economic yield for minimum 30 years.

Table 3.2 provides the figures for the gross and net annual income (for seed-yield of 1 Kg per tree and for sale price of Rs. 5/Kg of seeds), based on above assumptions.

We can draw the following conclusions from Table 3.2:

- It will take 7 years (completed) to fully recover the costs for plantation, maintenance, and seed harvesting.
- From seventh year onwards, the farmer will earn a stable gross annual income of Rs. 12500/- per year. This means stable annual net income of Rs. 8500/ Ha, after deducting the maintenance cost of Rs. 1000/- per hectare and seed harvesting cost of Rs. 3000/-.
- In short, after stabilization of seed-yield level, the gross annual income per 100 trees will be Rs. 500/- and after deducting the cost of maintenance and seed harvesting, the net annual income per 100 trees will come to Rs. 340/year.

Economic Viability

In the previous part of the chapter, we accepted certain values for different parameters, while calculating the total costs and income.

Table 3.2: Annual Income from 1 Ha of Jatropha Plantation (Plantation Density 2500 plants/Ha)

Year	Average Seed Yield (Kg/tree/ year)	Total Seed Yield (Kg/Ha/ year)	Gross Income/ Ha/ Year (@ Rs 5 /Kg)	Expenditure(Rs/Ha)		Net Yearly Income (Rs/Ha)
				Plantation & Maintenance Costs	Seed Harvesting Costs	
1st	—	—	—	25000	—	-25000
2nd	0.1	250	1250	5000	300	-4050
3rd	0.4	1000	5000	1000	1200	2800
4th	0.5	1250	6250	1000	1500	3750
5th	0.8	2000	10000	1000	2400	6600
6th	1.0	2500	12500	1000	3000	8500
7th	1.0	2500	12500	1000	3000	8500
		Total	**47500**	**35000**	**11400**	**1100**

However, as we have seen in the previous discussion on technical and economic parameters, there is large variation in different key parameters. This variation in key parameters would certainly affect the economics of Jatropha.

Factors Affecting Economic Viability

In this part, we will see the impact of the three key parameters on economic viability of Jatropha. The first is the density of plantation, which is dependent mainly on the soil conditions and, to some extent, on the availability of irrigation. The second parameter is the yield or production of seeds, and the third is the sale price of Jatropha seeds, which, in turn, is dependent on the oil-content of the seeds as well as on various market factors.

It is useful to recall here that the seed-yield and oil-content (and hence the sale price of seeds) are dependent on the quality of the planting material.

Plantation Density

As mentioned before, depending on the soil-quality and, even sometimes, the availability of irrigation, the plantation density would change. We will consider two different plantation densities referred to in the earlier chapter:

a. 2500 plants/Ha (accepted by NOVOD and assumes availability of some irrigation) and,
b. 1660 plants/Ha for plantations on lower quality of soils and in rain-fed conditions.

Seed-Yield

We will assume three different values for average stabilized seed-yield after full maturation of plant, viz.,

a) 0.5 Kg per tree per year

b) 1.0 Kg per tree per year

c) 2.0 Kg per tree per year

The first two values are based on data available from existing plantations in Maharashtra.[23] The first chosen value is the lower bound of the range of yields recorded in the plantations on wastelands and in rain-fed conditions, whereas the second value is the most representative value for yield in the state for plantations in similar conditions.

The third of the chosen values is the yield from the plantations raised by using the quality plantation material that fits the definition of NOVOD, and which is expected to be available on wide scale, once the NOVOD project is over in 2007.

Sale Price of Seeds

The only data available on the sale price of Jatropha seeds from non-commercial sources is the indicative data on the purchase price of Jatropha seeds assumed in calculations of bio-diesel in the report of Committee on Development of

[23] Here, as mentioned before, we are considering data available only from non-commercial sources, as there is no independent mechanism to cross-check the data coming from commercial sources.

Biofuels. We take this as one of the indicative prices. The seeds priced at this level are assumed to contain about 30% to 35% of oil. This is close to the oil-content assumed in definition of the quality planting material from NOVOD.

Further, as mentioned before, the NOVOD survey found the oil-content of the seeds from plantation in Maharashtra is in the range of 21% to 42%.

Considering these facts together, we assume three values for the sale price:

a) Rs. 5 per Kg

b) Rs. 3 per Kg

c) Rs. 7 per Kg

The first is the probable sale price if market conditions are good and if the average oil-content is in the range of 30-35%. The second is the probable price, if market conditions are not good and/or the oil-content is less than 30%. The third is the very optimistic price, if there is high market demand and/or the oil-content is higher than 40%.

Main Economic Indicators for the Farmers

Assessment of economic viability of Jatropha plantation is based on two indicators of economic viability that are relevant to plantation owners. The indicators are:

a) 'The Year of the First Profit' or 'Years Required to Reach Profitability' and

b) Stable Annual Net Income (per hectare of plantation).

The first indicator pertains to the year in which all the cumulative investments made to pay for the plantation, maintenance, and harvesting operations are paid back. The second indicator pertains to the net income per year, once the yield-levels of the plants are stabilized.

Economic Viability under Different Conditions

This section looks into impact of variation in the three above-mentioned factors—viz., plantation density, seed-yield, and sale price of seeds—on the two economic indicators.

Calculations presented in Table 3.2 are repeated for different assumed values for the three parameters (mentioned in the previous discussion). The results of these detailed calculations are presented in the Appendix VI. Here, in this section, these results are presented in a summary form and are depicted in the form of tables and charts.

Years Required To Reach Profitability

The values for the first indicator, viz., 'Year of First Profit' or 'Years Required to Reach Profitability' from detailed calculations in Appendix VI are presented here in two steps.

In the first step, the values are presented in Table 3.3 and Chart 3.1 for plantations with the plantation density of 2500 trees per hectare.

In the second step, Table 3.4 and Chart 3.2 (Refer page No. 20) present the values for the indicator

'Year of First Profit' for plantations with the plantation density of 1660/Ha. In the steps, the tables and the charts present the years required to earn first profit (or to recover all the investment) for different combina- tions of values of the 'seed-yields' and 'sale-prices'.

Stable Annual Net Income

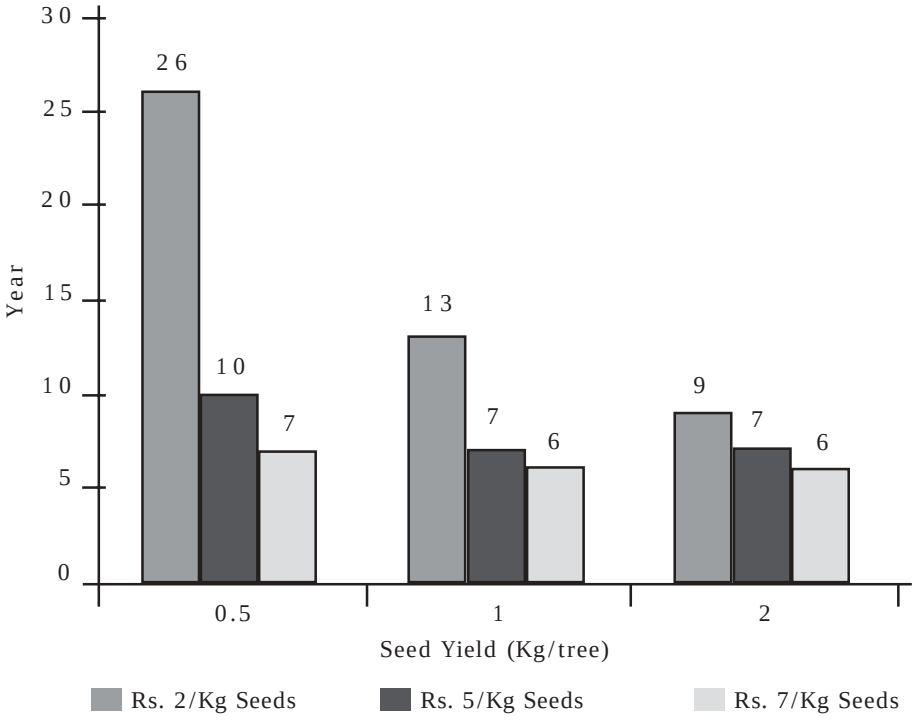
The values for the second indicator of Stable Annual Net Income for both of the plantation densities, viz., 2500 trees/Ha and 1660 trees/Ha from detailed calculations in Appendix VI are presented here in one single step.

Table 3.5 and Chart 3.3 (Refer page No. 21) present the stable annual yield figures as well as the figures for the stable annual net income for different combinations of values of the 'seed-yields' and 'sale-prices'.

Table 3.3: Year of First Profit for Plantation density 2500/Ha
(Years to Recover Entire Investment @ different seed prices)

Seed Yield	Seed Price		
	Rs 3/Kg	Rs 5/Kg	Rs 7/Kg
0.5 Kg/Tree	26	10	7
1.0 Kg/Tree	13	7	6
2.0 Kg/Tree	9	7	6

Chart 3.1 Year of first profit (Plantation Density 2500/Ha)



Implications for Plantations in Maharashtra

Before drawing any findings from the analysis presented in the tables and charts above, it will be useful to restate the different values of the three key parameters (seed-yield, seed price and plantation density) accepted for calculations. These are presented in Table 3.6.

Table 3.6: Values Considered for the Calculations

Seed Yield	Seed Price	Plantation Density
Kg/tree	Rs/Kg	plants/Ha
0.5	3	2500
1.0	5	1660
2.0	7	—

The rationale underlying the three different values of seed-yield, three different values of seed-price, and

Table 3.4: Year of First Profit for Plantation density 1660/Ha
(Years to Recover Entire Investment @ different seed prices)

Seed Yield	Seed Price		
	Rs 3/Kg	Rs 5/Kg	Rs 7/Kg
0.5 Kg/Tree	42	12	8
1.0 Kg/Tree	14	8	6
2.0 Kg/Tree	9	7	6

Chart 3.2 Year of first profit (Plantation Density 1660/Ha)

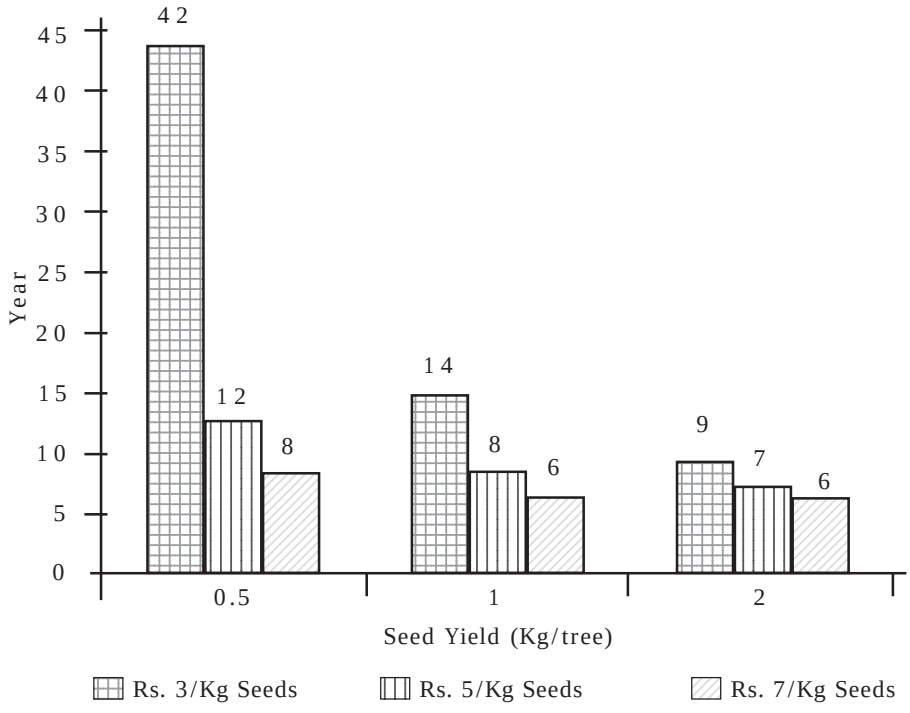
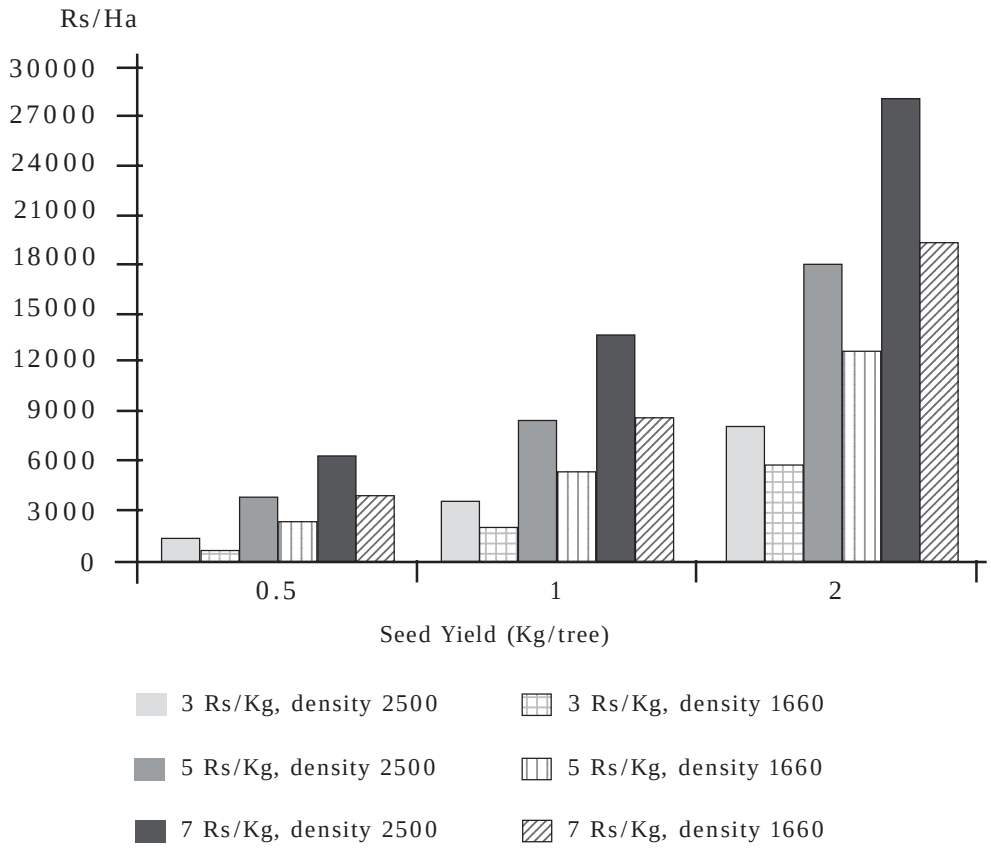


Table 3.5: Stable Annual Net Income

Seed Yield (Kg/Tree)	Stable Annual Yield (Kg/Ha)		Seed Price (Rs/Kg)	Stable Annual Net Income (in 7th Year) Rs/Ha	
	For Density 2500/Ha	For Density 1660/Ha		Density 2500/Ha	Density 1660/Ha
0.5	1250	830	**3**	1250	490
			5	3750	2150
			7	6250	3810
1.0	2500	1660	**3**	3500	1980
			5	8500	5300
			7	13500	8620
2.0	5000	3320	**3**	8000	5960
			5	18000	12600
			7	28000	19240

Chart 3.3 Stable Annual Income Comparison



two different plantation densities can be traced back to the detailed discussion presented in previous part of this chapter.

Plantations in Maharashtra, using existing plantation material, might get any of the three seed yield values and seed-price values mentioned above.

However, coming to the plantation densities, the higher plantation density (2500 plants per Ha) is possible only if the soil is not poor and some irrigation is available. In rain-fed plantations on wastelands, which are going to be the conditions for most plantations in Maharashtra, the appropriate density would be 1660 plants per hectare.

Based on this discussion, Table 3.7 provides the realistic values for plantations in typical conditions prevailing (waste-lands and rain- fed) in Maharashtra and using the currently available planting material.

Table 3.7: Realistic Values for Parameters for Plantations in Maharashtra

Plantation Density	**Seed Yield**	**Seed Price**
plants/Ha	Kg/tree	Rs/Kg
1660	0.5	3
—	1.0	5
—	—	7

Two Scenarios and Their Implications for Economic Viability

We can visualize two scenarios for assessing economic viability of Jatropha plantations in Maharashtra.

In first scenario—called the 'Current Scenario' or 'Business-as-Usual' scenario—the plantations are assumed to be using the currently available plantation material and are raised without the benefit of proven cultivation practices. In the second scenario called 'Improved Scenario', plantations are assumed to be using certified quality plantation material and proven cultivation practices developed after NOVOD experiment is successfully completed.

Table 3.8 depicts the three particular case combinations of the accepted range for the two parameters viz., seed-yield and seed-price, for each of the two scenarios. The cases are called worst, probable and optimistic.

The 'worst case' is combination of the lowest values of both the parameters in the range accepted in Table 3.7. This makes it the worst possible case in the scenario. The 'probable case' is combination of the values of both the parameters that have very high probability due to field conditions assumed in the given scenario. The 'optimistic case' is combination of highest values for both the parameters from the accepted range for both the parameters.

Table 3.9 gives the values for the two indicators of economic viability for all the three cases in each scenario that will help make comparison between the two scenarios.

Data in Table 3.9 can also be presented in a different format which is more suitable for comparison between the two scenarios.

Table 3.8: Values of Key Parameters: Two Scenarios and Three Cases

Scenario	Current Scenario			Improved Scenario		
Plantation Density	1660 plants/Ha			1660 to 2500 plants/Ha		
Case	Worst	Probable	Optimistic	Worst	Probable	Optimistic
Seed Yield (Kg/tree)	0.5	1.0	1.0	1.0	2.0	2.0
Seed Price (Rs/Kg)	3	5	7	3	5	7

Few interesting observations emerge from Table 3.10.

- For the 'worst case' of the 'improved scenario', the duration required to attain first year of profit is about three times (42 Vs 13) shorter than the worst case of the 'current scenario'. However, there is no significant comparative differ- ence in the duration required to attain first year of profit in the two scenarios for the 'probable' (8 Vs 7) cases. For the 'optimistic' case, the duration for the same is equal in each scenario.
- However, when it comes to stable annual net income, in all the cases, the improved scenario scores over the current scenario considerably (worst case: 7 fold, probable case: 3 fold, optimistic case: 3 fold)

These observations clearly indicate that the improved scenario may not seem alternative in term of

Table 3.9: Values of Indicators for Economic Viability in Two Scenarios

Scenario	Current Scenario			Improved Scenario		
Case in the Scenario	Worst	Probable	Optimistic	Worst	Probable	Optimistic
Year of First Profit	42 years	8 years	6 years	13 years	7 years	6 years
Stable Annual Net Income	Rs.490	Rs.5300	Rs.8620	Rs.3500	Rs.16650	Rs.28000

Table 3.10: Case Wise Comparison between the Two Scenarios (Plantation Density 1660/Ha)

Case	Worst		Probable		Optimistic	
Scenario	Current	Improved	Current	Improved	Current	Improved
Year of First Profit	42nd	13th	8th	7h	6th	6th
Stable Annual Net Income	Rs.490	Rs.3500	Rs.5300	Rs.16650	Rs.8620	Rs.28000

first year of profit in the last two cases, however, it makes significant difference when it comes to stable annual net income in all three cases.

In other words, waiting for NOVODs quality planting material as well as for the package of adapted cultivation practices, for about 3 to 4 years would be worth the delay involved, considering the 30 years of economic life of Jatropha plants.

Summary of Findings

- Majority of Jatropha plantations in Maharashtra will be on wasteland and in rainfed conditions. The realistic plantation density per hectare in these conditions, and therefore in Maharashtra state, is restricted to 1660 plants/Ha.
- While assessing the economic viability of Jatropha plantations, influence of variation in seed yield, seed oil-content, and effect of various market forces in deciding the seed purchase price have to be considered.
- To assess economic viability of Jatropha, two indicators viz., the year of first profit and stable annual net income, are considered.
- Comparison between 'Current scenario'[24] and 'Improved scenario' clearly indicate that stable annual net income shows at least three fold rise in improved scenario.
- Impact of the 'Current Scenario' and 'Improved Scenario' on the two indicators of economic viability of Jatropha plantation, clearly shows that stable annual net income shows at least 3 fold increment in the improved scenario.
- Considering that the economic life of Jatropha plantations is minimum 30 years and the benefits associated with the improved scenario, it is worth to wait 3 to 4 years for the package of standardized practices and planting material of standardized quality in adequate quantity.

[24] 'Current scenario' is defined as plantation with currently available planting material and without standardized cultivation practices. 'Improved scenario' is defined as plantation with improved planting material and with standardized cultivation practices.

Chapter 4

Jatropha through EGS: An Assessment

The Report of Committee on Development of Bio-fuels tried to link the National Mission on Bio-fuels with the efforts for development of wastelands and for rural poverty alleviation through employment generation. According to the report, a potential of 20 lakh hectares of land is estimated to be available for plantation on wasteland under Integrated Watershed Development and other poverty alleviation programs of Ministry of Rural Development (MoRD).

The state government of Maharashtra has recently included Jatropha in the Horticulture Program linked with EGS (Employment Guarantee Scheme). Considering the findings of the technical and economic analysis of the Jatropha plantations in the previous chapter, it is necessary to make an assessment whether the new Jatropha-based scheme will serve the objectives of the EGS.

The Horticulture Program linked with EGS has been in operation for about two decades. To help the assessment of the new scheme, it would also be useful to see how the Maharashtra government implemented the Horticulture Program through EGS in 1990s, and how the Jatropha-specific guidelines declared in year 2006 differ from the original Horticulture-EGS.

Background

Objectives of EGS

The main and short-term objective of the EGS is to provide guaranteed employment to rural adults who are capable of unskilled work and in the need of employment. The long-term objective of EGS is to create public assets which can increase employment potential in the local areas on sustained basis. The related objective is to prevent recurring droughts in the drought-prone areas. Thus, EGS is essentially aimed at providing security of income through guarantee of employment to people from the lowest economic strata of the

society, both, in short as well as long terms.

EGS has gone through many ups and downs during its approximately three-decade-long history. Many provisions have been added and deleted under pressures from different quarters. On one hand, the scheme has been successful in providing employment to the needy during the years of severe droughts. On the other hand, it has suffered many distortions and perversions that seriously affected its performance and its contribution to its original objectives.

Horticulture through EGS

One of the later additions into the EGS is the Horticulture Program which is being implemented in Maharashtra since 1990. The major objectives of the program are:

a. To provide self-employment to the farmers on their own field.

b. To develop waste-lands.

c. To generate wage-based employment.

The program has many good features, if we view it as a program for horticulture development. These include a well-defined package of cultivation practices for different types of land, along with guidelines for irrigation requirements, plantation methods, fertilizer dosage, maintenance, and disease and pest control. Similarly, there is a provision in the program to organize training sessions at the block level for interested farmers. Testing soil samples before plantation is also recommended and provided for in the program. In addition, to ensure success of the scheme, release of the subsidy in the second and third year is linked with survival of the plants.

From the employment angle—which is important as the program is funded through EGS money—the program is claimed to have covered roughly 13 lakh farmers and directly created 21.3 crore person-days of work / employment.[25]

Jatropha in Horticulture Program linked with EGS

In 2003, an expert committee was appointed by the Maharashtra state government to review EGS. Along with other policy level recommendations, the committee also suggested to include Jatropha plantation in the horticulture program of EGS in the report submitted in April 2005.

In August 2005, the Maharashtra government declared its "Policy for Non-Conventional Energy Resources". The major objectives of the policy are: a) cultivation of plants producing Jatropha and similar seeds useful for bio-diesel, and b) to set up countries first Bio-fuel Park.[26]

As a follow up of the decision, in December 2005, the government decided to include Jatropha in the

[25] Source: “Experts for linking job guarantee plan with horticulture growth” an article by Harish Damodarn, The Hindu Business Line, Dec. 19th 2004.

[26] Source: www.maharashtra.gov.on/english/chiefminister On Path of Progress.pdf

Horticulture-EGS. The government resolution (GR) declaring the plan for Jatropha plantation for the year 2006-07 under the Horticulture-EGS program provides details of the Jatropha-specific scheme.[27] A copy of the GR is included in the Appendix IV. The major decisions in the GR are listed below:

- In the year 2006-07, the state government aims to plant 1,11,10,000 (One Crore, Eleven lakh, and Ten Thousands) Jatropha plants on experimental basis, as part of Horticulture-EGS program.
- The maximum plantation limit for each district is set to 11,11,000.
- Planting material required to achieve the target can be sourced from government nurseries, nurseries of agricultural universities, 'Agricultural Science Centers', or from private nurseries.
- The Director (Horticulture), Krushi Aayuktalaya, will inform all concerned sections about availability of planting material (saplings/cuttings) and decisions regarding its distribution.
- The benefits of the scheme are extended to individual beneficiaries, planting minimum 100 and maximum 2200 numbers of Jatropha plants.
- A total amount of Rs. 18.40/-, spread over three years, will be given as subsidy for each planted Jatropha. The distribution of the subsidy will be in three installments of Rs. 9.20/ tree (first year), Rs. 5.50/tree (second year) and Rs. 3.70/ tree (third year).
- The release of subsidy for the second and third year is linked with survival of the plants (75% in the second year and in the third year).
- The government will neither take the responsibility of purchase of the seeds produced nor of the income.

Lacunas in the Design of the Jatropha-EGS Program

Original Horticulture Program linked with EGS

The main criticism of the Horticulture Program linked with EGS is that it has disproportionately benefited the non-poor sections of rural population.[28] In other words, farmers who do not have irrigation facility and have limited economic capabilities have not been able to seek benefits from the Horticulture Program linked with EGS. The small and marginal

[27] Source: Government of Maharashtra GR No. Jatropha-2005/pk253/9-A, Dated 26th April 2006.

[28] The official Human Development Report prepared in 2002 by UNDP and Government of Maharashtra arrived at the same conclusion. Source: Human Development Report 2002, Government of Maharashtra and UNDP.

farmers often have very limited land available for plantation, do not have irrigation facilities, and have very limited economic capabilities.[29] As a result, the scheme ended up providing more benefits to medium and big farmers having large pieces of lands, irrigation facilities, and other necessary capabilities. The only benefits that could reach small farmers and landless poor (towards whom the EGS is really targeted) are through temporary employment in the initial stages of plantations, which is a small component of total benefits generated through such a scheme.

This criticism has also been acknowledged in the recent report of the expert committee appointed by the state government to review EGS. Moreover, the committee recommended that the components of the EGS that provide benefits to individuals (such as horticulture program) should be restricted only to those farmers whose land-holding are less than 5 acres (2 hectares).

The Jatropha-EGS continues to have this lacuna. In fact, the Jatropha-EGS has less possibility of benefiting small farmers for two additional reasons (apart from those mentioned in the above paragraphs).

First, small farmers will experience a deterrent in taking up Jatropha plantation as it is an entirely new type of crop with very little past record.[30] This increases both the potential risks as well as the perception of risk by the beneficiary. Second, another deterrence for the small farmers would be in the form of unknown and very specialized buyers for Jatropha seeds, who would mostly be coming from outside, which would be the only outlet for the produce of their plantation. This would spawn a chain of local agents, severely affecting benefits received by farmers.

In the current design of the scheme, benefits from the Jatropha-EGS are restricted to maximum benefit that could be drawn by planting 2200 plants. However, for reasons mentioned before, most of these benefits would not reach the small farmers and landless poor, for whom the EGS is really meant for.

Omissions in the New Scheme

There are many provisions in Jatropha-EGS that are similar to the earlier Horticulture-EGS. However, the new Jatropha scheme has some major differences and deviations from the original scheme. These differences and

[29] The higher levels of economic capabilities are necessary to sustain long gestation periods of horticultural plantations and are also necessary to raise finance required to withstand the system of post-expenditure payments adopted by the government. This is further aggravated due to delays involved in receiving payments from government departments.

[30] Farmers know local varieties of Jatropha as plants, but have no experience of growing it as a crop.

deviations and the problems that they might cause are discussed in brief in the following paragraphs.

a. Though Jatropha is also a fruiting plant, its fruits are non-edible (rather are toxic) and even cattle do not browse its leaves. Hence, there is only one end-use for the Jatropha seeds and, hence, a limited number of probable buyers. This is significantly different from most plants in the horticulture scheme.

b. There is a well-defined package of agro-practices offered for most fruiting plants (covered under old scheme). These include fertilizer doses, hybrid varieties, and irrigation requirements as well as practices related to pest and disease control. As mentioned in the earlier chapter, this is not yet the case with Jatropha. This lack of standardized cultivation practices is bound to significantly affect the production levels of the Jatropha plantations.

c. In the initial years, the old scheme allowed sourcing of sapling only from government nurseries. In later years, the scheme allowed sourcing from private nurseries which are registered with government. This ensured supply of planting material of certain minimum level of quality and on a large scale. In the case of Jatropha, quality planting material from government nurseries will be available only after 3 to 4 years. At the same time, there is no system to regulate operations of private nurseries to ensure quality of Jatropha planting material.

   In short, unlike the original Horticulture Program linked with EGS, there is no effort by the government to ensure supply of planting material of standard or benchmark quality. This is especially problematic in the context of the results of our analysis which shows that the economic viability improves significantly with use of the planting material of the bench-mark quality as prescribed by NOVOD.

d. Wide scale secondary businesses with local and export markets, such as food processing industry, have been well established for many of the fruits covered in the horticulture scheme. It is expected that Jatropha based secondary businesses like latex industry, medicinal use of Jatropha will develop over time.

Thus, it can be seen that, on all the above counts, Jatropha does have serious disadvantages as compared to many other fruit trees covered under the scheme.

Unexplained Provisions and Bizarre Numbers

The bizarre scale of plantation target for the year 2006-07, i.e. the number of total 1,11,10,000 plants to be planted under the scheme, creates confusion and doubts that cannot be ignored. Similarly, the logic of putting restrictions in terms of number of plants (minimum 100, maximum 2200) to be made available to individual beneficiary

requires explanation. In the original Horticulture-EGS, the limit was on the area under cultivation (minimum 0.1 Ha, maximum 6 Ha), with the recommended plantation density/Ha for each fruiting plant. It is not explained why the restriction is brought on the number of plants in case of Jatropha.

Flawed Subsidy Structure: Largesse to the Land-Owners

The new scheme provides certain subsidy which is spread in terms of three yearly instalments. The logic of the total amount of subsidy and its division in the three yearly instalments cannot be explained on the basis of available data.

The standard data on the costs of the plantation is available from the NOVOD sources. The cost of plantation for a density of 2500/Ha is Rs. 25000 (Table 3.1 refer page no.14 The item-wise details of the cost of plantation for density of 2500/Ha are given in Appendix II). The cost of replantation and maintenance in the second year for the same is estimated to be around Rs. 5000/-Ha. As per assumptions made in the present study, the yearly cost of maintenance in the subsequent years in not more than Rs.1000/-. So even if we include this maintenance cost for the next five years, the total investment is not more than Rs 35,000/- for 2500 plants on one hectare of land. Hence, the maximum investment needed for five years of plantation is about Rs 14/plant.

As against this, total subsidy of Rs. 18.40/plant is offered for Jatropha plantation under the new Jatropha-EGS. This subsidy offer is about 31% higher than the estimated investment in the first seven years by Rs. 4/plant.

Economic and Employment Benefits

Economic Benefits from the Scheme

The basic economic analysis for the Jatropha-EGS remains same as that presented in Chapter 3. Here, we are presenting a summary of figures for the main economic indicator, viz., the 'net annual stable income' for different plant population from 100 plants to 3300 plants (though the maximum plant population allowed under EGS per farmer is 2200).[31] Here, the calculations are made for different values of sell-price of seeds, but only for the most probable value for the seed-yield in the state under present conditions, i.e. 1.0 Kg per plant per year (Refer Table 4.1).

Employment Benefits from the Scheme

While conducting analysis from the point of view of objectives of EGS, the employment generated in terms of number of person-days

[31] Two hectares of plantation would require about 3300 plants with plantation density of 1660 plants/Ha.

Table 4.1: Stable Annual Net Income
(from 9th year onward, and seed-yield of 1 Kg per tree)

Total Plants	Stable Seed Yield (Kg/year)	Harvesting Cost	Harvesting + Maintenance Cost	Stable Annual Net Income/Year for different seed prices (@Rs/Kg)		
				5	3	7
100	**100**	**120**	**170**	**330**	**130**	**530**
200	200	240	340	660	260	1060
500	500	600	850	1650	650	2650
800	800	960	1360	2640	1040	4240
1000	1000	1200	1700	3300	1300	5300
1660	**1660**	**1992**	**2822**	**5478**	**2158**	**8798**
2000	2000	2400	3400	6600	2600	10600
2200	**2200**	**2640**	**3740**	**7260**	**2860**	**11660**
2500	2500	3000	4250	8250	3250	13250
3000	3000	3600	5100	9900	3900	15900
3300	3300	3960	5610	10890	4290	17490

Note: The figures are highlighted for 100 plants (minimum under Jatropha-EGS), 1660 (one hectare of plantation), and 2200 plants (maximum under Jatropha-EGS)

(PDs) as well as the monetary wage value of this employment (i.e. the income in terms of money generated from the employment) also become important.

The main source of employment generation in Jatropha plantation will be: a) plantation and maintenance operations and b) seed harvesting operations. [32]

As per the estimation given in the report of Committee on Development of Bio-fuels, Jatropha plantation will generate 263 and 48 person-days (PD) of employment during the first and second year of plantation respectively (plantation density 2500/Ha). NOVOD estimates are based on the parameter of two person-days of employment per 100 Kg of seed harvested. As per assumptions made in the present study, continuation of minimal maintenance from third year will generate 8 additional days of employment per hectare per year.

Using these same parameters, calculations are carried out for employment generated during the first six years of a typical plantation raised under most prevailing

[32] Other employment generating activities will be seed storage and oil extraction unit. A seed procurement and oil expeller center is expected to employ minimum 3 person /day/unit. The total employment generated through seed procurement and oil extractions units is hard to estimate at this stage. Hence, we will focus only on employment generated through plantation, maintenance and seed harvesting.

conditions in Maharashtra (i.e. for plantation density 1660/Ha and seed-yield of 1.0 Kg/tree).[33]

The results-in terms of the number of person-days and the monetary wage value-are presented in Table 4.2. The person-days are calculated using the parameter of two person-days for harvesting 100 Kg of seeds and the monetary wage-value is calculated using the parameter of wages of Rs. 60/ person-day.

Employment generated through seed harvesting will depend on the yield of the seeds. For different values of seed yield, Table 4.3 (plantation density 1660/Ha) and Table 4.4 (plantation density 2500/Ha) give the figures for employment generated through harvesting operations, once the seed-yields stabilize from 7th year. The figures are in terms of both the number of person-days and the monetary wage-value of the employment generated.

Table 4.2: Magnitude of Employment Generation (Plantation Density 1660/Ha)

Plantation Year	Employment Generated (in PDs) /Ha			Wage-Value of Employment Created /Ha (@ Rs.60/ day)
	Employment from Plantation / Maintenance	Employment from Seed Harvesting	Total Employment	
1st	184	—	184	11,040
2nd	40	3	43	2,580
3rd	8	13	21	1,260
4th	8	17	25	1,500
5th	8	27	35	2,100
6th	8	33	41	2,460
Total in 6 Years	**256**	**93**	**349**	**20,940**

Table 4.3: Employment through Seed Harvesting and Maintenance (Plantation Density 1660/Ha)

Maximum Seed Yield (Kg/tree)	Maximum Seed Yield (Kg/Ha/ Year)	Employment Days/Ha/ Year (@ 2 MD/100 Kg seed)	Employ-ment Days/Ha/ Year	Total Employ-ment /Year/Ha	Wage-Value/ Year/Ha (@ Rs60/day)
0.5	830	17	8	25	1500
1.0	1660	33	8	41	2460
2.0	3320	66	8	74	4440

[33] For the sake of brevity, these calculations are carried out only for one value of plant population (i.e. 1660 plants, which is equivalent to plantation in one Ha under representative conditions in Maharashtra) which is allowed under the current Jatropha-EGS.

The following findings emerge from Table 4.2 and Table 4.3:

- Table 4.2 represents the probable and optimistic cases under the 'Current Scenario' as defined in the earlier chapter. For these cases, the operations in the first year will create significant opportunities for employment generation.
- However, the employment potential in the second year (mainly maintenance work) is substantially low, reduced to just 43 person-days (PDs)/Ha. In the third year, the total employment potential is further reduced to only 21 PDs/Ha.
- Once plantation matures in the sixth year, the employment comes primarily from seed harvesting operations and hence dependent on the seed-yield of the plantation. For the "Current Scenario" (defined in the Chapter 3), after maturation of the plantation, the stable employment generated, in terms of person-days, is between 25 and 41 person-days per year per hectare. This is equivalent to the wage-value varying between Rs. 1500/- and Rs. 2460/- per year per hectare (Refer Table 4.3).
- Over all, for the "Current Scenario", the employment generated after the first year is not significant, and hence the assets created in the form of the plantation do not create sustained employment, as expected in the EGS.
- However, if the plantation is raised using planting material of the standard quality as defined by NOVOD (i.e. seed-yield of 2 Kg/tree), then the employment potential rises to 74 person-days (or wage value of Rs. 4440/-) of per year per hectare.

Comparing Income and Employment

In order to assess the employment benefits generated through the Jatropha in EGS, the analysis can be extended further. Comparison can be made between the annual net income which will go to the plantation owner and the total wage value generated (through seed harvesting and maintenance activities) during the year, which could be assumed to contribute to the cause of employment generation, the main objective of EGS program.

Table 4.4: Employment through Seed Harvesting and Maintenance (Plantation Density 2500/Ha)

Maximum Seed Yield (Kg/tree)	Maximum Seed Yield (Kg/Ha/ Year)	Employment Days/Ha/ Year (@ 2 MD/100 Kg seed)	Employment Days/Ha/ Year	Total Employment /Year/Ha	Wage-Value/ Year/Ha (@ Rs 60/ day)
0.5	1250	25	8	33	1980
1.0	2500	50	8	58	3480
2.0	5000	100	8	108	6480

Table 4.5: Comparing the Benefits to Land-Owner with Employment Benefits

Seed Yield (Kg/tree)	Seed Price (Rs/Kg)	Components of Stabilized Annual Income (Rs/Ha)			
		For Density 2500/Ha		For Density 1660/Ha	
		Wage Value	Net Annual Income	Wage Value	Net Annual Income
0.5	3	1980 (158%)	1250	1500 (306%)	490
	5	1980 (53%)	3750	1500 (70%)	2150
	7	1980 (32%)	6250	1500 (40%)	3810
1.0	3	3480 (99%)	3500	2460 (124%)	1980
	5	3480 (41%)	8500	2460 (46%)	5300
	7	3480 (26%)	13500	2460 (29%)	8620
2.0	3	6480 (81%)	8000	4440 (74%)	5960
	5	6480 (36%)	18000	4440 (35%)	12600
	7	6480 (23%)	28000	4440 (23%)	19240

Table 4.5 provides such a comparison for two different plantation densities, three values of the seed-yield and three values of the seed prices.

In Table 4.5, the figures in the parenthesis in the columns of wage-value are for the ratio (in percentage form) of the wage-value to the net annual income to the land owner. The figures in the table indicate some interesting trends.

- For the same seed yield level, the share of the employment benefits is higher if the sale price of the seeds is lower. Further, for the same seed price level, the share of the employment benefits is lower if the seed-yield values are higher,
- For the realistic conditions for the plantations in Maharashtra using the currently available planting material (plant density 1660/Ha and the seed-yield of 1.0 Kg/tree), the employment benefits are in the range of 81% (for the seed-price of Rs. 3/Kg) to 36% (for the seed-price of Rs. 5/Kg).

Bad Practices in Policy Making

Experimentation at the Cost of the Poor

The state government aims to plant more than 1 crore trees on "experimental basis". This term—experimental basis—could be interpreted in two manners. The scheme could be seen as trying out Jatropha plantation on "experimental scale". If we assume a plantation density of 1660/Ha, the target set in the scheme would require 6692 Ha of land (1,11,10000/1660 ≈ 6692). As per estimation of the Department of Land Resources (under MoRD), the potential area for Jatropha

cultivation in Maharashtra is about 48.55 lakhs Ha. So the set target comes close to just 0.14%. This miniscule scale could have led to the use of the term "experimental basis."

Another interpretation of the term, "experimental"—which is very important in the context of the present analysis—suggests that the state government acknowledges the absence of standardized "package of practices" and lack of adequate validated data on yield levels and oil-content.

The candidness shown here by the policy makers in stating clearly the "experimental" nature of the plantation is well appreciated. However, as part of the 'National mission on Bio-fuels', experiments are already going on in forty-two different agricultural universities and research institutions in various parts of the country. Two agricultural universities from Maharashtra (viz., PDKV, Akola and MPKV, Rahuri) are part of the network.

This situation throws up some serious concerns over the "experimental" nature of the Jatropha plantation under EGS.

- There is no effort, either as part of the EGS or independently, to collect the data which would come out of this 'experiment'. Without such data and its analysis, the findings of the 'experiment' cannot be articulated and the whole expenditure on the 'experiment' will go waste. In other words, as there is no serious or systematic effort to carry out scientific experiment, the money put in this 'experiment' will be wasted.
- Technically-competent government agencies (including state agricultural universities) are already involved in serious efforts to carry out experiments in order to develop agricultural practices and hybrid varieties as part of the national mission. In this situation, it remains to be explained why the Maharashtra state government wants to take up another "experimental" initiative through a line department, which is not technically competent to carry out such "experiments".
- Even the plantation on experimental 'scale', i.e. on 6692 Ha[34] —which should instead be called as pilot plantations— should not be undertaken unless the laboratory scale experimentation is completed by the technically competent agencies and unless the quality planning material and protocols (in terms of standardized cultivation practices) are ready for the pilot plantation.
- It is a serious concern that the EGS resources—meant for providing employment to poorer sections—are being utilized for "experimentation." This is because, in the first place, this experimentation is unwarranted and premature duplication of efforts (which-

[34] This figure is arrived at by dividing the total number of plants mentioned in the GR (i.e. 1,11,10,000 plants) by the plantation density of 1660 plants/Ha.

ever interpretation of "experimentation" we accept). Second, the experimentation is being carried out by agencies which are not equipped to handle this task. Finally, it is being carried out in the manner which will not serve the purpose of experimentation.

- It is a different but equally serious matter that the "experimentation" is imposed on the beneficiaries and the associated risks involved in this "experimentation" will also be imposed on or passed to the putative beneficiaries of the Jatropha-EGS.
- The purpose of the EGS is not to conduct agricultural experiments but to provide reliable employment and livelihood—on short and long terms—to the rural unemployed poor. Hence, considering the observations made here, the Jatropha in EGS program is sheer squandering of scarce financial resources that, especially, are meant for poor.

The Process of Policy Making: Breach of Democratic Principles

As mentioned earlier, the expert committee appointed to review EGS recommended inclusion of Jatropha plantation under horticulture-EGS (April 2005). As per the norms of legislative procedures, all the recommendations of the committee should have been discussed and ratified in both the houses of the state assembly. This process has been delayed indefinitely by the government, and, without ratification by the state assembly, the government has included Jatropha in EGS and also declared an ambitious plan for Jatropha plantation through EGS.

In a meeting with the EGS minister on 7th March 2006, many activists and organizations working on issues related to EGS had expressed their objections to undertake Jatropha plantation through EGS.

Despite all this, the government has gone ahead and issued the Jatropha-EGS GR on 26th April 2006. This is a clear case of breach of principles of democracy.

Conclusion

- Most lacunas in the design of the old horticulture-EGS have not been rectified while designing the new Jatropha-EGS. As a result of this, benefits of Jatropha-EGS will mainly go the rich farmers in the state, instead of helping small farmers and poor sections of agrarian communities.
- The long term employment opportunities on Jatropha plantation are limited to seed harvesting.
- Not waiting for the current technical work to come to completion would adversely affect the long-term opportunities of employment generation as well as the economic benefits from Jatropha plantation.
- The benefits in form of 'wages through employment' are substantially lower than the benefits going to the owners of

Jatropha farms (most often the rich farmer).

- In the present state of technical development and scheme design, inclusion of Jatropha fails to fulfill the two major objectives of EGS. First, it does not provide significant temporary employment in a cost effective manner. Second, the assets created by the scheme do not provide significant employment on sustained basis in long term.
- The 'experimental' nature of the proposed Jatropha plantation through EGS does not fit into objectives of EGS.
- Government of Maharashtra is squandering money meant for poor on unwarranted 'experimentation'. This experimentation is being carried out at the cost of the poor who are expected beneficiaries of EGS.
- Besides, the subsidy offered for this 'experimental' plantation is at least 31% excess than actual expenditure as estimated by NOVOD. This is unwarranted largess provided to land owners from the funds meant for providing employment to poor and landless.

Chapter 5

Summary of findings and Recommendations

The present study has looked at the implications of the decision of inclusion of Jatropha in the Horticulture-EGS program from various angles. In the process we have discussed, technical feasibility, economic feasibility and also the magnitude of employment generation.

Summary of Findings

Technology and Economics

The level of seed-yield and oil-content from the current plantations are considerably lower and involve considerable variation. However, it is expected that improvement in the quality of the planting material and standardization and adaptation of cultivation practices would improve the seeds-yields and oil-content to the benchmark level prescribed by NOVOD. However, the planting material of prescribed quality will be available on large scale only after completion of NOVOD efforts to raise model plantations, possibly in the year 2007-08.

Even after the successful completion of NOVOD efforts, the levels of seed-yields and oil-content may have certain upper limitations, especially in the case of plantations on waste-lands and in rain-fed conditions. The density of plantations under these conditions will have to be significantly lower, (e.g. 1660 plants/Ha), than assumed by NOVOD (which is 2500 plants/Ha).

Regarding economic viability, both the indicators for economic viability—viz., 'Year of First Profit' and 'Stable Annual Net Income'—seem to be significantly dependent on all the key three factors, viz. seed-yield, seed price (or oil-content), and plantation density.

The indicators of economic viability show considerable improvement (about five times) if the plantations are developed using

improved planting material (Refer Table 3.9 on page no. 23). In other words, it does make economic sense if the plantations are postponed until NOVOD efforts to make available quality planting material on large scale. Hybrid varieties with high oil-content (like SDAUJ1) are expected to be available by in next three to four year (2010-11).

However, this suggestion may not apply to farmers who are ready to use plantation material made available by commercial sources. This is because analysis in this report does not consider the data and information provided by commercial sources. The underlying reason for this exclusion is the absence of any independent agency to validate the data provided or claims made by commercial entities in this regard.

Jatropha in EGS

The report then focuses on Jatropha plantation through EGS. The plantation scheme is analyzed on different grounds and from different angles.

The Jatropha plantations are introduced in EGS as part of the "Horticulture program linked with EGS". As a result, Jatropha in EGS attracts the same criticisms, which have been made against the Horticulture-EGS program. The main criticism in this regard points out that the horticulture linked EGS has disproportionately benefited the non-poor sections of society. This requires specific provision that would restrict non-poor from benefiting from the scheme.

Further, the government resolution (order) that prescribes inclusion of Jatropha in EGS does introduce other weaknesses in the Jatropha in EGS, which are not in the previous Horticulture program linked with EGS. The crucial weakness is in the form of absence of government support in terms of (direct or indirect) supply of assured quality of planting material, as well as in form of prescription and training of standardized cultivation practices. This certainly increases the risks and vulnerabilities of the beneficiaries.

The most controversial provision in the scheme is the amount of subsidy provided to plantation owners under this scheme. The scheme provides a total subsidy of Rs. 18.40/tree. As per the NOVOD figures, the total expenditure on plantation is Rs. 12/tree. This means that the government is providing subsidy which is Rs. 6.40 (or 53%) more than the total expenditure. Even if we consider the maintenance expenditure in the subsequent five years, the total expenditure per tree is about Rs. 14/tree. This would mean that the government is providing subsidy which is Rs. 4.40 (or 31%) more than the total expenditure. This largess provided by the government to non-poor sections, using the money meant for income security of poor, is unjustifiable, to say the least.

Employment and Economic Benefits

The report also analyzes the Jatropha in EGS for the possible economic and employment bene-

fits. This analysis throws up some interesting trends.

First, under the "Current Scenario"[35] and for seed-yield 1 Kg/tree, the highest stable annual net income for one hectare of plantation (1660 plants) would be between Rs. 2158/- (for seed price of Rs. 3/Kg) and Rs. 5478/-(for seed price of Rs. 5/Kg).[36]

Second, it indicates that the scheme would provide significant employment benefits in the first year of plantation, which is 184 person-days or of the wage value of Rs. 11,040/- for the above-mentioned case. This is about 36 % of the total subsidy under the Jatropha in EGS provided for the 1660 plants @ of Rs. 18.40/tree (i.e. Rs. 30,544/-).

However, the employment benefits generated in the subsequent years are considerably less. Between the second to fifth years, the employ- ment benefits are on average of 31 days per year (or wage-value of Rs. 1860/year), which is hardly 6 % of the total subsidy provided. From 6th year onwards, after maturation of the plantation, the employment benefits stabilize at the level of 41 person-days per year (or wage-value of Rs. 2460/year). This is about 8% of the total subsidy provided.

Altogether, it will take about 10 years to generate wage value (at Rs. 60/day) equivalent to the subsidy provided to the individual beneficiary land owner.

It would then be interesting to compare these employment benefits with the net benefits provided to the owner of the plantation. This is interesting because of the inference drawn in the previous chapter that the scheme would be availed mainly by middle and big farmers in the larger proportion, whereas the EGS is aimed at providing employment guarantee to poorer sections of the society.

As the calculations in the earlier chapter indicate, for the above-mentioned case under the 'Current Scenario,' the stable employment benefits after maturation of the plantation would be of wage-value of Rs. 2460/year. This is just 46% of the net yearly benefits the plantation owner would get in the form of the stable net annual income (which would be Rs. 5300/-).

It is interesting to note that the situation would not improve even if the plantation is raised using plantation material of improved quality (seed-yield value rising to 2 Kg/tree and seed-price varies between Rs. 5 to 7 per Kg of seeds). In such situations, the employment benefits would increase as the seed-yield (and hence employment required for harvesting) would increase. The value of total employment benefits would be Rs. 4440/year/hectare, which is about 14.5% of the total subsidy provided under the EGS. However, the percentage of employment benefits as compared to the benefits to the land-owner

[35] Refer Chapter 3 for definition of 'Current Scenario'.

[36] Refer Table 4.1 on page no. 31

(i.e. stable annual net income) would remain at lower levels, i.e. between 35% (for seed price of Rs. 5/Kg of seed) and 23% (for seed price of Rs. 7/Kg of seed).

This puts some question marks on the proposition of using EGS funds—which are primarily meant for providing income security to poorer sections of society—for Jatropha plantation. This is because it will continue to attract the criticism that the scheme disproportionately benefits to the non-poor sections of the society.

Concerns over 'Experimentation'

The last chapter of the report also raises many serious concerns over the 'experimental basis' on which the Jatropha in EGS is claimed to be designed by the government.

The first serious concern is that the EGS resources meant for providing employment to poorer sections—are being utilized for "experimentation." The purpose of the EGS is not to conduct agricultural experiments but to provide security of employment and income—both on short and long terms to the rural unemployed poor.

The other serious concern is about the manner in which the experimentation is conducted. In the first place, this experimentation is unwarranted and premature duplication of efforts already undertaken by other (more capable) government agencies. Second, the experimentation is being carried out by agencies which are not equipped to handle this task. Finally, it is being carried out in the manner which will not serve the purpose of experimentation, as there is no arrangement to collect and analyze data or learn lessons.

Hence, considering the points raised above, it could be said that using the funds from EGS for developing "experimental" plantations of Jatropha is sheer squandering of scarce financial resources, especially, those which are meant for poor. It is a sacrosanct principle of EGS that the EGS funds should be utilized for the direct benefit of rural poor, hence, this sheer squandering of scarce financial resources is highly objectionable.

If the target set for experimental Jatropha plantation through horticulture program in EGS in the year 2006-07 is achieved, approximately 6700 Ha area in Maharashtra will be brought under Jatropha (assumed plantation density: 1660 plants/Ha) and minimum 20 crore rupees would be spent as subsidy amount. For various reasons discussed before, there is a great danger that this money would be wasted.

The Maharashtra state government hopes to bring 22 lakh hectares of wasteland under Jatropha cultivation, with three lakh hectares plantation being planned on a yearly basis.[37] However, improved planting material and standardized cultivation practices (improved scenario) is expected to be

[37] Source: “Non-conventional energy policy for Maharashtra soon: Minister” The Hindu Business line, May 13th 2005.

available only after 3 to 4 years. By this time, if the state government implements Jatropha plantation program as mentioned above, about 10 lakh hectares of waste land will be brought under Jatropha plantation using present planting material and without standardized cultivation practices (i.e. Current Scenario).

Of this 10 lakh hectares area, if we assume that only 1 lakh hectare of land (plantation density 1660/Ha) is covered under EGS, with present rate of subsidy (Rs. 18.40/ plant) about 305 crore rupees would be spent on plantation with poor economic and employment returns. These figures indicate the scale on which the money meant for providing employment and income security to the poor could be squandered, if quick actions are not taken.

It must be pointed out that the money for EGS is coming form the special Professional Tax paid by all taxpayers in the state of Maharashtra. Altogether, the taxpayers contribute 50% of the "Employment Guarantee Fund" that supports the expenditure on EGS.

Considering all these facts, the way in which the Jatropha-EGS is being implemented needs to be immediately reconsidered.

Recommendations

At present, inclusion of Jatropha in the EGS program is not justifiable on any ground, and should be suspended until appropriate cultivation practices are developed and planting material of improved varieties is available on large scale (this will take at least three to four more years).

In the present form of the Jatropha-EGS program, the employment opportunities to the rural unskilled are limited primarily to seed harvesting. In addition, the farmers are being reduced to suppliers of raw material and all other benefits (from oil cake and cheap glycerol and possibly carbon credits) would be mainly going to the organized farming sector. At the same time, various other benefits, especially macro-level, from Jatropha plantations can not be overlooked.

To address this situation, a 'Jatropha-Based Livelihood Development Program' should be undertaken by the government.

- Apart from the macro-level objectives, "Jatropha-Based Livelihood Development Program" should focus on development of rural economy and agriculture based livelihoods in a manner that will significantly and surely benefit all the neglected sectors of the society.[38]
- Waste land could be made available directly to the poor and vulnerable sections of society and also to SHG (self help groups) of women to raise Jatropha plantations.
- The program can undertake establishing nurseries in rural

[38] The macro-level objectives include national energy security and reduction in vehicular pollution.

areas, for supplying quality planting material of Jatropha.

- Training programs can be arranged to educate the farmers about appropriate guidelines for Jatropha cultivation.
- The program can support establishment of seed procurement and storage centers and oil expellers in rural areas, as these operations will augment rural employment further.
- Efforts should be made through this program for development and diversification of Jatropha based secondary businesses like latex industry, soap industry, organic manure centers from Jatropha oil cake and medicine industry.
- In addition, a policy should be developed as part of the program, to make available the possible benefits from 'carbon credits' to the non-organized farmers undertaking Jatropha cultivation.

Appendices

I. Botanical Information

II. Employment Generation and Costs of plantation

III. Recommendations of Tamil Nadu Agricultural University, Coimbatore

IV. Maharashtra State GR Including Jatropha in Horticulture Related EGS

V. Press Release of Indian Council of Agricultural Research

VI. Income in First Seven Years: Case Studies

VII. Other Financial Support Structures

APPENDIX I

Botanical Information

Botanical Name	***Jatropha curcas* Linn**
Family	Euphorbiaceae
Common Names	Magali-erenda, Renay-erandi, Van-erandi

Habitat And Occurance

Jatropha (Ratanjyot) is native of South America and has a long history of its propagation by Portugese into Africa and Asia. It grows well throughout India. A.P., Gujarat, Rajasthan, Karnataka, Maharashtra etc. are some of the promising States where it occurs in the vicinity of villages and town as semi wild bush or shrub and also as hedge vegetation. It is hardy shrub to dry weather conditions and is not browsed by cattle.

Botanical Features

The flowers are yellowish green in loose panicles. The flowering occurs in March or in hot rainy season. The ripe fruits are about 2-5 cm. large and ripen fruits are yellow in color. The seeds resemble with castor seed in shape and are about 1.8-2.00 cm long and shape is either ovoid or oblong and are covered in a dull brownish black capsule. It attains the height of 3-4 meters.

Climate And Soil

Jatropha (Ratanjyot) is a wildly growing hardy plant, in arid and semi-arid regions of the country on degraded soils having low fertility and moisture. It can thrive well on stony, gravelly or shallow and even on calcareous soils. It can be grown under wide range of arid and semi-arid climatic conditions. For the emergence of seed, hot and humid climate is required. It can be cultivated successfully in the regions having scanty to heavy rainfall.

Flowering And Fruiting

In India, it flowers between September-December and March-April. The fruiting occurs from September to December. The fruits mature 2-4 months after flowering.

APPENDIX II

Employment Generation and Costs of Jatropha Plantation

S.No	Item	COST (Rs.)		Employment in person days	
		Year		Year	
		1st	2nd	1st	2nd
1	Site preparation i.e. cleaning and levelling of field - 10 MD	600	-	10	-
2	Alignment and staking - 5 MD	300	-		
3	Digging of pits (2500 Nos) of 30 Cm3 size @ 50 pits per MD - 50 MD	3000	-	50	-
4	Cost of FYM (including carriage) 2 Kg. per pits during 1st year (2 MT) 1 Kg. per pit during second year onwards @ Rs. 400/MT	2000	-	20	-
5	Cost of fertilizer @ Rs. 6 per kg (50 gm. Per plant during 1st year and 25 gm from 2nd year onward and 2 MD for each application.	870	495	2	1
6	Mixing of FYM, insecticides fertilizers and refilling of pits @100 pits per MD 25 MD	1500	-	25	-
7	Cost of plants (including carriage) 2500 Nos. during first year and 500 Nos. of plants during second year for replanting @ Rs. 4.0 per plant.	10000	2000	100	20
8	Planting and replanting cost 100 plants per MD.- 25 MD and 5 MD, respectively	1500	300	25	5
9	Irrigation - 3 irrigation during 1st and one irrigation during 2nd year @ Rs. 500/- per irrigation.	1500	500	5	2
10	Weeding and soil working 10 MD. x 2 times for 2 years	1200	1200	20	20
11	Plant protection measure	300	-	1	-
	Sub total :	22770	4495	263	48
	Contingency (approx. 10% of the above)	2230	505	-	-
	Grand Total :	25000	5000	263	48

Adopted from Annexure II of the Report of the Committee on Development of Bio-fuels, 2003.

APPENDIX III

Recommendations of Tamil Nadu Agricultural University, Coimbatore (Abstract)

(http://www.tnau.ac.in/tech/swc/evjatropha.pdf)

- It is grown in wide range of soils. For economic returns a soil with moderate fertility is preferred
- From second year onwards fertilizers are applied. For one acre 20:120:60 Kg of NPK respectively applied, during September-October respectively. From 4 year onwards, 150 g super phosphate is recommended over and above the regular dose.
- Irrigation is a must immediately after planting. Life irrigation should be given on third day after planting. The irrigation at fortnight interval is compulsory to ensure year round production of flowers and harvest of seeds.
- Being a perennial crop, intercrops can be raised in between the rows for the first two years. Crops like tomato; bitter gourd, pumkin, ash gourd, cucumber and black gram can be grown profitably.
- Wherever Jatropha is cultivated under irrigated condition, the flowering is throughout the year. Economic yield starts from 3-year end. It is estimated as 3000 Kg of seeds/acre @ 3 Kg of seeds per plant.
- Bark eater (Indarbella sp) and capsule borer are the two major pests affecting the plant. They may be controlled by spraying endosulphan @ 3 ml/litre of water.
- Collar rot may become a problem in the beginning and be controlled by spot drenching of 1% Bordeaux to the affected and neighbouring plants.
- Jatropha is a perennial and its cultivation through well-adopted management practices will certainly ensure economic viability and a successful venture for the investors.

APPENDIX III

- Since more productive branches are needed, it is better to clip the growing terminals so as to have a minimum of twenty-five growing branches at the end of second year. Two minimal irrigations per month ensure year round production of pods If these practices are followed, we can get economic yield in three years reaching maximum in 5 year onwards. To get income during the first two years of the crop period, the farmers are advised to go for inter-cropping such as pulses, oil seeds, and vegetables like ash gourd, tomato and bitter gourd.
- It is felt in some quarters that Jatropha and biodiesel will require massive subsidy. The economic analysis of Jatropha and biodiesel production by Tamil Nadu Agricultural University, and analyses by Indian Institute of Petroleum, Dehradun, and Indian Institute of Science, Bangalore provide evidence that Jatropha cultivation with better crop management practices and processing with modern technologies will result in significant reduction in unit cost of production thereby ensuring Jatropha as a viable proposition not warranting any subsidy.
- The Jatropha oil price is highly correlated with that of the diesel price and the secular rise in the diesel prices offers greater scope for realizing higher Jatropha seed prices for farmers in the future.

APPENDIX IV

Maharashtra State GR Including Jatropha in Horticulture Related EGS

महाराष्ट्र शासन
कृषि, पशुसंवर्धन, दुग्धव्यवसाय विकास व मत्स्यव्यवसाय विभाग,
शासन निर्णय क्रमांक:जट्रोफा-२००५/प्र.क्र.२५३/९-अे
मंत्रालय विस्तार, मुंबई - ४०० ०३२
दिनांक २६ एप्रिल, २००६

वाचा : १) कृषि व पदुम विभाग, शासन निर्णय क्र.रोहयो २००५/प्र.क्र.१/९अे, दि.२७.६.२००५
२) कृषि व पदुम विभाग, शासन निर्णय क्र.अभियान २००५/प्र.क्र.१७१/९अे, दि.२४.११.२००५
३) उद्योग, ऊर्जा व कामगार विभाग, शासन निर्णय क्रमांक:मेडा-२००५/प्र.क्र.२१४८/ ऊर्जा-७, दिनांक ८.१२.२००५

प्रस्तावना :

महाराष्ट्रातील शेतकऱ्यांची आर्थिक प्रगति घडविणे व पडिक जमिनीचा विकास या हेतूने रोजगार हमी योजनेशी निगडीत फळबाग लागवड कार्यक्रम राज्यात सन १९९० पासून राबविण्यात येत आहे. ऊर्जा विभागाने त्यांच्या दिनांक ८.१२.२००५ च्या शासन निर्णयान्वये जाहिर केलेल्या अपारंपारिक ऊर्जा स्त्रोत कार्यक्रम एकत्रित धोरणामध्ये जट्रोफाची लागवड रोजगार हमी योजना फलोत्पादन या योजनेतून करण्याचा निर्णय घेतला आहे. या निर्णयाच्या आधारे जट्रोफा लागवडीकरिता खर्चाची प्रमाणके निश्चित करणे,लागवडीची मर्यादा ठरविणे, लागवडीच्या अनुषंगाने इतर निकष ठरविणे_इ.बाबी शासनाच्या विचाराधीन होती.

शासन निर्णय -

दहाव्या पंचवार्षिक योजनेंतर्गत रोजगार हमी योजनेशी निगडीत फळबाग लागवडीद्वारे राबविण्यात येत असलेल्या फळविकास योजनेमध्ये सन २००६-०७ पासून जट्रोफाचा समावेश करण्यास शासनाची मान्यता देण्यात येत आहे.

२. उद्दीष्ट :

सन २००६-०७ मध्ये (प्रथम वर्षी) राज्यात या योजनेअंतर्गत १.११,१०,००० (एक कोटी अकरा लाख दहा हजार) जट्रोफा झाडांची लागवड प्रायोगिक तत्वावर करण्याचे उद्दीष्ट आहे. प्रत्येक जिल्ह्यात जास्तीत जास्त ११,११,००० (अकरा लाख अकरा हजार) जट्रोफा झाडांची लागवड करता येईल. सदर उद्दीष्ट साध्य करण्यासाठी आवश्यक असलेली कलमे/रोपे शासकीय रोपवाटीका, कृषि विद्यापीठ रोपवाटीका, शेती महामंडळ, कृषि विज्ञान केंद्र व राज्यातील खाजगी रोपवाटीकेकडून उपलब्ध करुन घ्यावयाची आहेत. उपलब्ध होणाऱ्या कलमा/रोपांचे नियोजन, त्यांचे वितरण या बाबतच्या सविस्तर सूचना संचालक (फलो.), कृषि आयुक्तालय हे सर्व संबंधितांना निर्गमित करतील.

३. लागवड मर्यादा :

या योजनेचा फायदा जट्रोफाची किमान १०० किंवा जास्तीत जास्त २२०० झाडांची लागवड करणाऱ्या वैयक्तिक लाभार्थींना देण्यात येईल.

APPENDIX IV

४. जट्रोफा लागवड योजनेसाठी प्रति हेक्टर रु.१८,५० एवढे अनुदान ३ वर्षांच्या कालावधीकरिता देय होईल व अनुदानाचे वाटप प्रती हेक्टर प्रथम वर्षी रु.९,२० दुस-या वर्षी रु.५,५० आणि तिस-या वर्षी रु.३,७० या प्रमाणात अदा करण्यात येईल. ज्या लाभार्थ्यांची दुस-या वर्षी ८५ टक्के व तिस-या वर्षी ९० टक्के हाडे जिवंत असतील त्या लाभार्थ्यांना दुस-या / तिस-या वर्षीचे अनुदान देय राहील.

५. उपरोक्तिखतील अ.क्र.१ येथील दि.२७.६.२००५च्या शासन निर्णयातील परि.६ मध्ये योजना राबविण्यासंदर्भात मार्गदर्शक सूचना या शिर्षाखाली ज्या विविध परिशिष्टांचा/प्रपत्रांचा उल्लेख करण्यात आला आहे व त्यामध्ये उपरोक्तिखतील अ.क्र.२ येथील दि.२४.११.२००५ च्या शासन निर्णयान्वये केलेल्या सुधारणा विचारात घेऊन ती परिशिष्टे/प्रपत्रे योग्य तो बदल करून जट्रोफा लागवडीचा कार्यक्रम राबविण्यासाठी स्वतंत्रपणे निर्गमित करण्याकरिता संचालक फलोत्पादन यांना प्राधिकृत करण्यात येत आहे.

६. जट्रोफा बियांच्या खरेदीबाबत किंवा उत्पन्नाबाबत शासनाची कोणतीही जबाबदारी राहणार नाही.

हे आदेश नियोजन विभाग (रोहयो), नियोजन विभाग (का.-१४४३) व वित्त विभागाच्या सहमतीने व वित्त विभागाचा अनौपचारिक संदर्भ क्र.१४३/व्यय-१ दि.१९.५.२००६ अन्वये निर्गमित करण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने

(वि.म.कोकाटे)
सह सचिव, महाराष्ट्र शासन

प्रति,
मा. मुख्यमंत्री यांचे प्रधान सचिव
मा. मंत्री फलोत्पादन यांचे खाजगी सचिव
मा. मंत्री (रोहयो) यांचे खाजगी सचिव / मा. ना.मं (कृषि) यांचे खाजगी सचिव
मा. राज्यमंत्री (फलोत्पादन) / मा. राज्यमंत्री (कृषि व रोहयो) यांचे खाजगी सचिव
सर्व विभागीय आयुक्त
सर्व कुलगुरु (कृषि विद्यापीठे)
आयुक्त कृषि, महाराष्ट्र राज्य, पुणे
संचालक फलोत्पादन, महाराष्ट्र राज्य, पुणे (१५ सदस्य प्रतीसह)
सर्व जिल्हाधिकारी
सर्व मुख्य कार्यकारी अधिकारी, जिल्हा परिषद
सर्व विभागीय कृषि सह संचालक
सर्व जिल्हा अधिक्षक कृषि अधिकारी
सर्व उपविभागीय कृषि अधिकारी / सर्व जिल्हा परिषदांचे कृषि विकास अधिकारी
सर्व तालुका कृषि अधिकारी
महालेखापाल, महाराष्ट्र-१ / २ (लेखा व अनुज्ञेयता/संस्था परिक्षा) मुंबई/नागपूर
सर्व जिल्हा कोषागार अधिकारी,
वित्त विभाग, मंत्रालय, मुंबई (व्यय-१)/
नियोजन विभाग, कार्यासन-(१४४३) / (रोहयो-१०), मंत्रालय, मुंबई
ग्राम विकास व जल संधारण विभाग, मंत्रालय, मुंबई/आदिवासी विकास विभाग, मंत्रालय,मुंबई
महसूल व वनविभाग (महसूल), मंत्रालय, मुंबई
सहसचिव/उपसचिव/अवर सचिव (कृषि व फलोत्पादन) कृषि व पशुसं विभाग
सर्व कार्यासने, कृषि व पशुसं विभाग
निवड नस्ती

APPENDIX V

Press Release of
Indian Council of Agricultural Research

भारतीय कृषि अनुसंधान परिषद

http://www.icar.org.in/pr/10052006.htm

New Jatropha Variety Identified For Commercial Cultivation New Jatropha Variety Means More Biofuel (10 May 2006)

The Indian Council of Agricultural Research has identified first ever Jatropha variety, SDAUJ I (Chatrapati) for commercial cultivation. The seeds of promising Jatropha variety SDAUJ I (Chatrapati) contain higher oil-content. The seeds contain 49.2 per cent oil and the non-edible protein in defatted seed case is 47.8 per cent. The variety SDAUJ I (Chatrapati) give higher yield compare to other local and popular varieties.

Farmer can get an average yield of 1000-1100 Kg per ha under rainfed conditions. It is recommended for the semi-arid and arid regions of Gujrat and Rajasthan. It is drought resistance and can be raised successfully in areas where annual rainfall is 300-500 mm. The plant attains a height up to 8 feet and shows resistant to all major pests.

SDAUJ I (Chatrapati) is developed by Sardar-krushinagar based Sardar Krushinagar Dantiwada Agricultural University (SDAU). The variety has been identified and recommended for release in Group Meet of All India Coordinated Research Project on Underutilized Crops held at Punjab Agricultural University, Ludhiana. At Regional Research Station, SDAU, crop improvement on Jatropha was initiated in late 90's. Large number of collections was made from different part of India. These genotypes were evaluated in replicated trial and found that entry SDAUJ 1 (Chatrapati) performed well and recorded significantly highest yield over other local varieties. The oil analysis showed that the seeds of this genotype contain 47.8 per cent. The other parts of Jatropha i.e. leaves, roots and latex are also useful in traditional medicine. An alkaloid derived from Jatropha plant i.e. crucin shows anticancer properties.

Jatropha *(Jatropha curcas)* locally known as Ratanjot belongs to family Euphorbiaceae and shows resemblance with castor. In India about nine species are reported out of which Jatropha curcus has economic value by virtue of oil present in its seed. The Govt. of India and Planning Commission are emphasizing on alternative fuels as a result the area under Jatropha is catching up. The oil finds many applications in various industries like soaps, illuminants and paints. With ever increasing demand and raising cost of fossil fuels, there is a need of alternative fuels. Out of 90 tree borne oil seeds, Jatropha is one of the important crop and it can be easily cultivated and not browsed by animals. Jatropha can be cultivated on any type of soils.

APPENDIX VI

Income in First Seven Years: Case Studies

Case I: Plantation density 2500/Ha and stable yield of 0.5 Kg/tree

Year	Seed/Tree/ Year(Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	250	750	1250	1750
3rd	0.4	1000	3000	5000	7000
4th	0.5	1250	3750	6250	8750
5th	0.5	1250	3750	6250	8750
6th	0.5	1250	3750	6250	8750
7th	**0.5**	**1250**	**3750**	**6250**	**8750**
Gross Income at end of 7th Year			**18750**	**31250**	**43750**
Profit = Gross Income at end of 7th Year-42500			**-23750**	**-11250**	**1250**

(Plantation + Maintenance cost = Rs. 35,000, Harvesting cost = Rs. 7500)

Case II: Plantation density 2500/Ha and stable yield of 1.0 Kg/tree

Year	Seed/Tree/ Year (Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	250	750	1250	1750
3rd	0.4	1000	3000	5000	7000
4th	0.5	1250	3750	6250	8750
5th	0.8	2000	6000	10000	14000
6th	1.0	2500	7500	12500	17500
7th	**1.0**	**2500**	**7500**	**12500**	**17500**
Gross Income at end of 7th Year			**28500**	**47500**	**66500**
Profit = Gross Income at end of 7th Year-46400			**-17900**	**-1100**	**20100**

(Plantation + Maintenance cost = Rs. 35,000, Harvesting cost = Rs. 11,400)

APPENDIX VI

Case III: Plantation density 2500/Ha and stable yield of 2 Kg/tree

Year	Seed/Tree/ Year (Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	250	750	1250	1750
3rd	0.4	1000	3000	5000	7000
4th	0.5	1250	3750	6250	8750
5th	0.8	2000	6000	10000	14000
6th	1.0	2500	7500	12500	17500
7th	**2.0**	**5000**	**15000**	**25000**	**35000**
Gross Income at end of 7th Year			**36000**	**60000**	**84000**
Profit = Gross Income at end of 7th Year-49400			**-13400**	**10600**	**34600**

(Plantation + Maintenance cost = Rs. 35,000, Harvesting cost = Rs. 14,400)

Case IV: Plantation density 1660/Ha and stable yield of 0.5Kg/tree

Year	Seed/Tree/ Year (Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	166	498	830	1162
3rd	0.4	664	1992	3320	4648
4th	0.5	830	2490	4150	5810
5th	0.5	830	2490	4150	5810
6th	0.5	830	2490	4150	5810
7th	**0.5**	830	2490	4150	5810
Gross Income at end of 7th Year			**12450**	**20750**	**29050**
Profit = Gross Income at end of 7th Year-29960			**-17510**	**-9210**	**-910**

(Plantation + Maintenance cost = Rs. 24,980, Harvesting cost = Rs. 4,980)

APPENDIX VI

Case V: Plantation density 1660/Ha and stable yield of 1.0Kg/tree

Year	Seed/Tree/ Year (Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	166	498	830	1162
3rd	0.4	664	1992	3320	4648
4th	0.5	830	2490	4150	5810
5th	0.8	1328	3984	6640	9296
6th	1.0	1660	4980	8300	11620
7th	**1.0**	1660	4980	8300	11620
Gross Income at end of 7th Year			**18924**	**31540**	**44156**
Profit = Gross Income at end of 7th Year-32550			**-13626**	**-4010**	**11606**

(Plantation + Maintenance cost = Rs. 24,980, Harvesting cost = Rs. 7,570)

Case VI: Plantation density 1660/Ha and stable yield of 2.0 Kg/tree

Year	Seed/Tree/ Year (Kg)	Seed Yield (Kg/Ha/Year)	Income/ Ha		
			@ Rs 3/Kg	@ Rs 5/Kg	@ Rs 7/Kg
1st	—	—	—	—	—
2nd	0.1	166	498	830	1162
3rd	0.4	664	1992	3320	4648
4th	0.5	830	2490	4150	5810
5th	0.8	1328	3984	6640	9296
6th	1.0	1660	4980	8300	11620
7th	**2.0**	3320	9960	16600	23240
Gross Income at end of 7th Year			**23904**	**39840**	**55776**
Profit = Gross Income at end of 7th Year-34540			**-10636**	**5300**	**21236**

(Plantation + Maintenance cost = Rs. 24,980, Harvesting cost = Rs. 9,560)

APPENDIX VII

Other Financial Support Structures

The primary source of income from Jatropha plantation is the oil yielding seeds. The other major source of can be the oil cake (the leftovers after oil extraction). The oil cake is rich in nutrients with 3.2% Nitrogen, 1.4% phosphorus and 1.2% potash content. This can be good manure and can be used in biogas generation plants. The oil cake also can be used as cattle meal but only after detoxification. Planning Commission puts the cost of oil cake at Rs 2/Kg Approximately 67 Kg of oil cake can be obtained from 100 Kg of seeds (if the seeds contain 33% oil). The effect of this additional income will be as follows.

Table A7.1: Other Financial Support Structures

Year	Seed Yield (Kg/Ha/year)	Income/Ha (@ Rs 5/Kg seed)	Oil Cake (Kg) @ Rs 2/Kg
1st	———	———	——-
2nd	250	1250	335
3rd	1000	5000	1340
4th	1250	6250	1675
5th	2000	10000	2680
6th	2500	12500	3350
Sum		35000	9380
Net Income (Seed + Oil cake)		**44380**	
7th	5000	25000	6700
Stabilized income from 7th year (Seeds + Oil cake)		**31700**	

Thus an additional income of Rs. 9380 can be obtained in first 6 years from oil cake. A stable income of 14175 Rs/year/Ha can be obtained from 7th year onwards. This income is under optimal suitable conditions (Quality Planting Material, Soil Quality, Irrigation facility). This income can increase if the purchase rate of seeds and oil cake go up in forth coming years.

However to have the oil cake, the farmer need to have an efficient oil expeller.

PRAYAS

Initiatives in Health, Energy,
Learning and Parenthood

Resources and Livelihoods Group

Mangeshpushp, S.No. 133,
Swami Vivekanada Society,
Pune 411058.
Phone: (020) 2523 2836

B-21, B. K. Avanue, S.No. 87/10A,
Azadnagar, New D.P. Road,
Kothrud, Pune 411038.
Phone: (020) 65614494, 65704453
E-mail : reli@prayaspune.org
Web-site : www.prayaspune.org

Registered Office

Amrita Clinic, Athawale Corner,
Karve Road, Pune 411004.
Phone: (020) 2544 1230, 2542 0337.

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Resources and Livelihoods Group of PRAYAS

PRAYAS is a registered charitable trust based in Pune. PRAYAS activities cover four substantive areas of Health, Energy, Learning and Parenthood, and Resources and Livelihoods. The Resources and Livelihoods (ReLi) Group of PRAYAS was founded in 2000. The mission of ReLi Group is to apply professional skills and knowledge to empower and build capacities of the disadvantaged sections of the society, as well as organizations and institutions working for/with these sections for their development and empowerment. The members of the group believe that, if these sections are adequately equippped with knowledge and skills, they can develop their own pathways for ensuring their livelihoods, and lead a life of security and dignity.

'Promotion of sustainable livelihoods for the marginalized sections', and 'promoting public interest (including the interests of the disadvantaged sections) by making the process of governance transparent, accountable, and participatory' are the two themes underlying all the activities of the group. The work of the group based on these themes spans two spheres: a) influencing mainstream discourse and policy on development, and b) influencing the practice of development by mainstream agencies and institutions and strengthening the work of grassroots practitioners. Within these spheres, the work is further sub-divided into various programs and projects.

Most of the projects and activities are supported through grants from charitable foundations. Some activities are conducted with support from individuals, community, or with government support.