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Biodiesel policies for rural development in India

Report

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List of abbreviations

BOT	Build-Operate-Transfer
CBDA	Chhattisgarh Biofuel Development Authority
CDM	Clean Development Mechanism
CREDA	Chhattisgarh Renewable Energy Development Authority
GDP	Gross Domestic Product
GTZ	Gesellschaft für Technische Zusammenarbeit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IOC	Indian Oil Corporation Ltd.
JFM	Joint Forest Management
JFMC	Joint Forest Management Committee
MNRE	Ministry of Renewable Energy
MoRD	Ministry of Rural Development
NABARD	National Bank for Agriculture and Rural Development
NOVOD	National Oilseed and Vegetable Oils Development Board
NREGS	National Rural Employment Guarantee Scheme
NTFP	Non-timber Forest Products
R&D	Research and Development
Rs.	Rupees (1€ = ~60 Rs.)
SHG	Self-Help Group
SVO	Straight Vegetable Oil
TBO	Tree-borne oilseed
TERI	The Energy Research Institute
UBB	Uttarakhand Biodiesel Board

VAT	Value Added Tax
VESP	Village Energy Security Programme

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1 Introduction

Producing biodiesel from tree-borne oilseeds is seen by many as a win-win opportunity to solve two of India's most pressing problems. First, India needs to stimulate rural development. Agricultural growth lags far behind growth in manufacturing and services, reflecting a lack of investment and low productivity in the sector. Three quarters of India's poor people live in rural areas, and their prospects to overcome poverty are dim if agriculture remains decoupled from India's current economic boom. Second, India needs energy. From 1990/91 to 2006/07, India's oil imports increased dramatically from 21 to 111 million tons. As economic growth continues to be strong and international energy prices quickly go up, the country's foreign exchange expenditure for oil imports are skyrocketing.

Biodiesel might stimulate agricultural development and create employment and income for many rural poor. At the same time it may satisfy a significant part of the country's fuel demand, thereby increasing India's energy security and saving foreign exchange. Shifting to biodiesel would also reduce greenhouse gas emissions and urban air pollution. And finally, as oil-bearing trees can be grown in semiarid regions, there is a potential to rehabilitate degraded lands which are abundantly available in India.

At the same time, biodiesel production has recently come under heavy criticism for two reasons. First, critics claim that fertile agricultural lands will be diverted for cultivation of fuel crops at the expense of food production. Food scarcity and rising prices would especially hit the poor. Second, it has been shown that biodiesel production in some countries in fact increase greenhouse gas emissions, because forests are cleared for their cultivation and high energy inputs are used to produce some of the fuel crops. Hence important debates about the development impacts of biodiesel remain unsettled, and the specific tradeoffs in the case of India need to be explored.

However, the whole biodiesel sector is in an early stage in India. Although a significant number of plantations and some processing plants have been set up in recent years, the first full yields are yet to come. Little is therefore known about the economics of biodiesel from tree-borne oilseeds, and it is still uncertain whether production will ever become economically viable. Likewise, it is not yet clear what its socio-economic and environmental impacts will be, e.g. how much additional employment will be created and how big the undesired side-effects will be. Furthermore, little is known about how the different stages of the biodiesel value chain should be organised in order to achieve the best socio-economic and environmental outcome, and which policies are most appropriate to achieve this.

The Government of India is currently discussing a National Biofuel Policy. Among other incentives it considers to make blending of fossil diesel with biodiesel compulsory. Moreover, well-funded government programmes for rural development are already used to subsidise the establishment of biodiesel plantations at a large scale throughout India. While the federal policy is still under discussion, several state governments took the lead and established their own biofuel policies, each setting its own priorities and employing particular policy mixes.

This report aims to contribute the knowledge about biodiesel in India and to inform policy-makers about development impacts and appropriate policy choices. Its focus is on the potentials and risks for rural development. It is the first report that systematically takes stock of existing ways of organising the value chain in India and assesses their pros and cons from a comprehensive development perspective. Furthermore, it identifies, describes and assesses the appropriateness of a broad range of federal and state policies and support programmes. Again, it is the first time that such a survey of existing biodiesel policies has been carried out in India.

The study is based on a eleven weeks of field research. More than 100 stakeholders of the biodiesel sector have been interviewed at the federal level as well as in five states: Uttarakhand, Chhattisgarh, Andhra Pradesh, Karnataka, and Tamil Nadu. These states were chosen because they pioneered in promoting biodiesel production, and they host a broad variety of different ways of organising the value chain and pursue a wide range of different policies to get the activity started. As no survey of biodiesel activities exists and little was known about different modalities of production, it was impossible to follow a systematic approach covering all existing modalities. Instead, an explorative research approach was taken. The same applies to the analysis of socio-economic and environmental impacts. As the whole sector is still in a nascent stage, many impacts have not yet materialised and are thus not measurable. Instead, qualitative information was collected on different socio-economic and environmental aspects. In each state, guided interviews were conducted with agricultural producers and processors, policy-makers and representatives of different organisations of civil society. This enabled the team to detect potentials, risks and tradeoffs, but further research should be carried out in a few years time, when cultivation, processing and marketing channels are well established, to corroborate these observations with hard data.

The report is structured as follows. The following chapter 2 gives an overview of the potentials of biodiesel and how they could contribute to India's development challenges. Furthermore, it names the factors that are necessary to make biodiesel production economically viable, as economic viability is a necessary condition for reaping the potentials and meeting the challenges. The third chapter provides a brief account of federal and state level biodiesel policies in India which aim at encouraging biodiesel consumption and foster production in a way that benefits rural India. It also raises critical issues with regard to policy-making in India and addresses some limitations regarding the public role in implementing ambitious programmes. The forth chapter offers an overview of the multiple ways of organising the biodiesel value chain that we have found in five Indian states. It describes their main characteristics and the policies supporting them and discusses their implications for rural development as well as their economic viability. The final chapter concludes with a summary of main research findings and policy recommendations on how the Government of India could support the biodiesel sector in a way that new opportunities for the livelihoods of the rural poor are created and environmental and energy security targets met.

2 Potential development effects and economic viability of biodiesel in India

This chapter gives an introduction to the Indian biodiesel sector. Put into the global context, India is still a small producer of biodiesel. However, as the first part of this chapter argues, the Indian biodiesel sector is highly interesting as it is different from those in other countries and has the potentials to avoid many of the concerns generally associated with biofuels. The second part highlights the major developmental potentials of the biodiesel sector in India. Finally, the third part elaborates on the interdependencies and factors that influence the current economic viability of the sector.

2.1 Indian biodiesel production in the global context

Due to rising oil prices and increasing environmental concerns, countries all over the world have launched biofuel programmes to develop alternatives to conventional fuels within the last decade. While the share of biofuels in overall fuel consumption was still marginal in 2006 (less than 1%), the growth rate of biofuel production is enormous. Since 2001 biodiesel production has increased almost sixfold to about six billion l in 2006 (Worldwatch Institute, 2007, p. 4).[1,2] In order to contribute to energy security and to abide by the requirements of the Kyoto protocol, large energy consumer countries have developed ambitious plans to further substitute fossil fuel through biofuels, thereby creating an additional demand for biofuels of 9.2 million tonnes.[3]

In the light of the massively rising demand by Western states, the public debate on biofuels has shifted from euphoria to increasingly critical and sceptical voices. In this sense the OECD asks in a discussion paper on biofuels whether "the cure is worse than the disease" (OECD, 2007). The criticism emphasises mainly two aspects of biofuel production: worries about the impact on the climate and environment as well as concerns about food security.

The first criticism questions the ability of biofuels to effectively reduce greenhouse gas (GHG) emissions and claims that biofuels may even do more harm than good to global climate and the environment. Two arguments in this regard shall be highlighted: First, heavy use of fertilisers for crop production increases GHG emissions and pollutes water. Particularly the cultivation of rapeseed, the primary feedstock for biodiesel production in Europe, and maize, the main source

[1] Germany with a share of about 40% is the world wide largest biodiesel producer (Worldwatch, 2007, p. 7).

[2] With 28.3 billion l, global production of fuel ethanol is about six times as large as biodiesel production (6.2 billion l in 2006) and therefore more relevant on the global scale. India is the world's 7th largest fuel ethanol producer, with a production of 200 Mio. l of ethanol (Worldwatch, 2007, p. 6). This study, however, focuses exclusively on biodiesel programmes in India that have started only few years ago.

[3] In 2003 the EU demanded its member states to set targets for blending biofuels in the transport sector of 2% by 2005 and 5.75% by 2010. In addition, several European countries support the use of biofuels through tax reduction or higher blending requirements (Worldwatch, 2007, p. 283ff). In the Energy Policy Act of 2005, the US set the target of blending 28.4 billion l biofuels by 2012. Furthermore, many US government fleet vehicles such as the military are required to use 20% biodiesel blending (ibd., p. 9).

for the US bioethanol programme, require intensive use of fertiliser.[4] Second, sometimes only the benefits of carbon sequestration of biofuel crops are included in calculations about their carbon balance, but the loss of carbon storage in the biomass removed from land to be used for biofuel plantations is not taken into account (Searchinger et al., 2008). Particularly where rainforests are diverted into agricultural land for biofuel production, CO_2 emissions increase as biomass and soil in rain forests store large amounts of carbon dioxide. These additional emissions exceed the reduction effects of fossil fuel substitution by far.[5]

The second strand of criticism points at the negative effects of biofuel production on world food supply. As agricultural land is diverted for cultivation of fuel crops and as food crops like maize, sugar, soy or cooking oil are used for biofuel production, food prices rise.[6] Higher food prices particularly hit the urban poor. For poor farmers or farm labourers in rural areas the situation is more complex: As food producers they could benefit from higher prices. But since they are usually also net food buyers, they might as well be negatively affected (Worldwatch, 2007, p. 135ff.).

The Indian biodiesel sector is different from biofuel activities elsewhere in the world. Biodiesel production in India involves much fewer risks for the environment and food security. This is mainly due to the type of feedstock: While most other countries use annual crops for fuel production, in India biodiesel is produced from the seeds of trees with a life time of 30 to 200 years. In comparison to most annual crops, oil-bearing trees need little fertiliser and thereby avoid negative impacts on the net carbon balance. In contrast to countries like Malaysia, Indonesia and Brazil, there is no threat that natural forests will be destroyed for biofuel plantations. Since biodiesel cultivation is to take place on land mostly with marginal biomass cover, planting of oil-bearing trees is likely to increase the carbon sequestration of the respective lands. In fact, biodiesel production can be integrated into forestry programmes and therefore contribute to afforestation.

Biodiesel production in India moreover not necessarily compromise food security. First, there is a broad consensus in India that biodiesel production should be restricted to non-edible oils to avoid

[4] In a study on the carbon balance of biodiesel, the German Chemistry Noble Prize winner Paul Crutzen highlights the negative impacts of nitrous-oxide, a GHG which emits to the atmosphere in the process of degrading fertiliser in the soil. Being 300 times more harmful to the climate than CO^2, Crutzen concludes that biofuels grown in intensive agriculture are more damaging to the climate than fossil fuels (Uken, Die Zeit Online, 02.11.2007).

[5] Particularly the peat in rainforests binds large amount of carbon dioxide that is released to the atmosphere when drained. According to Ernsting (2007, p.5ff) only in Indonesia this drainage of peat for palm oil plantation emits about one billion t of CO_2 to the atmosphere per year.

[6] According to the IMF, world biofuel programmes have contributed to 45% of the rise of food prices since 2006 (IMF, 2008). The US-biofuel programme has been blamed to have contributed to the massive price increases for maize in Mexico of more than 400%, which sparked the so called “tortilla protests” in early 2007 (BBC News, 01.02.2007). Biofuel programmes in Europe and Brazil are believed to have triggered a global rise of prices for rapeseed oil and sugar (Worldwatch, 2007, p. 135).

price increases on cooking oil.[7] Second the focus on land not used for intensive agriculture also contributes to minimising the competition between fuel and food. Although biodiesel plantation on agricultural land is an option also in the Indian case, there is large potential to integrate oil-bearing trees into farming systems and rural country-side without necessarily replacing food crops. Third, the biodiesel activity can even improve food security as it provides additional income opportunities for poor people, thereby increasing their capacity to reinvest the money in food production or to buy needed food.

The fact that biodiesel production in India is different from fuel programmes in other countries does not mean that environmental and social concerns are not relevant for the Indian biodiesel sector. Whether these concerns can be avoided depends much on how the sector, which is still in a nascent stage, will develop and which ways of organising the value chain will be adopted. The various implications of the different ways are displayed and discussed in chapter 4 of this study.

Several tree species can be selected for biodiesel production. More than 300 different species of oil-bearing trees exist in India. All of them are naturally grown wild species, which have not yet been cultivated and harvested systematically for oil production.[8] Some of the seeds have been collected by poor people for lightning for deacdes. Only in small quantities, tree-borne oilseeds (TBOs) are used for commercial purposes in the paint, lubricant and soap industry (GTZ/TERI, 2005, p. 6).

According to the National Oilseeds and Vegetable Oils Development Board of the Indian Ministry of Agriculture (NOVODd, s.a.) there are about ten species with economic potential for biodiesel production including Jatropha, Pongamia pinnata, Simarouba glauca,[9] Azadirachta indica (Neem) and Madhuca indica (Mahua) (see Table 1). Proponents of biodiesel in India almost exclusively focus on Jatropha and to some extent on Pongamia. Other species have not received much attention. The focus on Jatropha is justified mainly by two arguments: First of all, Jatropha does not grow into a tree but remains a shrub. Therefore, it is easier to harvest than large trees and has a much shorter gestation period. Since the time span between investments and returns is shorter, more people might adopt the cultivation of this crop. Second, the seed collection period of Jatropha does not coincide with the time of rainfalls in June-July where most agricultural activities take place. Therefore, people can generate an additional income in the slack agricultural season (Nigi/Komal/Ranjan, 2006, p. 34). Pongamia has become the second feedstock of the Indian biodiesel sector for the reason that this tree is traditionally planted in several states and therefore well known to the people. Being a multipurpose plant that is not only a source for oil but also for animal feed, manure, fire wood and medical uses, farmers already integrate Pongamia into their farming systems. Also on public land such as from forests or along

[7] India still cannot satisfy its huge demand on cooking oil and has to import 55% of the required volume. India is the worldwide larges importer of edible oil. Edible oil imports amount to more than 50% of India's total agricultural imports (Kumar/Sharma, 2005, p. 884).

[8] It was estimated that only 10% of the seeds from natural plantations have been collected (Ghasias, 2006, p. 217).

[9] Simarouba glauca is a promising oil-bearing tree, which was only recently introduced in India. Although Simarouba oil is generally edible, its consumption for cooking is not habitual in India (Joshi/Joshi, 2007, p. 99ff).

road sides, it already is common practice for people to collect and sell the seeds – provided they find a market (Int. Ramakrishna, Samagra Vikas).

Table 1: Oil-bearing tree species in India

	Jatropha	Pongamia	Mahua	Simarouba	Neem
Height (m)	3-4[h]	15-25[m]	21-23[d]	15[j]	15-20[f]
Climate	Arid, semi-arid and tropical areas with rainfall between 1000-1500mm; mixed hot and humid climate preferred; cannot withstand frost[c,e]	Grows almost throughout India up to altitude of 1.200 m. Requires of 500-2500mm annual rainfall; cannot withstand frost[e]		Grows almost throughout India up to altitude of 1000 m. Requires 700-4000mm[d]	Grows under sub-arid to sub-humid conditions with 400-1200 mm annual rainfall[f]
Soil	Hardy plant growing also on stony, gravely or shallow and calcareous soils with low fertility, well drained soils required[b]	Tolerate to salinity[k], alkaline and water logging soils[b]		Wide variety of drained soils with pH from 5.5-8.0. Loamy and red laterites are preferred[j]	Wide varieties of soils including clayey, saline and alkaline soils, with pH up to 8.5. Deep and well-drained black cotton soil preferred[f]
Gestation Period (years)	2-3[a,b,c]	4-7[a]	8[a]-15[i]	6-8 (3-4 when grafted)[j]	5-6[a]
Economic lifespan (years)	35[e]		60[i]		150-200[f]
Oil content per seed (in %)	28[e]-35[a]	27-39[k]	35[i]-40[a]	50-60 plus 20-32% oil in the nutlet[j]	45[a]
Yield per tree (kg)	1[k]-2.5[a]	20-25[a]	20[i]-40[a]	15[d]	15[a]
Oil / ha (t)	0.7-1.8[a]	1.5-3[a]	2.7[a]	1-2[j]	2.5[a]
Collection Period	Oct-Nov[k]	May – June[m]	June-July[c]	April/May[j]	
Density of Plant/ha	1500[g]	500[c]	200[c]	500[c]	400[a]
Other characteristics and uses	Seeds and oil are toxic. The plant is not browsed as the leaves are not palatable for animals. Not useful as firewood.[b] Used as lubricants, soap and candle manufacturing[h]	Non-toxic leguminous tree, fixing nitrogen into the soil and due to large canopy and nutritious leave and flower litter used for planting in pastures.[m] In villages leaves are used for protecting grains from insects.[m] Good as fire wood, leaf litter with high calorific value.[b]	Largest indigenous source for soap and bathing oil manufacture, medical purposes and animal feed.[i] Sugar rich flowers used as vegetable and for alcohol production (1 t flowers produce 405l of alcohol).[i]	Large root system, evergreen canopy and large amount of leaf litter (6-8t/ha); most suitable for wastelands reclamation and watershed development.[j] Sugar rich fruit pulp can produce ethanol (800-1000l/ha).[j]	Has a unique property of calcium mining, changing acidic soils into neutral. Famous as ecologically friendly biopesticide to control storage and field crop pests.[f]

Sources:
a: Ghasias, 2006, p. 216.
b: GTZ/TERI, 2005, p. 7.
c: Jongschaap et al., 2007, p. 5.
d: Joshi/Joshi, 2007, p. 28, 36.
e: NABARD Karnataka, 2006.
f: Neem Foundation online
g: Negi/Komal/Ranjan, 2006, p. 41
h: NOVOD, 2007, p. 1.
i: NOVODa (s.a.).
j: NOVODb (s.a.).
k: NOVODc (s.a.).
l: NOVODd (s.a.).
m: NOVODe (s.a.).

2.2 Potential development effects of biodiesel in India

While there is a chance that biodiesel in India will avoid the worst distortions associated with biodiesel production in other countries, biodiesel in India has the potential to address five of its most important development challenges. Firstly, biodiesel has the potential to contribute to India's energy supply and to decrease its dependency on oil imports. Due to high economic growth, continuous population growth, and increasing urbanisation, Indian energy and oil demand has risen significantly and will keep on rising in the near future.[10] With a constant domestic oil production at only 33-34 mio t per year, India depends strongly on oil imports to satisfy the increasing energy demand, exposing the Indian economy to the oil price fluctuations of the world market.[11] From 1990/91 to 2006/07, Indian oil imports increased dramatically from 21 to 111 mio t (Ministry of Petroleum and Natural Gas, s.a., p. 12; GTZ/TERI, 2005, p. 71). As world market prices for crude oil tripled during the same period, imports have a strong effect on India's foreign exchange expenditure, its trade balance and economy as a whole.[12] Biodiesel production has the potential to reduce pressure on oil imports. The draft National Biodiesel Mission of 2003[13] suggested to aim at substituting 20% of transport diesel by 2011-12, requiring 13,28 mio t of biodiesel. Thereby India would save at least Rs. 1.17 billion of foreign exchange and improve the trade balance by at least 15% (GTZ/TERI, 2005, p. 74).

A second potential of biodiesel is to reduce India's carbon-dioxide emissions. To achieve its development targets, the Government of India aims to achieve 8% growth in GDP, requiring substantial additional energy inputs. Therefore, economic growth is directly linked to growing GHG emissions, which have increased by about 7 % annually during the 1990s (UNDP, 2007). Despite relatively low levels of per capita emissions, estimations suggest that until 2020 they will increase by 400% compared to 1990.[14] As the Government of India is committed to promote renewable energies and to shift to a low carbon growth trajectory,[15]

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[10] From 1970 to 2001/02 India's primary energy supply has increased from 150 MT to 438 MT of oil equivalent. Estimates indicate that until 2031 India's primary energy supply will have to increase by 300 to 400% and its electricity generation capacity by 500 to 600% of the 2003/04 levels (Srivastava/Mathur, 2007, p. 2ff.).

[11] India's oil import dependency is projected to rise to 93% by 2030 (Kumar/Dhavala, 2006, p. 233). Due to this the Indian economy is highly vulnerable to oil price fluctuations on the world market. Calculations revealed that a $10 increase of the oil world market price would cause a deterioration of the Indian GDP by 1% and of the Indian trade balance by 1,2% (GTZ/TERI, 2005, p. 74).

[12] India's foreign exchange expenditure for oil imports sky-rocked from Rs. 61 billion in 1990/91 to Rs. 2200 billion in 2006/07 (Ministry of Petroleum and Natural Gas, s.a., p. 12; GTZ/TERI, 2005, p. 71), which in 2003 was equal to about 3% of India's GDP (GTZ/TERI, 2005, p. 73). Gross oil import amounts to 45% of India's total exports (Ministry of Petroleum and Natural Gas, s.a., p. 12) and are the main cause for India's increasing trade balance deficit, which rose to US$ 4229 million in February 2008 (Ministry of Finance).

[13] See Chapter 3.3.

[14] In 2000, India's per capita emission of GHGs amounted to 1.5t. This was far below the global average of 3.9t per capita and only 1/8 of the per capita emissions of Germany (Sharma/Bhattacharya/Garg, 2006, p. 329). The Indian emissions increased annually by about 7% from 682 MT in 1990 to 1.342 MT in 2004 (UNDP, 2007). Predictions estimate emissions to rise to 3000 MT by 2020, making India the third largest emitter worldwide, after the U.S. and China. (Sharma/Bhattacharya/Garg, 2006, p. 329).

[15] India has achieved a capacity of grid connected, renewable energy of 6100 MW, accounting for 5.5 % of the total electricity supply (Sharma, 2007, p. 167).

promotion of biodiesel is one way of reaching this goal.[16] Furthermore, biodiesel activities can be an opportunity to receive additional funds through the Clean Development Mechanism established by the Kyoto Protocol.

Box 1: The potential of the Clean Development Mechanism in the biodiesel sector

The Clean Development Mechanism (CDM) is a carbon trading system set up by the Kyoto Protocol. With this mechanism, companies in industrialised countries can buy "carbon credits" from project developers in developing countries in order to achieve their own green house gas reduction targets. The project developer in the developing country needs to hand in an application in order to receive Certified Emission Reduction (CER), which can then be sold to investors from industrialised countries. As biodiesel projects intend to reduce carbon emissions, they are potential candidates for CER. Eligibility for CER would increase the economic viability of biodiesel production.

There are currently three potential forms in which a CER can be obtained in the biodiesel sector. First, TBO plantation could be considered as afforestation. Second, the replacement of conventional diesel by biodiesel could be certified. Third, the whole production process from planting to the marketing of biodiesel could come under the CDM. Further possibilities – like, for example, obtaining a CER for any kind of oilseed produced for biodiesel production – might develop in the future. In order to obtain CERs, two conditions have to be fulfilled: The application needs to follow an approved CDM methodology[1] and additionality must be given – that is, green house gas reductions must be additional to those that would have occurred without the benefits granted by CDM.

Methodologies for the first and second type of CER mentioned above already exist. Therefore, application for such projects is theoretically possible. However, most interviewees have claimed that the certification process is too complex and too expensive (Int. Reddy, BAIF; Int. Bhat, GTZ India). Enabling access to CER for those lacking the required professional knowledge is therefore crucial to take advantage of the CDM in India. One way to do so can be to assist in bundling small projects (Int. Bhat, GTZ India). Bigger projects, however, are able to apply for CER without advisory aid. The Karnataka State Road Transport Corporation (KSTRC), for example, will soon receive CDM funds for 1000 buses running on a biodiesel blend. For every litre of diesel replaced, the corporation will receive Rs. 2.15 and for every ton of CO_2 replaced they will receive 16 US$ (Int. Rao, KSRTC). For the corporation, this is an important incentive to expand its biodiesel consumption.

A methodology for biodiesel *including* cultivation, processing and marketing is, however, still to be developed. GTZ India is working on such a methodology, but it has not yet been approved. This is because it is difficult to establish the respective "baseline", i.e. on the one hand, to trace back the entire value chain correctly and ensure its positive emission effects, and on the other hand, to quantify how many emissions would have occurred without the respective project. Too many aspects, ranging from the previous land use pattern to the energy requirements of fertilisation, processing and transport need to be taken into account (Int. Bhat, GTZ India).

Additionality is usually easy to prove for most biodiesel projects. However, certain policy decisions can have a major impact on this CER condition. If blending, for example, will be made compulsory, receiving CDM funds for it will not be possible anymore (Int. Bhat, GTZ India).

[1] For more information on the application process please refer to http://cdm.unfccc.int/Reference/Guidclarif/glossary_of_CDM_terms.pdf and http://cdmindia.nic.in.

The third potential of biodiesel is to contribute to the rural economy and to create employment and income for the rural poor. While the Indian economy has grown rapidly in the last decade,

[16] Life cycle assessments of Jatropha-based biodiesel indicate positive effects in reducing overall GHG emissions: It is estimated that every tonne of biodiesel reduces CO^2 emissions by 3t (GTZ/TERI, 2005: 56). While Jatropha based biodiesel contributes to the reduction of sulphur dioxide, negative effects for the emissions of nitrogen dioxide have been reported (Reinhardt et.al., 2007,p. 45).

little development has taken place in the rural areas, home to three quarters of the Indian poor.[17] While India's total economy and particularly the service sector is booming, the agricultural sector has almost stagnated.[18] This adversely affects the rural poor who depend on agriculture for their livelihoods (World Bank, 2006b). The Indian agricultural sector is characterised by low productivity: The sector contributes only 18% to the GDP (World Bank, 2007, p. 340), although it employs almost 60% of the Indian workforce (World Bank 2006a, p. 126).[19] While, for example, between 1990 and 2004 China and Vietnam achieved 4% annual growth in per capita food production, India's growth of only 0.9% is rather moderate (World Bank, 2007, p. 326). One reason for the stagnation in agriculture is that large amounts of public funds spent in rural areas are utilised for rather inefficient input subsidies such as fertiliser, power and food, instead of required public investments in agricultural infrastructure and research (World Bank, 2006a, p. 139). In this context, biodiesel has the potential to trigger private and public investments in rural areas, improve the diversification of agriculture, generate additional employment and income for farmers as well as for landless people, and increase the productivity of underutilised agricultural land.

Rural energy security is a fourth concern to which biodiesel might contribute. According to the 2001 Census of India, less than 50% of India's rural population has access to electricity. Since electricity not only increases living standards but is also indispensable for many productive and economic activities, there is a close connection between access to electricity and poverty alleviation (Chaurey/Ranganathan/Mohanty, 2004, p. 1693). The Indian Ministry of Power has set the target to electrify about 80,000 villages by 2012. Out of these, 18,000 villages in remote and inaccessible locations need decentralised solutions for energy supply (ibid., p. 1695). Biodiesel – or its preliminary product, Straight Vegetable Oil (SVO) (see chapter 4.2) – if produced in the respective villages, can be one option for decentralised, reliable and affordable electricity supply and a renewable energy source (see Box 3).

Fifth, cultivation of TBOs can be conducive to the protection of natural resources. In India, large amounts of land are not suitable for productive purposes due to harsh agro climatic conditions or unsustainable usage. The Wastelands Atlas of India, a satellite based land survey by the Indian Ministry of Rural Development, identifies 553,000 km² of the 3.3 Mio. km² total land area in India as wastelands (MoRD, 2005, p. 12). Particularly the 108,000 km² of degraded forests and 151,000 km² of land with only scrub vegetation – amounting to more than 8% of the total geographic area in India (ibid.) – need afforestation and soil improvement to prevent further degradation.[20] Being more drought resistant than most other crops and trees, oil-bearing trees can be an option to contribute to the rehabilitation of degraded land through stabilising soil, improving manure cover and bringing degraded land back to productive use.

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[17] 72% of the total Indian population (770 Mio.) live in rural areas (World Bank, 2007, p. 320). Almost 1/3 of the rural people lives below the poverty line (in contrast, to ¼ of the urban population) (ibid, p. 336).

[18] While in 2004/05 Indian GDP grew by 7.5% and the service sector by 9.9% the agriculture sector almost stagnated with a growth rate of only 0.7% (World Bank, 2006b, p. 6).

[19] The productivity of cereal production, for example is with 2,4kg/ha only half of the yields in China and Vietnam (World Bank, 2007, p. 326).

[20] Other relevant categories of wastelands with potentials for afforestation through oil-bearing trees include 37,000 km² land without scrub, 16,000 km² of shallow/medium gullied or ravenous land and 9,000 km² land with slight or moderate saline or alkaline slight (MoRD, 2005, p. 12; Shankar, 2006, p. 94).

2.3 Economic viability of the biodiesel sector

To achieve these high expectations, the biodiesel sector needs to be economically viable for the various entrepreneurs. However, this prerequisite is not yet given.[21] Economic viability hinges on various interrelated factors: income and yields to be generated as well as input and opportunity costs.

The income generated by TBOs depend on the biodiesel price, which in turn is connected to the price of conventional diesel. Since conventional diesel is heavily subsidised by the Government of India and negative environmental externalities are not reflected in the prices of conventional diesel, biodiesel is disadvantaged vis-à-vis conventional diesel. While Indian oil companies are obliged to buy biodiesel at a price of Rs. 26.5/l, entrepreneurs in the biodiesel sector state that currently biodiesel production is only viable at a price of Rs. 45-50/l (Int. Gulati, BDA). The economics can be improved by more efficient methods and by marketing by-products, like glycerine and seed cake (see chapter 4.2). While currently the price of glycerine is about Rs. 50/kg, the price is most likely to drop with increasing supply and constant demand. The seed cake can be used in biogas plants, as organic fertiliser and after boiling, drying and detoxification as animal feed. While in some regions entrepreneurs already sell the seed cake,[22] in other parts of India it is difficult to find a market (Negi/Komal/Ranjan, 2006, p. 44). Therefore, it can be stated that at the current purchase price, biodiesel production for the national transport market is not economically viable.

The second constraining factor for the Indian biodiesel industry lies in the poor quality of the available plant material. Since most oil-bearing trees have not been traditionally used as productive farm crops for fuel production, little breeding has taken place to improve yields and oil content. In fact, particularly Jatropha curcas is basically a wild plant (Int. Kureel, NOVOD). Kureel, Director of NOVOD, estimates that Jatropha yield needs to be improved considerably in order to make its cultivation viable (ibid.).

As shown in Table 3, mature Jatropha plantations are expected to yield more than 3.5t/ha. To achieve such yields, fertile soil, irrigation or high rainfall and inputs of fertiliser and pesticides are required.[23] Under similar conditions, however, food crops can also be grown in an intensive way. Such food crops achieve higher returns than for cultivating Jatropha. Due to these high opportunity costs, not many farmers have made available their agricultural land for Jatropha plantations. As shown in chapter 4.3, TBO cultivating farmers either integrate the oil-bearing trees into their farming systems (e.g. as intercrops or fences) or decided to grow fuel crops for lack of time to engage in more lucrative staples.

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[21] Only a few niche markets in the biodiesel sector are already economically viable. These include the reproduction of seedlings, the extraction of Pongamia oil for the chemical industry and very few CDM-funded projects.

[22] Channabasaveshware Oil Enterprises in Gubbi, Karnataka, sells the seed cake as fertiliser to farmers or to other companies for solvent extraction at Rs. 8,5/kg (Int. Swamy, General Manager of the company).

[23] Inputs are crucial for seed production, as demonstrated by a 40ha mother plant plantation for nurseries managed by the Department of Agriculture in Tamil Nadu. Due to lack of input (no irrigation and fertilisers have been used) and acid soil, even after 7 years, the yields are below 0.5kg/plant after 7 years (Int, Kumar, Department of Agriculture).

Table 2: Economics: Costs of Jatropha Plantation (at a wage rate of Rs. 60/man day[a] and 1500 plants/ha)			
Activity	**1st year**	**2nd year**	**3rd year onwards**
Site preparation and alignment (15 man days)[a]	900	-	-
Digging of pits (50 pits/man days) [a]	1.800	-	-
Costs for manure (2kg/pit first year; 1kg/pit second year onwards @ Rs. 400/t [a]	1.200	600	600
Costs of fertilizer @ Rs. 6/kg and 50g 1st year, 25g 2nd year onwards and 2 man days[a]	570	345	345
Mixing manure, insecticides, fertilizer and refilling pits @ 100 pits/man day [a]	900	-	-
Cost of plants (1500 1st year, 300 2nd year) @ Rs. 4/plant[a]	6.000	1200	-
Planting costs, 100 plants/man day[a]	900	180	-
Irrigation (3 times in 1st year, 1 time in 2nd year @ Rs. 500)[a]	1.500	500	-
Wedding and Soil Working (10 man days, 2 times)[a,b]	1.200	1200	
Plant protection measure	500	500	500
Pruning (20 man days)[b]	2.400	2.400	
Harvesting (1 man day/50kg seeds) [a]	-	-	
TOTAL (plus 10% for contingency)	**19.657**	**7.618**	**1.590**

Sources:
a: NOVODd, s.a..
b: Negi/Komal/Ranjan, 2006, p. 40/41.

Table 3: Economics: Rate of Return for Jatropha (at a assumed seed price of Rs. 6,5/kg)

Year	Seeds/tree[a] (kg)	Seeds/ha (kg)	Costs[b] (in Rs.)	Income	Net Benefit
1	-	-	19,657	-	-16,467
2	-	-	7,618	-	- 4,428
3	0.3	450	2,130	2,925	795
4	0.5	750	2,490	4,875	2,385
5	1	1,500	3,390	9,750	6,360
6	1.5	2,250	4,290	14,625	10,335
7	2.2	3,300	5,550	21,450	15,900
8	2.5	3,750	6,390	24,375	17,985
Rate of return:					**32,865**

Sources:
a: Negi/Koal/Ranjan, 2006, p. 41
b: see Table 2

Since availability of land with low opportunity costs is a prerequisite for the economic viability of the biodiesel sector, much attention has been given to so-called wastelands that could be utilised for cultivating oil-bearing trees. As already mentioned, there are large amounts of degraded and unfertile land in India. The Government of India identified 72,000 km² of the 553,000 km² wastelands as suitable for biofuel crop cultivation (Shankar, 2006, p. 94). However, considerable amounts of this land are already in used in some way or another. Furthermore, contrary to earlier assumptions (Planning Commission, 2003, p. 111f) experience by research institutions and practitioners in the past few years has shown that although Jatropha survives even in harsh and dry conditions, yields will be too low to be of economic interest.

Whereas the Indian national market does not yet provide sufficient demand for a viable biodiesel production, trading biodiesel on the world market is a very lucrative option. Due to compulsory blending policies in Europe and the United States, the demand for biodiesel on the world market has increased tremendously. Since TBO-based biodiesel from India is about 200$/t cheaper than biodiesel produced in Europe and has a better carbon balance, the world market is a relevant option for Indian biodiesel (Negi/Komal/Ranjan, 2006, p. 43). This could result in higher investments and income for the Indian biodiesel sector and contribute to

improve India's trade balance. Several interviewees however expect that the Government of India may install export restrictions (as it periodically does in the case of food crops) on biodiesel to achieve own targets, such as to reduce the oil import dependency as well as greenhouse gas emissions. So far, these claims have been neither confirmed nor objected by the Government of India.

For all these reasons, large-scale biodiesel production for the national Indian market is not economically viable at present. Farmers and private entrepreneurs are reluctant to invest in biodiesel activities unless they receive heavy subsidies. As a result, the biodiesel sector has been developing rather slowly and is still in a nascent stage. Although planting has recently picked up due to government subsidies, most of the plants are not yet yielding and the great majority of available seeds are used for new plantations. Although not much is available for processing, investments have taken place on the manufacturing side. Several smaller expelling and transesterification plants have been set up or are under construction. Five plants in Karhimara, Hyderabad, Latur (Maharashtra), Uttarakhand and Delhi are operating on industrial scale at a scale between 30 to 300t/day (Int. Gulati, BDA).

Those investing into biodiesel activities expect that TBO-based biodiesel will become economically viable in the near future since biodiesel prices are likely to rise and production costs may decrease. The price of biodiesel is expected to rise due to rising prices of fossil fuels on the world market.[24] As consumption soars, the Indian Government is furthermore unlikely to sustain the current level of subsidies for conventional diesel and electricity in the medium and long term. At the same time, production costs can be reduced if hybrid varieties of oil-bearing trees are developed with considerably higher yields and improved properties to serve the specific harsh conditions on degraded wastelands.[25] Additionally, experimenting with different ways of organising the biodiesel value chain will help to cut production costs. In order to achieve this, however, much research is needed.

[24] From the 1990s to 2007 the world price for crude oil increased from about $20/barrel to more than $70/barrel (IEA, 2007, p. 40). Due to rising oil demands from emerging countries, analysts predict that an oil price of $100/barrel is likely in the near future.

[25] One successful example for improving the productivity of plant material through R&D is the mycorrhiza technology developed by TERI. Applying this fungi to the roots of Jatropha shortens the gestations period and increases the yields up to 30% (Adholeya/Singh, 2006, p. 144). Another activity for R&D is to merge the positive properties of the 14 existing Jatropha species. While Jatropha curcas is known for its oil-rich seeds, other species have the advantage to grow on waterlogged or drought land. By merging the positive characteristics hybrid varieties can be created that better adjust to the different regional conditions (Int. Kureel, NOVOD).

3 Biodiesel policies in India

3.1 Rationale for policy intervention

As the first chapter has shown, India has to address the simultaneous challenges of energy security, climate change and rural development. Biodiesel bears strong potentials – but also risks – for all of these challenges. Despite these potentials, a biodiesel market has not yet fully developed in India due to by a series of market failures: Biodiesel cannot yet compete with fossil fuels, as the prices of the latter do not reflect the negative environmental externalities which they cause. If these costs were internalised, biodiesel with its higher production but lower environmental costs would be more competitive. At the same time, positive externalities of R&D efforts in biodiesel and of processes of self-discovery cannot be fully appropriated by investors and farmers. The vast part of this knowledge will constitute non-patentable incremental innovations that can be freely appropriated by anyone. The same applies to the positive social externalities which biodiesel production for rural development may imply. A number of market failures specifically prevent the poor in remote areas to benefit from the opportunities of the sector. Since TBO-based biodiesel production is a new activity, cultivators are not informed about cultivation methods and required inputs, expected yields, available support measures and the development of the market. Because of the high-risk and long-term nature of investments – many TBOs can only be used for the production of non-edible oil and have a long gestation period - information is a prerequisite for investment. However, access to information is often lacking in remote areas. Where consultancy services are available, poor farmers often underestimate the value of such services. Particularly when relating to strategic and long-term activities, the final outcome of consultancy services is unpredictable for the farmers, so that small farmers are usually not willing to spend money for consultancy services to obtain required knowledge and information. Another impediment is a lack of access to credit markets and to land. Vertical and horizontal coordination failures furthermore create barriers: Cultivators will be reluctant to enter into biodiesel production without linkages to processors. In order to establish such vertical linkages, horizontal coordination among cultivators is required as processors depend on the availability of a critical amount of oilseeds for operating at an economically viable capacity. This may be obstructed by high transport and transaction costs in remote areas.

All of these market failures justify and call for state intervention. Policy intervention, however, carries the risk of government failure. Heavy government intervention is prone to the problems of lacking information about market dynamics, high costs of acquiring such information, opening up room to rent-seeking, and distorting markets. Until the early 1990s, India relied on centralised policy planning and implementation and on strong regulation of the private sector, all of which was to correct real or perceived market failures. This policy produced inefficiencies, market distortions and rent-seeking activities.

3.2 Deregulation and Decentralisation – achievements and remaining challenges

Since the 1980s, India has made large efforts at deregulation and decentralisation and deregulation. As regards economic deregulation, industrial licensing requirements were

significantly relaxed. The government in general embarked on a rather pro-business policy aimed at easing the supply- and demand-constraints faced by private entrepreneurs (Kohli, 2006a, p. 1253). Subsequently, GDP growth accelerated to 5.8% per annum between 1980 and 1990 (Kohli, 2006a, p. 1254). At the beginning of the 1990s, India abolished or reduced numerous other regulations and restrictions in the area of the economic activity for the state, restrictions on large industrial houses, on the inflow of foreign capital and technology transfer, on imports, as well as high tariff levels (Kohli, 2006b, p. 1361). With the constitutional recognition of the three-tier Panchayati Raj system and the Joint Forest Management policies of many states, India has also made considerable efforts at decentralisation.

Yet despite these remarkable efforts and achievements, reforms remain largely incomplete. With regard to biodiesel we have identified five areas where reforms have been initiated to correct government failure, but much remains to be done: Land ownership, agricultural marketing and marketing of forest products, agricultural extension services, political decentralisation and forest management. The following section gives a brief account of these reforms as well as their shortcomings.

In contrast to the industrial sector and the service sector, the agricultural sector remains regulated and dominated by the government. This may be demonstrated by three examples: First, large amounts of forest and non-forest land belong to the government. Only around 58 percent of India's total land areas for which records are available are private, cultivable land. All other land is considered forest land (22%), uncultivated revenue land (7%) or common land[26] (20 %) (Mearns, 1999, p. 4). Since the end of the 19th century, uncultivated land has been continuously appropriated by the state and declared forest land (Sarin et al., 2003, p. 2) – even though about of that area has a forest cover of less than 40 percent (Mearns, 1999, p. 4). The Indian Forest Act classified reserve forests, in which people have no rights, protected forests, in which people have all rights unless forbidden by the Forest Department, and village forests, which are left for meeting people's needs (Sarin et al., 2003, p. 2). Between 1951 and 1988, the net area under the control of the Forest Department increased from 41 to 67 Mio. ha, the bulk of which has become reserve forest (Mearns, 1999, p. 4). As land ceiling laws have failed to bring about any significant redistribution of privately owned ceiling-surplus land, many states have sought to redistribute some public land ('wastelands') to landless households, usually in very small patches. However, much of the land redistributed is of low quality and generates low and uncertain crop yields. There has also been a parallel process of *de facto* privatisation or encroachment on commons by non-poor farmers with access to complementary inputs, and who are able to persuade or bribe the local officials to manipulate the record of rights in land in their favour (ibid.).

Second, agricultural marketing and marketing of non-timber forest products (NTFPs) is only slowly being liberalised. Agricultural marketing in India has traditionally been characterised by pervasive government intervention (Acharya, s.a., p. 8). Realising that regulation has not increased farmers' income and effectively limited much needed private investment in

[26] Commons provide a wide range of physical products (e.g. food, fuel, fodder), income and employment benefits (e.g. supplementary crops or livestock, drought period sustenance, off-season activities) for the rural poor and socially excluded groups (Mearns, 1999, p. 28f).

agriculture, in 2003 the Ministry of Agriculture formulated a Model Act that allows farmers to sell their produce directly to traders and processors and to enter into contract farming relationships. Although often only partially, most states have amended their agricultural marketing acts on the lines of the Model Act (Government of India, 2008). The situation of NTFPs is similar: During the 1960s, high-value NTFPs have been gradually nationalised in order to protect the interests of the poor against exploitation by private traders and middlemen. This policy, however, ran counter to community decision-making over their natural resources. Collectors were bound to sell to government-appointed agents, often Forest Development Corporations, cooperatives or tribal societies (Tewari, 2006, p. 280ff). In some states, government orders which "smacked of favouritism" (Saxena, 2003: ix) have granted monopoly lease rights of certain NTFPs to private companies. Although in theory a state- or district-level committee fixed the prices, in practice there was no check on the price paid to the collectors, and often collectors were paid much lower prices than the ones prevailing on the market (Tewari, 2006, p. 286). In several states monopolies on NTFPs prevailed even despite a new central law of 1996, which acknowledged the traditional ownership rights over NTFPs of Panchayats in tribal areas. In these cases, members of forest committees receive only wages for collecting NTFPs from forest lands of which they are supposed to be the managers (Saxena, 2003, p. 38ff).

A third example of enduring government intervention in agriculture relates to service provision. Different state departments have extensive administrative setups for service provision. The Department of Agriculture in Chhattisgarh, for example, currently has 650 posts for Agriculture Development Officers operating at district level and 3375 posts for Rural Agricultural Extension Officers, operating at block level. Apart assessing the input requirements of farmers and communicating the numbers to the district level, the latter are mainly involved in providing extension services free of cost to the farmers. One officer is responsible for 800 to 1000 farmers. There is no system of independent monitoring and evaluation or a mechanism for gathering and feeding back the farmers' opinion of the services delivered. Chhattisgarh only very rarely funds private services suppliers such as NGOs and if so this happens at the discretion of the respective district official, following no defined tendering procedure (Int. Kridutta, Agriculture Department) Acknowledging that public service provision suffers from a lack of outreach, lack of professionalism, top down planning and implementation and absence of performance-based monitoring, the Policy Framework for Agricultural Extension by the Ministry for Agriculture of 2000 recommended a number of far-reaching reforms, including contracting out of services to private suppliers and private co-financing of some services. Since agriculture is a state subject, it remains yet to be seen to which extent states will adopt these recommendations.

The 73rd Amendment to the Indian Constitution that came into force in 1993 gave village, block and district level bodies in rural areas – the Gram Panchayat, intermediate Panchayat or Panchayat Samithi, and Zilla Parishad – a constitutional status under Indian law. Panchayati Raj Institutions are elected for five year terms, with one-third of all seats reserved for women as well as proportional reservations for Scheduled Castes and Scheduled Tribes.[27] Their main

[27] Scheduled Castes and Scheduled Tribes are Indian communities that are explicitly recognized by the Constitution of India as requiring special support to overcome centuries of discrimination. Together they comprise over 24% of India's population, with Scheduled Castes at over 16% and Scheduled Tribes over 8% as

function relates to the planning and implementation of rural development activities – paying tribute to the Indian Planning Commission who has long pointed out that "various rural development programmes will be realistic and meaningful only if people's representatives are actively involved and associated in local level planning, design formulation and implementation of those programmes (…) and that there is no better instrument to meet this need other than the Panchayati Raj institutions" (Government of India, 1987, p. 16, in: Alagh, s.a., p. 6).

But despite the generally positive thrust of decentralisation and some encouraging effects for example in West Bengal and Kerala, many challenges remain. For one, establishment of Panchayat has not translated into effective decentralisation of power. Powers and functions of the Panchayati Raj Institutions under the Constitution remain vague, and most state Legislatures have satisfied only the basic constitutional requirements relating to the transfer of functions, functionaries, funds and financial autonomy to the Panchayats (ODI, 2003, p. 19; NAC, 2005, p. 5). Moreover, many state laws have vested wide powers of suspension of elected representatives in the state bureaucracy (Saxena/Ravi, s.a., p. 3). Together with a high dependency on tied government funds this leads to a lack of accountability of representatives to their constituencies. Second, decentralisation has often failed to overcome local inequalities. Studies show that people with low levels of education and lack of access to information, women and landless people are much less likely to participate in Panchayat activities (World Bank, s.a., p. 27ff). Voting behaviour is highly influenced by factors such as social solidarity, bribery, and fear of exclusion from below poverty line lists. As a result, sarpanchas, the heads of the Panchayats, are often able to manipulate the activities performed by the Panchayats to the advantage of themselves and their supporters (see also NAC, 2004, p. 23; Saxena, 2003, p. 28ff). Therefore, there is still a long way to go until decentralisation becomes an effective means to empower local governments and rural people on the lines of subsidiarity and equity.

Another area of reform pertains to the management of forests. Starting from colonial rule up to the post-independence period, large amounts of uncultivated common lands in India have been declared 'forest lands' and brought under the ownership and jurisdiction of state Forest Departments (for the following see Sarin et al., 2003, p. 2ff). In 1980 forest legislation has been centralised, preventing state governments from granting legal tenure to de facto ancestral cultivators and settlers without central government permission. In the past, forests exclusively served industrial and revenue purposes, which led to their excessive exploitation and subsequent degradation. Only in the late 1980s, local rebellions and a strong civil society movement prompted a reversal of this policy in favour of ecological stability and social justice. Since then, most Indian states have adopted Joint Forest Management (JFM) policies by which local communities are entitled to manage certain forest lands in partnership with Forest Departments. Although legislations vary strongly between the states, JFM Committees in general are to manage these lands and the non-timber forest products obtained from them for sustaining their livelihoods in an ecological sustainable manner. Parts of the revenues

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per the 2001 Census, available at http://www.censusindia.gov.in/Census_Data_2001/India_at_Glance/scst.aspx. The Scheduled Caste people are also known as Dalits; Scheduled Tribe people (Bhil) are also referred to as Adivasis.

generated have to be invested in replantations or given to government officials for conducting development works, other parts may be managed by the Committees. By transferring such rights and duties to local communities, JFM has increased the livelihoods of people living in forest areas and protected forests from further degradation. Nonetheless, in many instances contradictory policies and practices have limited the merits of this approach. Uttarakhand, for example, has a long history of diverse formal and informal self-governing community forestry institutions. The new state policy, however, has diminished rather than strengthened self-governance by local communities as the Forest Department has become a 'partner' in the management of village forests that were formerly under the sole control of local institutions (Sarin et al., 2003, p. 49). Village committees now have to prepare microplans which must conform to the working plans of the Forest Department. In practice, these microplans are often written either by externally imposed 'spearhead teams' or by the Forest Department itself, with villagers providing only labour for their implementation.[28] Some have argued that this kind of interference in community forest management has led to an inadequate focus on income generation as the main target, vis-à-vis direct uses of forests for household or grazing purposes (ibid., 52). Furthermore, committee members' control over the revenues generated has been restricted as functionaries of the Forest Department have been placed inside the committees, controlling its day-to-day activities (ibid., p. 53).[29]

These examples of enduring government intervention in India have shown that although policy intervention to correct market failures in the rural economy is justified and necessary, they do not always work towards the well-being of the target groups. Policies for empowering rural people have not gone far enough and their effects are being limited by local realities, government officials and contradictory policies. These risks of government intervention have to be considered when policies for promoting new activities such as biodiesel production are recommended.

The following subchapter will give a short review of Indian biodiesel policies at the central and state level that in principle can be justified by the market failures affecting biodiesel production and especially participation of the poor in it. We define "biodiesel policies" in a broad sense, including comprehensive policy initiatives that are explicitly framed as 'biodiesel policy' as well as programmes that are of a general nature but which several states are using to promote biodiesel. The chapter will point to selective weaknesses of some of these policies, which will be elaborated on more specifically in the analysis of the different ways of organising the value chain in this report. The analysis in Chapter 3 will show how these weaknesses with regard to transparency, participation, effectiveness, efficiency and sustainability affect the outcomes of biodiesel policies.

[28] According to the General Secretary of the Uttarakhand Biofuel Board, the Board sometimes prepared the microplans together with NGOs contracted by the Board (Int. Vaish, UBB). Referring to no specific state, Saxena has argued that microplans "become instruments by which the Forest Department retains control over the community, rather than building up participation and equality." (Saxena , 1997, p. 136).

[29] 1996, the Government of India passed a new law, according to which *Panchayat*s in tribal areas are the owners of NTFPs.

3.3 National Biodiesel/Biofuel Mission

Many states have already started to vigorously promote biodiesel, and more specifically, plantation of TBOs. However, a national effort is urgently needed. Whereas agricultural and land policy is a state matter, one of the crucial gaps that needs to be addressed – R&D – is mainly in the hands of the central government. The central government therefore needs to allocate a sufficient budget to R&D in biodiesel and to install strong coordination mechanisms for research efforts in this regard. Furthermore, demand-side policies, in particular efforts to reduce the non-competitiveness of biodiesel with conventional diesel, have to be addressed at central level.

Central-level policy-makers in India have taken up the challenge of addressing the market failures involved in the biodiesel sector in order to contribute to energy security, climate change and rural development. In 2002, the Government of India set up a committee on the development of biofuels under the chairmanship of the Planning Commission. The final report was presented to the Prime Minister's office in July 2003. The Ministry of Rural Development (MoRD) was to become the nodal agency processing the recommendations of the report (TERI/GTZ, 2005, p. 21). Consequently, the Ministry commissioned The Energy and Resource Institute (TERI) to prepare a Detailed Project Report. A draft Project Report was submitted in September 2004, discussed by various ministries, and submitted to the Planning Commission for in principle approval by February 2005 (Mohan/Phillippe/Shiju, 2006, p. 56).[30]

One major feature of the draft Mission was its focus on Jatropha curcas as the preferable plant to be promoted by the government.[31] Apart from having some other advantages it was assumed that Jatropha can be grown on low fertility marginal, degraded, and wasteland with rainfall requirements of only 200mm (Planning Commission, 2003, p. 111f). The plant was to start giving seeds max. 2 years after planting. Information about yields was highly vague, stating that they range from 0.4 to 12 t/ha (ibid.). However, experience in the past few years by research institutions and practitioners has shown that these assumptions were far from the reality, and that yields turn out to stay at the lower end of the given range. The focus on Jatropha therefore has been chosen although research results on the agro-climatic and soil conditions, inputs and maintenance activities that are necessary for getting economically viable yields from Jatropha were still missing. Moreover, research results on the environmental and social impacts of Jatropha plantations were and are still missing. This can be considered a significant flaw of the draft National Biodiesel Mission. Such unsubstantiated assertions and recommendations – even if still in the form of a draft - might have long-term repercussions, if they give wrong information to implementing agencies and ultimately to farmers who are highly dependent on the economic viability of the crops they plant.

Whatever happened to the National Mission and the Project Report after February 2005, matters have become rather obscure. The leading role for the Mission has been transferred from the MoRD to the Ministry for New and Renewable Resources (MNRE). The discussion

[30] See also http://biospectrumindia.ciol.com/content/BioBusiness/10511111.asp

[31] NOVOD, Indian Council of Forestry Research and Education (ICFRE), Forestry Research Institute (FRI).

on the topic was to be held by a Group of Ministers, headed by the Ministry of Agriculture. For months, the meetings on the topic have been postponed time and again. The reasons for this stalemate remain unclear, although it has been indicated by interview partners that it was less due to controversies about the content of the policy, but rather a) about which ministry will be assigned which role in it and b) whether it would be premature to release a policy before reliable research findings are available. Another factor that prevents policy-makers to come out with a biodiesel/biofuel policy at this point of time may be the current public debate on "food vs. fuel" that looms large internationally as well as in India.

This ambiguity on how the government intends to proceed on the issue and who the responsible agencies will be has not only created confusion among the ministries themselves, but also among the general public and, more specifically, the actors involved in the biodiesel sector. This is even more relevant in a case where policy drafts have already created expectations with regard to demand-side incentives and even recommended one specific tree species to be planted by farmers. Farmers and private investors in the biodiesel sector urgently need reliable research results regarding high-yielding plant varieties that are able to increase the economic viability of biodiesel. Engaging in the sector prior to having such results is highly risky: Farmers and investors who have already engaged in the biodiesel sector despite these uncertainties might be severely disillusioned with the whole biodiesel business once the final policy will come out. Having lost confidence in such recommendations, they might be reluctant to take up new initiatives by the government. Moreover, due to lack of research results some small and marginal farmers may even have lost their scarce resources due to the lack of economic viability.

In March of this year, it was not yet clear even at government level whether the new MNRE policy would by decided within the next month, or only after several more years. In April it has been voiced that the Group of Ministers will finalise a biofuel policy by end of May with the aim of a 10% blending by 2017 at its centre. An estimated 12 Mio ha of plantations on revenue and forest land, stimulated by subsidies for growers and tax exemptions for processors would be required to fulfil this goal. A national Biofuel Board, to be hosted by MNRE, is supposed to coordinate the activities (Times of India, 09.04.2008). The Secretary of MNRE did not want to confirm this information (int. Subramanian, MNRE). Discussions with officials from the Ministry have indicated that the new policy will revert the earlier focus on Jatropha only.

In the absence of a comprehensive national biodiesel policy, some central-level policy elements for the promotion of biodiesel exist and several states have taken the lead and adopted more or less coherent own biodiesel policies, which will be looked at in Chapter 3.4.

3.4 Other central-level policies supporting biodiesel production

At the central-level, a number of policy instruments exist for promoting biodiesel that will now be analysed briefly. The success of public support for TBO-based biodiesel production, as that of all sector policies, is contingent on its potential for future economic viability. Economic viability depends on the current base of capabilities – for example, the availability of sufficiently productive land and high-yielding and drought-resistant plant material, technologies for processing –, feasible rates of improvement, and the expected evolution of

demand. As the second chapter has shown, there is a chance that TBO-based biodiesel production might become economically viable if plant material can be improved and demand rises due to higher prices of conventional diesel. As long as this is not yet the case, public support is justified.

However, sector policies should consider two more factors. The first one is the cost-benefit ratio of support. Costs increase with the complexity of support policies and decrease with growing economic viability. Benefits include environmental and social externalities that cannot be measured economically (Lall/Teubal, 1998, p. 1379). Potential positive externalities of promoting biodiesel include, inter alia, the reduction of GHG emissions, soil conservation, and the empowerment and socio-economic inclusion of rural poor. It is especially the existence of such externalities that justifies long-term subsidies. The right level of subsidies depends on the preferences of societies and is thus a matter of policy choice in each country.

Secondly, policy-makers should consider that all subsidies have opportunity costs. Each rupee spent on subsidising biodiesel can not be spent for other useful purposes, e.g. other poverty alleviating programmes or other renewable energies. Policy choices thus need to be based on the comparison of cost-benefit ratios of development alternatives – a task that falls outside of the ambits of this study.

Hence there is a case for subsidising biodiesel, but subsidies should not be excessive and should be reduced as economic actors develop more viable business models. Given the history of policy intervention in India, policy-makers must be specifically careful not to increase costs by highly complex policies that surmount the implementing capacities of government bureaucracies and create space for intransparency and rent-seeking. Incentives must be set that put entrepreneurs and bureaucrats alike under pressure to make biodiesel production as competitive as possible under existing conditions. In practical terms, the Indian society and policy-makers may for example decide to make biodiesel blending compulsory, or to make TBO plantations eligible for government funding. With these measures to correct existing market failures, investments should then be economically viable without further subsidies. Furthermore, monitoring and evaluation mechanisms, conditionality and sunset clauses should be integrated into all policies to ensure efficient and sustainable implementation.

Research and Development

Recognising that "the role of Jatropha & Karanja[32] will likely remain small until major breakthroughs are realized" (NOVOD, 2008, no page), the National Oilseeds and Vegetable Oils Development Board (NOVOD) established a "National Network on Jatropha and Karanja" in 2004 in order to contribute towards development of high yielding varieties (ibid.). The network consists of 42 public research institutions – the State Agricultural Universities, Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), Indian Council of Forestry Research and Education (ICFRE), Central Food Technology Research Institute (CFTRI), Indian Institute of Technology (IIT) and TERI. Research is financed for issues such as identification of elite planting material, tree improvement to develop high yielding varieties with better quality of the reliable seed source,

[32] Local name for Pongamia pinnata.

inter-cropping trials, developing suitable package of practices, post harvest tools and technology, and detoxification of oil meal of important TBOs (NOVOD 2008, p. 1). The Department of Biotechnology (DBT) of the Ministry of Science and Technology has initiated a "Micromission on Production and Demonstration of Quality Planting Material of Jatropha" with the aim to select good germplasm and develop quality planting material. Under the Micromission, 500.000 ha plants of superior material have been produced in a nursery. Furthermore, DBT supports programmes for testing the potential of other tree borne oil seeds, including Pongamia (DBT, 2006-07, p. 129f).

Research seems to concentrate on Jatropha as the most suitable TBO for biodiesel production, with 25 institutes participating in NOVOD's Network on Jatropha, and only 8 institutes participating in the Network on Karanja (NOVOD, 2005/06, p. 4f). Current figures suggest that in order to reach economic viability, Jatropha must yield 2 kg seeds per plant without investments in irrigation and fertilisers, (Int. Kureel, NOVOD) whereas actual yields under these conditions tend to be well below 1 kg (NOVOD, 2007, p. 11). This highlights the urgent need for more research not only on the plant material, but also on the agro-climatic and soil conditions, inputs, and maintenance activities that are necessary to increase the productivity of TBOs. Achieving higher yields is a necessary condition to make the industry viable and increase rural income. Higher yields also lead to a greater substitution of fossil energy carriers and lesser greenhouse gas emissions (Reinhardt et al., 2007).

Furthermore, there is a lack of knowledge on the environmental impacts of TBOs. According to the Forestry Research Institute in Uttarakhand, the environmental impacts of Jatropha cannot yet be foreseen (Int. Negi, Forestry Research Institute). Currently TERI seems to be the only institution that has commissioned a social and environmental impact assessment on Jatropha with respect to its own plantation project in Andhra Pradesh (Int. Adholeya, TERI). At that site, TERI also conducts own research on the environmental effects of Jatropha, as Jatropha leafs falling on the soil might harm micro-organisms or other plants planted as intercrops.

Lastly, there is a lack of research on breeding drought resistant varieties of different oil-bearing tree species that give acceptable yields. At present, the assumption that Jatropha and other oil-bearing tree species can be grown profitably on land that is unsuitable for agriculture does not hold (Int Kureel, NOVOD). Hence crowding out of food crops is a real threat. At current market prices very few farmers abandon food production for TBOs. But this may change if fuel crop prices rise faster than food prices and if high yielding fuel crops become available (Int. Ramakrishnaia, MoRD; Int. Adholeya, TERI; Int Shukla CREDA/CBDA). If drought resistant high yielders were available, they would provide farmers an *additional* income that would generate resources to be invested in increased food production on fertile lands.

Demand-side policies

In October 2005, the Ministry of Petroleum and Natural Gas proclaimed a biodiesel purchase policy that came into effect in January 2006. According to the policy, oil marketing companies are to purchase biodiesel at a price of now Rs. 26.5/l at currently 20 purchase centres in 12 states. Suppliers must be registered with the state level coordinators and meet

the specifications of the Bureau of Indian Standards. The oil companies, for their part, are to blend conventional diesel with biodiesel at a maximum of 5% at the purchase centres.

A blending requirement is a strong signal that encourages investments in fuel crop cultivation and transesterification plants. So far, however, the purchase centres have not been able to procure any biodiesel, (Int. Choudhary, Indian Oil Corporation Ltd.) as large quantities of seeds and biodiesel are not yet available and the purchase price offered is much too low for the industry (Int. Ganguly, Confederation of Indian Industries; Int. Gulati, Biodiesel Association). This experience shows that compulsory blending makes sense only if production can meet demand. Moreover, given restrictions on land use, blending requirements bear the risk of increasing demand to a level that might lead to a substitution of food crops.

Supply-side policies

By giving the status as a non-conventional energy resource, biodiesel has been fully exempted from excise duty (S.No. 53A of the Notification No. 4/2006). At the current purchase prices, this reduces the price for biodiesel by about Rs. 4/l. (Int. Choudhary, Indian Oil Corporation Ltd.). This does not, however, outweigh the benefits that conventional diesel enjoys from heady subsidies. In addition, biodiesel is not recognised as a renewable energy source according to the legal definition, which would allow investors to obtain additional tax benefits.

In order to support the supply side of biodiesel, NOVOD initiated a back-ended credit linked subsidy program specifically for TBOs. The program provides subsidies for a) nursery raising and commercial plantation, b) establishment of procurement centres, and c) installation of pre-processing and processing equipments.[33] It can be extended to governmental organisations, NGOs or individuals. Interviewees in Karnataka and Andhra Pradesh have stated that NOVOD recommends to use these funds for Jatropha nurseries only. Nonetheless, both states have used these funds also for Pongamia plantations. (Int. Varma/Kanwerpal, Forest Department; Int. Nirmala, Department of Panchayati Raj and Rural Development). Loan assistances by the Rural Infrastructure Development Fund of the National Bank for Agriculture and Rural Development (NABARD) can also be used for funding biodiesel plantations

In addition, there are a large number of centrally-sponsored schemes that can be and are used for biodiesel plantation. In the four states under examination, we found that

— National Rural Employment Guarantee Scheme (NREGS)

— Watershed Development Programme

— Swarnajayanti Gram Swarozgar Yojana

— Village Energy Security Programme (VESP)

— National Afforestation Programme

[33] See http://www.novodboard.com/nb-schemes.pdf.

are being used for biodiesel plantation, with NREGS being the most important one. Centrally-sponsored schemes are a core element of biodiesel policies. It is therefore necessary to briefly discuss their main strengths and weaknesses.

Using these Schemes for biodiesel plantation is a convenient way to kick-start the supply of TBOs on a large scale. This takes due account of the fact that the uncertainties related to TBOs and their economic viability as well as their long gestation period prevent farmers and other people in the rural areas to enter into biodiesel planting without any such support. Moreover, as biodiesel plantations aim to contribute to achieve certain public goods such as afforestation and inclusion of marginalised people, using these governmental support Schemes is fully justified.

However, it has long been recognised that these Schemes are beset by a number of problems as regards their effectiveness, efficiency, sustainability and outreach. For example, the guidelines given by the line Ministries are often rather inflexible, and the planning process of the individual projects under the Schemes is often very top-down, lacking participation by the respective communities who are implementing projects in their villages.[34] As note Saxena and Ravi, "[m]ost often the Pradhan/Sarpanch selects the project which suits his needs or for which he is pressured by the dominant castes/clans. Participation of the poor especially women is missing" (Saxena/Ravi, s.a., p. 3). Similar problems pertain to their implementation. In 2004 an Impact Assessment of Watershed Development Schemes asserted that government departments implemented projects with very little interaction with the people, especially not with women (Planning Commission, 2006, p. 256). Programmes furthermore have problems to reach their respective target groups and to disburse funds to them without leakages and delays (MoRD, 2006, p.: 2). Rural employment programmes have often focussed on construction activities with little focus on institutions and capacity building, leading to non-sustainability of the assets created (Planning Commission, 2006, p. 256).

Many of these problems can be attributed to distorted incentive structures and lack of accountability on all levels. Outcome-based monitoring and evaluation as well as linking funding to performance are usually absent. As the National Advisory Council has observed "most Ministries and Departments are focused on meeting their physical and financial targets with limited emphasis on scheme quality (…)." (Saxena/Ravi, s.a., p. 35). Moreover, monitoring is often conducted by the respective Ministries themselves, often revealing considerable discrepancies between those of independent experts or the Planning Commission (ibid., p. 37).

[34] The planning process within NREGS, in contrast, is a bottom-up planning process, starting at the level of the Gram Panchayat, (MoRD, 2006, p. 9f).

Box 2: National Rural Employment Guarantee Scheme – Innovations and old problems

MoRD has recognised many of these problems and has tried to take these findings into account when designing the most recent National Rural Employment Guarantee Scheme in 2005 (MoRD, 2006, p. 2). For example, targeting errors should be less critical under NREGS as the programme is right-based and self-targeting: Every adult living in rural areas who is willing to do unskilled manual labour for 100 days in a year has a right to employment within 15 days of registration or compensatory unemployment allowance. The planning process of the activities under the Schemes is to be done at the level of the Gram Panchayat, within broad guidelines given in the respective State Schemes to be formulated (NREGA, Section 13(1)). The release of funds from MoRD is not based on predetermined allocations as per State, but on Annual Work Plan and Budget, which are based on the demands for funds received from the lower levels. The Annual Work Plans and Budgets are also to report on key performance indicators. Furthermore, monitoring and evaluation is to be carried out be the State Rural Employment Guarantee Councils and the National Council, as well as through social audits at the local level.

Despite these provisions, several problems relating to NREGS have already been reported. A 2006 study by PRIA, the International Centre for Learning and Promotion of Participation and Democratic Governance, found that even the new bottom-up planning process is not effectively participatory, as often the Sarpanch and Panchayat Secretary are planning the works without including villagers in the process. The works initiated are not the ones that had been prioritized by the Gram Panchayat (PRIA, 2006, p. 19f). Collective payments and improper measurements of works, delays of payments, inadequate human resources at the Panchayat level or lacking will of Sarpanches and Panchayat Secretaries to implement the schemes are hampering the effective implementation of the programme (ibid., p. 23f).

3.5 State policies supporting biodiesel production

In the absence of a national policy, many states have started to promote biodiesel on their own. State support programmes differ not only in scope – whether they take only limited supply-side measures or whether they establish comprehensive value chains by tackling both supply and demand (see Table 4) – but also with regard to the types of value chain organisation they promote. In this vein, the approach taken by a state depends on the particular state conditions such as availability and ownership of uncultivated land (e.g. government, Panchayat and private land), societal structure, and the involved actors (e.g. different government departments, local communities, private farmers and corporations) as well as on the specific targets it aims to achieve – with the latter being shaped by the local conditions. This chapter will give a brief overview of five selective state policies and the approaches taken by them. This will provide the necessary background for understanding the types of value chain organisation and their implications for rural development that are analysed in the next chapter

The states have been selected on the basis of the existence of a) a range of different biodiesel support policies and b) partner institutions that supported the research team in the field. In order to describe the policies, we have selected several general policy issues, supply-side as well as demand-side measures that we deem to be the most decisive elements of the policies.

Uttarakhand

Uttarakhand is a state in the north of India. 64.8% of its total area is legally classified as forest land, although much of that land has a forest cover of only 10% or less. The state has a low level of landlessness but high unemployment and out-migration. Around 50% of the rural households depend on village commons and forest lands for their livelihoods (Sarin et al.,

2003, p. 38). In August 2004 the state launched a biodiesel programme with the aim of creating employment and to regenerate degraded forest land. It is planned to cultivate Jatropha on 200.000 ha of village forest land until 2012. Jatropha is preferred over Pongamia because it has a shorter gestation period and is better adapted to the low temperatures in the state (Int. Singh, Forest Development Corporation). It is not clear, however, why other TBOs such as Wild Apricot, which are even better adapted to the Uttarakhand climate than Jatropha are not considered either. Until now, about 10.000 ha have been planted through the JFM-approach.[35]

In contrast to all other states, Uttarakhand's approach to biodiesel production is characterised by a high degree of regulation. At the same time, specific structures for biodiesel promotion have emerged, which make the programme independent from less committed government agencies and inflexible government funding mechanisms. In order to establish a full value chain and to secure additional funds, the Uttarakhand Forest Development Corporation entered into a Public-Private Partnership with one company, Uttarakhand Biofuels Limited. Together they established the Uttarakhand Biodiesel Board (UBB), whose Executive Board consists mainly of company representatives.[36] In fact, the whole biodiesel programme and its specific setup can be attributed to the initiative of the CEO of Uttarakhand Biofuels Limited, Mr. Atul Lohia who claims to have "designed the whole project" (Int. Lohia, Uttarakhand Biofuels Ltd.).

The role of UBB in the biodiesel programme far exceeds mere coordination tasks. Jointly with the heads of the JFMCs, the Board identifies the land to be used for Jatropha plantation. Moreover, the Board's staff is engaged in drafting the microplans of the JFMs in order to include the details on Jatropha cultivation - a task that is usually done by the JFMCs together with the Forest Department. The heads of the JFMCs, constituted by the Revenue and Forest Department, identify the beneficiaries. After the initial plantation these beneficiaries are given usufruct rights over patches of 1-2 ha of the plantations. During the first three years before the first harvest, beneficiaries are paid for pit digging and maintenance works via individual pay-cheques from the Board.[37] In contrast to most other states, Uttarakhand does not rely solely on central funding sources.[38] Rather, the Board receives supplementary funds from the state government and from the private company – in fact, most of the 68 staff of the Board are paid

[35] Uttarakhand enjoys a long history of formal and informal community forest management systems. Since the 1930s, the Van Panchayats that have emerged through bottom-up processes have been legally recognised. Since the end of the 1990s, Van Panchayats have been constituted by the Revenue Departments, and so-called Village Forest Joint Management Committees have been formed by the Forest Department (Sarin/Singh/Sundar/Bhogal, 2003, p. 37ff). In other Indian states, similar systems of social forestry have different names. For simplicity reasons, this report uses the term "JFM"/"JFMCs" for all those different kinds of systems.

[36] Out of seven members, five belong the Uttarakhand Biofuels Limited (Int. Vaish, UBB).

[37] Since 2008, however, issuance of pay-cheques from the second year onwards is at the responsibility of the head of the JFMC (Int. Vaish, UBB).

[38] The Board has used funds from NOVOD and from the Department of Land Ressources, MoRD, for raising nurseries. As regards centrally-sponsored schemes, it has used funds from Swarnajayanti Gram Swarozgar Yojana and the Village Energy Security Programme (VESP). Experiences with Swarnajayanti Gram Swarozgar Yojana were rather negative, as the beneficiaries did not respond well to the loan component that is an integrated part of the scheme. There is a strong apprehension against using funds from NREGS, as the scheme is considered to produce unsustainable outcomes, ibid.

by the company (Int. Vaish, UBB). More and more seedlings are produced by several Self-Help Groups (SHGs)[39] who have been formed and are funded by the Board, instead of being procured from the nurseries of the Forest Department. Together with a large number of NGOs, the Board furthermore trains, supervises and monitors all plantation activities. Tripartite agreements ensure that all seeds will be sold to the company at a price of currently Rs. 3.5, with the Forest Development Corporation as intermediary who will deduct Rs. 0.5 for overhead costs. The price is fixed and periodically adjusted by UBB with a view to the price of conventional diesel, which the price of biodiesel may not exceed. The low prices for seeds that are paid to the beneficiaries are justified with the additional costs that the company still has to bear after procuring of the seeds.[40] The tripartite agreements apply to all seeds grown on the envisaged 200.000 ha for plantations and are reinforced by restrictions on inter-state trade of Jatropha seeds. The company, in turn, is setting up a large-scale expelling and transesterification unit in which all steps of value-addition will be performed. Local consumption of SVO/biodiesel is not foreseen.

With the help of the Village Energy Security Programme (VESP) of MNRE, UBB has just embarked on a rural electrification programme in four villages of the state (for MNRE's policy see Box 3). UBB is facing great difficulties with the programme, which has turned out to be three to four times more costly than planned. Nonetheless, MNRE aims at electrifying 500 villages with biodiesel in Uttarakhand (Int. Vaish, UBB).

Chhattisgarh

In Chhattisgarh, Jatropha and Pongamia are traditional plants that grow wildly, especially in forest areas. They have been used for medicinal purposes and for producing soap for a very long time. So far, only about 15% of the plants have been collected, mainly by the large tribal population (Int. Shukla, CREDA/CBDA). Due to its low population density which is spread over the vast land area of the state, one of the main challenges is to link remote areas to the market (Resolution No. F 10-5/1-5/2005, available at http://www.cbdacg.com/resolution.htm; Int. Shukla, CREDA/CBDA; Int. Mandal, Department of Panchayati Raj and Rural Development). Nonetheless, Chhattisgarh follows a less regulated approach than Uttarakhand, allowing different value chains to emerge throughout the state.

In 2005, the Director of Chhattisgarh Renewable Energy Development Authority set off a biodiesel programme by creating the Chhattisgarh Biofuel Development Authority (CBDA). With the Chief Secretary of the state as its chairman, the programme has been enjoying strong political backing ever since. CBDA instructs and coordinates biodiesel-related activities of different state departments working in the areas of forest, agriculture, biotechnology, panchayats and rural development, revenue, tribal welfare, commerce and industries, finance,

[39] SHGs in India are considered small, economically homogenous affinity groups of rural poor, voluntarily formed to save and mutually contribute to a common fund to be lent to its members as per the group members' decision. Most SHGs in India have 10 to 25 members. As women's SHGs have been promoted by a wide range of government and non-governmental agencies, they now make up 90% of all SHGs (Adolph, 2003, p. 3).

[40] Dr. Singh of the Forest Development Corporation in Uttarakhand referred to prices "at plantation site" versus "prices at industry site". In addition to the price paid "at plantation site", namely Rs. 3.5, the company has to incur further costs for transportation, drying, cleaning and storage, amounting to a price "at industry site" of Rs. 5.5 (Int. Singh, Forest Development Corporation)

and minor forest produce (Resolution No. F 10-5/1-5/2005, available at http://www.cbdacg.com/resolution.htm.). The primary focus of CBDA's programme is on Jatropha. CBDA has very optimistic assumptions with regard to the economic viability of Jatropha, believing that after two to three years the plant will produce 2 kg of seeds per plant, with an average oil content of 35% - and all of this without "any special care as regards to fertilizers or pesticides".[41] Until 2007, about 150,000 ha of Jatropha plantations have been raised with funds from the state government (about Rs. 200,000 only in 2007) and MoRD (about Rs. 13 Mio. only in 2007) for raising nurseries as well as NREGS-funds for wage labour (Rs. 5.2 Mio. only in 2007) (Int. Tiwari, State Planning Board).

CBDA supports Jatropha plantation on all kinds of land: forest land, revenue and common land as well as private land. Private farmers who decide to grow Jatropha receive 500 seedlings free of cost from government nurseries; additional seedlings can be bought at a subsidised rate of Rs. 1. In the case of revenue and communal land, district task forces headed by the District Collector[42] identify land suitable for roadside, hedge or block plantations. CBDA, in turn, instructs the Forest Department to initiate the plantation process. The department uses seedlings from government nurseries and employs local workers via NREGS. After the gestation period of three years, people from the neighbouring villages are free to collect and sell the seeds. Collectors can sell the produce either to private traders or to the Minor Forest Produce Federation, the state procurement centre, at the minimum support price of Rs. 6.5. The same applies to JFMCs on forest land. Moreover, both private farmers as well as collectors on revenue land may enter into buy-back agreements with private companies. Private companies entering into buy-back agreements with farmers and collectors do not have to register with CBDA for receiving licenses. Rather, they informally coordinate with the relevant District Collector. Under the Industrial Policy of the state, companies setting up processing plants receive tax exemptions, electricity duty exemption, interest subsidies, infrastructure cost subsidies among others (Int. Sarkar, D1-BP Fuel Crops).

In addition to this free-market approach, Chhattisgarh has entered two additional paths of biodiesel production. In order to ensure proper maintenance of the plantations as well as a guaranteed market access, CBDA plans to lease out all existing block plantations. After a 2005 policy proposal was strongly opposed by the public who feared misuse of the land for other purposes, leasing has been limited to public sector companies entering into a Joint Venture with CBDA. Nonetheless, officials have voiced that the policy might again be extended to private companies in the future (Int. Shukla, CREDA/CBDA; Int. Mandal, Department of Panchayati Raj and Rural Development). The authority envisages that the Joint Venture will enter into large-scale contract farming agreements transcending the leasing area and establish transport, electrical and social infrastructure.

Furthermore, Chattisgarh is promoting Jatropha-based rural electrification programmes in remote villages. As part of the state government's plan to electrify all villages in the state by 2012, CREDA is responsible for electrifying 1,200 villages, out of which 400 remain

[41] See http://www.cbdacg.com/biovision.htm. In contrast, NABARD estimates a yield of 0.5 kg/plant after the third year (GTZ/TERI, 2005, p. 52). See also chapter 2 of this report.

[42] District Collectors are the administrative heads of the district. They represent all State Departments within a district.

unelectrified. These are planned to be electrified through Jatropha-based biodiesel, funded by the Village Energy Security Programme (VESP) of MNRE. Biodiesel is considered to have lower investment costs than solar systems. One oil extraction facility will be installed per village cluster, which consists of five to six villages. The SVO produced in three to four clusters will be brought to a small to medium transesterification plant. Electricity will be produced by generators in each village which – together with the local grid systems – will be installed and paid for by CREDA (Int. Gyani, CREDA). Villagers will have to pay for electricity consumption (Rs. 30 for two light bulbs per month) in cash or in-kind, for example with harvested Jatropha seeds (Int. Shukla, CREDA/CBDA). As required by MNRE, Village Electrification Committees (VEC) will decide on parts of the concrete project design such as the pattern of power supply.

Andhra Pradesh

Andhra Pradesh is a densely populated and, in parts, drought prone state. In 2005, the state made very discouraging experiences with the promotion of Jatropha. As the plant required high amounts of water,[43] the government introduced a 90% subsidy on irrigation. But farmers soon diverted this subsidy to food crops with much higher yields and abandoned Jatropha plantations (Int. Nirmala, Department of Panchayati Raj and Rural Development).[44] Since 2006, therefore, Andhra Pradesh focuses on the promotion of Pongamia, and, more recently, on Simaruba. Both Pongamia and Simaruba have been found to require less water than Jatropha. Pongamia moreover is also a local species in the state, the leaves of which have long been used as organic manure (Int. Goel, Rain Shadow Areas Development Department; G.O. Rt. No. 138, 27.12.2007). The goal is to achieve 100,000 acres biodiesel plantations in 13 districts of the state respectively in order to make productive use of degraded land (G.O. Rt. No. 148, 16.12.2006).

Andhra Pradesh has created a dual organisational structure for promoting biodiesel. While the Rain Shadow Areas Development Department is responsible for policy-making, monitoring and promoting entrepreneurship, the Department for Panchayati Raj and Rural Development is dealing with the implementation of the programme (G.O. Ms. No. 29, 31.01.2006; G.O. Rt. No. 138, 27.12.2007). A State Level Task Force Committee is also entrusted with monitoring the programme (G.O. Ms. Ns. 18, 17.11.2004). Furthermore, the state government funds an R&D programme amounting to Rs. 58 Mio. during 2005-08 (Int. Goel, Rain Shadow Areas Development Department).[45] Biodiesel plantations are promoted on specified private land and on forest land, putting emphasis on linkages with private entrepreneurs. Similarly to Chhattisgarh, the state tries to facilitate the emergence of a full – but diversified - value chain.

Since the 1960s, the state has been assigning small plots of revenue land to landless people, granting them ownership rights over the produce of that land. Today most revenue land has

[43] According to a government order of 2006, "the response of farmers was not encouraging as stable yields are possible only under irrigated conditions." (G.O. Rt. No. 148, 16.12.2006).

[44] This statement was slightly contradicted by ICRISAT. According to ICRISAT, the irrigation subsidy was only planned by the government. As research institutions anticipated the negative effects of such a subsidy, they voiced their concern and were able to avert the policy (Int. Wani, ICRISAT).

45 See also Government of Andhra Pradesh, Note on Rain Shadow Areas Development Department, Bio-diesel Programme - 2006-07.

been assigned. In most cases, however, it remains degraded and farmers remain poor. In order to rehabilitate this land and to provide additional income for the farmers the biodiesel programme initially focussed on these assigned farmers (together with Scheduled Castes and Tribes). In November 2006, the Department for Panchayati Raj and Rural Development extended the programme to all small and marginal farmers with landholdings below five acres (G.O. Ms. No. 478, 11.06.2006; Int. Nirmala, Department of Panchayati Raj and Rural Development). As the Andhra Pradesh Rural Employment Guarantee Scheme earmarks 20% of the funds for plantation programmes, all plantations – currently about 40,000 acres (GTZ/TERI, 2005, p. 23; Int. Krishna, Forest Department) are funded by this scheme (G.O. Ms. No. 27, 28.01.2006). This applies also to the seedlings that are distributed to the farmers by the Forest Department. In the future, the current funding period of three years might be extended as the gestation period of Pongamia lasts four to seven years (depending on whether the plants are grafted or not) (Int. Goel, Rain Shadow Areas Development Department).

In order to motivate more farmers and to provide them with better training and material and supply, Andhra Pradesh strongly promotes private sector engagement in the sector. If a company has the support of the local farmers, the Rainshadow Areas Development Department allots specific areas to private enterprises registered with a specific Sub-Committee of the State Level Task Force.[46] The state extends full NREGS-support to all small and marginal farmers under buy-back agreements with the company. The material component of NREGS is transferred to the bank accounts of the farmers, so that they are free to purchase the inputs, including the seedlings, from the company. In turn, companies are required to ensure 90% survival of grafted plants by the end of the third year of plantation and to procure the seeds at the market price or, at least, at the minimum support price of currently Rs. 10/kg (G.O. Ms. No. 6, 20.6.2007).[47] They are also required to set up expelling and transesterification units within their area of operation. All farmers furthermore have the option to sell to the Andhra Pradesh Oil Federation or, in tribal areas, to the state-owned Girijan Co-operative Corporation at the minimum support price set by the Rainshadow Areas Development Department.

While the Department for Panchayati Raj and Rural Development promotes plantations on private land, the Forest Department promotes plantations on forest land by way of the JFM-approach.[48] Until today, 20,000 ha have been planted, funded by loans from NABARD and from the World Bank as well as with the National Afforestation Scheme (Int. Krishna, Forest Department; GTZ/TERI, 2005, p. 24). The Forest Department is currently planning to replace these sources with NREGS, as funds from NREGS come as grants and funding rates are higher than those of the National Afforestation Scheme. The Girijan Cooperative Corporation has a monopoly over many important NTFPs, of which Pongamia is not part. JFMCs therefore are not forced to sell to the Corporation, but lacking other buyers they usually do so.

[46] The Sub-committee consists of representatives from the Finance Department, the Indian Institute of Chemical Technology, NABARD, the State Co-operative Oil Seeds Grower Federation as well as the Commissioner of Industries, among others (G.O. Ms. No. 18, 17.11.2004).

[47] The minimum support price for Jatropha is Rs. 6/kg (G.O. Rt. No. 148, 16.12.2006). In the future, a minimum support price as well as a nodal agency for purchasing the seed will also be set for Simaruba (G.O. Rt. No. 138, 27.12.2007).

[48] The local name of JFMCs in Andhra Pradesh is Vana Samrakshana Samiti (VSS)

Therefore, the Forest Department is planning to enter into a Public-Private Partnership with a private company for ensuring buy-back agreements with JFMCs. As Pongamia trees on forest lands are not grafted and the gestation period is rather long, this would provide additional funding sources for the pre-harvest period. Furthermore, the company is willing to contribute to the costs of setting up and maintaining a local expelling unit, thereby contributing to local value-addition (Int. Krishna, Forest Department).

In order to enhance demand, Andhra Pradesh has reduced the Value-Added Tax (VAT) for biodiesel to 4%. Moreover, the Andhra Pradesh State Road Transport Corporation was to run 10% of its fleet on 5% biodiesel-blending by 2007 (G.O. Rt. No. 148, 16.12.2006). This goal has not been achieved yet (Int. Rangarano, Department of Panchayati Raj and Rural Development).

Karnataka

In Karnataka, Pongamia has been planted by farmers and along the road side for centuries. A fully functioning oil expelling industry already exists, producing Straight Vegetable Oil (SVO) for manufacturing paint and leather. The price of SVO may reach levels of above Rs. 50/l. (Int. Swamy, Channabasaveshware Oil Enterprises). The price of seeds vary between Rs.10/kg and Rs. 16/kg (Int. Gowda, University of Agricultural Sciences Bangalore), with middlemen charging about Rs. 3-4/kg (Int. Swamy, Channabasaveshware Oil Enterprises). Since the beginning of the 2000s, the level of seed collection in Karnataka has increased from about 30% to 70% (Int. Ramakrishna, Samagra Vikas; GTZ/TERI, 2005, p. 14). Nonetheless, creating market access for farmers and increasing their income by eliminating middlemen is a major challenge in terms of supporting the rural economy in Karnataka.

Currently there is no comprehensive biodiesel support programme in Karnataka, but a biofuel policy is underway. The Forest Department has been using Pongamia as one of its major plants for afforestation purposes but does not promote it for biodiesel production (Int. Varma/Kanwerpal, Forest Department). Its activities appear to be rather disconnected from the activities of the Agriculture Department, which is the major driver of the upcoming policy. The Department is currently funding a pilot project on a cooperative model in Hassan district, implemented by the University of Agricultural Science in Bangalore (see Farmer-centred cultivation in Chapter 3.2) (Int. Sarvesh, Agriculture Department; Int. Gowda, University of Agricultural Sciences Bangalore). The model will be at the core of the upcoming Biofuel Policy, creating a cooperative system that is to cover the whole state. The cooperatives will be enabled to perform expelling and transesterification of seeds and to decide where to sell which product.

The draft Biofuel Policy was prepared under broad participation of farmers and civil society. A committee of seven Principal Secretaries, chaired by the Department of Agriculture, was coordinated by an official from the Mahatma Gandhi Regional Institute of Rural Energy and Development. Both the Karnataka Milk Federation and the Karnataka Oilseed Federation participated in the stakeholder workshops (Int. Kakkar, Mahatma Gandhi Regional Institute of Rural Energy and Development; Int. Gowda, University of Agricultural Sciences Bangalore). The policy envisages to set up a Biofuel Development Authority, to fund TBO plantations via NREGS and to exempt biodiesel from VAT. An important characteristic of the Karnataka approach is its emphasis on a multi-species approach and on biofuels, promoting SVO as

much as biodiesel. Promoting different TBOs will allow farmers to chose the right crop for the varying climate and soil conditions within the state. Moreover, the Department of Agriculture vigorously disapproves of monoculture plantations (Int. Sarvesh, Agriculture Department).

Tamil Nadu

In Tamil Nadu, there have been two approaches to support the cultivation of Jatropha, predominantly on private land. The first approach was based on the distribution of fee seedlings to farmers and Panchayats and failed miserably due to lack of maintenance. After change of government one year later, this programme was replaced. The programme of the new government consists of subsidizing seedlings and financing of cooperative banks for loans earmarked for Jatropha based contract farming.

The first Jatropha programme was launched in 2004 by the former Chief Minister of Tamil Nadu Mrs. Jayalalithaa (The Hindu, 03.07.2004). The government financed Jatropha nurseries for raising and distributing of 30 Mio. Jatropha seedlings free of cost to farmers and Panchayats. Due to an input based monitoring system, nurseries had the incentive to distribute seedlings, but not to ensure that the seedlings were actually planted and maintained. To receive government funds, the nurseries only had to report the figures of distributed plants. In consequence, masses of seedlings were produced and distributed without providing assistance to the cultivators. In fact, many distributors convinced farmers with false promises that Jatropha would not need any input to cultivate the plantand exaggerated the returns of investment. With a survival rate of only 20-30% of the distributed seedlings, the programme was a failure and was suspended immediately after change of government in 2006. Only in few cases – where Gram Panchayats showed interest and ownership – the programme was successful. As many farmers remember the failure of the programme, Jatropha has a poor reputation in Tamil Nadu (Int. Udhananyan, D1 Mohan Bio-Oil Ltd.).

A second programme to support the cultivation of Jatropha was launched by the new government of Tamil Nadu in 2006. In contrast to the previous approach, the government of Tamil Nadu only pays a subsidy of Rs.1.5/seedling to the nurseries managed by SHGs, NGOs and the Tamil Nadu Agricultural University. Therefore, farmers also have to make a financial contribution (Int. Udhanayan, D1 Mohan Bio-Oil Ltd.). While at the moment the policy of subsidising seedlings focuses only on Jatropha, it is planned to extend this programme to Pongamia seedlings (Int. Rajasekaran, Agricultural Officer in Pudukottai District).

To provide assistance to the farmers, the government cooperates with several private companies. The most prominent one is D1 Mohan Bio Oils Ltd.[49], with whom the Director of Agriculture in Tamil Nadu signed an MoU. The officers of the Agriculture Department (Assistant Directors on block level and Assistant Agriculture Officers on village level) encourage farmers to cultivate Jatropha and link them up with D1 Mohan Bio Oils Ltd. The company in turn offers a contract with a buy-back guarantee to the farmers and provides extension services. Contracts are offered to different kinds of farmers: small farmers usually

[49] Since about three years, D1 Mohan Bio Oils Ltd. operates in Tamil Nadu and has about 5,000 contracts with farmers on approximately 3,000 ha land. The company has set the target to have about 16,000 ha of Jatropha under contract by end of 2008 (Int: Udhanayan, D1 Mohan Bio Oils Ltd.)

plant boundary plantations to diversify the farming system and ensure additional income, better-off farmers opt for block Jatropha plantation for being a labour-extensive crop, and absentee landlords cultivate Jatropha mainly for fiscal reasons.

To further support contract farming with Jatropha, the government allocated Rs. 400 Mio. to Primary Agriculture Cooperative Banks[50] for subsidised loans earmarked for Jatropha cultivation in 2008. The Rs. 400 Mio. are equivalent to 20,000 ha of Jatropha cultivation. Since a buy-back agreement is a precondition to get access to a loan by the cooperative banks, and D1 is the only significant seed purchaser at the moment, the company has a monopoly until other companies step in.

Apart from these policy measures on the supply side, the Government of Tamil Nadu exempted Jatropha seeds from purchase tax and SVO from VAT and thereby encourages the demand.

[50] The members of Primary Agriculture Cooperative Banks are predominantly small and marginal farmers. Such Cooperative Banks operate on village level (Tamil Nadu Cooperative Department, 2008)

Table 4: State biodiesel policies

Policies \ State		Uttarakhand	Chhattisgarh	Andhra Pradesh	Karnataka	Tamil Nadu
General policy issues	**Coordination body**	Uttarakhand Biofuel Board (public and private actors)	Chhattisgarh Biofuel Development Authority (public actors only)	Rain Shadow Areas Development Department (public actors only)	Envisaged: Karnataka Biofuel Development Authority (public actors only)	No coordination body for biodiesel, Department of Agriculture responsible for all oil-bearing trees
	Promoted feedstock	Jatropha	Jatropha	Pongamia, Simaruba	Draft policy favours a multi-species approach	Currently only Jatropha, but soon also Pongamia
Supply-side measures	**Allocation of government land for TBO plantations**	Forest land, managed by JFMCs and individual beneficiaries	Forest land, managed by JFMCs, revenue land, common land	Forest land, managed by JFMCs	In pilot project: communal land, to be extended to more communal land	Insignificant
	Input subsidies/ distribution of input	Seedlings and organic fertiliser for selected JFMCs/beneficiaries distributed free of cost (seedlings partly produced by SHGs)	Limited number of seedlings per farmer distributed free of cost, Fertiliser for state nurseries subsidised	All inputs for small and marginal under NREGS distributed free of cost or 100% subsidised, Seedlings for JFMCs distributed for free	In pilot project: Seedlings distributed free of cost	Seedlings 50% subsidised
	Governmental funding sources	NOVOD, MoRD: Department of Land Ressources, State government, Swarnajayanti Gram Swarozgar Yojana, VESP	NREGS, MoRD: Department of Land Ressources, state government	On private land: NREGS On forestland: NABARD: Rural Infrastructure Development Fund-loan, National Afforestation Scheme (planned: NREGS)	In pilot project: State government (planned: NREGS)	Subsidised loans of Primary Agriculture Cooperative Banks
	Provision of extension services (free of cost)	Forest Department, UBB staff , NGOs	Agriculture Department, Forest Department,	Central Research Institute for Dryland Agriculture	In pilot project: University of Agricultural Sciences, Bangalore	Agriculture Department

Table 4: State biodiesel policies

Policies \ State		Uttarakhand	Chhattisgarh	Andhra Pradesh	Karnataka	Tamil Nadu
	Subsidies for/ government provision of processing facilities	Central-level subsidies for small-scale extraction units (VESP)	State government installed 10 small-scale oil extraction units, Subsidies and tax exemptions for large-scale private processing units	No	In pilot project: 100% subsidy of processing units for demonstration purposes planned	No
Demand-side measures	**Minimum support price**	Jatropha seeds: currently Rs. 3/kg, to be adjusted in 2009	Jatropha seeds: Rs. 6.5/kg SVO: Rs. 18/l	Pongamia seeds: Rs. 10/kg, to be adjusted Jatropha seeds: Rs. 6/kg	No	No
	Blending requirement and encouraging state-owned enterprises to consume biodiesel	No blending requirement, No information on consumption by state-owned companies	Blending requirement of 5% as long as price of biodiesel does not exceed Rs. 25/l, No information on consumption by state-owned companies	No blending requirement, Andhra Pradesh State Road Transport Corporation to run 10% of its fleet with 5% blending	No blending requirement, Karnataka State Road Transport Corporation runs 75 buses on 10% and 20% biodiesel blend, Southern Railways uses blending	No blending requirement, Southern Railways uses blending
	Tax exemptions	Exemption of biodiesel from VAT	No information	Reduced VAT of 4% on biodiesel	Envisaged: Full exemption of biodiesel from VAT	Exemption of Jatropha seeds from purchase tax and Jatropha SVO from VAT
	Promotion of local use of SVO and biodiesel	Small rural electrification programme (VESP)	Decentralised value addition and local consumption integral part of the state approach	Not promoted	Envisaged: Decentralised value addition and local consumption	No promotion of local use of SVO or biodiesel

4 Biodiesel production in India: Three categories of value chain organisation

4.1 Introduction

The following chapter discusses several forms in which TBO-based biodiesel production is organised in India. At the moment, the biodiesel sector is still in a nascent state and no dominant way of organising the value chain has yet been established. Rather, different actors have established different systems and are in the process of trying out different ways of organising the value chain. According to Bharat Thakkar, General Secretary of the Biodiesel Society of India, the main challenge of the biodiesel sector is to find the appropriate mode of organisation: "Creativity to experiment with organisational forms is required" (Int. Thakkar, Biodiesel Society of India).

In total, this study has examined cases of value chain organisation in five Indian states (see Table 4). Each case shows a specific form of value chain organisation with substantial differences regarding the main investors, the purpose of biodiesel production and the way plantation activities, processing and marketing are organised. Accordingly, potentials to contribute to rural development also differ. The question therefore is how policies can promote these potentials in the most effective and efficient way.

This study has grouped the 13 cases into three main categories of value chain organisation, taking the actor who organises the agricultural cultivation phase as distinguishing feature. This is because this feature is linked with three other aspects, which decisively influence developmental effects: ownership of the land on which cultivation takes place, main risk-taker, and main motivations. Therefore, these three categories are:

- Government-centred cultivation, characterised by cultivation on government (forest and/or revenue) and communal land, government as risk-taker, and social motivations (employment generation for the rural poor, increasing the national forest cover, and protecting the soil from further degradation).

- Farmer-centred cultivation, characterised by cultivation on private land, shared risk between government, farmer and private processing companies, and the objective of developing additional sources of income and/or new energy sources for sustaining their livelihood without incurring major investment risks.

- Corporate-centred cultivation, characterised by large-scale cultivation, private oil companies as the main risk-taker, and the objective of achieving high returns on investment.

The ways in which these aspects influence developmental effects will be shown in the respective case studies. More generally, the question of the main actor, land ownership and main motivation has a direct bearing on developmental effects. The question of the risk-taker influences the incentive structures of the actors involved in the activity, and this has an indirect bearing on developmental effects, as will be shown later on.

Whether or not one of these categories of value chain organisation emerge in one specific state depends on location-specific conditions such as availability and ownership of uncultivated land (e.g. government, communal and private land), societal structure, and the involved actors (e.g. different government departments, local communities, private farmers and corporations).

Table 5: Different possibilities of organizing the biodiesel value chain

Value chain / Cultivation	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchasing of the seeds	Organisation of processing	Consumption
Government-centred cultivation						
Case study Uttarakhand State	Uttarakhand Biodiesel Board, Forest Department, Biodiesel Ltd.	Forest land	Uttarakhand Biodiesel Board	JFMCs and similar groups harvest and sell seeds to Forest Development Corporation	Forest Development Corporation sells seeds to the biodiesel processing company Biodiesel Ltd.	Biodiesel for national market
Case study Chhattisgarh State	Forest Department, Agriculture Department, Horticulture Department, CREDA, Central government through MNRE (VESP)	Forest land, revenue land, communal land	Respective state department, Panchayati Raj	JFMCs and similar groups harvest and sell seeds *either* to Minor Forest Produce Cooperative … … *or* have buy-back agreement with private company (e.g. D1-BP Fuel Crops)	Minor Forest Produce Cooperative sells seeds on the market State government plans to set up processing units on district level in order to produce SVO for local consumption D1-BP Fuel Crops will set up processing units if viable	Biodiesel *either* for national and international market… … *or* for local electricity generation
Case study Andhra Pradesh State	Forest Department	Forest land	Forest Department	JFMCs harvest and sell seeds to Girijan Cooperative Corporation Buy-back agreement between JFMCs and private companies might be possible in the future	Girijan Cooperative Corporation sells seeds on the market	Biodiesel for national market
Case study Winrock International in Chhattisgarh State	Winrock International, Forest Department, Agriculture Department	Forest land, revenue land, communal land, private land	Winrock International takes supportive role on private as well as on public land	Villagers are responsible for harvesting, Winrock International assists in organising harvest	Village Electrification Committees organise processing	SVO for local electricity generation

Table 5: Different possibilities of organizing the biodiesel value chain

Value chain / Cultivation	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchasing of the seeds	Organisation of processing	Consumption
Farmer-centred cultivation						
Case study Free market in Karnataka State	Market actors provide input	Private farmland	Farmers	Middlemen purchase the seeds from the farmers and then sell them to private oil extraction units	SVO extraction is performed locally (private transesterification units might establish with a rising demand of biodiesel)	SVO/ biodiesel for the regional and national market
Case study Free market and public-private partnerships in Andhra Pradesh State	Free distribution of seedlings and other inputs to small and marginal farmers	Private farmland	Farmers Small and marginal farmers receive NREGS for planting	Farmers are responsible for harvesting on their lands Farmers *either* sell to Girijan Cooperative Corporation at minimum support price… … *or* to a state-registered company (buy-back agreement)	Girijan Cooperative Corporation sells seeds on the market Companies establish local processing facilities	Biodiesel for the regional and national market
Case study Free market and contract farming in Chhattisgarh State	500 free seedlings per farmer are provided by Agriculture Department Fertiliser and additional seedlings are subsidised by government	Private farmland	Farmers	Farmers are responsible for harvesting on their lands Farmers *either* sell to state purchase centres at minimum support price… … *or* to D1-BP Fuel Crops (buy-back agreement)	State purchase centres sell seeds on the market State government plans to set up processing units on district level D1-BP Fuel Crops will set up processing units if seed supply is sufficient	Biodiesel for the national and international market
Case study D1 Mohan Bio Oils Ltd. contract farming in Tamil Nadu State	Government provides 50% subsidy for seedlings	Private farmland	Farmers	D1 Mohan Bio Oils Ltd. purchases seeds from farmers under buy-back contract	Processing is performed by D1 Mohan Bio oils Ltd. D1 Mohan Bio oils Ltd. will set up further processing units if seed supply sufficient	Biodiesel for national and international market

Table 5: Different possibilities of organizing the biodiesel value chain

Value chain / Cultivation	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchasing of the seeds	Organisation of processing	Consumption
Case study Cooperative farming in Karnataka State	State government provides free seedlings	Private farmland	Farmers	Village cooperatives (associations) purchase the seeds	District and taluk cooperatives will perform the processing and marketing State government will finance a first set of processing units	Biodiesel for the regional and national market
Case study "Fences for Fuel" in Rajasthan	Inputs are provided by Humana People-to-People India	Private farmland	Farmers	Farmers are responsible for harvesting on their lands	SVO extraction is performed locally	SVO (and maybe biodiesel) for local consumption
Corporate-centred cultivation						
Case study Leasing to Joint Venture companies in Chhattisgarh State	State government provided input on already established plantations Joint Venture companies will provide input on future plantations	Revenue land	Joint venture companies are responsible for cultivation on leased land	Joint venture companies organise harvest	Joint venture companies will perform all the processing	Biodiesel for the national market
Case study D1 Mohan Bio Oils Ltd. Estate model in Tamil Nadu State	Absentee landlords pay for input for the plantations D1 Mohan Bio Oils Ltd. gives 70% of the costs for the input as an interest free loan	Private land of absentee landlords	With the support of D1 Mohan Bio Oils Ltd., landlords hire specialized workers for the plantation work	Labourers are hired to harvest the seeds which are then sold under a buy-back contract to D1 Mohan Bio Oils Ltd.	Processing is performed by D1 Mohan Bio oils Ltd. D1 Mohan Bio oils Ltd. will set up further processing units	Biodiesel for national and international market
Built-Operate-Transfer Model of the Biodiesel Society of India (so far non-existent)	Private company that establishes energy village provides inputs	Communal land	Company employs villagers for planting and maintenance	Company employs villagers for harvesting Company and Panchayat share the benefit of the harvested seeds	Company will perform all the processing	Biodiesel for the market

This chapter will be structured as follows: First, a general overview of the biodiesel value chain in India will be given. In the subsequent subchapters the three categories will be discussed. Each subchapter looks at three aspects. First, general characteristics of the respective category will be presented. Second, their implications on four dimensions of rural development will be discussed. Third, their economic viability and the underlying incentive systems are analysed in order to assess whether the respective value chain organisation is likely to become economically viable. This is important as all ways of organising the value chain are still at an experimental stage, and only those that are viable will become widely accepted and produce the expected socio-economic and environmental results.

The following four aspects of rural development are analysed: (1) "Income and employment generation" looks into the (potential) effects that the respective value chain organisation has on the economic condition of the rural poor. (2) "Participation and empowerment" analyses the respective effects biodiesel production can have on the political or the social strength of individuals and communities in rural areas. For this study, the most important aspects in this regard are the involvement in decision-making processes and the possibility to take independent and knowledge-based decisions. (3) "Environmental implications" deal with issues such as biodiversity, water and soil degradation as well as toxicity. Furthermore, (4) "Food security and the risk of displacement" are discussed. The notion of food security includes the two aspects of overall food production and availability in the country of India as well as food production for the cultivator's own consumption and the land available for it.

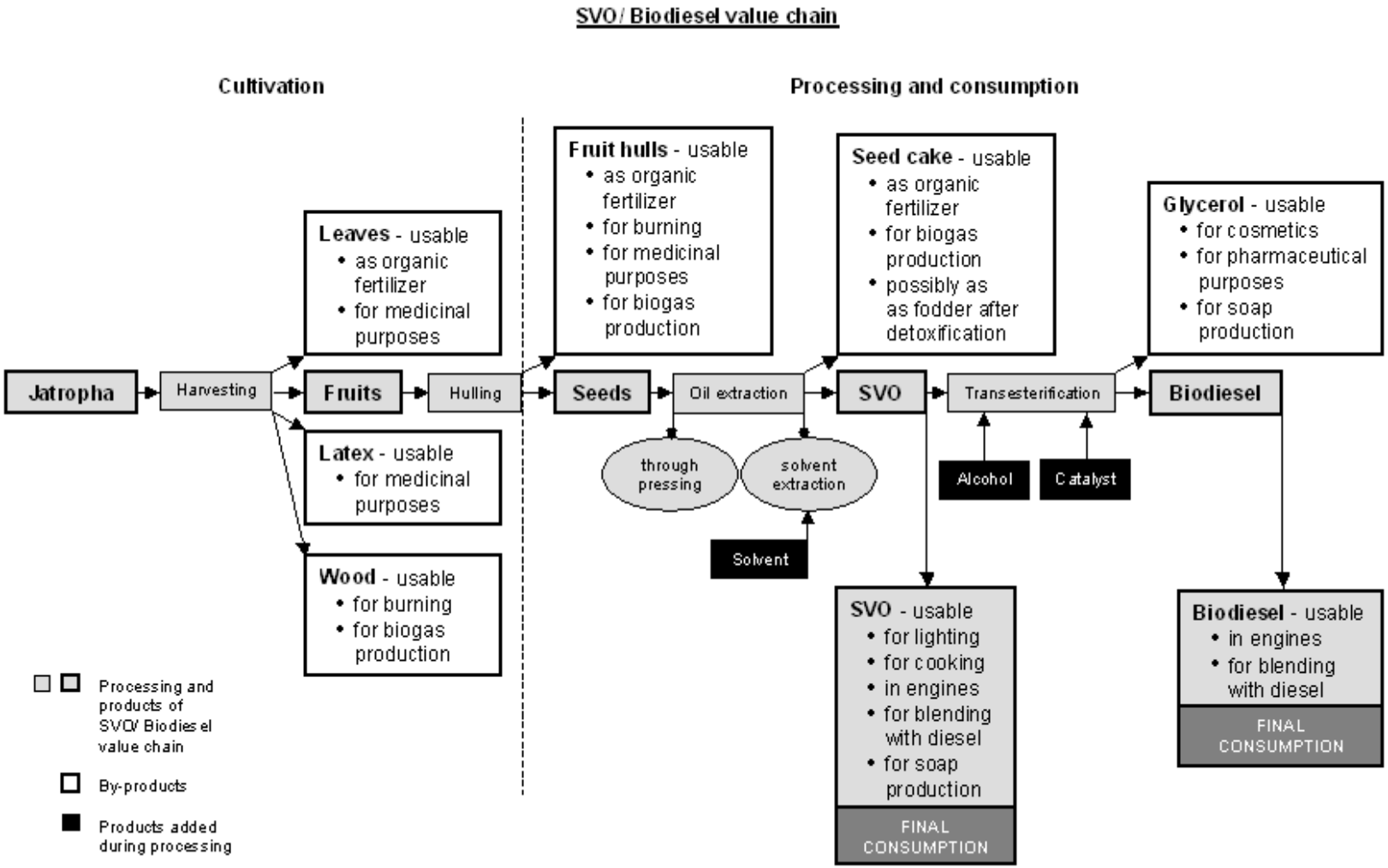
4.2 The biodiesel value-chain in India

The following chapter will briefly describe some general technical aspects of the biodiesel value chain in India. This will help to better understand and assess the developmental impacts of biodiesel production. The following chapter will briefly describe some general technical aspects of the biodiesel value chain in India. This will help to better understand and assess the developmental impacts of biodiesel production. For example, at the cultivation stage the type of land and the type of plantation have important impacts on socio-economic and environmental effects. Different ways of processing the raw material imply different cost structures and different technical capacities. Not all of them are suitable for the same conditions. Different end-products are consumed by different people at different levels – local or more distant – and have different developmental impacts. Moreover, the use of by-products allow for additional incomes. As not all crops generate the same by-products, some crops may be more economically viable than others.

SVO, the raw material for biodiesel, can be extracted from many different plants. Seeds of certain plants (e.g. rapeseed, soya, sunflowers) have high oil contents and are, in some countries, used for biodiesel production. In India, however, SVO is almost exclusively derived from oil-bearing trees such as Jatropha or Pongamia.

Chapter 4.2.1 describes the biodiesel value chain, starting from the cultivation of Jatropha and leading up to processing and consumption of SVO/biodiesel. Subsequently, different alternate uses and by-products of SVO and biodiesel that might generate an additional income sources for actors engaging in the sector will be discussed in chapter 4.2.2.

This graph presents the value chain of Jatropha-based biodiesel. It is divided into three steps: cultivation, processing and consumption. Processing and consumption are displayed as one single step, since SVO can both be used for further processing or for direct consumption. The grey boxes represent the core of the value chain. White boxes along the value chain show the various by-products, whereas the products that need to be added for processing are put into black boxes.


SVO/ Biodiesel value chain
Cultivation
Processing and consumption
Jatropha
Harvesting
Fruits
Hulling
Seeds
Oil extraction
SVO
Transesterification
Biodiesel
Leaves - usable
• as organic fertilizer
• for medicinal purposes
Latex - usable
• for medicinal purposes
Wood - usable
• for burning
• for biogas production
Fruit hulls - usable
• as organic fertilizer
• for burning
• for medicinal purposes
• for biogas production
Seed cake - usable
• as organic fertilizer
• for biogas production
• possibly as as fodder after detoxification
Glycerol - usable
• for cosmetics
• for pharmaceutical purposes
• for soap production
through pressing
solvent extraction
Solvent
Alcohol
Catalyst
SVO - usable
• for lighting
• for cooking
• in engines
• for blending with diesel
• for soap production
FINAL CONSUMPTION
Biodiesel - usable
• in engines
• for blending with diesel
FINAL CONSUMPTION
Processing and products of SVO/ Biodiesel value chain
By-products
Products added during processing

4.2.1 Cultivation, processing and consumption

Cultivation

The most important characteristic that distinguishes TBOs from other cash crops is the fact that they require very little nutrients in order to survive and therefore can also grown on less fertile land. Jatropha, for example, only needs a minimum of around 600mm of rainfall per year and temperatures that do not go below about 3°C (GTZ/TERI, 2007, p. 7; Jongschaap et al., 2007, p. 18). However, it is an input responding plant, meaning that fertile land, fertiliser and pesticides as well as irrigation will lead to much higher yields of oilseeds (Jongschaap et al., 2007, p. 15-16). Under favourable conditions, a yield of three to four tonnes of Jatropha seeds per ha can be achieved (see Table 3).

There are three ways of cultivating TBOs. First, they can be grown as boundary plantation, e.g. around plantations or along roads, railways and canals. Second, they can be planted in monoculture as block plantations. Third, TBOs can be cultivated through inter-cropping with other species, which is likely to happen when it is used for afforestation, but also possible when grown on fields.

Boundary plantations of TBOs, especially of Jatropha and Pongamia, are already common in India, even if the seeds are not used for SVO production. There remains a certain range up to which this kind of cultivation can be extended, but the amount of oilseeds produced will still stay marginal compared to the amount that could be reached through cultivation in regular plantations, either through monoculture or inter-cropping. Those plantations can, in turn, be set up on three types of land: regular agricultural land, forestland or underutilised land (often called “wasteland”).

Table 6: Land for cultivation of TBOs

Type of plantation	Type of land		
Boundary plantation	land along roads, railways, canals and around agricultural fields etc.		
Monoculture block plantation	regular agricultural land	forestland	underutilised land
Inter-cropping on plantation			

The first possibility, cultivating TBOs on fertile agricultural lands, implies competition with other crops that can also be grown here. In India, most farmers are not willing to plant TBOs on fertile lands because yields at this point of time are considerably lower than those of food crops such as rice, wheat or sugar. This could possibly change with an increase in demand for biodiesel. Changing cultivation patterns on already used fertile agricultural lands will only take place if the revenues from TBO cultivation exceed those from food crops, which would presuppose either a considerably higher demand (e.g. through higher prices of conventional fuel) or extraordinary increases in productivity.

The second possibility, to grow TBOs on forestland, mainly refers to afforestation. Regenerating degraded forest areas for ecological reasons and sustainable use of resources is desired in many forest regions of India. Pongamia – like any other tree – can serve this purpose very well. Jatropha, in contrast, is a shrub rather than a tree and therefore it is less useful for afforestation. India strongly promotes Joint Forest Management programmes in order to combine the benefits of afforestation and income generation for lower casts and tribal people.

The third – and in India's public discussion most favoured – possibility is the use of underutilised lands for cultivation of TBOs. As described above, underutilised land refers to land that is not suitable for any other crop production because of its low fertility.

Processing

After harvesting, the first step in processing is extracting the oil from the fruit. Only the seed of the fruit contains oil, so it is necessary to first separate the seed from the fruit hull. The seed itself also consists of a shell and a kernel. Before oil expelling, it is more efficient to remove the seed shell from the kernel in order to improve the extracted SVO. If this is not done, sediments of the shell will remain in the SVO. After hulling, kernels are grinded.

There are two methods of extracting the oil from the grinded kernels. First, the kernels can be pressed, using hand-powered pressing machines or mechanised equipment. When small-scale hand-powered pressing machines are applied, only around 60% of total extractable oil amount can be expelled. More mechanised expellers such as animal-powered *ghanis* can obtain about 75% of the oil content. Further advanced pressing machinery can obtain up to 90% of the extractable oil amount. Second, the more efficient way of expelling the oil from the kernel is to use a chemical solvent which can extract almost 100% of the oil content (Jongschaap et al., 2007). This requires a highly sophisticated industrial oil extraction, since the solvent needs to be handled with care and also must be removed from the oil after processing. The two methods, pressing and solvent extraction, can also be combined.

The second step in processing is the transformation of SVO into biodiesel. This process is called transesterification. Depending on the final use of the fuel, transesterification can be worthwhile.

Transesterification requires three raw materials: SVO, alcohol (usually methanol is used), and an alkaline catalyst (e.g. sodium or potassium hydroxide). A two-step chemical reaction first separates the SVO into free fatty acids and glycerol and then merges the free fatty acids with the methanol, generating fatty acid methyl ester, which is the chemical term for biodiesel. The glycerol remains as a by-product of the procedure. Transesterification units can have all kinds of processing capacity, from small-scale biodiesel units to large-scale transesterification plants. Handling and storage of biodiesel, however, require certain professionalism, since it is toxic and inflammable.

Consumption

Both SVO and biodiesel are suitable for final consumption. SVO can be used for lighting (replacing petroleum in lamps) and cooking (in specially designed cooking stoves). It can also replace conventional diesel in engines (e.g. electricity generators or water pumps). Since SVO has a very high viscosity, however, fuel injection pumps need to be modified or the abrasion of the engines will proceed much faster. Hence, operation and maintaining costs of engines running on SVO are higher compared to those running on conventional diesel. Fuel properties of biodiesel, on the other hand, are a lot better than those of SVO. Thus, replacing diesel with biodiesel instead of SVO reduces operation and maintaining costs. Some projects aiming at rural energy security use SVO for their machines and electricity generators while others first transesterificate and use BD for the same purposes. The advantages of the latter are better fuel properties, leading to more efficient fuel burning and less pollution. There are, however, economic and safety issues with the process of transesterification. Additional technology and equipment as well as other inputs (methanol, catalyst) are needed to process SVO into BD. This means additional costs both for investment and maintenance. Also, qualified personnel have to be trained to operate the complicated transesterification process. Besides, this process is a dangerous one since highly inflammable material such as methanol is used. These issues, however, could be resolved with careful planning and implementation.

A solution to this problem of viscosity is to blend diesel with either SVO or biodiesel. A SVO-diesel blend, though, still requires a modification of the engine for proper functioning in most cases. The characteristics of the SVO can vary a lot due to differences in seed quality and extraction methods. Therefore, the percentage up to which a blending of diesel with SVO is possible highly depends on SVO quality and the kind of engine. By contrast, the characteristics of biodiesel are rather consistent because of the standardised chemical reaction processes during transesterification. Blending diesel with biodiesel is therefore much more efficient. Depending on the study, such a blending up to 50% is possible without major operational difficulties for engines (Jongschaap et al., 2007, p.15).

4.2.2 By-products and alternate uses of SVO and biodiesel

Several by-products are have economic value. Oil-bearing trees not only produce seeds/fruits, but their leaves, latex and wood can also be used. Leaves of some oil-bearing trees can serve as valuable organic fertiliser,[51] and both leaves and latex of some species are used for medicinal purposes. When trees or bushes are pruned, branches can be used as firewood or – like any other biomass – for biogas production. Furthermore, fruit hulls are proper for all the possible uses mentioned above – as organic fertiliser, for burning, for medicinal purposes as well as for biogas production.

[51] In the case of Jatropha, leaves have toxic properties and its effects on soil fertility are not yet well researched.

Two other important by-products of SVO/biodiesel production emerge during further processing: seed cake and glycerol. After extracting the oil, the particulate material of the kernel, which is called seed cake, remains. It can be used as an organic fertiliser. Since yields increase a lot when fertiliser is applied, the seed cake can be taken back to the field and facilitate cultivation. In addition, producing biogas from the seed cake is also possible. Theoretically, seed cake could also serve as fodder for animals. However, Jatropha seedcake has to be detoxified, but detoxification has only been successful at laboratory scale (Jongschaap et al., 2007). The process – if possibly applied in the field – would currently be very expensive, so that Jatropha seed cake as fodder could not take a stand on the market.

Glycerol (Glycerine) is removed from the SVO during transesterification. It is an important ingredient to many kinds of cosmetics, soaps and pharmaceutical products. If the demand of glycerol on the market is high and the by-product can be sold at a good price, biodiesel production can become a lot more cost-efficient. However, this is not an important issue in India (yet). During the course of the field research for this study, glycerol has not played a role in any of the cases examined.

Compared to the various by-products, the opportunities for alternate uses of SVO or biodiesel are very limited. The single most important mode of consumption is the use as some kind of a fuel. Biodiesel, in fact, can only serve as petrol. Some SVO – depending on their plant of origin – can, on the other hand, be consumed as food, but since Jatropha-based SVO is toxic, it cannot enter the edible oil market. An alternate use of Jatropha-based SVO lies, however, in the production of soap. A soap of good quality can be produced from SVO and in some countries (e.g. in Mali and Haiti), there are projects promoting this kind of processing in order to generate income for poor rural families. In India, however, the production of Jatropha-based soap is currently not competitive on the local soap market.

4.3 Government-centred cultivation

4.3.1 General Characteristics

This section first describes general characteristics of government-centred cultivation. It will then give a brief overview over the individual cases within this category that this report has examined. In government-centred cultivation, cultivation may take place on government land (under the jurisdiction of the forest or the revenue department) and on communal land. It is identified by the respective state agency, in accordance with the local Panchayat. Inputs such as seedlings and fertiliser are subsidised and usually also provided by the government. Material and labour costs for planting and maintenance are mainly funded by centrally-sponsored schemes. The labour is either performed by established committees such as Joint Forest Management Committees (JFMCs) on forest land or by labourers who are employed via certain centrally-sponsored schemes. Training is provided by the government agency in charge. In this approach, therefore, the central government is the sole risk-taker. The type of

plantation can either be boundary plantations along roads, railways and canals, monoculture block plantations or intercropping for afforestation. The approach is a developmental one with the potential to generate employment for the rural poor and to regenerate degraded land. It is further characterised by a low input, meaning that the use of irrigation, fertilisers and pesticides (if at all) is restricted to the first years. The end product biodiesel (or in some cases SVO) is either used for rural energy generation (see Box 3) or for the (inter-) national fuel market.

This study analyses three cases of government-centred cultivation, which will briefly be introduced. The first one is Jatropha cultivation on forest, revenue and communal land in Chhattisgarh. Out of 2 Mio. ha of revenue fallow land, 157,000 ha have been identified for Jatropha plantations in various districts of the state. Chhattisgarh also possesses 17 Mio. ha of degraded forest land which could be utilised for Jatropha plantation (Shukla, 2008, p. 113). Most of the plantations have been carried out by the Forest Department. In the last few years, it has planted approx. 200mio seedlings on revenue and on forest land (Int. Prakash, Forest Department). The Chattisgarh Biofuels Development Authority (CBDA) distributes government funds at district level to the respective departments. The main funding source is NREGS. The state departments in charge cooperate with Panchayats to employ NREGS-listed labourers for setting up and maintaining the plantations. The case of Chhattisgarh is an excellent example for a well-functioning cooperation between state and private actors, because the latter are actively involved in setting up plantations and offer training facilities, too (Int. Sarkar, D1-BP Fuel Crops). Companies such as D1-BP Fuel Crops have buy-back agreements with Panchayats and JFMCs. Chhattisgarh also utilises SVO and biodiesel for rural energy generation (see chapter 3.5 and Panwar, 2006, p. 115). This approach of electrifying villages on the basis of locally cultivated Jatropha is carried out by two projects, the Chhattisgarh rural energy project by CREDA, and an electrification project of Winrock International.

Box 3: TBO-based biofuel production for rural energy security

For thousands of remote villages in India that do not have access to reliable electricity or lack funds to buy fuel for their agricultural equipment such as irrigation pumps or tractors, TBO-based biofuel production can be a way of achieving energy security. Its simple technology and relatively easy maintenance as well as its property as a renewable and therefore environmental friendly energy are its greatest advantages. TBO-based biofuel production can therefore have positive potentials for rural energy security. However, there are two main points of consideration. First, economic viability has to be ensured. It only makes sense to promote TBO-based projects if conventional sources of energy are either not accessible or more expensive Secondly, to ensure the highest possible income and empowerment of the rural poor, beneficiaries should have the choice of whether to sell the harvested seeds on the market or to supply them to the local energy provider.

There are different approaches to achieve energy security in rural areas through SVO or biodiesel production all over India. As indicated in Table 5 and in the chapter on Government-centred cultivation, three of those projects have been examined in the course of this study: the NGO projects of Winrock International in Chhattisgarh and „Fences for Fuel" of Humana People to People India in Rajasthan as well as the government-driven Chhattisgarh Rural Energy Project.

Although some differences exist between the three different approaches, there are many more similarities, especially in the way value chains are organised. The main feature is the local and decentralised processing of harvested seeds: Instead of selling the seeds on the market, they are used in the villages themselves. All examined projects have in common that they provide almost all inputs such as seedlings or fertilisers as well as the processing technology (grinding, oil extraction etc.) for free. Another important similarity is the fact that the project implementer plans and organises the value chain: The project agency pre-decides what will happen with the seeds after they are harvested. All examined projects are currently in a pilot stage. However, they all consider themselves already as successful and are therefore planning implement their approach in other villages and districts throughout the country.

Socio-political motivations play a major role in both government's and NGOs' projects. In fact, if NGOs' projects are successful they can be taken as models for future large-scale government roll-outs, which can then be financed through large programmes such as the Government of India's Remote Village Electrification (RVE) programme. According to the Ministry of New and Renewable Energy (MNRE) this programme "aims at providing basic lighting/electricity facilities through renewable energy sources (…) where grid connectivity is either not feasible or not cost effective" (MNRE, 2008). It is in line with India's Rural Electrification Policy, which aims at providing one unit of electricity per household per day in the next years (Ministry of Petroleum and Natural Gas, 2006, p. 2). The RVE programme is not restricted to biofuel-based electrification. In fact, MNRE prefers small hydro and biomass power plants over bio-fuel based electricity generation systems because they are seen as more energy efficient (MNRE, 2006). 90% of the respective project costs (both electricity generation systems and five years of maintenance) are paid by MNRE – the remaining 10% are borne by the project implementer (NGO or State agency) (MNRE, 2006).

Also supported by the Government of India, the Village Energy Security Programme (VESP) is part of RVE but focuses on specific projects (NEDA, 2008). In its guidelines it asks implementing agencies to facilitate formation of Village Energy Committees (VEC) and Village Energy Funds (VEF) to give sufficient ownership to the concerned communities.

The second case of government-centred cultivation is Jatropha cultivation on forest land in Uttarakhand. In contrast to Chhattisgarh, Jatropha plantations are exclusively on forest land; cultivation on revenue land does not exist. As already stated in the chapter 3.5, this case is characterised by a strong cooperation between the Uttarakhand Biodiesel Board (UBB) and the processing company, Biofuels Limited. UBB is very reluctant to use NREGS as a funding

source due to implementation obstacles of the scheme (Int. Vaish, UBB). In contrast to Chhattisgarh, there are less actors involved in the biodiesel production in Uttarakhand, the main ones being the UBB, the Forest Department, the Forest Development Corporation and JFMCs[52]. The Uttarakhand case also differs from the Chhattisgarh case because the UBB employs NGOs for the implementation of projects, whereas in Chhattisgarh all projects are carried out by government agencies. Jatropha is not a NTFP in Uttarakhand, but through an agreement between the Forest Department and UBB, Jatropha can only be sold to the Forest Development Corporation (Int. Vaish, UBB).

The third case is cultivation of Pongamia on forest land in Andhra Pradesh. Like in Uttarakhand, government-centred cultivation in Andhra Pradesh is only on forest land. The work is organised through JFM-like committees. So far, 20,000 ha have been afforested with Pongamia, and 20,000 more are planned (Int. Goel, Rain Shadow Areas Development Department). Pongamia is indigenous to the area and has been used for more than 50 years for afforestation purposes, but only recently on a large scale. In difference to Uttarakhand, where members of JFMCs are paid individually (Int. Singh, UBB), wages for its equivalent in Andhra Pradesh are channelled through joint account systems. After an activity has been carried out, the forest guard hands over a check to the JFMC. The Pongamia oil is expelled locally, which contributes to local value addition. So far, the Forest Department cooperates with one company, Southern Online, which buys the SVO and further processes it into biodiesel (Int. Krishna, Forest Department; Int. Kumar, Southern Online Biotechnologies).

The next subchapters will assess the differences between these three cases of government-centred cultivation in terms of their socio-economic implications and their incentive structure.

4.3.2 Socio-economic and ecological implications

Government-centred cultivation can have different implications on income and employment generation, on participation and empowerment, on the environment, and on food security.

Income and employment generation

As stated above, one of the main objectives of government-centred cultivation is employment generation for the rural poor. The study shows that the analysed cases have the potential to improve rural livelihoods by contributing to employment as well as to income generation. Especially landless labourers might benefit from cultivating and collecting TBOs on government or communal land. They can either benefit through government-sponsored wage employment programmes for planting and maintenance or through income from the collection

[52] We found that the terms JFMC and SHG were often used synonymously in the field, even though they differ regarding their legal status and definition.

of seeds, or through both. Government-centred cultivation provides a supplementary income source for people and does not substitute their main occupation.

On Chhattisgarh forest land, the planting, maintenance and harvesting is carried out by JFMCs who are trained by the Forest Department. On revenue and communal land, harvesting has not yet taken place, but it is planned that Panchayats will organise the harvest and give the collection allowance either to community groups or to individuals (Int. Shukla, CREDA/CBDA). In Uttarakhand, beneficiaries are given the responsibility for maintenance and harvesting on 1-2 ha plantation. In the first year they earn Rs. 1.7 per plant for pit digging and planting, for the maintenance in the second and third year Rs. 0.5. SHGs who raise the seedlings are paid Rs 1.5 per plant and receive the seeds and all other inputs for free from UBB (Int. Singh, Forest Development Corporation). The Andhra Pradesh Forest Department currently applies for NREGS-funding of plantations. The wages of the National Afforestation Programme are too low, and have not been adapted during the last years. The department hopes that NREGS will provide a greater incentive for JFMCs to carry out the labour (Int. Krishna, Forest Department). JFMCs in Andhra Prasdesh contribute to an employment generation of 2,410 person days per year per village, regarding all tasks they carry out, not only TBO-cultivation (Sudha et al., 2003, p. 38). However, a recent study arrives at a rather sceptical conclusion:

> *The minimal benefits under the project were confined to the start of the intervention, and then only to occasional wage labour on soil conservation and plantation works prioritised by the APFD [Andhra Pradesh Forest Department]. Villagers report that in 2005 and 2006 these minor benefits stopped as the APFD rarely contracts [JFM] members for forestry works. (Griffith, 2006, p. 2)*

Besides labour wages, sale of seeds is the main source of income for beneficiaries. If prices are too low, beneficiaries will not collect the seeds. The analysed states have different price systems. In Chhattisgarh, beneficiaries are guaranteed a minimum support price of Rs. 6.5/kg seeds for Jatropha, whereas in Uttarakhand they receive Rs. 3/kg. UBB emphasised that once biodiesel will be available from Jatropha plants, the seed price will be increased (Int. Vaish, UBB). In Andhra Pradesh, the minimum support price for Pongamia was set at Rs. 6/kg in 2005, but augmented to Rs. 10/kg in 2006 (Int. Goel, Rain Shadow Areas Development Department). In Uttarakhand it is not allowed to sell seeds outside the state, and since the Forest Development Corporation is the sole purchaser, collectors do not have the opportunity to earn more than the fixed price, whereas in Chhattisgarh and in Andhra Pradesh they can choose their trading partner. It remains to be seen to what extent TBO-plantations will generate attractive and long-term sources of income for the rural poor.

In the rural electrification projects in Chhattisgarh, villagers might not see immediate financial benefits from electrification through SVO or biodiesel, because grid electricity (as far as it is accessible) is highly subsidised. They do, however, benefit indirectly, because additional hours of electricity and lightning contribute to improved livelihoods and income allowing for longer working hours in the evening after people return from the fields. Fuel for

generators and farming machinery might also increase agricultural productivity, but since conventional fuel is highly subsidised as well, effects of locally produced fuel on the agricultural productivity cannot be measured currently. Both the government's and NGOs' projects in Chhattisgarh have furthermore generated some employment opportunities for locals who now work as operators in the local biodiesel unit.

Participation and empowerment

Through the establishment of SHGs or similar community formations, government-centred cultivation has the potential to empower marginalised groups. Such approaches exist in all analysed states. JFMCs have the potential to empower their members because they encourage the self-management of plantations and self-organisation in groups in general. In JFM in Andhra Pradesh for example, Pongamia plantations will be handed over to local forest committees (Int. Kalaghatgi, Forest Department). An approach with similar effects is taken up in Chhattisgarh, where SHG manage the plantations, and where the work (planting, pruning, harvesting) is carried out by JFMCs or similar committees of the respective Panchayat.

However, as the concept and structure of JFM are not initiated by local communities, but by the Forest Department, it can also enforce existing top-down structures between the department and forest communities (Sarin, 1995, Griffith, 2006). According to the Forest Department of Andhra Pradesh, the JFM-concept especially benefits the poor (Int. Kalaghatgi, Forest Department).[53] In contrast, other sources criticise that communities' decisions such as the choice of the crop to be planted are forced upon them by Forest Department officials (Forest Peoples Programme & Samata, 2005) and that JFM further intensifies existing inequalities within communities:

> *Because of [the Joint Forest Management's] primary focus on forest protection for timber production rather than need-based forest management, the programme is empowering those with the least forest dependence to compel the more dependent community members to forsake immediate extraction without providing them any alternatives. (Sarin, 1995)*

Government-centred cultivation carries the potential to empower rural women. An NGO working with JFMCs in Uttarakhand claims that the committees provide the opportunity for women to manage the whole plantation process and to receive their own income (Int. Centre for Technology and Development). SHG as promoted by D1-BP Fuel Crops in Chhattisgarh and by UBB in Uttarakhand in particular have the potential to make rural women less dependent on their husbands' income and promote their management capacities. With regard to JFM some studies claim, however, that "in most states the representation of women is restricted to the quota stipulated in the JFM orders […] women don't participate in the JFM process and are unaware of their rights and their role in the decision-making process" (Sudha et al., 2003, p. 33-34; see also Murali et al., 2003, p. 19).

[53] See also http://forest.ap.nic.in/JFM%20CFM/JFMINAP.htm.

Beneficiaries in rural energy security projects rarely have the possibility to decide what to do with the harvested seeds. Projects should offer different possibilities to choose from and empower beneficiaries to make their choice. In the assessed projects, Village Electricity Committees are mostly concerned with the project implementation. Project initiators seem to neglect the committees' decision-making capacity (Int. Shiv, Winrock International; Int. Gyani, CREDA). If, for example, cultivators sell their seeds to the processing site for Rs. 4/kg although they could earn Rs. 12-35 on the market, a considerable amount of income is lost. It is argued, however, that this low price is needed to be able to economically produce electricity and to sell it back to the beneficiaries at a low price (Int. Shiv, Winrock International).

Environmental implications

What can be seen so far is that government-centred cultivation of TBOs contributes to the rehabilitation of soils and forest cover if planted in a sustainable way. It does not make intensive use of inputs, since its main objective is not profit maximisation. Negative effects on water and soil condition are therefore less likely than on commercial plantations.

Earlier Jatropha plantations in various states have failed due to the plant's water demand (Negi et al., 2006, p. 29). Jatropha is furthermore not indigenous to some regions, and as such susceptible to diseases (ibid.). Pongamia, especially if not grafted (as promoted by the Andhra Pradesh Forest Department), needs far less water than Jatropha. With in situ grafting, as favoured by private actors, seedlings need moisture immediately after the grafting procedure (Int. Krishna, Forest Department). This is also relevant considering food security, because the less water is needed to irrigate oil-bearing trees, the more is available for other crops. Studies referring to ecological impacts of JFM suggest that the practice generally contributes to regeneration of degraded lands (Sudha et al., 2003, p. 36). However, particular impacts of TBO-cultivation within JFM have not yet been evaluated.

Food security and risk of displacement

According to the findings of this research, food security is currently not threatened through government-centred plantations. There is, however, the potential that this will happen because government land is often used for minor agricultural purposes, fodder production and grazing. In principle, planting of fuel plants on government land should not harm food security because every Panchayat has land set aside for grazing. According to Ram Prakash, Commissioner of the Forest Department of Chhattisgarh, the department usually takes revenue land "which is not used for any other purpose such as grazing" (Int. Prakash, Forest Department). All state actors emphasised that land identification happens in concurrence with the respective Panchayat and that the committee's approval is not only *needed* in order to cultivate oil-bearing trees but that that the approval of the local community is also essential for a successful plantation (Int. Prakash, Forest Department). However, individuals don't necessarily agree with the decision of their representatives to cultivate oil-bearing trees on common land (Int. Mandal, Department of Panchayat Raj and Rural Development). There are

also villages which objected the plans and decided not to cultivate Jatropha (Int. Vaish, UBB). Some civil society representatives are concerned that large-scale cultivation of oil-bearing trees will lead to a "decline of commons" (Ramdas, 2007, p. 17). Therefore, according to Ram Prakash from the Andhra Pradesh Forest Department, the government needs to support the notion that "the poor must have first right over the common property" (Int. Prakash, Forest Department).

In Uttarakhand, SHGs raise seedlings on their members' private land. Since the seedlings are cultivated during the four month in which crops are already harvested and new ones are not yet planted, the nurseries don't have a negative impact on the villagers food security. Instead, they provide an additional income during a time in which the land is vacant (Int. Vaish, UBB). In Chhattisgarh, there are more than 7 Mio ha land available alongside railroad tracks. To utilise this land for Jatropha cultivation, as currently considered by CBDA (Shukla, 2006, p. 113), would have the advantage that its usage won't interfere with other agricultural purposes.

4.3.3 Economic viability of TBO cultivation and incentive structure

This section evaluates the incentives given by the government in government-centred TBO cultivation. It argues that it is necessary to provide incentives for all stakeholders (e.g. plantation labourers as well as state authorities) to ensure the environmental and economic sustainability of the plantation. Government-centred cultivation pursues developmental objectives, but having the government as main organiser of the value chain and sole risk-taker is a challenge in this regard.

Since biodiesel on government-centred plantations is predominantly produced for national consumption, the existence of reliable market links is vital to ensure economic sustainability of the programme. Differences in the incentive structure of the cases partly derive from differences in the cooperation between public and private sector. In all analysed states market links are ensured by a vital private sector, which is often initiating the cooperation with the responsible state agencies. Through measures like buy-back agreements between community organisations and companies, the economic sustainability of the plantation can be enhanced. In the case of Chhattisgarh, D1-BP Fuel Crops approached the government as well as Panchayats. D1 encourages the Panchayats to apply for government funds for TBO cultivation (Int. Sarkar, D1-BP Fuel Crops), from which the company will then profit indirectly, because it won't have to invest in own plantations. In all cases, the government bears the risk of crop failure and largely absorbs the transaction costs involved in organising planting and seed collection. In Uttarakhand, the company Biofuels Limited which has Memorandums of Understanding with the Forest Development Corporation and JFMCs is the driving force in the sector. In Andhra Pradesh, Southern Online Biotech sets up decentralised oil expelling units and has (amongst others) buy-back agreements with JFMCs.

The existence of a market link alone is not sufficient in order to ensure economic sustainability. Sellers also need to have the choice of whom to sell to. In Chhattisgarh and Andhra Pradesh, JFMCs are free to sell to a state-owned corporation or to a private company. In Uttarakhand, however, JFMCs are restricted to sell to the Forest Development Corporation. There is no competition in purchasing seeds there, because the monopoly right of purchase was given to a single private company, Uttaranchal Biofuels Limited. The state is practically protecting the company from competition. D1-BP Fuel Crops also seeks to persuade state governments to give priority rights to those pioneering companies who take the risk of building up the whole biodiesel value chain in a particular region (Int. Sarkar, D1-BP Fuel Crops).

The main problem of government-centred cultivation we came across during our research is its lack of environmental and economic sustainability. A lack of economic sustainability hinders the positive implications biodiesel production can have on rural development. A plantation which is not economically sustainable cannot generate long-term income and will not have a sustainable impact on community development and environmental protection. When highlighting this, interviewees referred not only to biodiesel plantations but also to prior government-initiated plantations with other crops.

The problem partly results from a lack of ownership. Neither the implementing state agency nor the labourers who receive public funds feel fully responsible for the maintenance of a government plantation. As labourers won't profit from the harvest, they might as well not be concerned with raising high quality crops. Not taking proper care of maintaining the plants results in lower yields. An alternative approach which might lead to sustainable asset creation is the granting of usufruct rights. Through usufruct rights state governments set incentives to ensure that individuals and communities take care of plantations on forest land. For JFMCs, the incentive is to have a long term additional income and to manage the plantation process up to the commercialisation of the harvest. In Andhra Pradesh in particular, the incentive for planting Pongamia is a 100% revenue from the harvest. Usually they are obliged to reinvest 50% of the benefit from a minor forest produce in replanting (Int. Kalaghatgi, Forest Department). In Andhra Pradesh, 2,500 out of 8,000 JFMCs have become partly, if not fully, self-sufficient through the revenues they obtained from eucalyptus, bamboo and teak wood production (Int. Kalaghatgi, Forest Department). JFM, however, is often implemented with the help of external funds (in the case of Andhra Pradesh this is a US$108 million loan from the World Bank, Int. Krishna, Forest Department). It is questionable whether the project can be sustained after the loan ends in 2009.

At this point of time the usufruct rights-principle is applied to land under the jurisdiction of the Forest Department only. There is only one example of usufruct rights on revenue land: The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) pushed the respective District Collector to issue certificates of usufruct rights on some hectares of revenue land to nearby villagers (Int. Wani, ICRISAT).

Furthermore, schemes generally monitor only inputs, not outcomes (Int. Vaish, UBB), and funding is not linked to outcomes. Consequently, there is neither an economic incentive on the state agency's nor on the Panchayat's side to optimise the use of centrally-sponsored schemes. As a consequence, what is seen as a successful implementation is the amount of people on (short-term) employment, rather than the creation of sustainable assets. In Tamil Nadu, for example, masses of seedlings were produced and distributed in 2005. No output monitoring was done with the result that only 20-30% of the distributed plants survived. With the change of government, the programme was stopped (Int. Udhanayan, D1 Mohan Bio Oils Ltd.). In contrast, the Uttarakhand Biofuel Board together with the Forest Department and JFMCs regularly conducts so called 'physical verifications' which measure the plant survival rate on all plantations. The results of these verifications can be found in monitoring reports (Int. Center for Technology and Development).

Another problem related to centrally-sponsored schemes funding of plantations is that material costs as well as wages are not always paid on time.[54] If labourers have to wait for weeks until they receive their wage, they may not be motivated to continue the work and the plantation process is interrupted. The same applies to delayed and inflexible provision of or fund-disbursement for material inputs. This is why in case of Uttarakhand, the private company steps in with its own resources whenever the government subsidy is insufficient or delayed (Int. Vaish, UBB).

Furthermore, the analysed cases of government-centred cultivation often lack competition amongst service providers. In Chhattisgarh and Andhra Pradesh, ministries in charge choose a state actor to provide a certain service, instead of carrying out a tender. Chhattisgarh recently started to employ NGOs for the provision of training, but these are area-specific NGOs (~10-15 per block) and there is no competition between them (Int. Mandal, Department of Panchayat Raj and Rural Development). Due to the absence of competition and effective monitoring systems funds are used by inefficient agencies who often also lack technical and management capacities. An exception is Uttarakhand, where the Biofuel Board has contracts on tender basis with several NGOs. Their services range from awareness-raising to implementation of planting through SHGs and monitoring. Nonetheless, these are restricted to mere project implementation along the lines prescribed by the UBB and do not extend to project planning activities (Int. Centre for Technology and Development). A similar approach is taken in Karnataka, where line ministries cooperate with certified NGOs.

With regard to the projects aiming at rural energy security, these are not financially sustainable. While operational costs for maintaining the projects are partly paid out of the project's cash flow, as in the case of Winrock, investment costs were borne by governments or NGOs in all examined projects (Int. Gyani, CREDA; Int. Shiv, Winrock International). It

[54] "In the face of the inordinate delays in the releasing of money by the Finance Departments in the states to the districts, many Central Ministries option for releases to district level societies (DRDAs) for receipt of funds directly from the Central government bypassing the State governments seems justified." (Saxena/Ravi, s.a., p. 44).

should be noted that rural electrification projects usually require government subsidies. TBO-based electrification however only make sense if it requires less subsidies than alternative power supplies. Such projects should not be rolled out at a large scale as long as no reliable data are available to calculate their opportunity costs.

4.4 Farmer-centred cultivation

4.4.1 General Characteristics

Farmer-centred cultivation is characterised by the fact that small, marginal and medium farmers plant oil-bearing trees on their privately owned land. Private farming of Jatropha or Pongamia trees is only encouraged in four of the five analysed states. In Uttarakhand, neither the government nor any private company targets private farmers for oil-bearing tree cultivation.

Cultivating oil-bearing trees for the purpose of biodiesel production is a fairly new activity, and the economic viability for private farmers remains quite insecure. In many regions of India, oil-bearing trees have already been traditionally used as boundary plantations – Jatropha for example in Chhattisgarh and Pongamia in Karnataka and Andhra Pradesh. But most farmers are still reluctant to start systematic TBO cultivation for the purpose of biodiesel production and only do it if input and opportunity costs are low (Int. Sharma, D1-BP Fuel Crops; Int. Kridutta, Agriculture Department; Int. Nirmala, Department of Rural Development; Int. Sarvesh, Agriculture Department).

Small and marginal farmers cultivating oil-bearing trees usually do so in the form of hedge plantations. In India, marginal land holdings of one ha or less constitute about 70% of all operational holdings, whereas 16% of the land holdings are defined as small with one to two ha (Ministry of Statistics and Programme Implementation, 2006). Those small and marginal farmers rely on fast returns on investment in order to ensure their livelihoods and cannot afford to take high risks in experimenting with a new crop. If they start planting Jatropha or Pongamia they usually integrate it into their farming pattern in the form of boundary plantations in order to earn some supplementary income.

Farmers with larger land holdings (up to 10 ha) account for about 13% of all Indian land owners. If such farmers cultivate oil-bearing trees, they do so in the form of block plantations.[55] Their large farm size enables them to diversify the sources of their income, and they can afford to dedicate part of their land to risky cash crops like oil-bearing trees. This is especially true for better-off farmers who have additional non-farm income at their disposal.

[55] Large land holdings of over 10 ha account for less than 1%. (Ministry of Statistics and Programme Implementation, 2006)

Farmers are linked to the market in four different ways:

1. Production for consumption on the own farm;
2. Arms-length relations with local processors;
3. Buy-back arrangement with companies or governments;
4. Integration in a cooperative.

The first type of farmers – those cultivating oil-bearing trees with the aim of using the fuel on their own farm – were found in a pilot project that the NGO "Humana People to People India" launched in Virat Nagar District in Rajasthan.[56] The NGO has encouraged small and marginal farmers to plant Jatropha as boundary plantation around their fields. In doing so, the farmers cultivate 10-15% of their lands with Jatropha. The aim is to facilitate access to fuel, as diesel which is needed for running water pumps and vehicles is an expensive commodity for small and marginal farmers. The objective of the project – suitably called "Fences for Fuel" – is to expel the SVO in the respective villages in Virat Nagar District and barter it back to the farmers for their Jatropha seeds. This way, the Jatropha growers will get access to SVO which can be used as fuel in their water pumps and vehicles.

The second type of farmers – those who engage in arms-length relations with local processors – was encountered in the State of Karnataka. Here, the oil expelling industry is well-established and the demand for oilseeds has risen considerably during the past few years. While in 2002 the price of Pongamia seeds was at about 4 Rs./kg, the price has risen to currently about 15-17 Rs./kg (Int. Swamy, Channabasaveshware Oil Enterprises). Still, most farmers in Karnataka do not cultivate Pongamia or Jatropha as a cash crop but as boundary plantation or on unfertile soils. Collection of the seeds takes place as an additional activity on the farms, and the produce is then – via middlemen – sold to the many existing oil expelling enterprises. These middlemen sell the SVO on the market, but only a very small portion goes into the production of biodiesel. The SVO is mostly used by the leather tanning and painting industries.

The third – and most frequently encountered – category is formed by farmers who have a reliable market link through a buy-back agreement or contract signed with a private company. This has been found in Chhattisgarh and Tamil Nadu with D1-BP Fuel Crops and D1 Mohan Bio Oils Ltd., respectively, and in Andhra Pradesh with various enterprises that are working in the biodiesel sector.

The British company D1 Oils plc. – in a joint venture with BP in Chhattisgarh and with Mohan Breweries in Tamil Nadu – is one of the most important actors promoting contract farming in the biodiesel sector in India. In Chhattisgarh, D1-BP Fuel Crops developed an

[56] The policies of the State of Rajasthan are not further analysed, since the "Fences for Fuel" project does not draw on any policies. However, the socio-economic and environmental affects of organizing the biodiesel value chain in such a way are included in the analysis.

approach that is based on so called Jatropha Interest Groups (JIGs). JIGs consist of 5-20 small, marginal and semi-medium farmers that grow Jatropha as boundary plantation or on small parts of their lands. Each JIG cultivates an area of about four to ten ha and signs a buy-back Memorandum of Understanding with the company. D1-BP Fuel Crops guarantees to purchase the seeds, whereas the farmers commit themselves to selling to D1-BP Fuel Crops. So far, seeds have mostly been used for the establishment of nurseries, but the first considerable amount of yields is expected to come this year.

D1 Mohan Bio Oils Ltd. is the only noteworthy biodiesel processing actor in the State of Tamil Nadu (Int. Udhayanan, D1 Mohan Bio Oils Ltd.). The company operates in 12 districts where a number of employees enlist farmers for Jatropha cultivation. D1 Mohan Bio Oils Ltd. offers a buy-back contract to the farmers. Furthermore, it provides assistance in training and linking up the farmers to credit facilities and crop insurances. The company signs the contracts with each individual farmer. So far, the clientele is mostly medium farmers that – encouraged by the buy-back contract with D1 Mohan Bio Oils Ltd. and the assistance given by the company – start cultivating Jatropha as block plantation on part of their agricultural land. Around 5000 such contracts are already in place. As not enough medium farmers are willing to engage in major block plantations, the company has recently shifted its focus to small and marginal farmers. Therefore D1 Mohan Bio Oils Ltd. will now start promoting boundary plantation, and it is planned to adopt the JIG-model of Chhattisgarh in order to reduce transaction costs (Int. Udhayanan, D1 Mohan Bio Oils Ltd.). A transesterification unit of a capacity of 24t/day already exists in Coimbatore, but the first significant yields are yet to come. In the future, D1-BP Fuel Crops as well as D1 Mohan Bio Oils Ltd. plan to build up oil extraction and transesterification units according to to the supply of seeds available in the respective region.

In contrast to Chhattisgarh and Tamil Nadu, where the initiative for buy-back agreements emanates from a specific private company, the state of Andhra Pradesh is directly involved in contract farming through a public-private partnership model. In a Memorandum of Understanding between a biodiesel processing company and the District Collector as representative of the state government, Andhra Pradesh assigns certain areas to certain companies for the development of the biodiesel sector. Those authorised companies in turn line up buy-back agreements with private farmers and set up the necessary processing facilities. Private farmers entering such an agreement are mostly small and marginal farmers, since the Andhra government explicitly encourages the use of NREGS funds for the establishment of Pongamia cultivation on the land of farmers that own less than five ha (Int. Nirmala, Department for Rural Development). The authorised processing companies target especially those farmers that are eligible to receive NREGS funds for Pongamia block, boundary or intercropping plantation, since a guaranteed income from NREGS for the plantation facilitates the farmer's decision to try out a new crop. So far, five companies operate in seven districts, but more than 30 companies are in negotiations with the state government.

In the fourth category, the management of the whole value chain is organised through cooperatives on local, regional and state level. Such an organisation system is favoured in a pilot project in Hassan District in the State of Karnataka, where the University of Agricultural Sciences, Bangalore, tries to establish cooperatives on local and district level in order to create a structure similar to the Indian dairy sector.[57] The University – supported by a funding of about 370 Mio Rs. of the Government of Karnataka – established a so called Biofuel Park near Hassan where TBO-related research takes place and seedlings of various oil-bearing trees are produced. Those are distributed free of cost to farmers in the district, and staff of the Biofuel Park provides technical assistance and consultancy to them. In this way, the formation of a cooperative system is promoted. So far, farmers of 20 villages have established village associations, the first step in setting up a cooperative system. The idea is that a cluster of those associations will form a cooperative at taluk[58] level owning an oil expelling and transesterification unit. The first set of small processing units is planned to be financed by the Biofuel Park, whereas a market-based expansion of the sector is expected in the long run. The SVO or biodiesel that is produced is supposed to be marketed via a State Federation – a cooperative formed by the various cooperatives at taluk level. Use of the produced fuel within the region will be encouraged through the establishment of power generation plants in the village clusters. Funding for such plants is envisaged to come from the state (Int. Gowda, University of Agricultural Sciences Bangalore). At this point in time, such a cooperative system is far from being implemented in Hassan District, let alone in the whole State of Karnataka. However, the number of villages creating an association is rising and Prof. Balakrishna Gowda of the Biofuel Park expects to have more than 200 village associations at the end of May 2008 (Int. Gowda, University of Agricultural Sciences Bangalore).

4.4.2 Socio-economic and ecological implications

Cultivating TBOs on private farmland can have positive implications for the farmers and the rural economy. However, possible negative effects on food security and the environment should be closely monitored.

Income and employment generation

In general, farmers will only decide to plant oil-bearing trees if they expect to generate additional income from the activity. Oil-bearing trees can meet this criteria of additional income generation especially because opportunity costs for land remain quite low.

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[57] The Indian dairy sector is one of the most successful cooperative systems in the world. In 1946, milk producers in the State of Gujarat founded the Kaira District Cooperative Milk Producers' Union – now known as AMUL – and soon established a large share on the regional market. In the 1960s, the Central Government of India launched the so called "Operation Flood", a policy program designed to replicate the AMUL model nationwide. Today, India has become the second largest milk producer in the world and the market is dominated by cooperatives on all levels (Banerjee, 1994).

58 In some Indian states, the term taluk is used for the administrative entity of a developing block.

The main potential of oil-bearing trees is the fact that they can turn formerly unproductive lands into a source of income. In general, opportunity costs of land are high on fertile agricultural land. However, if oil-bearing trees are cultivated as hedges or planted on barren land, opportunity costs for land remain low since in most cases the land was not in productive use before. Also, investments in labour are usually low as cultivation of oil-bearing trees, in comparison to other crops, is not very labour intensive.

The potential additional income to be generated depends on the price per kg of seeds on the market. At this point in time, prices vary a lot. The biodiesel sector is currently at a nascent state, and many seeds are not sold for the purpose of crushing, but rather for the establishment of further nurseries. The supply on the seed market is tight, so that prices are exceptionally high at the moment. In Chhattisgarh, for example, one kg of Jatropha seeds can cost Rs. 14 to 35 on the market (Int. Shiv, Winrock International). But prices will most probably fall as soon as the first significant yields are coming. Then a farmer can be expected to gain six to seven Rs./kg of Jatropha seeds and nine to ten Rs./kg of Pongamia seeds.[59] In Andhra Pradesh, the possibility to generate income for farmers that own less than five ha of land is not limited to the price they obtain for their product on the market. Those farmers are explicitly encouraged to apply for NREGS funds for their Pongamia plantations.

The biodiesel sector also has a potential to create employment, but – since TBO cultivation is not very labour intensive – only if the TBO industry is emerging as an additional activity in the rural area, and not in the case that oil-bearing trees replace the traditional agricultural activities. To harvest one Pongamia tree, for example, three to four people would take about three hours (Int. Ramakrishna, Samagra Vikas). Newly planted Pongamia trees would therefore create some employment during harvest season in the respective areas.

Furthermore, additional employment for landless unskilled labourers will be generated through the expansion of biodiesel processing facilities. Channabasaveshware Oil Enterprises at Gubbi employs, for example, six to seven unskilled workers per day. The company is expanding and building another such oil extraction unit due to the high demand for SVO in the region (Int. Swamy, Channabasaveshware Oil Enterprises). Similar developments can be assumed to take place in all regions and states where a biodiesel sector will emerge.

Participation and empowerment

Besides the positive impacts that TBO cultivation can have for rural income and employment generation, certain forms of value chain organisation can contribute positively to the empowerment of the farmers. In the pilot project of "Fences for Fuel" for example, the farmers are organised in so called farmers clubs. Around 40 such clubs with 10-20 members exist (Int. Swamy, Channabasaveshware Oil Enterprises). This facilitates the access of the

[59] Seed prices are very hard to predict, since they depend directly on the demand-supply ratio, but actors in all Indian states expect that these will be the approximate prices in about one to two years.

members to micro-credit schemes and bank accounts – crucial elements for the development and empowerment of the rural population. Moreover, the organisational form of a cooperative system fosters the empowerment of the individual farmer, especially if the cooperative takes up additional village level activities.

Environmental implications

Implications for the environment of farmer-centred cultivation depend much on the species and the type of cultivation. Chapter 1 described the effects that different oil-bearing tree species can have on the soil and the greening. These, of course, also apply to farmer-centred cultivation.

The plantation of tree species helps to fix the soil and, in the case of Pongamia, build highly nutritious organic matter. As a nitrogen-fixing plant, Simarouba is especially favourable for soil regeneration and could probably have very positive implications for farmer. The Simarouba tree additionally enables the farmer to plant minor agricultural produce in an intercropping system because of its relatively small canopy. However, the cultivation of Simarouba is not very common in India (Int. Joshi, University of Agricultural Science Bangalore). The tree is not well known by farmers and its cultivation requires training and some ability to take investment risks.

Besides the type of species, the type of cultivation influences the environmental implications. As will be pointed out in the following, economic profitability is crucial for farmers. Therefore, their interest is not to cultivate TBOs as environmentally friendly as possible, but to obtain as much yield as possible. Especially when cultivating Jatropha, fertiliser – organic or inorganic – and irrigation can increase the yield several fold and will be applied if possible and economically viable. In the "Fences for Fuel" project in Rajasthan, for example, farmers extent the irrigation of their field to their newly planted Jatropha hedge plantations (Int. Moeller, Humana People to People India). Also in Tamil Nadu, some farmers were performing high input cultivation of Jatropha, for example Mr. Duraisamy, a medium-sized farmer cultivating three acres of Jatropha in Perambaur District.

Food security

The effects that farmer-centred cultivation of Jatropha or Pongamia can have on food security are not yet foreseeable. At this point in time, most farmers do not use fertile agriculture land due to high opportunity costs – foods crops like wheat and rice still fetch much higher prices on the market – for TBO block plantations. However, certain small and marginal farmers in Chhattisgarh, for example, were reported to have grown Jatropha instead of minor millets due to higher expected income (Int. Shukla, CREDA/CBDA). Also, medium farmers – especially those that are not primarily dependent on their agricultural produce – started to cultivate Jatropha on fertile land. Farmers interviewed in Tamil Nadu, for example, switched from the cultivation of peanuts, cassava and onion to Jatropha because of an agricultural labour

shortage in the region and the low labour costs of TBO plantation.[60] Therefore, although Jatropha and Pongamia are not yet replacing more economically viable food crops on a large scale, there is a potential that farmers will cultivate them on fertile agricultural lands in the future, especially if biodiesel prices rise. However, the food security of those particular farmers will not necessarily have to be afflicted with such a change in crop, since an improved monetary income situation enables the farmers to buy food for the own consumption on the local market.

4.4.3 Viability of TBO cultivation and incentive structure

The decision of a farmer to systematically cultivate oil-bearing trees depends on a cost-benefit-analysis. If farmers do not see the additional benefit they can get from TBO cultivation, they will not start growing Jatropha or Pongamia. For D1 Mohan Bio Oils Ltd. in Tamil Nadu, for example, it is therefore a crucial part of their business model to convince farmers through one-to-one marketing (Int. Udhayanan, D1 Mohan Bio Oils Ltd.). The farmers' decision is influenced by two main factors: the existence of a market for the produce and a market link – which minimises the risks of TBO plantation – on the one side and the input and opportunity costs on the other side.

Market access

The ways of organising the value chain that we encountered differ especially with regard to marketing. Access to the market is either guaranteed through a private buy-back agreement or the farmer has to find a market for the product himself. In the latter case, he has the possibility to get organised in a cooperative. Cooperative and contract-farming models have the advantage of leaving out middlemen and thereby offer the potential to leave a greater share of the value-added with the farmer.

Private buy-back agreements between farmers and companies have the potential to stabilise farm income. Much risk is taken off the farmer's shoulders through the assurance that his product will be purchased. Furthermore, the farmer profits from the technical knowledge and R&D activities of the company. The danger that a farmer becomes entirely dependent on his contract partner and is forced to sell his produce below market prices is marginal, since in the case of simple buy-back agreements they are not legally obliged to sell to the respective company and even buy-back contracts are hardly enforceable on the farmers. Governments can support private buy-back agreements through different policies. In all states, the private companies that take care of procurement and processing benefit from the government's investment on the input side, be it through free or subsidised seedlings or even – like in Andhra Pradesh – through the allotment of NREGS funds for farmer plantations.

[60] Although labour shortage is usually not a problem in rural India, some regions – where much work is generated in other sectors, like the construction sector, for example – suffer from shortage of agricultural labourers.

Furthermore, government can foster contract farming and buy-back agreements by providing credit facilities to farmers in a buy-back arrangement. This is the case in Tamil Nadu where the above mentioned primary agriculture cooperative banks link their loans to the existence of a buy-back agreement of the farmers. The state government earmarked 40 Mio. Rs. for such credits to Jatropha cultivators (Int. Udhayanan, D1 Mohan Bio Oils Ltd.).

Another possibility to encourage contract farming are Public-Private Partnerships that link up farmers with a processing company. Public-Private Partnerships have the additional advantage that the private company can compensate bureaucratic delays that often characterise government activities. Financing farmer plantation through NREGS for example is of no use to a farmer if the money is not transferred before the planting phase of the oil-bearing tree starts – as it was reported to happen in Andhra Pradesh (Int. Reddy, Roshini Bio Tech). When Public-Private Partnerships are promoted, however, care should be taken that this does not prevent the entry of competitors into the sector. The authorised companies in Andhra Pradesh are strongly favoured over possible competitors. Although non-registered private actors are not explicitly banned from Andhra Pradesh, this might – in the long run – hinder the development of a functioning competitive market. On the other hand, the practice of Andhra Pradesh ensures that as many regions of the state as possible are included in the establishment of a biodiesel sector. In Tamil Nadu, the Department of Agriculture also allotted certain districts to four companies for the promotion of contract farming in the biodiesel sector in 2005 (Agriculture Department, 2005). However, those regulations never became reality and seem to be outdated. The State of Chhattisgarh does not interfere legally with private companies. That means that there could – theoretically – be a competition between different companies. In reality however, D1-BP Fuel Crops in Chhattisgarh has no competitor in the districts it operates in.

While the organisational model of a cooperative structure does not guarantee a market, the advantage of such a system is that a larger share of the sales price of seeds may be appropriated by the individual farmer. If the cooperative functions well and its overhead costs remain low, members will directly benefit from the whole value addition that takes place from the TBO to the final product of biodiesel. Nevertheless, such a cooperative structure needs strong organisational skills of civil society and the will of the individuals to get engaged in the system. It is doubtful whether it is possible to "design" such a cooperative system at government level. The Detailed Project Report commissioned by the central Ministry of Rural Development in order to give substantial input for a national biodiesel policy proposed a detailed cooperative system on paper that is far from being realised. (TERI, 2005) It remains to be seen if the establishment of a biodiesel cooperative system can be triggered by a government actor – as it is currently tried in Hassan district of Karnataka. But top-down approaches are unlikely to be successful.

An ensured market for SVO and biodiesel without any buy-back agreement structure was only encountered in Karnataka. This is due to long established oil mills in the region, but also to the fact that the Karnataka State Road Transport Corporation (KSRTC) runs 75 buses on a diesel-biodiesel blend and is planning to expand this number up to 1000. For this amount,

they recently obtained CDM certificates. Due to a lack of seed supply, KSRTC is currently unable to fulfil its blending targets and needs to import biodiesel from Andhra Pradesh (Int. Rao, KSRTC). Its huge demand however stabilizes the market for local farmers.

Minimum support prices that exist in Chhattisgarh as well as in Andhra Pradesh and are foreseen in the Draft Karnataka Biofuel Policy can have positive impacts on cooperative farmers and those who sell to the market as individuals. Similar to buy-back agreements with private companies they also ensure a market for the produce. However, minimum support prices imply the risk of incurring losses for the government and therefore tend to be fixed at low rates. The minimum support price for Jatropha, for example, is Rs. 6.5/kg in Chhattisgarh and Rs. 6/kg in Andhra Pradesh. In comparison to this, D1 Mohan Bio Oils Ltd. in Tamil Nadu pays the market price of Rs. 7 /kg of Jatropha seeds.[61]

Input and opportunity costs

Besides the question of finding a market for the seeds, farmers need to consider the opportunity and input costs they have to incur when taking up biodiesel plantations. Opportunity costs exist for land, whereas input costs mainly need to be considered in terms of the seedlings and fertiliser that are necessary to start cultivation and the labour costs. As explained above, opportunity costs for land remain quite low, if plantation takes place on formerly underutilised land. So the reduction of input costs can provide a more important incentive for farmers to start TBO cultivation.

Concerning the initial investment to start cultivation, all states have decided to heavily reduce input costs through the distribution of free or subsidised seedlings. Chhattisgarh has gone furthest with the decision to freely distribute 500 seedlings to anybody who likes to start cultivation of Jatropha and provide further seedlings at a reduced price. 500 Mio. seedlings have been given out to farmers within the last three years. In Andhra Pradesh, the distribution of free Pongamia seedlings is reserved to small and marginal farmers. While in Andhra Pradesh the policy explicitly targets those farmers, also in Chhattisgarh the beneficiaries of the policy will mainly be small and marginal farmers that need less than 500 seedlings to start a plantation. Larger farmers have to pay for additional seeds. In the district of Hassan in Karnataka, seedlings of various oil-bearing tree species are as well given out for free. About 1.2 Mio. seedlings have already been given out and 3.5 Mio. seedlings are planned to be distributed this year. The state of Tamil Nadu pays a 50% subsidy on Jatropha seedlings.

On the one hand, such easy access to seedlings can be an important incentive for farmers to start cultivation and is therefore a means of stimulating the biodiesel sector. In Uttarakhand, for example, where private farmers do not receive free seedlings, they do not take up the cultivation of oil-bearing trees, even though a market is existent through the

[61] These prices refer to seeds used for crushing in order to obtain SVO, while at the moment, prices for seeds in order to establish nurseries are much higher.

transesterification plant of Biodiesel Limited. On the other hand, low input costs might result in adopting a crop without really knowing much about its properties, and farmers are probably more likely to care for seedlings they have paid for than those they have received for free.

Back-ended subsidies[62] help to ensure that as many seedlings as possible are well taken care of and become productive plants. In the government schemes in Uttarakhand, part of the labour wages are only paid after the survival of a certain percentage of planted seeds is proven. Another approach was observed within the Public Private Partnership between the Government of Andhra Pradesh and Roshini Bio Tech. While the private farmers under buy-back agreement with the company receive money from the government for seedlings, Roshini Bio Tech has to pay for the replantation of lost plants. The company thus has an incentive to ensure through extension services and monitoring that the farmers take good care of each seedling they plant.

Besides the free distribution of inputs and back-ended subsidies, well-designed credit facilities are also appropriate to take part of the investment risk off the farmer's shoulders. In Tamil Nadu, primary agriculture cooperative banks give credit to the farmers for Jatropha cultivation at a subsidised interest rate. In combination with the buy-back contract with D1 Mohan Bio Oils Ltd., the investment risk for these Tamil farmers is bearable.

4.5 Corporate-centred cultivation

4.5.1 General Characteristics

Corporate-centred cultivation builds on large-scale block plantations with the aim of maximising productivity. It can take place either on government owned, community owned or privately owned land. Corporate planting on privately owned land is distinguished from farmer planting in so far as the landlords own large amounts of land without being farmers themselves. What further determines this category is the fact that private companies take the risk of investment and organise planting, maintenance and training. Three different cases of corporate-centred activities were encountered during the research.

The first case of corporate-centred cultivation is located in Chhattisgarh. The state government plans to lease out large patches of revenue land to a Joint Venture with oil companies. Through a notification, the Government of Chhattisgarh made leasing possible for Jatropha cultivation in September 2006 (Government of Chhattisgarh, 2006). The objective is to form a Joint Venture company with a 26% share of the government authority CREDA and a 74% share of an oil company. This Joint Venture company will manage Jatropha block

[62] Back-ended subsidies are paid ex post to the beneficiary. In order to enable the beneficiary to make the investment in the first place, those subsidies are usually linked to credit schemes.

plantations, while the oil company involved will take charge of processing of the seeds and use the end product for blending purposes. 157,000 ha of revenue land have been identified for Jatropha plantation by the various districts (Shukla, 2008). The nodal agency – Chhattisgarh Biofuel Development Authority (CBDA) – already initiated Jatropha cultivation on part of this land. Those already existing plantations will be transferred to the Joint Venture companies. In the long run, however, the idea of the leasing policy is that the companies will establish and maintain the plantations on the revenue land leased to the Joint Venture.

When the programme was announced in 2005, many companies approached the Government of Chhattisgarh. Several of them were not in the fuel business at all, so land grab under the false pretences of Jatropha cultivation was suspected (Int. Shukla, CREDA/CBDA). In reaction to this, the Government of Chhattisgarh decided to only lease out land to Joint Ventures with public oil companies. The first Joint Venture with Indian Oil Corporation Ltd. (IOC) – the largest public oil company in India – has recently been launched. Negotiations with other companies, like Bharat Petroleum Corporation Ltd. (BPC) for example, are ongoing.

The second case of corporate-centred cultivation was encountered in Tamil Nadu. Here, the Estate Model – where plantation takes place on private land of absentee landlords – is a strategy of D1 Mohan Bio Oils Ltd. in order to encourage absentee landlords to start Jatropha cultivation on at least 20 ha. The company realised that, in Tamil Nadu, much agricultural land is under the ownership of absentee landlords who invest in land holdings for speculative and fiscal reasons. Comparatively low expected returns from agriculture have been preventing those land owners from cultivating anything on the land. About six months ago, D1 Mohan Bio Oils Ltd. started to approach absentee landlords to submit an attractive offer: The company provides 70% of the input costs for a plantation as an interest free loan to the land owners and assists in organising planting, maintenance and harvesting of the trees. Furthermore, D1 Mohan Bio Oils Ltd. provides a buy-back contract. The objective of the company is to increase seed supply, on the one hand, and to establish large Jatropha plantations that can be used for demonstration purposes to smaller private farmers, on the other hand. So far, five such Estate Model contracts have been signed, and about 80 more are under negotiations (Int. Udhayanan, D1 Mohan Bio Oils Ltd.).

The third possible type of corporate-centred cultivation is – so far – not existent, but has been developed as a model by the Biodiesel Society of India. These are the so called Community Energy Resource Farms which are organised as a Build-Operate-Transfer (BOT) Model. In this model, Panchayats enter into cooperation with a private company. The community identifies unutilised part of communal land which can be made available for TBO block cultivation and hands it over to the company free of lease. The company, in turn, will establish a plantation – employing labourers from the respective village – and also manage the maintenance and harvesting for the next 25 to 30 years. Villagers will be involved in the activities; and eventually, the plantation will be transferred back to the Panchayat. Until this re-transfer has taken place, community and corporate share the yield from the plantation. In the first 20 years 70% to 80% of the yield will remain with the company, from the 20th year

onwards, the share will be equal (50%-50%). The objective is that a sustainable plantation is built up and that, after the community has received back sovereignty, it will still sell the yield to the formerly involved company (Int. Thakkar, Biodiesel Society of India).

4.5.2 Socio-economic and ecological implications

Corporate-centred activities may have certain positive – as well as negative – implications for rural development in terms of income and employment generation, empowerment, food security and environmental issues. These implications, however, differ between the different cases that we have found within corporate-centred activities.

Income and employment generation

In general, due to the large amounts of capital that corporate investors can channel into the rural sector, corporate-centred activities offer a potential for income and employment generation. In the case of the Joint Venture in Chhattisgarh, the company will employ people from the neighbouring villages on large-scale plantations of several thousand ha for maintenance and harvesting activities. However, it is impossible – at this point in time – to predict the amount of work created through such a plantation. The Forest Department in Chhattisgarh, for example, created employment for 3.2 to 3.7 labourers per ha for 25 days for the *establishment* of a Jatropha plantation (Shiva and Sankar, 2007). But since most plantations are not yet in the stage of harvesting, the amount of labourers needed in the long run for a large-scale Jatropha plantation is still unknown. Most employment and income opportunities for the rural population will certainly be created during the harvesting months, while year round full-time positions will probably be quite limited. IOC stated that within the coming year – when its Joint Ventures in Chhattisgarh and Madhya Pradesh will be launched – 100 extra people will be employed /Int. Choudhary, Indian Oil Corporation Ltd.). Those positions will most likely be filled with skilled employees and not local landless labourers. However, considering the fact that most of the revenue land in Chhattisgarh is not farmed so far, the income and employment effects can – in most cases – only be positive.

This is, of course, different in cases where the land actually has been in use before. Revenue land in Chhattisgarh is often used by the nearby villagers for grazing their cattle. No systematic studies exist on the question whether the employment created for a few villagers through a Jatropha plantation can compensate the losses the villagers have through less pasture land. Further research and monitoring of the matter is needed.

The BOT Model offers employment and income opportunities to the villagers in two ways. First, the villagers are employed by the company for maintenance and harvesting. Second, the Panchayat as such receives part of the benefits from the plantation, and after 25 to 30 years even becomes the operator of it – and all additional resources of the Panchayat should ideally come back to the villagers. Nevertheless, the question of alternate land use is even more important in such a case of Community Energy Resource Farms. Panchayat land is most

likely already in use for activities such as grazing and minor agriculture. If democratic decision-making works well, TBO plantation will not take place against the will of the majority of villagers. However, since this is not the case in all regions of India, crowding out of the poorest parts of the population is a risk in this model that should not be underestimated.

In contrast to the other two ways of organising the value chain, the D1 Mohan Bio Oils Ltd. Estate model in Tamil Nadu has much less potential for employment creation in the neighbouring villages, since the company subcontracts the plantations to specially trained and highly efficient entities for plantation and maintenance. Employment opportunities for local labourers exist only during the harvesting period. But here again, it has to be taken into account that the lands that fall under the Estate model in Tamil Nadu laid barren before – and, in this case, have not even be used by the nearby villagers, since private land owners strictly combat encroachment (Int. Keeranur, farmer in Pudukottai District; Int. Manivaasan, D1 Mohan Bio Oils Ltd.). Any agricultural activity on those lands will therefore enhance the rural economy.

Participation and empowerment

The effects on empowerment of the rural population are marginal in the case of leasing out revenue land to a Joint Venture in Chhattisgarh as well as in the case of the Estate Model in Tamil Nadu. Since the Estate Model involves only private land, participation of rural villagers in any decision-making processes is not given.

In Chhattisgarh, the village Panchayats close to the land envisaged for leasing are involved in the decision-making process. Before a Memorandum of Understanding of the state government is signed with the Joint Venture partner, the neighbouring Gram Panchayat has to give its approval. This procedure should ensure that the concerns of the affected villages are taken into account, but whether dominant groups are able to manipulate this process could not be assessed during the research (see chapters 3.2, 4.3.2). The leasing period is first limited to 20 years, but prolongation of the contract for another 50 years is already envisaged. It is unclear whether the respective Gram Panchayats also have to agree to the renewals of the leasing contracts (Int. Shukla, CREDA/CBDA). However, once the control over the land lies in the hand of a Joint Venture company, villagers will have lost the possibility to utilise the land for their purposes. Attempts to reclaim such land will most probably not be successful – given the inequitable power structures between public oil companies and the state government on the one side and uneducated and destitute villagers on the other side.

The BOT Model has a certain potential to empower village Panchayats, since those are directly involved in the project. The community is the contractual partner to the company, although the respective company bears most of the financial risk through the investment in the plantation. Mutual trust has to be built because the economic success of the plantation depends on both the labour force of the nearby villages and the ability of the private company to link the plantation to a viable market. Since Panchayats receive part of the benefits, they are encouraged to take interest in the project. Additional financial resources that the

Panchayat receives through the plantation also encourage its ability to act independently. Through the cooperation and communication with the private company, village Panchayats might furthermore develop better skills in economic decision-making. Spill-over effects to other policy areas would be likely. Moreover, the plantation is transferred back to the Panchayat after 30 years at the most. So the community has an incentive to work for the success of the TBO plantation. In case it is not functioning to its satisfaction, the Panchayat can decide whether to replace the oil-bearing trees by something else. However, also in a BOT Model, one needs to consider the differences in the organisational form of the Panchayats in India. In some regions, such a model might be suitable. In other regions, paternalistic or corrupt structures might hinder a successful cooperation with private companies or Panchayats with weak institutions might – instead of being empowered through participation in the project – become rather dependent from the company partner.

Environmental implications

With regard to the environmental implications of corporate-centred activities, several risks must be stated. Corporate-centred cultivation focuses on economies of scale, and those likely come along with monocultures, thereby causing harm to biodiversity and leading to over-exploitation of soil nutrients. Moreover, as corporate investment depends on high productivity, input requirements tend to be high. These may lead to over-exploitation of resources like water and soil and excessive use of chemical fertiliser. On the other hand, large-scale organisation of planting and processing activities simplify the use of the processing by-product – the seed cake – as organic fertiliser on the respective plantations. The interlinkage between processing site and plantation is much easier than in the case where plantation takes place on hundreds of smaller farms. Large-scale production usually goes along with high productivity in agriculture and industrial processing, which has a clearly positive effect on the carbon balance of the whole biodiesel life-cycle (Reinhardt et al., 2007).

Corporate-centred cultivation can have a significant impact on the green cover of a region. In Chhattisgarh, for example, S.K. Shukla, head of CREDA, stated that 30,000 to 50,000 ha of Jatropha plantation on revenue land is envisaged per district (Int. Shukla, CREDA/CBDA). Converted to the whole State of Chhattisgarh that means an area of 3.5% to 5.9% will be brought under Jatropha plantation. If this land is currently only covered with minor shrubs and grasses, the cultivation of Jatropha bushes do make a difference in the green cover of the state. However, planting just one type of tree is not favourable in terms of biodiversity.

Food security and risk of displacement

With regard to food security, corporate-centred activities allow for a range of outcomes. The risk of displacement of poor and landless farmers that encroached government land or make use of communal land needs to be considered. In the case of D1 Mohan Bio Oils Ltd. in Tamil Nadu, absentee land owners are looking for ways to use their land without much care-taking, as they own the land mainly for non-productive reasons. Biodiesel plantations on this land do not replace food crops, as the land would otherwise lie barren. Encroachment on the land of

absentee landlords can take place – in fact, preventing further encroachment is often also a reason to put the land under productive use. However, displacement from private land cannot be considered a developmental problem, since land ownership is clear-cut. Displacing marginal farmers from government or communal land, on the other hand, can be regarded as a problem of equity and social rights, as such land is a public good.

In the BOT Model and in the case of leasing out revenue land for TBO cultivation in Chhattisgarh, food production of the villagers is quite likely to be affected through displacement. However, the effects differ significantly between the two cases. Community Energy Resource Farms rely on communal land – a category of land which is well defined in India. If villagers used the communal land for cultivating food crops before it was transferred to the company, the Panchayat needs to compensate those for their losses in some way. Furthermore, it is unlikely to happen that a village community will allow transforming large amounts of fertile agricultural land into a TBO plantation. Decision-making takes place relatively close to the persons concerned, so that influencing such decisions becomes easier. But as already said, power structures in Panchayats in India are not always fully democratic, so that less influential people might be elided.

In the case of revenue land in Chhattisgarh, land use and ownership are not this clearly defined. Villagers often use government-owned revenue land, simply because there is a need for it and distinction between revenue and communal land is not clear-cut. This way, official land titles differ in many cases from the actual land use pattern on the ground. Decisions taken by the state government – even if under consideration of the local Panchayats – are hard to influence by the concerned people. In Bilaspur District in Chhattisgarh, for example, local tribal farmers were displaced by the Forest Department that decided to cultivate Jatropha on the farmers' paddy land – land that was officially classified as forest land. Pleas and petitions to the Block Development Officer, the District Collector and even the Chief Minister did not have any effect (Shiva and Sankar, 2008). The leasing of government land in Chhattisgarh will not concern forest land, but still, this case points out the implications such cultivation on government land could have on farmers without land titles.

So the question of whether or not corporate-centred activities cause major displacement and put food security at risk depends to a large degree on the local decision-making procedures regarding the use of government and communal land.

4.5.3 Viability of TBO cultivation and incentive structure

Corporate investors have a much stronger incentive to ensure the economic viability of their investments than governments. Hence they will take action to make their projects sustainable and minimise the risk of failure.

Increase in productivity

Corporate-centred cultivation provides good preconditions for enhancing productivity and boosting the biodiesel sector. Large plantations enable the development of more productive agricultural practices. Especially Jatropha is a very input-responsive plant whose yields can be highly increased through improved care. Corporate-centred cultivation is likely to develop best practises – more than in government- and farmer-centred cultivation – first, because the necessary capital is available for investment in research and experiment and second, economies of scale are necessary for a high return of investment. Obtimised cultivation techniques will leverage the biodiesel sector and have spill-over effects onto smaller private farmers.

B.B. Choudhary, General Manager for Business Development of Biofuels at IOC, for example, explicitly stated that the objective for IOC is to create model plantations in order to bring forward farmer-centred cultivation in the respective regions. “We are not a cultivation company”, he explained. The interest of IOC is not the management of large TBO plantations but the augmentation of biodiesel supply for their purchasing centres Int. Choudhary, Indian Oil Corporation Ltd.). Also in the Estate model of D1 Mohan Bio Oils Ltd., the main objective is to improve agricultural practices of Jatropha plantation and to demonstrate the success to the private farmers under contract farming with the company. The interest free loan that D1 Mohan Bio Oils Ltd. provides to the absentee landlords is mainly an investment in demonstration plantations and the development of more productive methods that could then be transferred to the contract farmers (Int. Udhayanan, D1 Mohan Bio Oils Ltd.). Furthermore, productivity can be enhanced through R&D carried out by the involved corporate. D1 Oils plc., for example, has its own research centre – D1 Oil Plant Science – in Coimbatore, Tamil Nadu.

But there is also a downside to such involvement of corporate investors in R&D. Certification systems for TBO seeds and seedlings do not exist in any of the analysed Indian states. Hence there is no independent quality control of seeds. Another highly controversial topic is the introduction of genetically modified plants. The German NGO Forum on Environment and Development, for example, expects that the development of a genetically modified herbicide resistance in Jatropha plants will soon be fostered by multinational companies (Gura, 2008). Little is known about the risks of genetically modified plants, thus calling for some regulation of private R&D.

Economic viability

Corporate-centred cultivation is promising with regard to the economic viability of a plantation, especially when compared to government-centred cultivation, where the public sector is responsible for the investment. Corporate investors directly benefit – or suffer – from the investment decisions they have taken, and in contrast to farmer-centred cultivation, they have the means for undertaking high investments. High risks imply high benefits or high

losses that directly accrue to the investor himself. Therefore, corporate investors are highly interested in ensuring that their investments are economically viable and sustainable.

Through the support of corporate-centred cultivation, policy-makers can encourage such sustainable investment in the agriculture sector. In this regard, the main policy mechanism which was encountered during the research is the allocation of land. Leasing in Chhattisgarh as well as the allocation of Panchayat land in the BOT Model both imply the transfer of public land to a corporate. The access to land can be an important incentive for corporate investors to enter into the biodiesel sector. At this point in time, investment into biodiesel production is not yet an economically viable undertaking. Free or very inexpensive access to land might therefore be a decisive feature for corporate investors when calculating the risks of ivestment. In the BOT Model, the investing company only has to pay for the Panchayat land through a share of the produce. But the initial access to land is free, so the company has zero input costs in terms of cultivable land. However, the respective company transfers the management of the plantation back to the community after 25 to 30 years. In Chhattisgarh, the lease rate starts with 500 Rs./ha in the first year and is gradually increased to 1400 Rs./ha from the eighth year onwards (Shukla, 2008). Compared to the expected returns from a plantation, this is a moderate lease rate. 26% of the money is furthermore paid by the state government, since is remains a 26% stakeholder of the Joint Venture company involved.

5 Main findings and policy recommendations

5.1 Main findings

Biodiesel is currently a hot topic internationally as well as in India. Since the beginning of the 2000s, the Government of India and, to a greater extent, various state governments have been promoting TBO-based biodiesel, using a number of policy measures in order to enhance supply and demand of biodiesel. Proponents of biodiesel point to the potential of non-edible TBOs to substitute fossil fuels, thereby reducing India's energy dependency and bringing down greenhouse gas emissions. They also highlight opportunities for greening the country-side and creating rural employment and income. Critics claim that production of biodiesel will lead to food scarcity and seizure of common lands by corporate investors, thereby putting livelihoods at risk. This report shows that the reality in India is far more complex than both propositions suggest.

Before looking at the actual and potential impact of biodiesel on rural development, one has to realistically assess the chances that a market for biodiesel will emerge in India. This report emphasises that the future of biodiesel in India hinges on its economic viability. Up to now, only few private farmers and corporate investors have engaged in fuel crops and a market for biodiesel has not yet emerged, because biodiesel is not competitive with conventional diesel at current market prices. This is due to a number of reasons: First, the Government of India heavily subsidises the price of conventional diesel, keeping it artificially low. Hence, the negative environmental externalities of conventional diesel are not reflected in its price. Second, biodiesel production needs to become more productive. Little research has been conducted and most oil-bearing trees are basically still wild plants. The expectation that oil-bearing trees, especially Jatropha, would give good yields even on marginal and dry lands without inputs such as irrigation, fertilisers and pesticides has not materialised. In order to achieve economical yields, farmers would have to bear high input and opportunity costs. Therefore, without government subsidies, at this moment only niche markets such as the reproduction of seedlings, oil extraction for the chemical industry and CDM-funded projects are economically viable. To kick-start the biodiesel sector, certain policy initiatives are thus required. In addition to the ongoing government subsidies for TBO plantations these include, above all, research aiming at higher yields of oil-bearing trees and fair price competition between conventional diesel and biodiesel.

This report focusses on the potential for biodiesel for rural development. Developmental impacts of the sector are strongly interrelated with differences in value chain organisation and the policies that shape them. The report identifies not less than 13 different ways of organising the biodiesel value chain that have emerged on the basis of varying local conditions and power relations in five Indian states. These cases have been grouped into three different categories, namely government-centred cultivation, farmer-centred cultivation and corportate-centred cultivation. The study distinguishes these categories according to the two questions of who owns the land on which oil-bearing trees are cultivated and who bears the

risks of cultivation, as these two questions are highly relevant for the developmental impacts of biodiesel production.

An important positive impact of **government-centred cultivation** on rural development is the fact that it puts formerly unproductive land to use. Rural poor are the beneficiaries as centrally-sponsored schemes provide employment explicitly for these groups. Harvesting and selling the seeds creates additional income. Rural electrification creates options for rural non-farm employment and income, thereby reducing people's dependency on agriculture. Apart from these social objectives, biodiesel programmes on government land pursue environmental goals by protecting degraded soils and establishing forest cover.

These potentials of government-centred cultivation, however, depend strongly on the sustainability of the plantations – and this is where the effects of policies come in. According to our research, proper maintenance of the plantations is a major problem. Both workers and government agencies are protected from market forces and lack incentives to invest sufficient effort into the activity. For example, labourers only rarely have usufruct rights on the crops which they plant. If they do, purchase monopolies artificially reduce the price they can obtain on their produce. Public implementing agencies, for their part, are not subjected to competition. As output monitoring is rarely conducted in a systematic way and funding is not linked to performance they are susceptible to ineffectiveness and inefficiency. Furthermore, funding and procurement procedures are highly inflexible. Delays in funding and provision of inputs can fully obstruct the plantation process since agriculture strongly depends on seasonal timings. The latter problem can be solved by public-private partnerships in which the private partner can flexibly correct for these deficiencies.

Potential negative impacts on food security and on displacement depend on the decision-making process by which the land is given out for plantations. The report has shown that the internal democratic accountability of Panchayats and respect for the self-governance rights of JFMCs are prerequisites in this regard.

In contrast to government-centred cultivation, the extent to which farmers engage in the biodiesel sector is determined by the question of economic viability. Small and marginal farmers, in contrast to large or absentee farmers with guaranteed additional income, depend on low-risk investments carrying fast returns. TBOs currently do not fulfil these conditions. Therefore, these farmers plant TBOs mainly as hedges or integrate them into their farming system, sometimes for their own consumption. The report has shown that the potential of **farmer-centred cultivation** depends on whether small and marginal farmers' risk of engaging in biodiesel production can be reduced. state policies have successfully done so by taking supply-side measures such as introducing minimum support prices, facilitating buy-back agreements or helping to establish cooperatives. On the supply side, states have subsidised or distributed free seedlings and other inputs to farmers. As such measures might also target farmers who have not really convinced of TBO cultivation, supporting access to credit or back-ended subsidies seems to be a more appropriate option. In any case, restricting

subsidies to one single crop that – such as Jatropha – does not allow for multiple purpose usages increases the investment risks of farmers.

At the current stage the developmental impacts of farmer-centred cultivation are purely positive: It generates additional income, protects against degradation, and – in the case of some oil-bearing trees like Pongamia – produces valuable organic manure. As opportunity costs of agricultural land are high, there are no risks to food security and the environment. In the dynamic perspective, however, impacts are less clear. If seed prices cross a certain threshold, farmers will replace formerly agricultural area for biodiesel plantations. Assessing the effects of such a scenario on local and national food security is beyond the capacity of this report. In general terms, however, mixed effects of high biodiesel prices can be expected. Prices of food would most likely rise at least temporarily. Farmers would benefit from this situation, even if they had to spend more to satisfy their own food requirements. Other segments of the rural and urban poor, however, would have to bear higher food prices. In the long run, increasing investment in agriculture is likely to benefit the rural economy in general and stimulate food production.

The main objective of corporate investors engaging in the biodiesel sector is to maximise productivity and returns on investment. This objective implies the main potential of **corporate-centred cultivation**: Large-scale investments in proper agricultural practices and R&D on TBOs can boost supply of biodiesel and possibly allow for spill-over effects to other actors.

The effects of large-scale plantations on rural development may be far-reaching – but they are ambiguous. On the one hand, they have the potential to generate employment and expand green cover substantially. On the other hand, the need for productivity maximisation may lead to monocultures and environmentally harmful use of inputs. Additional risks relate to the possibility that corporate investors invest on land that was previously used by the local poor, thereby jeopardising income sources and local food production. How big these risks are depends two things. First, the ex-ante land use situation; and second, *de jure* and *de facto* local decision-making processes. Giving out revenue land for long or even indefinite lease periods increases the risks of deficient decision-making processes and lacking complaint procedures.

In conclusion, the report shows that biodiesel production offers promising opportunities to create additional sources of income for the rural population India and to intensify land use while greening the country-side.

Developmental effects differ between the three categories of value chain organisation due to the different objectives of their respective main actors: achieving social welfare and environmental protection in the case of the government, generating additional income in the case of farmers, and maximising productivity and returns on investment in the case of corporate investors. Each category potentially has positive as well as negative effects on many of the different aspects related to rural development. Whether or not these effects materialise

depends to a large extent on policies. As has been illustrated, policies can design subsidies in ways that stimulate or deter the economic sustainability of plantations, they can promote a functioning free market or monopolies, and they can increase or reduce participation by local villagers and thereby increase or reduce the chances of displacement.

At present, Indian policy-makers are well advised to look at these categories as a social laboratory, maximising their respective potentials and minimising risks. In this regard, it will be important to increase the sustainability of government-centred plantations, to support cultivation of TBOs by small and marginal farmers without exposing them to the risks inherent in the activity, and to promote and effectively regulate corporate investment in the sector. Looking at experience gained so far, policies may build on alliances between government programmes and/or local communities and/or companies, helping to put sizeable land reserves that are currently being unutilised or underutilised to productive use and to contribute to rural development.

None of this, however, will yield the expected results as long as biodiesel production remains economically unviable. Increasing prices of fossil fuels are likely to make TBO-based biodiesel production in India more competitive. However, strong research efforts as well as a reduction of subsidies for conventional energies are needed to give the industry a boost. This calls for a clear political signal of the Government of India – in particular, the long-debated National Biofuels Policy should be passed as soon as possible.

5.2 Policy recommendations

A number of policy recommendations are derived from the previous analysis. They answer the question of how government should support biodiesel in order contribute to rural development. The recommendations are based on the analysis of strengths and weaknesses of different categories of value chain organisation and on general assessments of the policy process and programme implementation in India. The recommendations refer to "biodiesel policies" in the broad sense that the term is used throughout this study. They address issues for the upcoming Indian National Biofuels Policy, the state policies as well as related support schemes and cover subjects ranging from policy formulation to implementation and monitoring.

5.2.1 General recommendations on biodiesel production in India

The consumption of biodiesel should be favoured over fossil diesel, provided the energy and carbon balance of biodiesel production is positive. To establish this, the life-cycle carbon balance needs to be looked at. The balance of biodiesel production in general may be negative if the production and transport of biodiesel consumes large amounts of energy inputs or if forest cover is removed. Tree-borne oilseeds that are produced in an input-extensive manner on degraded lands are likely to have a positive balance.

Demand-side incentives are crucial to get the biodiesel sector going and make investment risks more calculable. This applies to all types of value chain organisation, especially those targeting production for wider markets and not only energy use at the village level. A discussion on suitable demand-side measures is held in Chapter 5.2.3.

A considerable research effort is needed to increase the knowledge about TBO-based biodiesel. Further research is needed on plant breeding, the agro-climatic and soil requirements of TBOs, as well as inputs and maintenance activities that are necessary for making TBO cultivation profitable and their environmental and socio-economic impacts. A particular research focus should be given to breeding drought resistant varieties of different oil-bearing tree species that give acceptable yields.

Government should facilitate the productive use of those lands that are owned by various government departments but remain unutilised. Such barren lands should be put to productive use in a way that is both environmentally and financially sustainable. Better maintenance and thus better outcome both in terms of yields and resource protection can be achieved through private ownership or reliable usufruct rights that ensure a sense of ownership among the users. Land may be assigned to poor families, leased or sold to farmers, or village committees may be allowed to raise energy plantations under guaranteed usufruct rights.

Leasing to corporate investors may be a alternative if it does not threaten traditional sources of livelihood. To avoid land use conflicts, the concerned Panchayat should agree on the lease and individual community members should have an opportunity to raise their concerns. As an alternative to leasing, Build-Operate-Transfer models may be preferred, where private investors develop and exploit biodiesel plantations give a share to the communities and transfer the plantation after a certain period of time.

Government should preferably support ways of cultivation that integrate oil-bearing trees into rural areas. Planting of oil-bearing trees along roadsides, railway-tracks, canals and as boundaries should be promoted. For the management, leasing and transfer of usufruct rights to local communities can be relevant options. This form of plantation allows for economies of scale and avoids competition for land at the same time.

Oil-bearing trees can be used among other species in areas where forest land is assigned for afforestation. It should be considered that Jatropha being a shrub is not very suitable for afforestation. Other oil-bearing tree species may be more appropriate because they develop a large canopy and some even have leguminous properties.

Joint Forest Management is a system that balances environmental and economic interests of the rural poor. Yet, implementation should be improved along the lines described in the section on supply-side measures (Chapter 5.2.2). Community participation ensures that planting and maintaining will not only be carried out for the sake of receiving wages, but for receiving a high quality harvest. The beneficiaries should not only take care of

plantation and maintenance but also have the usufruct rights and be able to market their produce freely. These principles should not only be applied on forest, but also on revenue and communal land.

Small and marginal farmers should not be encouraged to cultivate fuel crops on their farms until certified high yielding seeds are available and investments are calculable. Especially monoculture cultivation should not be fostered. However, there is considerable scope to integrate oilseeds in the farm economy in the form of boundary plantations or by planting on uncultivated fallows in order to generate a supplementary income. Here, multi-species approaches and tree species with multiple usage such as Simarouba and Pongamia should be given preference on small farms in order to spread risks and provide sources of income at different seasons as well as to maintain biodiversity.

For farmers whose livelihood does not depend on the farm income, block planting may be a reasonable investment. Contract farming should be promoted wherever reasonable and reliable buy-back agreements are offered.

Farmers should be assisted in setting up cooperatives. Government should act as a facilitator and support strong leadership rather than trying to "engineer" a cooperative model in a top-down manner.

Government should support private biofuel farming with soft loans. Subsidies should be back-ended and credit-linked. Government may also wish to encourage agricultural insurance companies to develop suitable insurance cover for biofuel plantations.

Independent power generation at the village or block level should be encouraged for meeting rural energy requirements. Decentralised electricity providers should be allowed to feed locally produced bio-energy into electricity grids at subsidised rates. The capacity and efficacy of the existing grid network should be suitably enhanced to enable the assimilation of new and decentralised feeds including straight vegetable oil and biodiesel. Government plans for grid extension should be transparent to signal to village communities whether they should invest in a separate village system.

5.2.2 Recommended supply-side measures

Paternalistic and top-down approaches should be avoided. For example, the choice of oil-bearing trees to be cultivated should be left to investors. Also, subsidies should not be linked to one specific crop. Especially the focus on Jatropha curcas that was at the centre of the Planning Commission's draft policy document and is reflected in several state policies should be reconsidered. Government should refrain from predefining one ways of organizing production and trying to create this in a top-down approach.

Production and marketing activities should be left to the private sector. Public-private partnerships are a suitable option for combining social and environmental targets of

government programmes with the advantages that private companies have in production and marketing.

Competition should be stimulated by inviting tenders from government and semi-government institutions, NGOs and commercial service providers for programme implementation. Competition should also be fostered in the case of public-private partnerships or government licenses for the operation of processing plants.

To ensure a sense of ownership, the beneficiaries should always make a contribution to the programmes, either in cash or in kind. This could be done at differential rates, and contributions could feed into a group fund as is being done in Watershed programmes.

Programmes should focus on outcomes rather than outlays. Budgets for the respective services should be allocated based on proven performance. This calls for a monitoring and evaluation system which needs to be improved on all levels.

Services for the biodiesel sector, such as agricultural extension, provision of seedlings, marketing and processing of produce, should be delivered in an efficient, customer-oriented and business-like manner. Government institutions should have the task of defining targets, providing funds and supervising implementation. Proper implementation however can often better be achieved by private non-profit or for-profit organisations. Non-governmental service providers should not be confined to merely fulfilling detailed, predefined instructions in selective areas such as awareness raising and training, but should have a certain degree of autonomy in developing innovative and participatory ways of programme implementation.

Service providers should be accountable to village committees as well as to funding agencies. Social audits, that is, participatory village gatherings where state agencies inform about and are held accountable for government programmes, should periodically be carried out in addition to evaluations.

Participation of the Panchayati Raj institutions must be strengthened in planning, implementation and monitoring. A certain percentage of funds may be earmarked for capacity building at the Panchayat level in order to ensure better management of funds, especially with a view to project sustainability.

Group approaches (self-help groups etc.) should be encouraged as they have proven to be an effective means of resource conservation and asset creation and to contribute to the empowerment of its members. If funds are paid to group leaders, heads of villages and JFMCs, specific attention must be paid to the accountability of these functionaries and to the transparency of all transactions. Notwithstanding such group approaches, usufruct rights should be granted to individuals wherever possible.

5.2.3 Recommended demand-side measures

Taxes and subsidies are the best way to promote a shift from fossil to renewable fuel consumption. The current incentive structure in India does the opposite. Conventional diesel prices are heavily subsidised. Although biodiesel is exempted from excise duty, the subsidies for conventional diesel outweigh this benefit.

Ideally an environmental tax should be levied on vehicles running on fossil fuels. This would shift demand towards renewable energies. However, taking into account that an environmental tax reform is currently not politically realistic in India, alternatives have to be considered. In any case, biodiesel should be recognized as a "renewable energy" source according to the legal definition which would allow investors to obtain additional tax benefits.

As an alternative to an environmental tax, blending of fossil diesel with biodiesel should be made compulsory. Blending requirements must start at a rather low level and be increased step by step, taking given restrictions on land use and the long gestation period of oil-bearing trees into account. Compulsory blending makes sense only if production can meet demand. Government railway and bus companies and other large-scale consumers (e.g. coal-fuelled facilities such as cement factories) should be encouraged to use biodiesel. The effects on food prices must be closely monitored and blending requirements adapted accordingly.

State governments should offer minimum support prices and use its existing procurement infrastructure for purchasing oilseeds. These minimum support prices need to be fixed at levels that enable processing companies to earn a return on investment. They should be indexed to the market price of diesel to maintain the parity in the face of fluctuating prices. Governments should also encourage private corporations to sign buy-back agreements with contract farmers, e.g. by linking credit schemes to the existence of such agreements.

Competition should be allowed on the demand side: Farmers and village committees should be free to sell oilseeds to the highest bidder. This should also apply if publicly funded schemes are employed, i.e. forest dwellers should not be obliged to sell seeds to the forest department. Market should also not be distorted by controlling the trade of oilseeds across state boundaries.

Biodiesel exports should not be restricted. If the product fetches a high price on international markets (e.g. due to blending requirements in other countries) it helps to reduce India's energy trade deficit, provides an opportunity to increase rural income and encourages rural investment.

Government of India should make a strong effort to enable biodiesel producers and consumers to benefit from CDM funds. It should contribute to developing consolidated methodologies in areas where those do not yet exist. Furthermore, opportunities of the CDM should be assessed systematically, for example through the establishment of respective committees on state level as it is forseen in the Draft Karnataka Biofuel Policy. Government

should ensure knowledge trasfer in this regard to all actors of the biodiesel value chain and facilitate access to the CDM application process especially for small projects.

5.2.4 Coordination

Government of India needs to formulate and implement a coherent and comprehensive policy framework to develop the sector in a socially inclusive and environmental friendly way. Policies should be designed and agreed upon among government agencies in a joined-up manner, based on diverse research results and taking into account the views of all stakeholders active in the biodiesel sector.

A National Biofuel Board with its own budget should be set up as a coordination body to ensure a coherent policy approach. In contrast to previous suggestions,[63] the Board should represent all relevant stakeholders, including those from the private sector, representatives of the Panchayati Raj, farmer organisations and civil society. The Board should continuously monitor the overall content and direction of the policy and revise the policy according to past performance and to changing contexts.

Biodiesel policies should leave considerable autonomy to the states and Panchayats because local conditions vary greatly: in terms of the agro-climatic situation, availability of barren land, level of unemployment, degree of electrification, implementing capacity of state governments and Panchayats and many other factors.

Close coordination with centrally-sponsored schemes are required in order to avoid inconsistent guidelines especially with regard to co-financing or monitoring requirements. This is necessary due to the fact that any biofuel programme necessarily pursues many objectives that are shared by other programmes, such as the National Rural Employment Guarantee Scheme (NREGS) and other schemes for watershed development, water harvesting, drought prone areas or afforestation.

[63] The Coordination Committee and the Steering Committee envisaged in the report of the Planning Commission were to comprise no non-governmental actors (Planning Commission 2003, 127f).

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7 Annex: Interview partners during research

Organisation	Name	Position	Interview date
Delhi			
Center for Alternate Energy Research, University of Petroleum and Energy Studies	Jai Uppal	Senior Advisor	7th Mar 2008
Confederation of Indian Industry (CII)	Suprotim Ganguly	Deputy Director Biofuels & Energy Efficiency	6th Mar 2008
D1-BP Fuel Crops India	Samiran Das	Chief Executive Officer	7th Mar 2008
D1-BP Fuel Crops India	Sarju Singh	Chairman / Managing Director	7th Mar 2008
Delhi College of Engineering (DCE)	Naveen Kumar	Assistant Professor	6th Mar 2008
Friedrich-Ebert-Stiftung, India	Dr. Dr. Peter Gey	Resident Representative	11th Mar 2008
German Embassy	Dr. Andreas Pfeil	Head, Economic Cooperation and Development	21st Feb 2008
German Embassy	Dr. Heinz Wirth	Science Counsellor	5th Mar 2008
German Embassy	Ursula Holzhauser	Agriculture Counsellor	5th Mar 2008
German Embassy	Eva Tiemann	Commercial Officer	5th Mar 2008
GTZ India	Pamposh Bhat	Director Climate Change	5th Mar 2008
GTZ India	Dr. Michael Glück	Programme Co-ordinator, Natural Resource Management Programme (NRMP)	22nd Feb 2008
GTZ India	Divya Kashyap	Technical Manager, NRMP	22nd Feb 2008
GTZ India	Anil Misra	NRMP	22nd Feb 2008
GTZ India	Dr. Rolf Suelzer	Country Director	5th Mar 2008
Humana People to People India / Fences for fuel	Anna Marie Moeller	Partnership Director	7th Mar 2008
India-Europe-Consultancy / Freie Universität Berlin	Dr. Klaus Voll	Head/Lecturer	8th Mar 2008

Organisation	Name	Position	Interview date
Indian Oil Corporation Ltd. (IOC)	B.B. Choudhary	General Manager Business Development – Biofuels	11th Apr 2008
Konrad Adenauer Stiftung	Joerg Wolff	Resident Representative to India	29th Feb 2008
Kreditanstalt für Wiederaufbau (KfW) India	Nand Kishor Agrawal	Programme Officer, Rural Development and Watershed	5th Mar 2008
Ministry of Environment and Forest (MoEF)	Dr. J.V. Sharma	Deputy Inspector General of Forests	29th Feb 2008
Ministry of New & Renewable Energy	Ajit K. Gupta	Adviser	7th Mar 2008
Ministry of New & Renewable Energy	Dr. H.L. Sharma	Scientist F	7th Mar 2008
Ministry of New & Renewable Energy	Er. J.P. Singh	Scientist D	7th Mar 2008
Ministry of Rural Development (MoRD)	Dr. D. Ramakrishnaiah	Director/Scientist, Department of Land Resources	26th Feb 2008
Ministry of Rural Development (MoRD)	Vinay Shankar I.A.S.	Former Secretary (Retired)	29th Feb 2008
National Oilseeds and Vegetable Oils Development (NOVOD) Board	Dr. R. S. Kureel	Director (Production)	7th Mar 2008
National Rainfed Area Authority (NRAA)	Dr. J. S. Samra	Chief Executive Officer	6th Mar 2008
Navdanya	Dr. Vandana Shiva	Head	9th Apr 2008
Nova Bio Fuels Pvt. Ltd. / Biodiesel Association of India	Rajeev Gulati	Vice President/Vice President	26th Feb 2008
Research and Information System for the Developing Countries (RIS)	Dr. Sachin Chaturvedi	Fellow	25th Feb 2008
Society for Promotion of Wastelands Development (SPWD)	Vijay K. Sardana	Executive Director	28th Feb 2008
Society for Promotion of Wastelands Development (SPWD)	Ajay Bhan Singh	Senior Programme Officer	28th Feb 2008

Organisation	Name	Position	Interview date
Society for Promotion of Wastelands Development (SPWD)	Pramod Tyagi	Programme Director	28th Feb 2008
The Energy and Resources Institute (TERI)	Dr. Alok Adholeya	Director, Biotechnology & Management of Bioresources	22nd Feb 2008
TERI University	Jai Kumar	Student	8th Apr 2008
Winrock International India	Aditi Dass	Coordinator Climate Science Group	10th Mar 2008
Winrock International India	Produyt Mukherjee	Program Officer (Energy & Environment)	10th Mar 2008
Worldbank	Vikram K. Chand	Senior Public Sector Management Specialist	10th Mar 2008
Andhra Pradesh			
Department of Rural Development	K. Nirmala	Commissioner of Rural Development	31th Mar 2008
Department of Rural Development	C. H. Rangarano	n.a.	8th Apr 2008
Forest Department	Ramesh G. Kalaghati	Chief conservator of Forests	8th Apr 2008
Forest Department	B. Murali Krishna	Addl. Prl. Chief Conservator of Forests	8th Apr 2008
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Suhas P. Wani	Principl Scientist and Regional Theme Coordinator Asia	1st Apr 2008
Rainshadow Areas Development Department	R. S. Goel	Principal Secretary	29th Mar 2008
Roshini Biotech	Anil Reddy	Chief Executive Officer	2nd Apr 2008
Southern Online Bio Technologies Ltd.	N. Satesh Kumar	Managing Director	3rd Apr 2008
The Energy and Resources Institute (TERI)	Sandeep Arora	Manager	5th Apr 2008
The Energy and Resources Institute (TERI)	Pramod G.	Research Associate	4th Apr 2008

Organisation	Name	Position	Interview date
The Energy and Resources Institute (TERI)	V. V. V. Satyanarayana,	Field Forest Expert	5th Apr 2008
The Energy and Resources Institute (TERI)	Syed Arif Wali	Research Associate, Forestry and Biodiversity	4th Apr 2008
The Energy and Resources Institute (TERI)	Kamlesh Shukla,	Research Associate, Centre for Mycorrhizal Research	4th Apr 2008
Chhattisgarh			
Chhattisgarh Renewable Energy Development Agency (CREDA)/ Biofuel Development Authority (CBDA)	Dr. S. K. Shukla	Director of CREDA/ Executive Director of CBDA	20th/25th Mar 2008
Chhattisgarh Renewable Energy Development Agency (CREDA)	Rajeev Gyani	Executive Engineer	24th Mar 2008
Chhattisgarh Biofuel Development Authority (CBDA)	Anil Ambast	Technical Officer	24th Mar 2008
D1-BP Fuel Crops	Sumit Sarkar	Regional Manager	17th Mar 2008
D1-BP Fuel Crops	Manoj Sharma	Senior Executive – Plantation	19th Mar 2008
Department of Agriculture, Cooperation, Animal Husbandry and Fisheries	P. R. Kridutta	Director in the Directorate of Agriculture	24th Mar 2008
Department of Panchayat Raj and Rural Development	R. P. Mandal	Secretary	25th Mar 2008
State Planning Board	Dr. D. N. Tiwari	Vice-chairman	18th Mar 2008
Winrock International India	Jay Chand Shiv	Project Officer	25th Mar 2008
Karnataka			
Agriculture Department	Dr. K. V. Sarvesh	Agriculture Commissioner	2nd Apr 2008
BAIF Institute of Rural Development	Dr. GNS Reddy	Director	29th Mar 2008

Organisation	Name	Position	Interview date
Biodiesel Society of India	Bharat Thakkar	Secretary General	28th Mar 2008
Channabasaveshware Oil Enterprises	Ohileshwara Swamy	General Manager	29th Mar 2008
Finance Department	K. Amaranarayana	Addl. Secretary (former Deputy Commissioner of the District of Chitradurga)	31th Mar 2008
Forest Department	A. K. Varma	Principal Chief Conservator of Forests	2nd Apr 2008
Forest Department	Mr. Kanwerpal	Chief Conservator of Forests	2nd Apr 2008
Government of Karnataka	Sudhakar Rao	Chief Secretary	2nd Apr 2008
Government of Karnataka	V. Balasubramanian	Retd. Additional Chief Secretary	28th Mar 2008
Indian Institute of Science, Department of Mechanical Engineering	Prof. Udipi Shrinivasa	Professor	28th Mar 2008
Institute for Social and Economic Change	K. V. Raju	Professor and Head of the Centre for Ecological Economics and Natural Resources	28th Mar 2008
Karnataka State Road Transport Corporation (KSRTC)	Ananda Rao P. S.	Chief Environment Officer	1st Apr 2008
Mahathma Gandhi Regional Institute of Rural Energy and Development, Government of Karnataka	Ritu Kakkar	Executive Director	1st Apr 2008
National Bank for Agriculture and Rural Development (NABARD)	C. V. Reddy	Assistant General Manager	3rd Apr 2008
National Bank for Agriculture and Rural Development (NABARD)	Sangeeta Prasad Mehra	Manager	3rd Apr 2008
Samagra Vikas	Ramakrishna Y. B.	President	29th Mar 2008

Organisation	Name	Position	Interview date
University of Agricultural Science Bangalore	Prof. Balakrishna Gowda	Professor	29th Mar 2008
University of Agricultural Science Bangalore	S. Joshi	Retd. Professor	1st Apr 2008
Uttarakhand			
Centre for Technology and Development	Rajeev Choudhury	n/a	3rd Mar 2008
Indian Council of Forestry Research and Education/ Forestry Research Institute/ Arid Forest Research Institute	Dr. Negi	Director	4th Mar 2008
Indian Council of Forestry Research and Education/ Forestry Research Institute/ Arid Forest Research Institute	Dr. Rabindra Kumar	Deputy Director General	4th Mar 2008
Indian Council of Forestry Research and Education/ Forestry Research Institute/ Arid Forest Research Institute	Dinesh Kumar	Researcher	4th Mar 2008
Uttarakhand Biodiesel Ltd.	Atul Lohia	Chief Executive Officer	3rd Mar 2008
Uttarakhand Biodiesel Ltd.	Pawan K. Agrawal	Chief Financial Officer	3rd Mar 2008
Uttarakhand Biofuel Board (UBB)	Capt. (I.N.) (Retd) Vinod Vaish	General Secretary	3rd Mar/11th Apr 2008
Uttarakhand Forest Development Corporation	Dr. S. D. Singh	Regional Manager	1st Mar/10th Apr 2008
Tamil Nadu			
D1 Mohan Bio Oils Ltd.	S. Udhanayan	Senior General Manager	7th Apr 2008
D1 Mohan Bio Oils Ltd.	M. Manivaasan	Zone Officer	8th Apr 2008

Organisation	Name	Position	Interview date
Department of Agriculture	S. Rajasekaran	Agricultural Officer in Pudukottai District	8th Apr 2008
Department of Agriculture	V. Bumpath Kumar	Agricultural Officer in Pudukottai District	8th Apr 2008
Farmer in Perambalur District	Mr. Duraisamy	Farmer	7th Apr 2008
Farmer in Perambalur District	Mr. Manisundaram	Farmer	7th Apr 2008
Farmer in Perambalur District	Mr. Roweligam	Farmer	7th Apr 2008
Farmer in Pudukottai District	Mr. Keeranur	Farmer	8th Apr 2008
Tamil Nadu Agricultural University	Prof. Sridhar	Professor	8th Apr 2008