Biodiesel in India: value chain organisation and policy options for rural development

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Veröffentlichungsversion / Published Version
Forschungsbericht / research report

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
SSG Sozialwissenschaften, USB Köln

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The German Development Institute (DIE) is a multidisciplinary research, consultancy and training institute for Germany's bilateral and for multilateral development cooperation. On the basis of independent research, it acts as consultant to public institutions in Germany and abroad on current issues of cooperation between developed and developing countries. Through its 9-months training course, the German Development Institute prepares German and European university graduates for a career in the field of development policy.

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Bonn 2009

Studies / Deutsches Institut für Entwicklungspolitik
ISSN 1860-0468

Biodiesel in India : Value chain organisation and policy options for rural development / Tilman Altenburg … – Bonn : DIE, 2009. – (Studies / Deutsches Institut für Entwicklungspolitik ; 43)
ISBN 978-3-88985-379-0

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Acknowledgements

With a view to contributing to the ongoing discussion on biofuels in India, the German Development Institute, as part of its postgraduate training programme, prepared this report on *Biodiesel in India: Value chain organisation and policy options for rural development*. From November 2007 to February 2008, a team of six researchers carried out a desk study in Germany, followed by eleven weeks of field research in India in February–April 2008. We conducted interviews with about 100 biodiesel stakeholders from the Federal and State Governments, the business and farmer communities, civil society, and the academia.

Our team wants to thank all the interview partners for their valuable inputs, their patience and their hospitality. We owe our thanks to many individuals and institutions, both in India and Germany. In all the Indian States that we have visited we have greatly benefited from extraordinary support and willingness to contribute to our study. However, we would like to give our special thanks to Jai Uppal and Y.B. Ramakrishna who devoted much time and effort to this study and supported our team as professional advisers and personal friends. We also very much appreciate the great help and support both in understanding the Indian biodiesel field and in logistic issues provided by GTZ India, especially by Dr. Michael Glück, Divya Kashyap and Anil Misra.

At the German Development Institute, we received very helpful critical comments from several of our colleagues, especially from Steffen Bauer, who accompanied the project throughout the whole process.

Tilman Altenburg Bonn, December 2008

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Abbreviations

AMUL	Anand Milk Union Limited
APFD	Andhra Pradesh Forest Department
BOT	Build-Operate-Transfer
BPC	Bharat Petroleum Corporation Ltd.
CBDA	Chhattisgarh Biofuel Development Authority
CDM	Clean Development Mechanism
CEO	Chief Executive Officer
CER	Certified Emission Reduction
CFTRI	Central Food Technology Research Institute
CREDA	Chhattisgarh Renewable Energy Development Authority
CSIR	Council of Scientific and Industrial Research
DBT	Department of Biotechnology
DRDA	District Rural Development Agency
FRI	Forestry Research Institute
GDP	Gross domestic product
GTZ	Gesellschaft für Technische Zusammenarbeit
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIT	Indian Institute of Technology
IOC	Indian Oil Corporation Ltd.
JFM	Joint forest management
JFMC	Joint Forest Management Committee
JIG	Jatropha Interest Group
KSRTC	Karnataka State Road Transport Corporation
MNRE	Ministry of Renewable Energy
MoEF	Ministry of Environment and Forest
MoP	Ministry of Petroleum and Natural Gas
MoRD	Ministry of Rural Development
NABARD	National Bank for Agriculture and Rural Development
NGO	Non-governmental organisation
NOVOD	National Oilseed and Vegetable Oils Development Board
NRAA	National Rainfed Area Authority

NREGS	National Rural Employment Guarantee Scheme
OECD	Organisation for Economic Co-operation and Development
PRIA	Society for Participatory Research in Asia
R&D	Research and development
RIS	Research and Development System for Developing Countries
Rs.	Rupees (1€ = ~60 Rs.)
SHG	Self-help group
SPWP	Society for Promotion of Wastelands Development
SVO	Straight vegetable oil
TBO	Tree-borne oilseed
TERI	The Energy Research Institute
UBB	Uttarakhand Biodiesel Board
VAT	Value added tax
VEC	Village Electrification Committee
VESP	Village Energy Security Programme
VSS	Vana Samrakshana Samiti (JFMC in Andra Pradesh)

Summary

Biodiesel is 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 promoted the production and consumption of biodiesel. Proponents of biodiesel point to the potential of oilseeds as a substitute for fossil fuels, underlining their ability to reduce India's energy dependency and bring down greenhouse gas emissions. They also highlight opportunities for greening the countryside 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, putting livelihoods at risk. Some also question whether the life-cycle carbon balance, that is, the net carbon effect, taking inputs, transports and other side effects into account, is really positive.

This report shows that biodiesel production in India is a special case which has much more positive development effects than biodiesel production elsewhere. India is different because there is far-reaching consensus there that biodiesel production will only be promoted on the basis of non-edible oil seeds on marginal lands. Hence the risks of driving up prices for edible oil or crowding out food production are relatively low. In addition, cultivating tree-borne oilseeds on degraded lands stabilizes soils and creates carbon sinks, and production requires low inputs, which serves to further improve the carbon balance.

Even within India, however, the development effects of the biodiesel industry vary greatly, depending on how the value chain is organized. This study identifies no less than 13 different ways of organizing the value chain, ranging from cultivation on large plantations to contract farming arrangements, farm-based production for rural electrification, and social forestry projects. Between these different types of value chains, there are marked differences in terms of income generation, participation and empowerment, food security, natural resources management and climate change, and economic sustainability. Development effects thus vary greatly depending on the type of value chain organization to be promoted.

This study aims to contribute to 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*. The study starts with an overall assessment of the economic viability of biodiesel. To date, biodiesel production is not a lucrative business, except for some niche markets. However, this may change in the future, depending on fossil fuel prices, government pricing policies, and progress on agricultural yields. Furthermore, the study contributes two novel aspects to the discussion on the Indian biodiesel sector:

1. It takes stock of the variety of existing ways of organising the value chain in India and assesses their pros and cons from a comprehensive development perspective;
2. It identifies, describes and assesses the appropriateness of a broad range of federal and state policies and support programmes. Given the diversity of value chain organization, many different policies are taken into account. Whether a state government chooses for example to promote social forestry, large-scale leasing contracts with corporations, or contract farming, and how effectively these policies are implemented, has a bearing on the development outcomes.

The issue of economic viability

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. Thus far, 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 on it and most oil-bearing trees are basically 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. Yields are higher on fertile farmlands, but here tree-borne oilseeds yield lower returns on investment than most alternative crops. 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.

Development impacts of different biodiesel value chains

The report identifies 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 corporate-centred cultivation. The study distinguishes between these categories on the basis of the two questions: 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.

One important positive impact of **government-centred cultivation** on rural development is the fact that it puts formerly unproductive land to use. The rural poor are the beneficiaries as centrally-sponsored schemes provide employment explicitly for these groups. The harvesting and selling of seeds creates additional income. Rural electrification creates options for rural non-farm employment and income, 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 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 shielded from market forces and lack incentives to invest sufficient effort in the activity. For example, labourers only rarely have usufruct rights to the crops that they plant. If they do, in

some cases purchase monopolies artificially reduce the price they can obtain for their produce. Public implementing agencies, for their part, are not subject 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 planting process since agriculture strongly depends on seasonal timing. The latter problem can be solved by public-private partnerships in which the private partner can flexibly compensate for these deficiencies.

Potential negative impacts on food security and displacement depend on the decision-making process by which 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 that yield 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 it is possible to reduce the risk faced by small and marginal farmers engaging in biodiesel production. 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 may also reach farmers who are not really committed to TBO cultivation, support for access to credit or back-ended subsidies seems to be a more appropriate option. In any case, restricting subsidies to one single crop that – like Jatropha – does not allow for multiple-purpose uses increases the investment risk 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 long-term perspective, however, impacts are less clear. If seed prices cross a certain threshold, farmers will replace formerly agricultural land with biodiesel plantations. Assessing the effects of such a scenario on local and national food security is beyond the scope 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 the supply of biodiesel and possibly allow for spill-over effects to other producers.

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 may invest on land that was previously used by the local poor, jeopardising income sources and local food production. How big these risks are depends on two things. First, the *ex ant*e land use situation; and second, *de jure* and *de facto* local decision-making processes. Giving out revenue land for long, or indeed indefinite lease periods increases the risks implied by deficient decision-making processes and lacking complaint procedures.

Assessing Union and state policies aimed at enhancing rural development effects of biodiesel

Multiple market failures justify state intervention in the biodiesel sector. For example, biodiesel cannot yet compete with fossil fuels, as the prices for the latter do not reflect the negative environmental externalities they cause. If these costs were internalised, biodiesel would be more competitive as it causes far lower environmental costs. Furthermore, the benefits of R&D in terms of agricultural practices and high-yielding varieties cannot be fully appropriated by investors and farmers; and there are market imperfections with regard to information, credit markets and the like.

Policy intervention, however, carries the risk of government failure. In India, the history of policy intervention has been marked by inefficiencies, market distortions and rent-seeking activities, especially in the period before the late 1980s. Since then, progress has been made in deregulation and decentralisation, but reforms remain incomplete. With regard to biodiesel, policies concerning political decentralisation, land ownership, marketing of agricultural and forest products, agricultural extension services, and forest management need to be further reformed if the country wishes to fully exploit the potential of biodiesel for rural development.

Concrete policies with regard to biodiesel exist on the Union as well as on the state level. In 2008, the Government of India adopted a National Biofuels Policy. This policy establishes demand-side incentives aimed at increasing the blending of biofuels and emphasizes the need for more and better coordinated research. Additionally, a large number of centrally-sponsored schemes are used to promote biodiesel plantations. The most important one is the National Rural Employment Guarantee Scheme, which guarantees 100 days of paid work to rural unemployed people.

Several states have furthermore adopted more or less coherent biodiesel policy packages of their own. This study looks into the policies of five states which are among those with a relatively coherent set of policies. Interestingly, each of them pursues specific biodiesel strategies and uses different incentive schemes. Uttarakhand launched a

biodiesel programme with the aim of creating employment and regenerating degraded forest land. The approach is characterised by a high degree of regulation, since the state entered into a public-private partnership with one single company, limiting competition in the sector. In Chhattisgarh, the state follows a less regulated approach, allowing different value chains to emerge. Andhra Pradesh focuses on the promotion of biodiesel plantations on specified private land and forest land, putting emphasis on linkages with private entrepreneurs. In ways similar to Chhattisgarh, the state seeks to facilitate the emergence of a full – but diversified – value chain. In Karnataka, a functioning oil-expelling industry already exists. Efforts are underway to establish a cooperative biodiesel system of small farmers, shaped after India's successful dairy cooperatives. The state of Tamil Nadu, in contrast, especially promotes contract farming with international corporations on the basis of subsidized seedlings and earmarked loans.

Main conclusions

The report shows that biodiesel production offers promising opportunities to create additional sources of income for India's rural population and to intensify land use while greening the countryside. The developmental effects, however, differ between the many ways of organizing biodiesel value chains. 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 inhibit 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 risk of displacement.

At present, Indian policy-makers would be well advised to view the different biodiesel value chains as a social laboratory and to try to maximise their respective potentials and to minimise their risks. In this regard, it will be important to increase the sustainability of government-centred plantations, to support cultivation of tree-borne oilseeds 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 the 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 unutilised or underutilised to productive use and contributing 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 biodiesel production in India more competitive. However, strong research efforts as well as reduction of subsidies for conventional energies are needed to give the industry a boost. This calls for a clear political signal from the Government of India. Whether the National Biofuels Policy, which was approved in September 2008 after four years of discussion, will create the appropriate incentives for farmers and corporate investors still remains to be seen.

1 Introduction

Producing biodiesel from tree-borne oilseeds (TBOs) 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 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 tonnes. As economic growth continues to be strong and international energy prices quickly rise, the country's foreign exchange expenditures for oil imports are skyrocketing.

Biodiesel could stimulate agricultural development and create employment and income for many of the rural poor. At the same time, it may satisfy a significant part of the country's fuel demand, increasing India's energy security and saving foreign exchange. Shifting to biodiesel could 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 abundant 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 to 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 trade-offs in the case of India need to be explored.

However, the 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 TBOs, 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 bio-

diesel 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 approved a National Policy on Biofuels in September 2008, setting an indicative target to raise blending of biodiesel with diesel to 20 % by 2017 and scrapping taxes and duties on biodiesel. Moreover, well-funded government programmes for rural development are already used to subsidise the establishment of biodiesel plantations on a large scale throughout India. While the federal policy has only recently been approved, several state governments took the lead and established their own biofuel policies, each setting its own priorities and employing particular policy mixes.

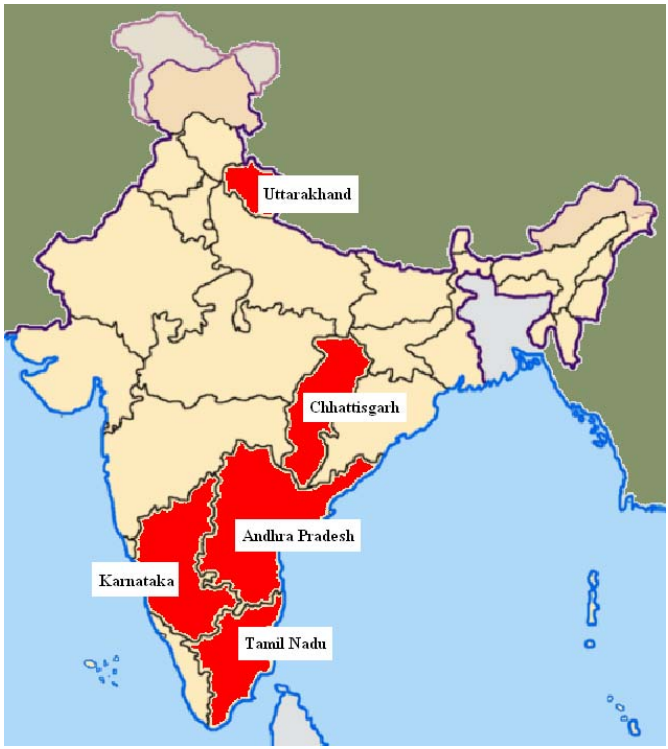
This study aims to contribute to the knowledge about biodiesel in India and to inform policy-makers about development impacts and appropriate policy choices. Its focus is on the potentials and risks for rural development. The study makes two important contributions to the discussion on the Indian biodiesel sector:

1. It takes stock of existing ways of organising the value chain in India and assesses their pros and cons from a comprehensive development perspective. The study identifies as many as 13 different ways of producing and consuming biodiesel in India, and it shows that all of them have different impacts in terms of employment and income generation, participation and empowerment, food security, natural resources management, and climate change.

2. It identifies, describes and assesses the appropriateness of a broad range of federal and state policies and support programmes. Given the diversity of value chain organization, many different policies have to be taken into account. Whether a state government chooses, for example, to promote social forestry, large-scale leasing contracts with corporations, or contract farming, and how effectively these policies are implemented, has a bearing on development outcomes. Again, this is the first time that such a survey of existing biodiesel policies has been carried out in India.

The study is based on eleven weeks of field research. About 100 stakeholders of the biodiesel sector were interviewed at the federal level as well as in five

Map 1: Map of India, with the five visited states highlighted



Source: Own illustration

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 designed 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 for the analysis of socio-economic and

environmental impacts. As the 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 trade-offs, but further research should be carried out in a few years time, when cultivation, processing and marketing channels are well established.

The study is structured as follows. The Chapter 2, which follows, gives an overview of biodiesel in the global context. Chapter 3 then describes the situation of the biodiesel sector in India. After explaining the general aspects of the biodiesel value chain in India, a look is taken at the potentials of biodiesel for India's development challenges. Furthermore, the chapter 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 fourth chapter provides a brief account of federal and state level biodiesel policies in India which aim at encouraging biodiesel consumption and fostering 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. Chapter 5 offers an overview of the multiple ways of organising the biodiesel value chain that we 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 the main research findings as well as policy recommendations bearing on how the Government of India could support the biodiesel sector in such a way as to create new opportunities for the livelihoods of the rural poor and ensure that environmental and energy security targets are met.

2 Biodiesel in the global context

From 1971 to 2005, the world's final consumption of oil rose from about 2000 million tonnes/year to almost 3500 million tonnes/year (IEA 2007a, 33). Correspondingly, the price for crude oil on the world market went up from 20 US$/barrel in the 1990s to over 145 US$/barrel in July 2008. Although prices fell below 100 US$/barrel again in October, when this study was finalized, most analysts expect higher oil prices in the long term. In view of rising prices and the environmental – and primarily climate-change – concerns that result from increased global energy consumption, countries all over the world have launched biofuel programmes to develop alternatives to conventional fuels.

While the share of biofuels in overall global fuel consumption was still marginal in 2006 (less than 1 %), the growth rate of biofuel production is enormous. Between 2000 and 2005, worldwide production of bioethanol rose by 95 % and biodiesel output even grew by 295 % (IEA 2007b).[1] Bioethanol and biodiesel need to be distinguished when we speak of liquid biofuels.[2] Bioethanol is derived from starch and sugar, making maize and sugar cane – or the waste products produced during their processing – the most important feedstock used for its production. In contrast, biodiesel is obtained from any kind of vegetable oil like rapeseed, soybean, palm or sunflower oil, for example. With 28.3 billion litres, global production of ethanol is about six times as high as biodiesel production and therefore more relevant on the global scale.

Demand for biofuel is rising especially due to mandatory blending requirements adopted by large energy consumer countries. In order to contribute to energy security and to abide by the requirements of the Kyoto protocol, many have developed ambitious plans to further substitute biofuel for fossil fuel. In 2003, for example, the EU set targets for blending biofuel in the transport sector at a rate of 2 % by 2005 and 5.75 % by 2010. In addition, several European countries support the use of biofuels through tax reductions or higher

1 The driving countries in bioethanol production are mainly Brazil and the United States, while especially Germany and France are engaged in producing biodiesel. Germany, with a share of about 40 %, is the world's largest biodiesel producer (Worldwatch Institute 2007, 7).

2 Since any kind of motor or generator can also be designed to run on gas, gas can also be considered a fuel in a broader sense. This study, however, only refers to bioethanol and biodiesel when it speaks of biofuels.

blending requirements (Worldwatch Institute 2007, 283 ff.). The United States set – in the Energy Policy Act of 2005 – the target of blending 28.4 billion litres of biofuel by 2012. It is estimated that these measures will create demand for an additional 9.2 million tonnes of biofuel worldwide (ibid., 9).

The international public debate on biofuel, though, 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" (Doornbosch / Steenblik 2007). The criticism mainly regards two aspects:

a) concerns about the impact of biofuel production on **food security**, and

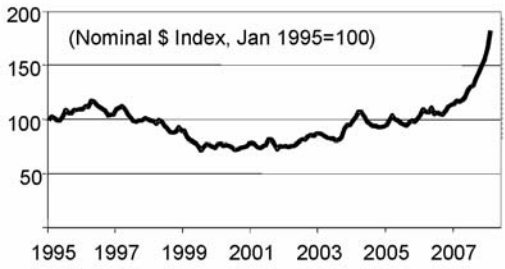
b) doubts about the overall positive **net carbon balance** of those fuels.

Both points of criticism will be discussed briefly in the following.

With regard to worldwide **food security**, two questions arise about the effects of biofuels: First, it is unclear how big the impact of biofuel production is on the rise of food prices. Second, it is disputed whether a rise in food prices increases or decreases food security, especially of the world's poor.

The fact is that food prices have been rising, especially in the last few years (see Figure 1). There are three reasons why biofuel production has some kind of impact on this rise of food prices. First, the raw material used for biofuel production – mainly maize, sugar cane, rapeseed and palm oil – does not enter the food market, and therefore food supply is reduced. Second, farmers world-

Figure 1: Food price development



Source: World Bank (2008)

wide could shift their lands to fuel crop production, also diminishing the supply of food crops. Third, rising prices for food trigger financial speculation on agricultural commodities on the world's stock exchanges, in turn leading to price rises. But estimates of the actual influence of biofuels on food prices differ dramatically. From the point of view of the United States Department of Energy, for example, *"today's biofuels account for only a small percentage of the increase in global food prices"* (US Department of Energy 2008, 2). Contradicting this view, Mark W. Rosegrant, of the International Food Policy Research Institute, estimates that increased demand for biofuels is responsible for about 30 % of the recent increase in grain prices (Rosegrant 2008). Going even further, an unpublished note by the World Bank economist Donald Mitchell – cited in the July 4, 2008, edition of the British "The Guardian" – even states that biofuels have forced global food prices up by 75 % (Chakrabortty 2008). Whatever the exact percentage of the influence of biofuels on the rise in food prices may be, the fact is that demand for raw materials like maize, sugar and vegetable oil has increased significantly due to biofuel production, forcing prices up. Between 2004/05 and 2006/07, the amount of cereal that went into bioethanol production, for example, went up by about 40 %, from 43 million tonnes to 71.8 million tonnes worldwide (von Braun 2008).[3] The biofuel programme of the United States has been blamed for contributing 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 1 Jan. 2007). So an impact – probably even a quite considerable impact – of biofuel production on food prices can be seen. But rising food prices need not be judged negatively from the perspective of the world population living below the poverty line. How the poor are affected depends heavily on whether they are net food buyers or net food sellers. A recent World Bank study conducted in nine low-income countries showed that most poor households are net food buyers. However, most of these households are only marginal food buyers that spend very little money on food and at the same time depend on food *production* for a living (Aksoy/Isik-Dikmelik 2008). That is because 75 % of the world population below the poverty line live in rural areas and depend on agricultural activities. So a simple focus on net food buyers *versus* sellers does not properly reflect the real interrelations. Analyses that take into account long-term effects on labour markets, land markets and the rural economy overall demon-

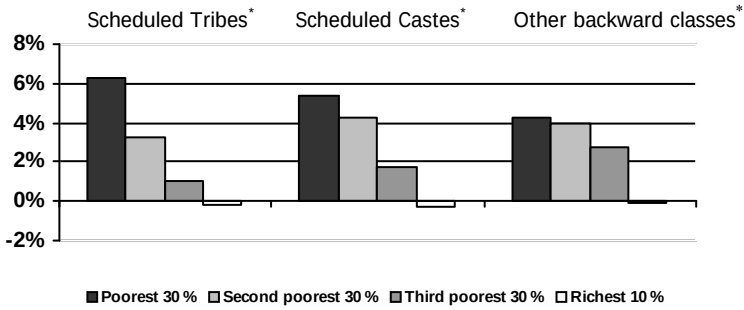
3 Since the total world production of maize was about 703.9 million tonnes in 2006/07, the amount used for bioethanol rose to almost 10 % (US Department of Agriculture 2007).

strate that positive effects could outweigh higher food prices in the long run. A good example – especially in the context of this report about India – is a recent study about the impact on higher grain prices on poor households in India (see Polaski 2008). It reveals that if the world rice price went up by 50 %, only the richest 10 % of the population regarded as vulnerable to poverty would have less income, while all other parts of the poor population would, in contrast, actually gain up to 6.3 % in real income (see Figure 2).

Hence the argument that biofuels contribute to an increase in poverty via rising food prices may not be correct. In-depth and detailed analyses of each case are needed to come up with a judgement on whether or not a certain activity of biofuel production increases poverty among the respective parts of the population.

The second strand of criticism regards the ability of biofuels to effectively **reduce greenhouse gas emissions**. When energy is derived from a crop, only as much CO_2 is put back into the atmosphere as the plant has bound before. To assess the impact of biofuels on climate change, however, *life-cycle emissions* need to be taken into account. Thus indirect energy inputs need to be calculated, including the amount of energy embedded in the fertilizer and the water used, as do emissions from fertilizer production and transportation, and a comparison is needed with alternative uses of the farmland concerned. In some cases, life-cycle emissions may be negative. Particularly, the cultivation of rapeseed, the primary feedstock for biodiesel production in Europe, and maize, the main source for the United States bioethanol programme, require intensive use of fertiliser. Furthermore, often only the benefits of carbon sequestration of biofuel crops are included in calculations of their carbon balance, while 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 rainforests store large amounts of carbon dioxide. Particularly the peat in rainforests binds large amounts of carbon dioxide that is released to the atmosphere when it is drained. According to Ernsting (2007, 5 ff.), in Indonesia alone, this drainage of peat for palm oil plantations emits about one billion tonnes of CO_2 into the atmosphere per year. However, the international expert community by and large agrees that biofuels are better for the world climate than fossil fuels (Doornbosch / Steenblik 2007).

Figure 2: Impact of a 50 % increase of the world rice price on Indian households



* The Indian constitution lists as Scheduled Tribes, Scheduled Castes and other backward classes groups of the population that are especially poor and vulnerable.

Source: Polaski (2008)

Production of biofuel from primary feedstock like maize or vegetable oil thus implies risks in terms of food security and CO_2 emissions. The cost-benefit ratio depends on crop type and local conditions. Competition between food and fuel could largely be avoided if biofuels were produced on the basis of by-products of food or wood production (stems, leaves and husks) or non-edible crops. Likewise, life-cycle greenhouse gas emissions from such so-called second-generation biofuels may be much more favourable than those of biofuels produced from primary feedstock. A wide range of products can be used to obtain second generation biofuels (see Paul/Ernsting s.a.), but many technologies are not yet economically viable.

3 Biodiesel in India

The Indian biodiesel sector is different from biofuel activities in many other countries of the world because it is based on the use of non-edible oils derived from oil-bearing trees that can grow on less fertile land. This renders it more positive because risks of food crop replacement can be avoided, many small farmers and landless cultivators can generate additional income and the plants can serve for greening barren lands.

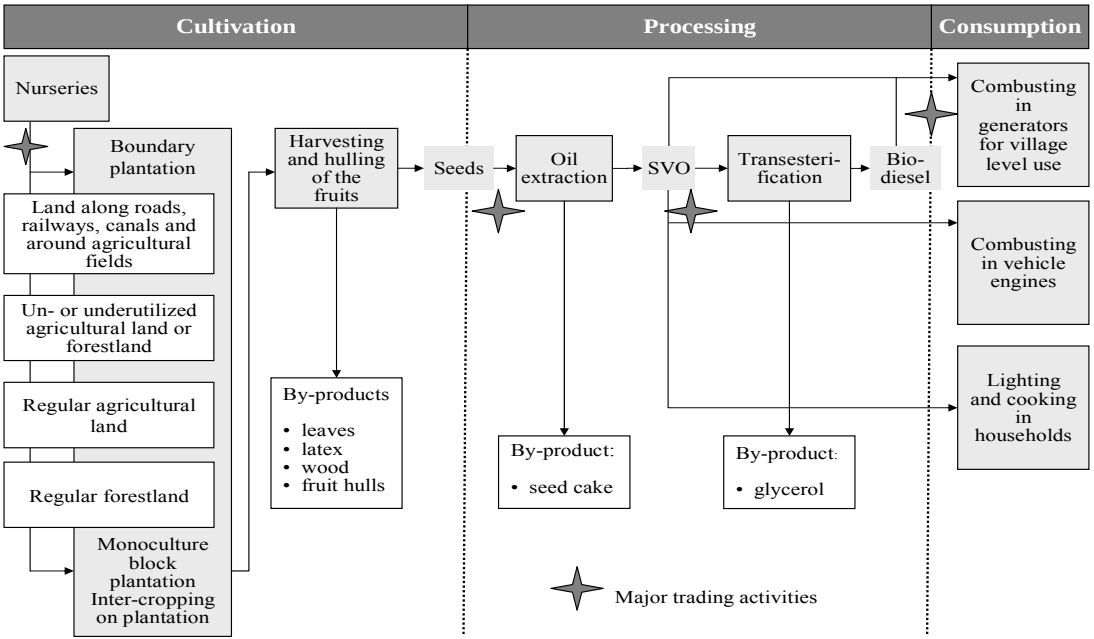
This study focuses exclusively on *biodiesel* programmes in India. While the country is already the world's 7th largest ethanol producer, with an annual production of 200 million litres of ethanol (Worldwatch Institute 2007, 6), biodiesel production started only a few years ago. The following chapter portrays the biodiesel sector. Chapter 3.1 first describes the biodiesel value chain in India, laying special emphasis on the feedstock and – resulting from this – the type of land needed for production. The potentials for development will be depicted in Chapter 3.2. These are manifold, but certain risks remain that food crops may be displaced. Potentials and risks will be taken up again in Chapter 5 and discussed in greater detail for specific ways of value chain organisation. However, the biodiesel sector in India is still in a nascent state, which is mainly due to a lack of economic viability for almost all activities related to the sector. Reasons for this general barrier to the development of biodiesel production in India will be specified in Chapter 3.3.

3.1 The biodiesel value chain in India

The following chapter describes some general aspects of the biodiesel value chain in India. This will help to better understand and assess the developmental impacts of biodiesel production and consumption. For example, at the cultivation stage the type of land and type of plantation have important impacts on socio-economic and environmental effects. Different ways of processing the raw material imply different cost structures and require 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 allows people to earn additional income. As not all crops generate the same by-products, some crops may be more economically viable than others.

The chapter is divided into separate sections on the three steps of the value chain – cultivation, processing, and consumption – and a last section on different alternate uses and by-products of straight vegetable oil (SVO) and biodiesel that may generate additional income sources. The following figure presents the simplified value chain of biodiesel in India. It breaks down into three steps: cultivation, processing, and consumption.

Figure 3: Biodiesel value chain in India



Source: Own design

Cultivation

SVO, the raw material for biodiesel, can be extracted from many different plants. Seeds of certain plants (e.g. rapeseed, soya, sunflowers) have a high oil content and are, in some countries, used for biodiesel production. In India, SVO is derived almost exclusively from oil-bearing trees. 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 growing wild species that have not yet been cultivated and harvested systematically for oil production on a larger scale.[4] Some of the seeds have been traditionally collected by poor people for lighting. In small quantities, TBOs are used for commercial purposes in the paint, lubricant and soap industries (GTZ / TERI 2005, 6).

According to the National Oilseeds and Vegetable Oils Development Board of the Indian Ministry of Agriculture (NOVOD s.a.[d]) there are about ten species with economic potential for biodiesel production, including Jatropha curcas, Pongamia pinnata, Simarouba glauca,[5] Azadirachta indica (Neem) and Madhuca indica (Mahua) (see Table 1). Proponents of biodiesel in India focus almost exclusively on Jatropha and to a lesser extent on Pongamia. Other species have not received much attention. The focus on Jatropha is justified mainly on the basis of two arguments: First of all, Jatropha is a shrub, i.e. it does not grow into a tree. Therefore, it is easier to harvest than large trees and has a much shorter gestation period. Since the time span between investment and return is shorter, more people could be willing to start cultivating this crop. Second, the seed collection period of Jatropha does not coincide with the rainy season in June-July, when most agricultural activities take place. This makes it possible for people to generate additional income in the slack agricultural season (Negi et al. 2006, 34). Pongamia has become the second most important feedstock of the Indian biodiesel sector for the reason that this tree is tradition-

4 It is estimated that only 10 % of the seeds from natural plantations are been collected (Ghasias 2006, 217).

5 Simarouba glauca is a promising oil-bearing tree, which was only recently introduced in India. Simarouba oil is edible, but its consumption for cooking is not habitual in India (Joshi / Joshi 2007, 99 ff.). Therefore, the tree is promoted for the production of biodiesel by some supporters, although the general Indian consensus is not to use edible oil for fuel production.

ally planted in several states and therefore well known to people. Being a multipurpose plant that is a source not only of oil but also of animal feed, manure, fire wood and substances with medicinal uses, farmers already integrate Pongamia into their farming systems. Pongamia is also systematically planted on public land such as forests or along roads, and it already is common practice for people to collect and sell the seeds – provided they find a market (Int. Ramakrishna, Samagra Vikas).

The most important characteristic that distinguishes oil-bearing trees from other cash crops is the fact that they require very few nutrients to survive and therefore can also be grown on less fertile land. To survive, Jatropha, for example, only needs a minimum of around 600 mm of rainfall per year and temperatures that do not go below about 3°C (GTZ / TERI 2007, 7; Jongschaap et al. 2007, 18). However, it is an input-responding plant, meaning that fertile land, fertiliser and pesticides as well as better irrigation will lead to much higher oilseed yields (Jongschaap et al. 2007, 15-16). Under favourable conditions, a yield of up to 2.5 kg/plant can be achieved (see Table 1).

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

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

Table 1: Oil-bearing tree species in India					
	Jathropha	**Pongamia**	**Simarouba**	**Neem**	**Mahua**
Height (m)	3 – 4[h]	15 – 25[m]	15[j]	15 – 20[f]	21 – 23[d]
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]	n / a
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]	n / a
Gestation Period (years)	2 – 3[a,b,c]	4 – 7[a]	6 – 8 (3 – 4 when grafted)[j]	5 – 6[a]	8[a] – 15[i]
Economic life-span (years)	35[e]			150 – 200[f]	60[i]
Oil content per seed (in %)	28[e] – 35[a]	27 – 39[k]	50 – 60 plus 20 – 32 % oil in the nutlet[j]	45[a]	35[i] – 40[a]

Table 1: Oil-bearing tree species in India (cont.)					
	Jathropha	**Pongamia**	**Simarouba**	**Neem**	**Mahua**
Yield per tree (kg)	1[k] – 2.5[a]	20 – 25[a]	15[d]	15[a]	20[i] – 40[a]
Oil / ha (t)	0.7 – 1.8[a]	1.5 – 3[a]	1-2[j]	2.5[a]	2.7[a]
Collection Period	Oct – Nov[k]	May – June[m]	April / May[j]	n / a	June – July[c]
Density of Plant / ha	1500[g]	500[c]	500[c]	400[a]	200[c]
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 fire-wood.[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]	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]	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 405 l of alcohol).[i]

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

The first possibility, plantations on regular fertile agricultural lands, implies competition with other crops that can also be grown here. In India, most farmers are not willing to plant oil-bearing trees on fertile lands because yields and prices are considerably lower than those of food crops such as rice, wheat or sugar at this point in time. Changing cultivation patterns on already used fertile agricultural lands will only take place if the revenues from the cultivation of oil-bearing trees exceed those from food crops, which would presuppose either considerably higher demand (e.g. through higher prices of conventional fuel) or extraordinary increases in productivity (see Chapter 3.3).

Table 2: Land for cultivation of oil-bearing trees

Type of plantation	Type of land		
Boundary plantation	Land along roads, railways, canals and around agricultural fields etc.		
Monoculture block plantation	Regular agricultural land	Regular forest land	Un- or underutilised land
Inter-cropping on plantation			

Source: Own design

The second possibility, to grow oil-bearing trees on forest land, 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 it is therefore less useful for afforestation. India strongly promotes joint forest management (JFM) programmes in order to combine the benefits of afforestation and income generation for lower casts and tribal people (see Chapter 5.1).

The third possibility – and the one most favoured in the public discussion in India – is the use of un- or underutilised land for cultivation of oil-bearing trees. Such land that is not suitable for any other crop because of its low fertility is called "wasteland" in day-to-day parlance. 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 million km² of total land area in India as

wasteland (MoRD 2005, 12). Considerable parts of India's degraded forest land (108,000 km²), land with scrub vegetation (151,000 km², ibid.) – together amounting to more than 8 % of the total geographic area in India – as well as certain other lands[6] could serve for plantations of oil-bearing trees. Although more recently, the Government of India reduced its estimate of land reserves that are suitable for biofuel crop cultivation to 72,000 km², even this potential is enormous (Shankar 2006, 94). More drought-resistant than most other crops, oil-bearing trees can contribute to the rehabilitation of unutilised land by stabilising soil, improving manure cover and bringing degraded land back into productive use.

However, the term wrongly suggests that all of this land lies waste and is not used by anybody. In reality, even unsuitable degraded land is still often used illegally by the poorest parts of the population for subsistence agricultural production or – even more commonly – for cattle husbandry. Claims of 13.4 million ha of available land for TBO cultivation (Planning Commission 2003) therefore need to be looked at with care. Bringing much of this land under Jatropha or Pongamia plantation would certainly imply the displacement of marginalised groups of the population.

Processing

Once the fruits have been harvested, the first step in processing is extracting the oil. Only the seed of the fruit contains oil, so it is necessary first to separate the seed from the fruit hull. The seed itself also consists of a shell and a kernel. Before the oil is expelled, 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, the kernels are ground.

There are two methods of extracting the oil from the ground kernels. First, the kernels can be pressed, using hand-powered pressing machines or mechanised equipment. When small-scale hand-powered pressing machines are used, only around 60 % of the total extractable oil can be expelled. More mechanised expellers such as animal-powered so-called *ghanis* can expel about 75 % of the oil content. Further advanced pressing machinery can obtain up to 90 % of the

6 Other relevant categories of wastelands with potentials for the cultivation of oil-bearing trees include 37,000 km² of land without scrub, 16,000 km² of shallow/moderately gullied or ravinous land and 9,000 km² of land with slight or moderate saline or alkaline values (MoRD 2005, 12; Shankar 2006, 94).

extractable oil. Second, the more efficient way to expel the oil from the kernel is to use a chemical solvent that can extract almost 100 % of the oil (Jongschaap et al. 2007). This requires a highly sophisticated industrial oil extraction process, 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 may prove worthwhile.

Transesterification requires three raw materials: SVO, alcohol (usually methanol is used), and an alkaline catalyst (e.g. sodium or potassium hydroxide). A two-stage 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 a large range of processing capacities, 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 very high viscosity, however, fuel injection pumps need to be modified, otherwise engines will abrade much faster. Hence, operational and maintenance costs of engines running on SVO are higher than for those running on conventional diesel. The 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 operational and maintenance costs. Some projects aiming at rural energy security use SVO for their machines and electricity generators, while others first transesterificate and use biodiesel for the same purposes. The advantages of the latter are better fuel properties, leading to more efficient fuel combustion and less pollution. There are, however, economic and safety issues associated with the process of transesterification. Additional technology and equipment as well as other inputs (methanol, catalyst) are needed to process SVO into biodiesel. This means additional costs both for investment and maintenance. Also, qualified person-

nel has to be trained to operate the complicated transesterification process. These issues, however, could be resolved with careful planning and implementation.

One solution to this problem of viscosity is to blend diesel with either SVO or biodiesel. An SVO-diesel blend, though, still requires a modification of the engine for proper functioning in most cases. The characteristics of the SVO may 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 depends in large measure on SVO quality and engine type. 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 consulted, blending of up to 50 % is possible without any major operational difficulties for engines (Jongschaap et al. 2007, 15).

By-products and alternate uses of SVO and biodiesel

Several by-products have economic value. Oil-bearing trees not only produce seeds/fruits, their leaves, latex and wood can also be used. Leaves of some oil-bearing trees can serve as valuable organic fertiliser,[7] 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 may serve for all the possible uses mentioned above – as organic fertiliser, for burning, for medicinal purposes as well as for biogas production.

Two other important by-products of SVO/biodiesel production emerge during further processing: seed cake and glycerol. After the oil is extracted, what remains is the particulate material of the kernel, which is called seed cake. It can be used as an organic fertiliser. Since yields increase substantially when fertiliser is applied, the seed cake can be taken back to the field and used to facilitate cultivation. In addition, it is also possible to produce biogas from the seed cake. Theoretically, seed cake could also serve as fodder for animals. However, Jatropha seedcake has to be detoxified, and detoxification has proven successful only in the lab (Jongschaap et al.

7 In the case of Jatropha, the leaves have toxic properties and its effects on soil fertility have not yet been properly researched.

2007). The process – if applied in the field – would currently be very expensive, so that Jatropha seed cake as fodder would not be able to hold its own in the market.

Glycerol (glycerine) is removed from the SVO during transesterification. It is an important ingredient for many kinds of cosmetics, soaps and pharmaceutical products. If the market demand for glycerol 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 did not play 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 use as some kind of fuel. Biodiesel, in fact, can only serve as "petrol." On the other hand, some SVO can – depending on the plant of origin – be consumed as food, but Jatropha and Pongamia-based SVO is non-edible. One alternate use of the oil, however, is for soap production. A soap of good quality is produced from Jatropha-based SVO, in some countries (e.g. in Mali and Haiti). Some projects promote this kind of processing in order to generate income for poor rural families. In India, however, the production of soap from tree-borne oilseeds is not common.

3.2 Potential development effects of biodiesel in India

The Indian biodiesel sector is different from biofuel activities in many other countries of the world. Biodiesel production in India involves far fewer risks for the environment and food security. This is mainly due to the type of feedstock used and the land it is planted on. While most other countries use annual crops for fuel production, biodiesel in India is produced from the seeds of trees or shrubs with a life time of 30 to 200 years. Oil-bearing trees need less nutrient soil and fertiliser then most annual crops, and this translates into fewer negative impacts on the net carbon balance. In contrast to countries like Malaysia, Indonesia and Brazil, there is little threat in India that natural forests will be destroyed for biofuel plantations. Since biodiesel cultivation is set to take place mostly on land

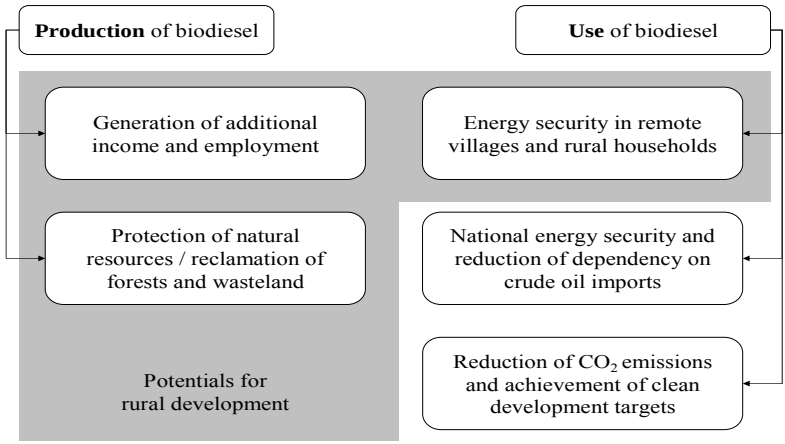
with marginal biomass cover, planting of oil-bearing trees is likely to increase the carbon sequestration of the respective lands. In fact, biodiesel production can be integrated into forestry programmes and therefore contribute to afforestation.

Biodiesel production in India, moreover, does 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 price increases for cooking oil.[9] Second, the focus on land not used for intensive agriculture also contributes to minimising competition between fuel and food. Although biodiesel plantations on agricultural land are an option in the Indian case as well, there is large potential to integrate oil-bearing trees into farming systems and the rural countryside without necessarily replacing food crops. Biodiesel activity can even improve food security, as it provides additional income opportunities for poor people, thereby increasing their capacity to reinvest 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. However, biodiesel production has the potential to address some of the most important development challenges in India. First, the production of biodiesel holds large potentials for the development of India's agricultural sector and rural areas. It can create additional income and employment and – depending on the organisation of production – strengthen participation patterns and empowerment of the rural population. Second, oil-bearing trees may help to restore degraded land and to increase Indian forest cover. Third, it can diminish India's dependency on oil imports and reduce CO_2 emissions substantially. Consumption of biodiesel or SVO – in rural areas on a smaller scale – is furthermore one possibility of ensuring rural energy security and reducing the dependency of poor rural population groups on expensive conventional fuels (see Figure 4).

9 India is still unable to satisfy its huge demand for cooking oil and has to import 55 % of the volume needed. India is the worldwide largest importer of edible oil. Edible oil imports amount to more than 50 % of India's total agricultural imports (Kumar / Sharma 2005, 884).

Figure 4: Development potentials of biodiesel in India



Source: Own design

Rural income and employment generation

While the Indian economy grew rapidly in the last decade, little development has taken place in rural areas, home to three quarters of the Indian poor.[10] India's total economy, and in particular the service sector, is booming. In 2004/05, India's gross domestic product (GDP) grew by 7.5 % overall. The agricultural sector, however, has close to stagnated. While the service sector grew by 9.9 %, the agricultural sector grew at a rate of only 0.7 % (World Bank 2006b, 6). This adversely affects the rural poor who depend on agriculture for their livelihoods (World Bank 2006b). The sector contributes only 18 % to GDP (World Bank 2007, 340), although it employs almost 60 % of the Indian workforce (World Bank 2006a, 126). In

10 72 % of the Indian population (770 million) live in rural areas (World Bank 2007, 320). Almost 1/3 of the rural population live below the poverty line (in contrast to 1/4 of the urban population) (ibid., 336).

comparison to China and Vietnam, for example, with their 4 % annual growth in per capita food production between 1990 and 2004, India's growth of only 0.9 % is relatively low (World Bank 2007, 326).

The reasons for the poor performance of the Indian agricultural sector are manifold. Among other things, Indian agriculture is characterised by very low productivity. In the case of a few crops, Indian productivity can keep up with global markets – mainly sugar cane and tea. But productivity in other important crops lags far behind – for example, average wheat yields in Ireland are three times higher than in India (Mahadevan 2003). Infrastructure is weak in many regions. Additionally, agricultural markets are overregulated, and this leads to high transaction costs and discourages private investment. Agricultural subsidies have gone up, but productive investment has steadily declined (World Bank 2006a, 139). Biodiesel has the potential to trigger private and public investment in rural areas, improve the diversification of agriculture and therefore generate additional employment and income for farmers as well as for landless people.

Protection of natural resources and reclamation of forests and wasteland

In India, large amounts of land are not suitable for productive purposes because of harsh agro-climatic conditions or overexploitation of soils in the past. More drought-resistant than most other crops and trees, oil-bearing trees contribute to the rehabilitation of degraded land by stabilising soils and improving manure cover, thereby bringing soils back into productive use.

As explained in Chapter 3.1, about 16 % of the Indian land mass is identified as wasteland (MoRD 2005, 12). That means that an area about as large as France is not under productive use. Not all of this land is, of course, suitable for Jatropha or Pongamia plantations, or is unavailable because of land ownership issues. However, the ecological properties of such non-edible oil-bearing trees permit them to be cultivated on dry land, where other crops like wheat or rice do not grow. Pongamia is, furthermore, a non-toxic leguminous tree that fixes nitrogen in the soil, and it can in this way even restore degraded land (see Table 1).

Energy security in remote villages and rural households

Thousands of remote villages in India lack access to reliable electricity. According to the 2001 Census of India, less than 50 % of India's rural population has access to electricity, for example. 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 et al. 2004, 1693). The Indian Ministry of Power has set the target to electrify about 80,000 villages by 2012. Of these, 18,000 villages in remote and inaccessible locations need decentralised solutions for energy supply (ibid., 1695). Biodiesel, or its intermediate product SVO, can – if produced in the respective villages – be one option for decentralised, reliable and affordable electricity supply and a renewable energy source. Furthermore, many rural households lack funds to buy fuel for their agricultural equipment, such as irrigation pumps or tractors. Long transport routes often make it impossible for remote farmers to obtain conventional diesel without major difficulties. TBO-based biofuel production can be one way of producing a sufficient amount of fuel for a farmer's or a village community's own consumption.

However, there are two main points that need to be taken into 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. Second, 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 use them in their own villages.

Both governments and non-governmental organisations (NGOs) were found to promote pilot projects in this area (see Box 1). If NGO 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's Remote Village Electrification 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).[11]

11 The programme is in line with India's Rural Electrification Policy, which aims at providing one unit of electricity per household per day in the coming years (Ministry of Petroleum and Natural Gas 2006, 2). This is not restricted to biofuel-based electrification. In fact, MNRE prefers

Box 1: Rural energy security projects

There are different approaches to achieving energy security in rural areas on the basis of SVO or biodiesel production all over India. As indicated in Table 6 and in the chapter on government-centred cultivation, three of these projects were 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 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 projects examined 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 have been harvested. All projects examined are currently in a pilot stage. However, they all consider themselves already as successful and are therefore planning to implement their approach in other villages and districts throughout the country.

National energy security and reduction of dependency on crude 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.[12] With constant domestic oil production of only 33-34 million tonnes per year, India depends strongly on oil imports to

small hydro and biomass power plants over biofuel-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 for by MNRE – the remaining 10 % is borne by the project implementer (NGO or state agency) (MNRE 2006). Also supported by the Government of India, the so called Village Energy Security Programme (VESP) is part of the Remote Village Electrification programme, although it focuses on specific projects (NEDA 2008). In its guidelines, it asks implementing agencies to facilitate the formation of Village Energy Committees and Village Energy Funds to give sufficient ownership to the communities concerned.

12 From 1970 to 2001/02, India's primary energy supply increased from 150 million tonnes to 438 million tonnes of oil equivalent. Estimates indicate that by 2031 India's primary energy supply will have to increase by 300-400 % and its electricity generation capacity by 500-600 % over 2003/04 levels (Srivastava / Mathur 2007, 2 ff.).

satisfy its increasing energy demand, which exposes the Indian economy to oil price fluctuations on the world market.[13] From 1990/91 to 2006/07, Indian oil imports increased dramatically from 21 to 111 million tonnes (MoP s.a., 12; GTZ / TERI 2005, 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.[14] Biodiesel production has the potential to reduce pressure on oil imports. The National Policy on Biofuels approved in September 2008 aims at substituting 20 % of transport diesel by 2017. If this target is achieved, India will improve its trade balance substantially and save large amounts of foreign exchange.

Reduction of CO_2 emissions and achievement of clean development targets

To achieve its development targets, the Government of India aims at 8 % growth in GDP, which will require substantial additional energy inputs. Economic growth is directly linked to growing green house gas emissions, which increased by about 7 % annually during the 1990s (UNDP 2007). While per capita emissions are very low, estimates suggest that by 2020 they will increase by 400 % over 1990 levels.[15] As the Government of India is committed to promote renewable energies and to shift to a low-carbon growth trajecto-

13 India's oil import dependency is projected to rise to 93 % by 2030 (Kumar / Dhavala 2006, 233). Calculations revealed that a 10 US$ increase of the oil price on the world market would cause a deterioration of the Indian GDP by 1 % and of the Indian trade balance by 1.2 % (GTZ / TERI 2005, 74).

14 India's foreign exchange expenditure for oil imports skyrocketed from 61 billion Rs. in 1990/91 to 2200 billion Rs. in 2006/07 (MoP s.a., 12; GTZ / TERI 2005, 71), which in 2003 amounted to about 3 % of India's GDP (GTZ / TERI 2005, 73). Gross oil imports amount to 45 % of India's total imports (MoP s.a., 12), and they are the main reason for India's increasing trade balance deficit, which rose to 4229 million US$ in February 2008 (Ministry of Finance).

15 In 2000, India's per capita emissions of green house gas amounted to 1.5 tonnes. This was far below the global average of 3.9 tonnes per capita and only 1/8 of Germany's per capita emissions (Sharma et al. 2006, 329). Indian emissions increased annually by about 7 % from 682 million tonnes in 1990 to 1.342 million tonnes in 2004 (UNDP 2007). Predictions estimate that emissions will rise to 3000 million tonnes by 2020, making India the third largest emitter worldwide, after the United States and China (Sharma et al. 2006, 329).

Box 2: The potential of the Clean Development Mechanism (CDM) in the Indian biodiesel sector

The 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 submit an application in order to receive Certified Emission Reductions (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 recognized as afforestation. Second, the replacement of conventional diesel by biodiesel could be certified. Third, the overall 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 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 taking 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 should be able to apply for CER without advisory support.

A methodology for biodiesel *including* cultivation, processing and marketing still however, needs 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 what levels of 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, is made compulsory, it will no longer be possible to receive CDM funds for it (Int. Bhat, GTZ India).

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

ry,[16] promotion of biodiesel is one way of reaching this goal. Life-cycle assessments of Jatropha-based biodiesel indicate positive effects in reducing overall green house gas emissions: It is estimated that every tonne of biodiesel reduces CO_2 emissions by three tonnes (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, 45). Furthermore, biodiesel activities can be an opportunity to receive additional funds through the Clean Development Mechanism (CDM) established by the Kyoto Protocol. 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 2.15 Rs. and for every tonne of CO_2 replaced they will be given 16 US$ (Int. Rao, KSRTC). For the corporation, this is an important incentive to expand its biodiesel consumption.

So the potentials of TBO cultivation are high in India. But as described in Chapter 2, concerns about possible negative implications of biofuel production must be taken into account. Whether these negative implications can be avoided depends in large measure on how the sector is organised as well as on effective regulations and government support to ensure that the poor in particular will benefit from an emerging biodiesel sector. The later analysis in this report mainly focuses on the development effects on *rural* India and in this regard especially on the agricultural production phase of TBOs. The effects on national energy security and large-scale CO_2 reduction will, however, be taken into account as important framework conditions.[17]

3.3 Status of the biodiesel sector in India: Lack of economic viability hindering takeoff

The previous chapter outlined the potentials that biodiesel production and consumption could have in India. To put it simply, TBO-based biodiesel could contribute to satisfying two of India's greatest needs: the need for energy and the need for rural development. However, although the potentials have already

16 India has achieved a capacity for grid-connected, renewable energy – mostly hydropower – accounting for 5.5 % of the total electricity supply (Sharma 2007, 167).

17 For a discussion of the potential of biodiesel production for the transport sector, see GTZ / TERI (2005).

been recognised years ago, not much actual biodiesel production has taken place in India so far. No exact numbers are available on the amount of biodiesel produced, but it is probably marginal. Biodiesel is mentioned in the statistics neither of the Ministry of Petroleum nor of the Ministry of New and Renewable Energy. The low levels of production are mainly due to two reasons. First, private farmers and entrepreneurs are hesitant to take up biodiesel production because the activity, with the exception of some niche markets,[18] is not yet economically viable. Although plantation is taking off in several Indian states, it still depends on subsidized programmes. Second, the long gestation period of at least three years (in the case of Jatropha) is another reason for the rather slow development of the biodiesel sector in India: Trees planted in the last two years do not yet contribute to production.

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 depends 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 at a disadvantage *vis-à-vis* conventional diesel. While Indian oil companies are obliged to buy biodiesel at a price of 26.5 Rs./litre, entrepreneurs in the biodiesel sector state that currently biodiesel production is only viable at a price of 45-50 Rs./litre (Int. Gulati, BDA). The economics can be improved by more efficient methods as well as by the marketing of by-products, like glycerol and seed cake. While currently the price of glycerol is about 50 Rs./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,[19] in other parts of India it is difficult to find a market (Negi et al. 2006, 44). Therefore, it can be stated that at the current purchase price biodiesel production for the national transport market is not economically viable.

18 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 small number of CDM-funded projects.

19 Channabasaveshware Oil Enterprises in Gubbi, Karnataka, sells the seed cake as fertiliser to farmers or to other companies for solvent extraction at 8.5 Rs./kg (Int. Swamy, General Manager of the company).

Table 3: Expected costs of a Jatropha plantation of one hectare
(at a wage rate of. 60 Rs/man daya and 1500 plants/ha)

Costs	**1st year**	**2nd year**	**3rd year onwards**
Costs for site preparation and alignment (15 man days)[a]	Rs. 900	–	–
Costs for digging of pits (50 pits/man day)[a]	Rs. 1,800	–	–
Costs for manure (2 kg/pit first year; 1kg/pit second year onwards at 400 Rs./tonne[a])	Rs. 1,200	Rs. 600	Rs. 600
Costs of fertilizer at 6 Rs./kg and 50g in the 1st year, 25g from the 2nd year onwards and 2 man days[a]	Rs. 570	Rs. 345	Rs. 345
Costs for mixing manure, insecticides, fertilizer and refilling pits at 100 pits/man day[a]	Rs. 900	–	–
Costs of plants (1500 1st year, 300 2nd year) at 4 Rs./plant[a]	Rs. 6,000	Rs. 1,200	–
Planting costs, 100 plants/man day[a]	Rs. 900	Rs. 180	–
Costs for Irrigation (three times in the 1st year, one in the 2nd year at 500 Rs.)[a]	Rs. 1,500	Rs. 500	–
Costs for wetting and soil working (10 man days, 2 times)[a,b]	Rs. 1,200	Rs. 1,200	–
Costs for plant protection measures	Rs. 500	Rs. 500	Rs. 500
Costs for pruning (20 man days)[b]	Rs. 2,400	Rs. 2,400	–
Costs for harvesting (1 man day/50 kg seeds)[a] (harvest increases each year, so costs rise after 3rd year)	–	–	Rs. 540 (only 3rd year)
TOTAL (plus 10 % for contingency)	**Rs. 19,657**	**Rs. 7,618**	**Rs. 2,130**

Sources: a: NOVOD (s.a. [d]) b: Negi et al. (2006, 40, 41)

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, Jatropha curcas in particular is basically a wild plant (Int. Kureel, NOVOD). Mr. 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 4, mature Jatropha plantations, for example, are expected to yield more than 3.5 tonnes/ha. To achieve such yields, fertile soil, irrigation or high rainfall and inputs of fertiliser and pesticides are required.[20] Under similar conditions, however, food crops can also be grown in an intensive way. Such food crops achieve higher returns than cultivation of Jatropha. Due to these high opportunity costs, not many farmers have made their agricultural land available for Jatropha plantations. As shown in Chapter 5.2, TBO-cultivating farmers either integrate the oil-bearing trees into their farming systems (e.g. as intercrops or fences) or grow them for lack of time to engage in more lucrative staples.

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, the Government of India identified 72,000 km² as suitable for biofuel crops. However, considerable amounts of this land are already used in one way or another. Furthermore, contrary to earlier assumptions (Planning Commission 2003, 111 f.), 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 viable biodiesel production, export may become a lucrative option. Due to compulsory blending policies in Europe and the United States, the demand for biodiesel on the world market has increased significantly. Since TBO-based biodiesel from India would be about US$ 200/t cheaper than biodiesel

20 Inputs are crucial for seed production, as demonstrated by a 40 ha 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 seven years, the yields are still below 0.5 kg/plant (Int. Kumar, Department of Agriculture).

Table 4: Expected rate of return for a Jatropha plantation of one hectare (at a assumed seed price of 6.5 Rs./kg)

Year	Seeds/tree[a] (kg)	Seeds/ha (kg)	Costs[b] (in Rs.)	Income (in Rs.)	Net benefit (in Rs.)
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 et al. (2006, 41) b) Negi et al. (2006, 40, 41)

produced in Europe, and has a better carbon balance, the world market is a relevant option for Indian biodiesel (Negi et al. 2006, 43). This could result in higher investments and income for the Indian biodiesel sector in the near future and contribute to improving India's trade balance. Several interviewees, however, expect that the Government of India may impose export restrictions (as it periodically does in the case of food crops) on biodiesel to achieve its own targets, such as to reduce oil import dependency as well as greenhouse gas emissions. So far, these claims have been neither confirmed nor rejected 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 recently been set up or are under construction. Five plants in Karhimara, Hyderabad,

Latur (Maharashtra), Uttarakhand and Delhi are operating on industrial scale at a level between 30 to 300 tonnes/day (Int. Gulati, BDA).

Those investing in biodiesel activities expect that TBO-based biodiesel will become economically viable in the near future since biodiesel prices are likely to rise – especially since compulsory blending of diesel has been endorsed – and production costs to decrease. The price of biodiesel is expected to rise due to rising prices of fossil fuels on the world market. 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 suited to the specific harsh conditions on degraded wastelands.[21] 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.

4 Biodiesel policies in India

The following chapter gives an overview of Indian biodiesel policies at the central and state level. We use the term "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 may be used to promote biodiesel, such as afforestation and rural employment programmes.

The first part of the chapter discusses the rationale for policy-makers to intervene in the biodiesel market. It shows that market failures are relevant and justify government support in principle (4.1). However, India's government has a long history of overregulation of the economy. Until the late 1980s, distorted incentives and red tape hampered investment and productivity growth. Against this background, several policy reforms and remaining weaknesses (e.g. related to rural development, forest management, and decentralization) are addressed that are directly related to the biodiesel industry (4.2). Following

21 One successful example for improving the productivity of plant material through R&D is the mycorrhiza technology developed by TERI. Applying this fungus to the roots of Jatropha shortens the gestations period and increases yields by up to 30 % (Adholeya / Singh 2006, 144).

this, an overview is provided of the National Policy on Biofuels and other Union policies (4.3) as well as of biodiesel policies of five Indian states (4.4).

4.1 Rationale for policy intervention

As the previous chapters have shown, biodiesel bears strong potentials – but also risks – with regard to India's simultaneous challenges of energy security, climate change mitigation, and rural development. Despite its potentials, a biodiesel market has not yet fully developed in India. This is due to 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 would be more competitive as it causes far lower environmental costs. 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 consist in non-patentable incremental innovations that can be freely appropriated by anyone. The same applies for the positive social externalities which biodiesel production may imply for rural development.

A number of market failures specifically prevent the poor in remote areas from benefiting from the opportunities of the sector. Most importantly, since TBO-based biodiesel production is a new activity, poor potential cultivators lack information about cultivation methods and required inputs, expected yields, available support measures and the development of the market. Such information is especially important because TBO-based biodiesel production is a risky business: First, because markets are not yet established; second, because of the long-term nature of investments – most TBOs have very long gestation periods; and third, because some of them can only be used for the production of non-edible oil and are thus worthless if the biodiesel market does not take off ("asset specificity"). 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 as regards strategic and long-term activities, the final outcome of consultancy services is unpredictable for farmers, so that small farmers are usually not willing to spend money for consultancy services to obtain the knowledge and information they need.

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 to operate 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. However, policy-makers should consider two more factors. The first one relates to 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 spaces for rent-seeking, and distortion of markets. Until the late 1980s, India relied on centralised policy planning and implementation and on strong regulation of the private sector, all of which was intended to correct real or perceived market failures. This policy, however, produced inefficiencies, market distortions and rent-seeking activities, and ultimately slowed down India's economic development.

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

In sum, 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. As section 4.2 will show, India, from independence to the late 1980s, imposed many heavy-handed regulations that engendered red tape and corruption rather than spurring growth and reducing poverty. Policy-makers must therefore be careful not to increase costs by adopting highly complex policies that exceed 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, 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.

The following section briefly presents some policy reforms that are relevant for developing biodiesel value chains in a way that benefits rural development in India. It shows that despite considerable efforts at deregulation and decentralisation, ineffectiveness and distorted incentives are still a major concern.

4.2 Reforming the policy environment for biodiesel production – achievements and remaining challenges

Since the 1980s, India has made considerable efforts towards deregulation and decentralisation. As regards economic deregulation, industrial licensing requirements have been significantly relaxed. The government adopted a more pro-business attitude aimed at easing the supply- and demand-side constraints faced by private entrepreneurs (Kohli 2006a, 1253). Subsequently, GDP growth accelerated to 5.8 % per annum between 1980 and 1990 (ibid., 1254). At the beginning of the 1990s, India abolished or reduced numerous other regulations and restrictions on economic activities, including restrictions on the inflow of foreign capital and technology transfer; moreover, import tariffs were reduced and service provision liberalized (ibid., 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 noteworthy efforts and achievements, reforms remain largely incomplete. This is especially true for land market, agricultural and forest policies, which remain much more regulated than the manufacturing and urban service sectors. While there are good reasons to regulate these areas in consideration of the need to protect the livelihoods of the rural poor, existing regulations are often inefficient, hold back investments and slow down productivity growth, and in some cases even turn out to be directly anti-poor. With regard to biodiesel value chains, we have identified five areas where reforms have been initiated to correct government failure, but much remains to be done:

1. political decentralisation,
2. land ownership,
3. forest management,
4. marketing of agricultural and non-timber forest products,
5. provision of agricultural extension services.

The following section gives a brief account of these reforms as well as their shortcomings.

Political decentralisation: The 73rd Amendment to the Indian Constitution, which 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. The so-called 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.[22] Their main functions relate to the planning and implementation of rural development activities – paying tribute to the Indian Planning Commission, which 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, 16, in: Alagh s.a., 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 thing, 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 (Johnson 2003, 19; NAC 2005, 5). Moreover, many state laws have given the state bureaucracy wide powers to suspend elected representatives (Saxena / Ravi s.a. [b], 3). Together with a high level of 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. 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.

22 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 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.

Voting behaviour is highly influenced by factors such as social solidarity, bribery, and fear of exclusion from 'below poverty line lists', which allow the listed persons to benefit from a number of social funds. As a result, sarpanchas, the heads of the Panchayats, are often able to manipulate the activities performed by the Panchayats to their own advantage and that of their supporters (see also NAC 2005, 23; Saxena 2003, 28 ff.). 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.

Land ownership: 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[23] (20 %). Between 1951 and 1988, the net area under the control of the Forest Department increased from 41 to 67 million ha, the bulk of which has become 'reserve forests' (Mearns 1999, 4) in which people have no rights.[24] 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 have been able to persuade or bribe local officials to manipulate the records of land rights in their favour (ibid.).

Forest management: From the era of colonial rule up to the post-independence period, large amounts of uncultivated common lands in India were declared 'forest lands' and brought under the ownership and jurisdiction of state Forest Departments (for the following, see Sarin et al. 2003, 2 ff.). In 1980 forest legislation was 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 pur-

23 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, 28 f.).

24 The Indian Forest Act classifies 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 to meet people's needs (Sarin et al. 2003, 2).

poses, which led to their excessive exploitation and subsequent degradation. Only in the late 1980s did local rebellions and a strong civil society movement bring about a reversal of this policy in favour of ecological stability and social justice. Since then, most Indian states have adopted JFM policies under which local communities are entitled to manage certain forest lands in partnership with Forest Departments. Although legislation varies strongly between the states, JFM Committees in general are to manage these lands and the non-timber forest products obtained from them to sustain their livelihoods in an environmentally sustainable manner. Parts of the revenues generated have to be invested in replantation or given to government officials for conducting development work, other parts may be managed by the Committees. By transferring such rights and duties to local communities, JFM has improved 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-governance of community forestry institutions. The new state policy 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, 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.[25] Some have argued that this kind of interference in community forest management has led to an inadequate focus on income generation as the main objective, *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 their day-to-day activities (ibid., 53).[26]

25 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, 136).

26 1996, the Government of India passed a new law, according to which *Panchayat*s in tribal areas are the owners of non-timber forest products.

Moreover, lands that are declared 'forest lands' are often heavily degraded. According to Mearns (1999, 4), half of India's declared 'forest lands' have a forest cover of less than 40 %. The Forest Departments, however, have rarely been able to afforest these lands or even to prevent illegal encroachment. As a result, neither can such 'forests lands' be put to productive use by private investors (e.g. for TBO plantations) nor are effective measures taken to restore their forest cover. In Karnataka we found large tracts of land that had been totally deforested decades ago and are still declared forest lands, although nothing is being done to reverse this situation.

Marketing of agricultural and non-timber forest products is slow in being liberalised. Trade in agricultural produce and inputs has traditionally been characterised by pervasive government intervention (Acharya s.a., 8). Realising that regulation has not increased farmers' income, and instead limited much needed private investment in 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 in part, most states have amended their agricultural marketing acts on the lines of the Model Act (Agricultural Marketing Division 2008). The situation of non-timber forest products is similar: During the 1960s, high-value non-timber forest products were 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 on local natural resources. Collectors were obliged to sell to government-appointed agents, often Forest Development Corporations, cooperatives or tribal societies (Tewari 2006, 280 ff.). In some states, government orders which "smacked of favouritism" (Saxena 2003, ix) granted monopoly lease rights to certain non-timber forest products 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 collectors, and often collectors were paid prices much lower than those prevailing on the market (Tewari 2006, 286). In several states monopolies on non-timber forest products prevailed even despite a new central law of 1996, which acknowledged the traditional ownership rights over non-timber forest products of Panchayats in tribal areas. In these cases, members of forest committees receive only wages for collecting non-timber forest products from forest lands of which they are supposed to be the managers (Saxena 2003, 38 ff.).

Provision of agricultural extension services: 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 farmers. One officer is responsible for 800 to 1000 farmers. There is no system of independent monitoring and evaluation or mechanism for gathering and feeding back the farmers' opinion of the services delivered. Chhattisgarh only very rarely funds private service 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 issued by the Ministry for Agriculture in 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 matter, it remains to be seen to what extent states will adopt these recommendations.

These examples of enduring government intervention in India show that although policy intervention to correct market failures in the rural economy is justified and necessary, it does not always work in favour of the well-being of the target groups. Policies designed to empower rural people have not gone far enough and their effects are often offset by interference of government officials, by local corruption, or by contradictory policies. These risks of government intervention have to be considered when policies for promoting new activities such as biodiesel production are recommended.

4.3 National Policy on Biofuels and other Union policies

India is a federal state with relative autonomy for the federal states. Among other things, agricultural and land policy, managements of forests, and the rules for local government are all state matters. The states thus set most of the conditions for the production of biodiesel. However, the Union also has important competences, e.g. with regard to taxes and fiscal incentives. Demand-side policies, such as mandatory blending of diesel with biodiesel and the rela-

tive taxation of fossil and biofuels are Union matters. Moreover, the Union has a key role in economic and social planning, and it uses a great number of centrally-sponsored Schemes to influence policymaking in the states. Likewise, one of the crucial gaps that needs to be addressed – R&D – is mainly in the hands of the central government.

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 to implement the recommendations of the report (GTZ/TERI 2005, 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 et al. 2006, 56).[27] Since 2004, more than seven ministries and the Planning Commission debated the biofuel policy until it was finally approved in September 2008.

The stalemate of the overall process created considerable uncertainty in the four years between publication of the draft biofuels policy and its final approval. Farmers and corporate investors had no reliable information as to whether compulsory blending of fuels would be decreed, what tax incentives would be available, and which crops to select. One major feature of the draft policy of 2004 was its focus on Jatropha curcas as the preferable plant to be promoted by the government.[28] 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 200 mm (Planning Commission 2003, 111 f.). The plant was to start producing seeds two years after planting. Information about yields was highly vague, stating that they range from 0.4 to 12 tonnes/ha (ibid.). However, experience made in the past few years by research institutions and practitioners has shown that these assumptions were far from reality, and that yields in fact remain at the lower end of the given range. The focus on Jatropha was thus chosen even though research results on the agro-climatic and soil conditions, inputs and maintenance activities that are necessary to obtain economically viable yields from Jatropha were still miss-

27 See also http://biospectrumindia.ciol.com/content/BioBusiness/10511111.asp.

28 NOVOD, Indian Council of Forestry Research and Education (ICFRE), Forestry Research Institute (FRI).

ing. Moreover, research findings 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 though still in the form of a draft - may 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. According to NOVOD, the lack of reliable information on the economics of Jatropha cultivation was one reason for holding back the launching of the new policy (Int. Kureel, NOVOD).

In September 2008, a "National Policy on Biofuels"[29] was finally approved, and it was decided to set up a National Biofuel Coordination Committee, chaired by the Prime Minister, and a Biofuel Steering Committee, chaired by the Cabinet Secretary. The Ministry of New and Renewable Energy has been given responsibility for the National Policy on Biofuels and overall co-ordination. The Panchayati Raj Ministry would also be included as a member of the Steering Committee.

The National Policy on Biofuels reaffirms that biodiesel production will only be promoted on the basis of non-edible oil seeds on marginal lands. The focus would be on indigenous production of biodiesel feedstock, and import of oil from other crops (e.g. oilpalms) will not be permitted. Biodiesel plantations on community and government lands will be encouraged, while plantation on fertile irrigated lands will not be encouraged.

The new policy establishes a number of demand-side support mechanisms and emphasizes the need for more research. In addition, a range of supply-side incentives have been set for the cultivation of TBOs, although most of these are not formally part of the National Policy on Biofuels.

Demand-side policies

The National Policy on Biofuels sets the target of raising blending of biofuels (bioethanol and biodiesel) with petrol and diesel to 20 % by 2017. Moreover, a *Minimum Support Price* for biodiesel oil seeds will be announced to provide a fair price to the growers. The details of the minimum support price mechanism will be worked out subsequently and considered by the Biofuel Steering Committee. The price will be revised periodically. Also, a *Minimum Purchase*

29 See Satish Lele (http://www.svlele.com/biodiesel_in_india.htm) and The Financial Express, Sept. 12, 2008 (http://www.financialexpress.com/news/Biofuel-policy-gets-Cabinet-nod/360218/).

Price for the purchase of biodiesel by the Oil Marketing Companies will be established, and it is to be linked to the prevailing retail diesel price.

Although a target for blending fuels has been set, there are no provisions to make blending compulsory. Mandatory blending would have been a strong signal to encourage investments in fuel crop cultivation and transesterification plants. Under the new policy, it remains to be seen whether the minimum purchase price will be sufficiently high to encourage production. Already in October 2005, the Ministry of Petroleum and Natural Gas proclaimed a biodiesel purchase policy that came into effect in January 2006. According to that policy, oil marketing companies were to purchase biodiesel at a price of now 26.5 Rs./l at currently 20 purchase centres in 12 states. Suppliers had to be registered with the state-level coordinators and meet the specifications of the Bureau of Indian Standards. The oil companies, for their part, were to blend conventional diesel with biodiesel at a maximum of 5 % at the purchase centres. So far, these 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).

Research and Development

The new policy stipulates the establishment of a sub-committee under the Steering Committee comprising the department of biotechnology as well as the Ministries of Agriculture, New and Renewable Energy, and Rural Development, to support research on biofuels. Already in 2004, the National Oilseeds and Vegetable Oils Development Board (NOVOD) had established a "National Network on Jatropha and Karanja"[30] to contribute to the development of high-yielding varieties (NOVOD 2008, no page number). 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 The Energy Research Institute (TERI). Research is financed for issues such as identification of elite planting material, tree improvement to develop high yielding varieties with better quality of reliable seed source, inter-cropping trials, development of a suitable package of prac-

30 Local name for Pongamia pinnata.

tices, post-harvest tools and technology, and detoxification of oil meal of important TBOs (NOVOD 2008, 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 of selecting good germplasm and developing quality planting material. Under the Micromission, 500,000 ha of plants of superior material have been produced in a nursery. Furthermore, the Department of Biotechnology supports programmes for testing the potential of other TBOs, including Pongamia (DBT 2007, 129 f.).

Research seems to be concentrated 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 2006, 4 f.). Current figures suggest that in order to reach economic viability, Jatropha must yield 2 kg of 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, 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 necessary to increase the productivity of TBOs. Achieving higher yields is a necessary condition to make the industry viable and to increase rural income. Higher yields also lead to a greater substitution of fossil energy carriers and lower 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).

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 there is a real threat that food crops may be crowded out. At current market prices very few farmers are abandoning 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 additional income that would generate resources to be invested in increased food production on fertile lands.

Supply-side policies

The New Biofuels Policy confers 'declared goods status' on biodiesel and ethanol. This implies that both will attract a uniform central sales tax or VAT rate rather than the varied sales tax rates prevalent in the states, and movement of biofuels within and outside the states will not be restricted. Already in 2006, the government gave them the status of a 'non-conventional energy resource', meaning that biodiesel was fully exempted from excise duty (S. No. 53A of the Notification No. 4/2006). At the current purchase prices, this 'non-conventional energy resource' status reduces the price for biodiesel by about 4 Rs./litre (Int. Choudhary, Indian Oil Corporation Ltd.). This does not, however, outweigh the benefits that conventional diesel enjoys from heavy 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.

As another measure to encourage the supply of biodiesel, NOVOD initiated a back-ended credit-linked subsidy programme 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.[31] It can be extended to governmental organisations, NGOs or individuals. Interviewees in Karnataka and Andhra Pradesh stated that NOVOD recommends using these funds for Jatropha nurseries only. Nonetheless, both states have also used the funds for Pongamia plantations (Int. Varma/Kanwerpal, Forest Department; Int. Nirmala, Department of Panchayati Raj and Rural Development). Loan assistance by the Rural Infrastructure Development Fund of the National Bank for Agriculture and Rural Development (NABARD) can also be used to fund 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 the

- National Rural Employment Guarantee Scheme (NREGS)
- Watershed Development Programme
- Swarnajayanti Gram Swarozgar Yojana

31 See http://www.novodboard.com/nb-schemes.pdf.

- Village Energy Security Programme
- National Afforestation Programme

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 rural areas to enter into biodiesel planting without any such support. Moreover, as biodiesel plantations aim to contribute to achieving 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 implementing projects in their villages.[32] As Saxena and Ravi note, "[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. [b], 2). 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, 256). Programmes furthermore have problems in reaching their respective target groups and disbursing funds to them without leakages and delays (MoRD 2006, 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, 256).

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

Box 3: National Rural Employment Guarantee Scheme (NREGS) – Innovations and old problems

MoRD has recognised many of these problems and has tried to take these findings into account in designing the most recent National Rural Employment Guarantee Scheme in 2005 (MoRD 2006, 2). For example, targeting errors should be less critical under NREGS as the programme is rights-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 to a compensatory unemployment allowance. The planning process for 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 per state, but on the 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 plan 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, 19 f.). Collective payments and improper measurement of works, delays in payments, inadequate human resources at the Panchayat level or lack of the will on the part of Sarpanches and Panchayat Secretaries to implement the schemes are hampering the effective implementation of the programme (ibid., 23 f.).

Many of these problems can be attributed to distorted incentive structures and lack of accountability on all levels. There is usually no outcome-based monitoring and evaluation as well as no linking of funding to performance. 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. [a], 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., 37).

4.4 State policies in support of biodiesel production

As the discussion on the national biodiesel policy did not make much progress between the publication of the Planning Commission's first report on biofuels in 2003 and its approval in 2008, many states 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 promote comprehensive value chains by tackling both supply and demand (see Table 5) – but also with regard to the types of value chain organisation they promote. In this vein, the approach taken by a state depends on particular state conditions such as availability and ownership of uncultivated land (e.g. government, Panchayat and private land), societal structure, and the actors involved (e.g. different government departments, local communities, private farmers and corporations) as well as on the specific targets it aims to achieve. This chapter gives a brief overview of biodiesel policies in five states. This will provide the background needed to understand the types of value chain organisation and their implications for rural development that are analysed in the following chapter.

The states were 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. 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. Table 5 provides an overview of the most important policies of the five states.

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 rural households depend on village commons and forest lands for their livelihoods (Sarin et al. 2003, 38). In August 2004 the state launched a biodiesel programme with the aims of creating employment and rehabilitating 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, have not been considered. Thus far, about 10,000 ha have been planted through the JFM approach.[33]

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 of 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.[34] 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 goes far beyond mere coordination tasks. Jointly with the heads of the Joint Forest Management Committees (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 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.[35] In contrast to most other states, Uttarakhand does

33 Uttarakhand has 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 et al. 2003, 37 ff.). In other Indian states, similar systems of social forestry have different names. For reasons of simplicity, this report uses the terms "JFM"/"JFMCs" for all these systems.

34 Of seven members, five belong to the Uttarakhand Biofuels Limited (Int. Vaish, UBB).

35 Since 2008, however, issuance of pay cheques from the second year onwards has been the responsibility of the head of the JFMC (Int. Vaish, UBB).

not rely solely on central funding sources.[36] 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 by the company (Int. Vaish, UBB).

More and more seedlings are produced by several self-help groups (SHGs)[37] that 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 currently 3.5 Rs. at the plantations, with the Forest Development Corporation as an intermediary that will deduct 0.5 Rs. for overhead costs. Uttarakhand Biofuels Ltd. calculates that the price "at industry site" is 5.5 Rs., reflecting the costs of transportation, drying, cleaning and storage (Int. Singh, Forest Development Corporation). 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 prices for seeds paid to the beneficiaries are much lower than those in other states (e.g. compared to a minimum support price of 6.5 Rs. in Chhattisgarh), which is probably due to lack of competition in Uttarakhand. The tripartite agreements apply to all seeds grown on the 200,000 ha envisaged 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. No local consumption of SVO/biodiesel is foreseen.

With the help of the Village Energy Security Programme of MNRE, UBB has just embarked on a rural electrification programme in four villages of the state

36 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. Experiences with Swarnajayanti Gram Swarozgar Yojana were rather negative, as the beneficiaries did not respond well to the loan component that is an integral part of the scheme. There is strong apprehension about using funds from NREGS, as the scheme is considered likely to produce unsustainable outcomes.

37 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, 3).

(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; 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 launched a biodiesel programme by creating the Chhattisgarh Biofuel Development Authority (CBDA). With the Chief Secretary of the state as its chairman, the programme has enjoyed 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, and minor forest produce (Resolution No. F 10-5/1-5/2005). 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 this without "any special care as regards to fertilizers or pesticides."[38] By 2007, about 150,000 ha of Jatropha plantations had been raised with funds from MoRD (about 13 million Rs. only in 2007) for raising nurseries as well as NREGS funds for wage labour (5.2 million Rs. only in 2007) as well as some additional funds from the state government of Chhattisgarh (Int. Tiwari, State Planning Board).

38 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, 52). See also Chapter 2 of this report.

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 communal and revenue land, district task forces headed by the District Collector[39] 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 to the Minor Forest Produce Federation, the state procurement centre, at the minimum support price of 6.5 Rs., but they are also free to sell to private traders at any price. The same applies for JFMCs on forest land. Moreover, both private farmers and collectors on revenue land may enter into buyback agreements with private companies. Private companies entering into buyback agreements with farmers and collectors do not have to register with CBDA for licenses. Instead, 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 exemptions, interest subsidies, and infrastructure cost subsidies, among others (Int. Sarkar, D1-BP Fuel Crops).

In addition to this free-market approach, Chhattisgarh pursues two other paths for biodiesel production. In order to ensure proper maintenance of the plantations as well as guaranteed market access, CBDA plans to lease out all existing block plantations. A policy proposal in 2005 was strongly opposed by the public, which feared that leasing arrangements for Jatropha might be abused to circumvent existing land ceiling regulations, and that land might be appropriated for other purposes, including speculative ones. Leasing has therefore been limited to public sector companies entering into a joint venture with CBDA. Nonetheless, officials have stated 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 agree-

39 District Collectors are the administrative heads of the district. They represent all state departments within a district.

ments going beyond the leasing area and establish transport, electrical and social infrastructure.

Furthermore, Chhattisgarh 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, 400 of which will not be connected to the grid. These are planned to be electrified using Jatropha-based biodiesel, funded by the Village Energy Security Programme of MNRE. Biodiesel is considered to have lower investment costs than solar systems. One oil extraction facility will be installed per village cluster consisting 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 (30 Rs. 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 (VECs) 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 much more water than expected,[40] 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).[41] Since 2006, therefore, Andhra Pradesh has focused 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

40 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).

41 This statement was contradicted somewhat 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).

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 40,500 ha of biodiesel plantations in 13 districts of the state, and 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 has funded an R&D programme amounting to 58 million Rs. during 2005-08 (Int. Goel, Rain Shadow Areas Development Department).[42] Biodiesel plantations are promoted on specified private land and on forest land, with emphasis placed on linkages with private entrepreneurs.

Since the 1960s, the state has been assigning small plots of revenue land to landless people, granting them ownership rights to the produce from that land. Today most revenue land has 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 16,200 ha (GTZ / TERI 2005, 23; Int. Krishna, Forest Department) are funded by this scheme (G.O. Ms. No. 27, 28.01.2006). This applies also for the seedlings that are distributed to farmers by the Forest Department. In the future, the current funding period of three years could be extended, as the gestation period of Pon-

42 See also Government of Andhra Pradesh, Note on Rain Shadow Areas Development Department, Biodiesel Programme 2006-07.

gamia takes four to seven years, depending on whether or not the plants are grafted (Int. Goel, Rain Shadow Areas Development Department).

With a view to motivating more farmers and providing them with better training and material inputs, Andhra Pradesh strongly promotes private sector engagement in the sector. If a company has the support of 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.[43] 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, currently 10 Rs./kg (G.O. Ms. No. 6, 20.6.2007).[44] 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.[45] Until today, 20,000 ha have been planted, funded by loans from NABARD and from the World Bank as well as on the basis of the National Afforestation Scheme (Int. Krishna, Forest Department; GTZ/TERI 2005, 24). The Forest Department currently plans 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

43 The Sub-committee consists of representatives from the Finance Department, the Indian Insti tute 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).

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

45 The local name of JFMCs in Andhra Pradesh is Vana Samrakshana Samiti (VSS).

Girijan Cooperative Corporation has a monopoly over many important non-timber forest products, not including Pongamia. JFMCs are therefore not forced to sell to the Corporation; but lacking other buyers, they usually do so. Therefore, the Forest Department is planning to enter into a public-private partnership with a private company to guarantee 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 % blended biodiesel 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 roadsides for centuries. A fully functioning oil-expelling industry already exists, producing SVO for manufacturing paint and processing leather. The price of SVO may reach levels of above 50 Rs./litre (Int. Swamy, Channabasaveshware Oil Enterprises). The price of seeds varies between 10 Rs./kg and 16 Rs./kg (Int. Gowda, University of Agricultural Sciences Bangalore), with middlemen charging about 3-4 Rs./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, 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 it 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 Has-

san district, implemented by the University of Agricultural Science in Bangalore (see Farmer-centred cultivation in Chapter 5.2) (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 carry out the expelling and transesterification of seeds and to decide where to sell which product.

The draft Biofuel Policy was prepared with 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 setting up a Biofuel Development Authority, funding TBO plantations via NREGS and exempting biodiesel from the VAT. One 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 choose 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 supporting the cultivation of Jatropha, predominantly on private land. The first approach was based on the distribution of free seedlings to farmers and Panchayats; it failed miserably due to lack of maintenance. After change of government one year later, this programme was replaced. The main activities of the new government are to subsidize seedlings and to provide loans to cooperative banks 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 to raise and distribute 30 million Jatropha seedlings free of cost to farmers and Panchayats. Thanks to an input-based monitoring system, nurseries had an 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 figures on plants actually distributed. In consequence, masses of seedlings were produced and distributed without any assistance being provided to the cultivators. In fact, many distributors used false promises to convince farmers that Jatropha did not require any fertilizer and irrigation and exaggerated the returns on investment. With a survival rate of only 20–30 % for the seedlings distributed, the programme was a failure and was suspended immediately after the change of government in 2006. Only in a few cases – where Gram Panchayats showed interest and ownership – was the programme relatively 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 1.5 Rs./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, there are plans to extend this programme to Pongamia seedlings (Int. Rajasekaran, Agricultural Officer in Pudukottai District).

To provide assistance to farmers, the government cooperates with several private companies. The most prominent one is D1 Mohan Bio Oils Ltd.,[46] with whom the Director of Agriculture in Tamil Nadu signed a memorandum of understanding. 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 farmers a contract with a buy-back guarantee and provides extension services. Contracts are offered to different kinds of farmers: Small farmers usually plant boundary plantations to diversify the farming system and ensure additional income, better-off farmers opt for block Jatropha

46 For about three years now, D1 Mohan Bio Oils Ltd. has been operating in Tamil Nadu, and it has about 5,000 contracts with farmers on approximately 3,000 ha of land. The company has set the target to have about 16,000 ha of Jatropha under contract by the end of 2008 (Int. Udhanayan, D1 Mohan Bio Oils Ltd.)

plantation because it is a labour-extensive crop, and absentee landlords cultivate Jatropha mainly to benefit from tax rebates. Interviewees also mentioned another reason for absentee landlords to invest in biofuel plantations: Barren lands are sometimes invaded by landless people, and planting Jatropha is a way to demonstrate that land is actually in use, without having to engage in intensive farming activities.

To further support contract farming with Jatropha, the government allocated 400 million Rs. to Primary Agriculture Cooperative Banks[47] for subsidised loans earmarked for Jatropha cultivation in 2008. The 400 million Rs. is equivalent to 20,000 ha of Jatropha cultivation. Since a buy-back agreement is a precondition for the cooperative banks to gain access to loans, and D1 is the only significant seed purchaser at the moment, the company will have a monopoly until other companies step in.

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

47 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 5: 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 farms 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

Table 5: State biodiesel policies (cont.)

Policies \ State		Uttarakhand	Chhattisgarh	Andhra Pradesh	Karnataka	Tamil Nadu
Supply-side measures (cont.)	**Governmental funding sources**	NOVOD, MoRD: Department of Land Resources, State government, Swarnajayanti Gram Swarozgar Yojana, VESP	NREGS, MoRD: Department of Land Resources, 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
	Subsidies for government provision of processing facilities	Central-level subsidies for small-scale extraction units (VESP)	State govern-ment 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

Table 5: State biodiesel policies (cont.)

Policies \ State		Uttarakhand	Chhattisgarh	Andhra Pradesh	Karnataka	Tamil Nadu
Demand-side measures	**Minimum support price**	Jatropha seeds: currently 3 Rs./kg, to be adjusted in 2009	Jatropha seeds: 6.5 Rs./kg SVO: 18 Rs./l	Pongamia seeds: Rs. 10/kg, to be adjusted Jatropha seeds: 6 Rs./kg	No	No
	Blending requirement and incentives for state-owned enterprises to use 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 25 Rs./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

Table 5: State biodiesel policies (cont.)

Policies \ State		Uttarakhand	Chhattisgarh	Andhra Pradesh	Karnataka	Tamil Nadu
Demand-side measures (cont.)	**Promotion of local use of SVO and biodiesel**	Small rural electrification programme	Decentralised value addition and local consumption integral part of the state's approach	Not promoted	Envisaged: Decentralised value addition and local consumption	No promotion of local use of SVO or bio-diesel

Source: Own design

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

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 mode of organisation has yet been established for the value chain. Instead, different actors have established different systems and are 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 identified 13 cases of value chain organisation in five Indian states (see Table 6). 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 the distinguishing feature. This is because this feature is linked with three other aspects that decisively influence developmental effects: ownership of the land on which cultivation takes place, main risk-taker, and main motivations. 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 protection of 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 to sustain farmer livelihoods 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 further below.

Whether or not one of these categories of value chain organisation emerges 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 actors involved (e.g. different government departments, local communities, private farmers and corporations).

This chapter is structured as follows: First, a general overview of the biodiesel value chain in India will be given. The three categories will be discussed in the subchapters that follow. Each subchapter looks at three aspects. First, the 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 in that 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 assessed: (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 involvement in decision-making processes and freedom to choose forms of cultivation and trading partners. (3) "Environmental implications" deals with issues such as biodiversity, water and soil degradation as well as toxicity. Furthermore, (4) "Food security and the risk of displacement" is 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 the purpose. It should be noted that for lack of exact data the appraisal of development implications is based on qualitative information from interviews as well as on some secondary sources.

Table 6: Different possibilities of organizing the biodiesel value chain						
Value Chain / Identi-fiedCases	**Provision of inputs for cul-tivation**	**Land used for cultivation**	**Respon-sibility for planting**	**Organisation of harvest and purchase of seeds**	**Organisation of processing**	**Con-sumption**
Government-centred cultivation						
Uttarakhand	Uttarakhand Biodiesel Board, Forest Depart-ment, 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
Chhattisgarh	Forest Depart-ment, Agricul-ture Department, Horticulture Department, CREDA, Cen-tral government through MNRE (VESP)	Forest land, revenue land, com-munal land	Respective state depart-ment, Pancha-yati Raj	JFMCs and similar groups harvest and *either* sell seeds to Minor Forest Produce Coop-erative... ...*or* have buy-back agreement with private company (e.g. D1-BP Fuel Crops)	Minor Forest Pro-duce Cooperative sells seeds on the market State government plans to set up pro-cessing 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 elec-tricity gen-eration

Table 6: Different possibilities of organizing the biodiesel value chain (cont.)

Value Chain / Identified Cases	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchase of seeds	Organisation of processing	Consumption
Farmer-centred cultivation						
Andhra Pradesh	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
Winrock International in Chhattisgarh	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 6: Different possibilities of organizing the biodiesel value chain (cont.)

Value Chain / Identified Cases	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchase of seeds	Organisation of processing	Consumption
Farmer-centred cultivation (cont.)						
Free market in Karnataka	Market actors provide inputs	Private farmland	Farmers	Middlemen purchase the seeds from the farmers and then sell them to private oil extraction units	SVO extraction is carried out locally (private transesterification units might be established with rising demand for biodiesel)	SVO/biodiesel for the regional and national market
Free market and public-private partnerships in Andhra Pradesh	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

Table 6: Different possibilities of organizing the biodiesel value chain (cont.)

Value Chain / Identified Cases	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchase of seeds	Organisation of processing	Consumption
Farmer-centred cultivation (cont.)						
Free market and contract farming in Chhattisgarh	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
D1 Mohan Bio Oils Ltd. contract farming in Tamil Nadu	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 6: Different possibilities of organizing the biodiesel value chain (cont.)

Value Chain / Identified Cases	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchase of seeds	Organisation of processing	Consumption
Farmer-centred cultivation (cont.)						
Cooperative farming in Karnataka	State government provides free seedlings	Private farmland	Farmers	Village cooperatives (associations) purchase the seeds	District and taluk cooperatives will be in charge of processing and marketing State government will finance a first set of processing units	Biodiesel for the regional and national market
"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 carried out locally	SVO (and maybe biodiesel) for local consumption
Corporate-centred cultivation						
Leasing to joint venture companies in Chhattisgarh	State government provides inputs on already established plantations Joint venture companies will provide inputs on future plantations	Revenue land	Joint venture companies are responsible for cultivation on leased land	Joint venture companies organise harvest	Joint venture companies will carry out all processing	Biodiesel for the national market

Table 6: Different possibilities of organizing the biodiesel value chain (cont.)

Value Chain / Identified Cases	Provision of inputs for cultivation	Land used for cultivation	Responsibility for planting	Organisation of harvest and purchase of seeds	Organisation of processing	Consumption
Corporate-centred cultivation (cont.)						
D1 Mohan Bio Oils Ltd. Estate model in Tamil Nadu	Absentee landlords pay for inputs for the plantations D1 Mohan Bio Oils Ltd. covers 70 % of input costs as an interest-free loan	Private land of absentee landlords	With the support of D1 Mohan Bio Oils Ltd., landlords hire specialized workers for 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 carried out 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 (not yet implemented)	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 carry out all processing	Biodiesel for the market

Source: Own design

5.1 Government-centred cultivation

5.1.1 General characteristics

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. The latter 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 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 used at all) is restricted to the first years. The end-product biodiesel (or in some cases SVO) is either used for rural energy generation or sold on the (inter-) national fuel market.

This study analyses three cases of government-centred cultivation, which will be introduced briefly. The first is Jatropha cultivation on forest, revenue and communal land in Chhattisgarh. Of 2 million ha of fallow revenue land, 157,000 ha have been identified for Jatropha plantations in various districts of the state. Chhattisgarh also possesses 17 million ha of degraded forest land which could be utilised for Jatropha plantation (Shukla 2008, 113). Most of the plantations have been carried out by the Forest Department. In the last few years, it has planted approximately 200 million seedlings on revenue and forest land (Int. Prakash, Forest Department). The Chhattisgarh 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 to set up and maintain the plantations. The case of Chhattisgarh is an example of a smoothly functioning cooperation between state and private actors, because the latter are actively involved in setting up plantations and also offer training facilities (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 Panwar 2006, 115). This approach to electrifying villages on the basis of locally cultivated Jatropha is pursued by two projects, the Chhattisgarh rural energy project by CREDA, and an electrification project of Winrock International.

The second case of government-centred cultivation is Jatropha cultivation on forest land in Uttarakhand. In contrast to Chhattisgarh, here Jatropha plantations are exclusively on forest land; there is no cultivation on revenue land. As already stated in Chapter 4.2.3, this case is characterised by strong cooperation between the Uttarakhand Biodiesel Board (UBB) and the processing company, Biofuels Limited. UBB is reluctant to use NREGS as a funding source due to implementation obstacles in the scheme (Int. Vaish, UBB). In contrast to Chhattisgarh, there are fewer actors involved in biodiesel production in Uttarakhand, the main ones being the UBB, the Forest Department, the Forest Development Corporation and JFMCs.[48] The Uttarakhand case also differs from the Chhattisgarh case in that the UBB employs NGOs for the implementation of projects, whereas in Chhattisgarh all projects are carried out by government agencies. Jatropha is not a non-timber forest product in Uttarakhand, but an agreement between the Forest Department and UBB stipulates that Jatropha can be sold only to the Forest Development Corporation (Int. Vaish, UBB).

The third case is cultivation of Pongamia on forest land in Andhra Pradesh. As in Uttarakhand, government-centred cultivation in Andhra Pradesh is restricted to 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, though only recently on a large scale. Unlike 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. At present, the Forest Department cooperates with one company, Southern Online, which buys the SVO and further processes it into bio-

48 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.

diesel (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.

5.1.2 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 cases analysed have the potential to improve rural livelihoods by contributing to employment as well as to income generation. Especially, landless labourers can benefit from cultivating and collecting TBOs on government or communal land, either through government-sponsored wage employment programmes for planting and maintenance or through income from the collection 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, planting, maintenance and harvesting is carried out by JFMCs trained by the Forest Department. On revenue and communal land, there has not yet been a harvest, but the plan is for Panchayats to 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 plantations. In the first year they earn 1.7 Rs. per plant for pit digging and planting, 0.5 Rs. in the second and third years for maintenance work. SHGs that 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 is currently applying for NREGS funding for 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 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, 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, 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 states analysed have different price systems. In Chhattisgarh, beneficiaries are guaranteed a minimum support price of 6.5 Rs./kg of seeds for Jatropha, whereas in Uttarakhand they receive 3 Rs./kg. UBB emphasised that once biodiesel is available from Jatropha plants, the seed price will be raised (Int. Vaish, UBB). In Andhra Pradesh, the minimum support price for Pongamia was set at 6 Rs./kg in 2005, but augmented to 10 Rs./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 by making it possible to work longer 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 agricultural productivity cannot be measured at present. Both government and NGO projects in Chhattisgarh have furthermore generated some employment opportunities for locals who now work as operators in the local biodiesel unit.

Participation and empowerment

The establishment of SHGs or similar community formations gives government-centred cultivation 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 has been taken up in Chhattisgarh, where SHGs 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 initiated not by local communities but by the Forest Department, this can also reinforce 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).[49] In contrast, other sources criticise the fact 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 has 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). SHGs, 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 to promote their management capacities. With regard to JFM, some studies claim, however, that

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

> *"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, 33-34; see also Murali et al. 2003, 19)

In rural energy security projects beneficiaries 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 projects assessed, Village Electricity Committees are mostly concerned with 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 local electrification project for 4 Rs./kg, even though they could earn 12-35 Rs. on the market, they lose a considerable amount of income. It is argued, however, that this low price is needed to be able to viably 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. All this implies a positive carbon balance for government-centred TBO cultivation.

Earlier, Jatropha plantations in various states failed due to the plant's water requirement (Negi et al. 2006, 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 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, 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 our research, food security is currently not threatened by 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 is done 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 the approval of the local community is also essential for a successful plantation (Int. Prakash, Forest Department). However, individuals do not 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 to 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". 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 months in which crops are already harvested and new ones are not yet planted, the nurseries do not have a negative impact on the villagers' food security. Instead, they provide additional income during a time in which the land is vacant (Int. Vaish, UBB). In Chhattisgarh, there are more than 7 million ha of land available along railroad tracks. To utilise this land for Jatropha cultivation, as currently under consideration by CBDA (Shukla 2008, 113), would have the advantage that its usage would not interfere with other agricultural purposes.

5.1.3 Viability of TBO cultivation and incentive structure

Since biodiesel on government-centred plantations is predominantly produced for national consumption, the existence of reliable market links is vital to en-

sure the economic sustainability of the programme. Differences in the incentive structure of the cases described in this report partly derive from differences in the cooperation between public and private sector. In all states analysed, market links are ensured by a vital private sector, which often initiates the cooperation with the responsible state agencies. Measures like buy-back agreements between community organisations and companies make it possible to enhance the economic sustainability of a plantation. 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 in this case it will not need to invest in plantations of its own. 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 (among others) buy-back agreements with JFMCs.

The existence of a market link alone is not sufficient 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 selling 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. D1-BP Fuel Crops is also seeking 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 is its lack of economic sustainability. A lack of economic sustainability hinders the positive implications that biodiesel production can have on rural development. A plantation that is not economically sustainable cannot generate long-term income and will not have a sustainable impact on community development and environmental protection. In highlighting this, interviewees referred not only to biodiesel plantations but also to prior government-initiated plantations with other crops.

The problem results in part from a lack of ownership. Neither the implementing state agency nor the labourers who receive public funds feel fully respon-

sible for the maintenance of plantations on government land. As labourers do not profit from the harvest, they do not have an incentive to take care that high-quality crops are raised. Granting of usufruct rights, in contrast, would encourage individuals and communities to take care of plantations and could lead to sustainable asset creation. For JFMCs, the incentive is to have long-term additional income and to manage the plantation process up to the commercialisation of the harvest. In Andhra Pradesh in particular, JFMCs are granted 100 % revenue from the Pongamia harvest. This is an exemption only for Pongamia, as JFMCs in this state are usually obliged to reinvest 50 % of the benefit from a minor forest produce in replanting (Int. Kalaghatgi, Forest Department).

In Andhra Pradesh, 2,500 of 8,000 JFMCs have become partly, if not fully, self-sufficient through the revenues they obtain 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 108 million US$ 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 principle of usufruct rights 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) pressed the respective District Collector to issue certificates of usufruct rights for 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 an economic incentive neither on the state agency side nor on the Panchayat side to optimise the use of centrally-sponsored schemes. As a consequence, what is used to gauge successful implementation is the number 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. When the government changed, 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 sur-

vival 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 the funding of plantations by centrally-sponsored schemes is that material costs as well as wages are not always paid on time.[50] If labourers have to wait for weeks to receive their wages, they may not be motivated to continue working, and the plantation process may be interrupted. The same applies for 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 among service providers. In Chhattisgarh and Andhra Pradesh, the ministries in charge choose a state actor to provide a certain service, instead of carrying out a tendering procedure. 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 that often also lack technical and management capacities. One exception is Uttarakhand, where the Biofuel Board has contracts on a 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.

As far as the aim of reaching rural energy security is concerned, the projects 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 should be noted that rural electrification projects usually require government subsidies.

50 *"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., 44).

TBO-based electrification, however, only makes sense if it requires lower subsidies than alternative power supplies. Such projects should not be rolled out on a large scale as long as no reliable data are available to calculate their opportunity costs.

5.2 Farmer-centred cultivation

5.2.1 General characteristics

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

Cultivation of oil-bearing trees for the purpose of biodiesel production is a fairly new activity, and its economic viability for private farmers remains quite unsure. In many regions of India, oil-bearing trees have been used traditionally 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 are willing to do so only 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 account for about 70 % of all operational holdings, whereas 16 % of land holdings are defined as small, with one to two ha (Ministry of Statistics and Programme Implementation). These small and marginal farmers rely on fast returns on investment in order to ensure their livelihoods, and they 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

mostly in the form of block plantations.[51] Their large farm size enables them to diversify their sources of income, and they can afford to dedicate part of their land to risky cash crops like oil-bearing trees. This is especially true of better-off farmers who have additional non-farm income at their disposal.

Farmers are linked to the market in four different ways:

1. Production for consumption on their own farm;
2. Arms-length relations with local processors;
3. Buy-back arrangements with companies or governments;
4. Integration into 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.[52] 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, needed to run 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 for 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 about 4 Rs./kg, the price has since risen to about 15-17 Rs./kg (Int. Swamy, Channabasaveshware Oil Enterprises). Still, most farmers in Karnataka cultivate Pongamia or Jatropha not as a cash crop but as boundary planta-

51 Large land holdings of over 10 ha account for less than 1 % (Ministry of Statistics and Pro gramme Implementation).

52 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.

tion or on unfertile soils. Collection of the seeds takes place as an additional activity on the farms, and the produce is then sold – via middlemen – 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 paint 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 was 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 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 approach 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 land. 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 that it will 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 substantial yields are 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 insurance providers. The company signs a contract with each individual farmer. So far, the clientele is made up mostly of medium farmers who – encouraged by the buy-back contract with D1 Mohan Bio Oils Ltd. and the assistance given by the company – start cultivating Jatropha as a 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 there are plans to adopt the JIG-model of Chhattisgarh in order to reduce transaction costs (Int. Udhayanan, D1

Mohan Bio Oils Ltd.). A transesterification unit with 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 in accordance with 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. These authorised companies in turn line up buy-back agreements with private farmers and set up the necessary processing facilities. Private farmers entering into 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 who 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 are operating in seven districts, but more than 30 companies are in negotiations with the state government.

In the fourth category, the management of the overall value chain is organised through cooperatives on local, regional and state level. A system of organisation is favoured in a pilot project in Hassan District in the State of Karnataka, where the University of Agricultural Sciences, in Bangalore, is seeking to establish cooperatives on local and district level in order to create a structure similar to the Indian dairy sector.[53] The university – supported by funding of about 370 million Rs. from the Government of Karnataka – established a so-

53 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 gained a large share of 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 (http://www.nextbillion.net/node/3230/print).

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 provide technical assistance and consultancy to them. The formation of a cooperative system is promoted in this way. 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 these associations will form a cooperative at *taluk*[54] level and own 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 fuel produced within the region will be promoted 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, a cooperative system of this kind is far from being implemented in Hassan District, let alone in the whole State of Karnataka. However, the number of villages creating associations is rising, and Prof. Balakrishna Gowda of the Biofuel Park expects to have more than 200 village associations by the end of May 2008 (Int. Gowda, University of Agricultural Sciences Bangalore).

5.2.2 Socio-economic and ecological implications

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

Income and employment generation

The main potential of oil-bearing trees is the fact that they can turn formerly unproductive land 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,

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

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 widely. The biodiesel sector is currently in a nascent state, and many seeds are sold not for the purpose of crushing but rather to establish further nurseries. Supply in 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 14 to 35 Rs. on the market (Int. Shiv, Winrock International). But prices will most probably fall as soon as the first significant yields are forthcoming. Then a farmer can be expected to earn six to seven Rs./kg of Jatropha seeds and nine to ten Rs./kg of Pongamia seeds.[55] 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 emerges as an additional activity in rural areas, and not in the case that oil-bearing trees replace traditional agricultural activities. To harvest one Pongamia tree, for example, takes three to four people 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.[56]

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, farmers are organised in so called farmers

55 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.

56 Channabasaveshware Oil Enterprises at Gubbi for example, a typical extraction plant, employs six to seven unskilled workers per day (Int. Swamy, Channabasaveshware Oil Enterprises).

clubs. There are at present around 40 such clubs, with 10-20 members (Int. Swamy, Channabasaveshware Oil Enterprises). This facilitates access of 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 used and the type of cultivation. Chapter 1 described the effects that different oil-bearing tree species can have on soils and forest cover. 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 farmers. The Simarouba tree additionally enables the farmer to plant minor agricultural produce in an intercropping system because of its relatively small canopy. However, 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 characteristics of the respective species, the type of cultivation determines the environmental impacts. As will be pointed out in the following, economic profitability is crucial for farmers, particularly in the case of block plantations. Especially in cultivating Jatropha, fertiliser – organic or inorganic – and irrigation can increase yields several times, and it will be used wherever possible and economically viable. Some farmers, e.g. in Tamil Nadu, were found to use fertilisers and irrigation on their Jatropha plantations. This is likely to worsen the climate effects of cultivation substantially. In the "Fences for Fuel" project in Rajasthan, farmers even use irrigation for their Jatropha hedges (Int. Moeller, Humana People to People India).

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 – food 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, grow Jatropha instead of minor millet due to higher expected income (Int. Shukla, CREDA/CBDA). Also, medium farmers – especially those that are not primarily dependent on their agricultural produce – have started to cultivate Jatropha on fertile land. Farmers interviewed in Tamil Nadu, for example, have 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.[57] 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. While the food security of those particular farmers may not necessarily be negatively affected by such a change in crop, since an improved monetary income situation enables them to buy food for the own consumption on the local market, decreasing food prices may affect other segments of Indian society.

5.2.3 Viability of TBO cultivation and incentive structure

A farmer's decision to cultivate oil-bearing trees depends on a cost-benefit analysis. 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 mainly depends on two key factors: the existence of a market for their produce and a market link; and input and opportunity costs.

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 coopera-

57 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.

tive. Cooperative and contract-farming models have the advantage of leaving out middlemen, and they thus offer the potential to leave a greater share of 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 company's technical knowledge and R&D activities. The danger that a farmer may become entirely dependent on his contract partner and be forced to sell his produce below market price is marginal, since in the case of informal, unwritten buy-back commitments he is not legally obliged to sell to the respective company, and even written buy-back contracts are more than difficult to enforce on farmers. Governments can use a number of different policies to support private buy-back agreements. 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.

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 held by farmers. The state government has earmarked 40 million Rs. for such credits to Jatropha cultivators (Int. Udhayanan, D1 Mohan Bio Oils Ltd.).

Another possibility to encourage contract farming is public-private partnerships that link up farmers with a processing company. Public-private partnerships have the additional advantage that the private company is in this way able to compensate for bureaucratic delays that often characterise government activities. Financing farmer plantation through NREGS, for example, is of no use to a farmer if funds are not disbursed before the start of the planting phase of the oil-bearing trees – which is reported to have happened in Andhra Pradesh (Int. Reddy, Roshini Bio Tech). In promoting public-private partnerships, however, care should be taken to ensure that this does not prevent competitors from entering 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 could – 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. However, those regulations never became reality and now seem outdated. The State of Chhattisgarh does not interfere legally with private companies. That means that there could – theoretically – be competition between different companies. In reality, however, D1-BP Fuel Crops in Chhattisgarh has no competitor in the districts in which it operates.

While the organisational model of a cooperative structure does not guarantee a market, the advantage of such a system is that it permits the individual farmer to appropriate a larger share of the sales price for seeds. If the cooperative functions well and its overhead costs remain low, members will directly benefit from the whole of value addition, from the TBO to the final product, biodiesel. Nevertheless, such a cooperative structure requires strong organisational skills on the part of civil society and the will of 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 to provide substantive 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 whether the establishment of a biodiesel cooperative system can be triggered by a government actor – as it is currently being tried in Hassan district of Karnataka. But top-down approaches are unlikely to be successful.

A reliable market for SVO and biodiesel without any buy-back agreement structure was encountered only 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 to 1000. The corporation recently obtained CDM certificates for this number. Due to an insufficient supply of seeds, KSRTC is currently unable to fulfil its blending targets and needs to import biodiesel from Andhra Pradesh (Int. Rao, KSRTC). Its huge demand, however, serves to stabilize the market for local farmers.

Minimum support prices, which are in place 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. In ways similar to buy-back agreements with private companies, they also ensure that there is a market for the produce. However, minimum

support prices imply the risk that the government may incur losses, and they therefore tend to be fixed at low rates. The minimum support price for Jatropha, for example, is 6.5 Rs./kg in Chhattisgarh and 6 Rs./kg in Andhra Pradesh. By comparison, D1 Mohan Bio Oils Ltd. in Tamil Nadu pays the market price of 7 Rs./kg of Jatropha seeds.[58]

Input and opportunity costs

At current market prices, and given continuing low yields, TBO cultivation is not yet competitive on fertile farm land. Farms therefore usually cultivate them on formerly underutilised land, where opportunity costs are low. On such lands, input costs are decisive for farmer's willingness to engage in biodiesel production.

All states have decided to sharply reduce input costs by distributing free or subsidised seedlings. Chhattisgarh has gone furthest with its decision to freely distribute 500 seedlings to anybody interested in starting cultivation of Jatropha and to provide further seedlings at a reduced price. 500 million seedlings have been given out to farmers within the last three years. In Andhra Pradesh, distribution of free Pongamia seedlings is reserved for small and marginal farmers. While in Andhra Pradesh the policy explicitly targets these farmers, in Chhattisgarh as well the beneficiaries of the policy will mainly be small and marginal farmers who need fewer 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 also distributed for free. About 1.2 million seedlings have already been given out and 3.5 million are set to be distributed in 2008. The state of Tamil Nadu pays a 50 % subsidy on Jatropha seedlings.

On the one hand, such easy access to seedlings may 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 the establishment of a huge transesterification plant ensures that there is a market. On the other hand, low input costs could result in a crop being adopted without any really sound knowledge about its properties, and

58 These prices refer to seeds used for crushing to obtain SVO, while at the moment prices for seeds to establish nurseries are much higher.

farmers are probably more likely to care for seedlings they have paid for than seedlings they have received for free.

Back-ended subsidies that are paid ex post to the beneficiary help to ensure that as many seedlings as possible are well taken care of and become productive plants. In order to enable the beneficiary to make the investment in the first place, back-ended subsidies are usually linked to credit schemes. In the government schemes in Uttarakhand, part of labour wages are paid out only after the survival of a certain percentage of planted seeds has been proven. Another approach was observed in 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 an appropriate means of removing part of the investment risk from the farmer's shoulders. In Tamil Nadu, primary agriculture cooperative banks give credit to 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.

5.3 Corporate-centred cultivation

5.3.1 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 that in the former case 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 in September 2006 made leasing possible for Jatropha cultivation (Government of Chhattisgarh 2006). The objective is to form a joint venture company, with the government authority, CREDA, holding a 26 % share and an oil company holding a 74 % share. This joint venture company will manage Jatropha block 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 has been identified for Jatropha plantation by the various districts (Shukla 2008). The nodal agency – Chhattisgarh Biofuel Development Authority (CBDA) – has already initiated Jatropha cultivation on part of this land. These 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 a land grab under the false pretences of Jatropha cultivation was suspected (Int. Shukla, CREDA / CBDA). In reaction to this, the Government of Chhattisgarh decided only to 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 planting takes place on private land of absentee landlords – is a strategy of D1 Mohan Bio Oils Ltd. aimed at encouraging 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 and unwillingness to deal with farming operations have prevented absentee land owners from cultivating anything on the land. About six months ago, D1 Mohan Bio Oils Ltd. started to approach absentee landlords, submitting an attractive offer to them: 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. So far, five such Estate Model contracts have been signed, and about 80 more are under negotiation (Int. Udhayanan, D1 Mohan Bio Oils Ltd.).

A third possible type of corporate-centred cultivation is a model that, while not yet in practice, has been developed 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 parts 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 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 takes place, community and corporation 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 to build up a sustainable plantation and then, after the community has received back its sovereign land rights, it will continue to sell the yield to the company formerly involved (Int. Thakkar, Biodiesel Society of India).

5.3.2 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 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 that such a plantation may finally create. 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/Sankar 2008). But since most plantations have not yet reached the harvesting stage, the number 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 in the coming year – when its joint ventures in Chhattisgarh and Madhya Pradesh are 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 at present, 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 cattle-grazing purposes. No systematic studies exist on the question whether the employment created for a few villagers through a Jatropha plantation can compensate for the losses the villagers will sustain through loss of pasture land. Further research and monitoring of the matter is needed.

The BOT Model offers employment and income opportunities to 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 to be 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, the risk that the poorest parts of the population may be crowded out is one that should not be underestimated in this model.

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 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 had lain barren before – and, in this case, were not even used by the nearby villagers, since private land owners take strict measures to combat encroachment (Int. Keeranur, farmer in Pudukottai District; Int. Manivaasan, D1 Mohan Bio Oils Ltd.). Any agricultural activity on these 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 is signed between the state government and the joint venture partner, the neighbouring Gram Panchayat has to give its approval. This procedure is designed to ensure that the concerns of the affected villages are taken into account, but our research was unable to assess whether dominant groups are able to manipulate this process (see Chapter 4.2). 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 own 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.

The BOT Model has a certain potential to empower village Panchayats, since these are directly involved in the project. The community is the company's contractual partner to, although the respective company bears most of the financial risk through its 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 foster its ability to act independently. Cooperation and communication with the private company may furthermore enable village Panchayats to develop better skills in economic decision-making. Spill-over effects to other policy areas would be likely. Moreover, the plantation will be transferred back to the Panchayat after 30 years at the latest. So the community has an incentive to work for the success of the TBO plantation. Should it not function to the former's satisfaction, the Panchayat can decide whether to replace the oil-bearing trees with something else. However, in a BOT Model as well, 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 could hamper successful cooperation with private companies, or Panchayats with weak institutions could – instead of being empowered through participation in the project – become dependent on the company partner.

Environmental implications

With regard to the environmental implications of corporate-centred activities, several risks must be noted. Corporate-centred cultivation focuses on economies of scale, and these are most likely go hand in hand with monocultures, 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 simplifies the use of the by-product of processing – the seed cake – as organic fertiliser on the respective plantations. Interlinkage between processing site and plantation is much easier to establish than it is in the case where plantation takes place on hundreds of smaller farms. Large-scale production usually goes hand in hand with high productivity in agriculture and industrial processing, which has a clearly positive effect on the carbon balance of the overall 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). Recalculated for the whole State of Chhattisgarh, that means a share of land area of 3.5 % to 5.9 % will be brought

under Jatropha plantation. If this land is currently covered only with minor shrubs and grasses, the cultivation of Jatropha bushes will 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 certain range of outcomes. The risk of displacement of poor and landless farmers who have encroached on government land or are making 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 having to devote much effort to caring for it, 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 may 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 development 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 of revenue land for TBO cultivation in Chhattisgarh, food production of villagers is quite likely to be affected by 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 communal land to cultivate food crops before it was transferred to the company, the Panchayat needs to compensate them in some way for their losses. Furthermore, it is unlikely that a village community will allow large amounts of fertile agricultural land to be transformed into a TBO plantation. Decision-making takes place at a level relatively close to the persons concerned, making it easier for them to influence such decisions. But as already noted, power structures in Panchayats in India are not always fully democratic, and thus less influential people could be left out.

In the case of revenue land in Chhattisgarh, land use and ownership are not so clearly defined. Villagers often use government-owned revenue land, simply because there is a need for it, and there is no clear-cut distinction between revenue and communal land. In this regard, official land titles differ in many

cases from actual land use patterns on the ground. Decisions taken by the state government – even if under consideration of the local Panchayats – are difficult for the people concerned to influence. In Bilaspur District in Chhattisgarh, for example, local tribal farmers were displaced by the Forest Department, which 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 had no effect (Shiva / Sankar 2008). The leasing of government land in Chhattisgarh will not concern forest land, but still, this case points to 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 local decision-making procedures regarding the use of government and communal land.

5.3.3 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 to 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. Jatropha in particular is a very input-responsive plant whose yields can be greatly increased by improved care. Corporate-centred cultivation is likely to develop best practices – more than in the case of government- and farmer-centred cultivation – first, because the necessary capital is available for investment in research and experiment and second, because economies of scale are necessary for a high return on investment. Optimised cultivation techniques will leverage the biodiesel sector and have spill-over effects for smaller private farmers.

B.B. Choudhary, General Manager for Business Development of Biofuels at Indian Oil Corporation (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 management of large TBO plantations but augmentation of the supply of biodiesel 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 to the company. The interest-free loan that D1 Mohan Bio Oils Ltd. provides to absentee landlords is mainly an investment in demonstration plantations and the development of more productive methods that could then be transferred to contract farmers (Int. Udhayanan, D1 Mohan Bio Oils Ltd.). Furthermore, productivity can be enhanced through R&D carried out by the corporation involved. 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 Indian states analysed. Hence there is no independent quality control for seeds. Another highly controversial issue is the introduction of genetically modified plants. The German NGO Forum on Environment and Development, for example, expects that efforts to develop 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, and this calls 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 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 to undertake major 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.

The support provided for corporate-centred cultivation makes it possible for policy-makers to encourage such sustainable investment in the agricultural sector. In this regard, the main policy mechanism encountered during our research is the land allocation. Leasing in Chhattisgarh as well as allocation of Panchayat land in the BOT Model both imply the transfer of public land to a

corporate entity. Access to land may be an important incentive for corporate investors to enter into the biodiesel sector. At this point in time, investment in biodiesel production is not yet an economically viable undertaking. Free or very inexpensive access to land could therefore be a decisive feature for corporate investors in calculating the risks of investment. In the BOT Model, the investing company has only to pay for Panchayat land by surrendering a share of 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 at 500 Rs./ha in the first year and is gradually increased to 1400 Rs./ha from the eighth year on (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 it remains a 26 % stakeholder in the joint venture company involved.

6 Main findings and policy recommendations

6.1 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 promoted TBO-based biodiesel, using a number of policy measures to enhance supply and demand of biodiesel. Proponents of biodiesel point to the potential of non-edible TBOs to substitute fossil fuels, reducing India's energy dependency and bringing down greenhouse gas emissions. They also highlight opportunities for greening the countryside 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, 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. Thus far, only a limited number of 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 rea-

sons: 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 economically viable 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 for oil-bearing trees and fair price competition between conventional diesel and biodiesel.

This report focuses on the potential for biodiesel for rural development. The 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 corporate-centred cultivation. The study distinguishes between these categories on the basis of two questions: 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.

One important positive impact of **government-centred cultivation** on rural development is the fact that it puts formerly unproductive land to use. The 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, 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 poli-

cies come in. According to our research, proper maintenance of the plantations is a major problem. Both workers and government agencies are shielded from market forces and lack incentives to invest sufficient effort in the activity. For example, labourers only rarely have usufruct rights to the crops they plant. If they do have such rights, purchase monopolies in some cases artificially reduce the price they can obtain for their produce. Public implementing agencies, for their part, are not subject to competition. As output monitoring is rarely carried out 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 wholly obstruct the plantation process, since agriculture depends heavily on seasonal timing. The latter problem can be solved by public-private partnerships in which the private partner can flexibly compensate 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 in 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 may also reach farmers who are not really committed to TBO cultivation, support for access to credit or back-ended subsidies seems to be a more appropriate option. In any case, restricting subsidies to one single crop that – like 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 degrada-

tion, 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 long-term perspective, however, impacts are less clear. If seed prices cross a certain threshold, farmers will replace formerly agricultural land with biodiesel plantations. Assessing the effects of such a scenario on local and national food security is beyond the scope of this report. In general terms, however, mixed effects of high biodiesel prices can be expected. Food prices 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 needs. 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 to 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 the supply of biodiesel and possibly allow for spill-over effects to other producers.

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 concern the possibility that corporate investors may invest on land that was previously used by the local poor, 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 indeed indefinite lease periods increases the risks implied by 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 in India and to intensify land use while greening the countryside.

The 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 inhibit 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 risk of displacement.

At present, Indian policy-makers would be well advised to view 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 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 from the Government of India. Whether the National Biofuels Policy approved in September 2008 after four years of discussion will create the appropriate incentives for farmers and corporate investors still remains to be seen.

6.2 Policy recommendations

A number of policy recommendations have been derived from the previous analysis. They address the question of how government should support biodiesel in order to 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 in which the term is used throughout this study.

They address issues for the upcoming Indian National Biofuels Policy, state policies as well as related support schemes and cover subjects ranging from policy formulation to implementation and monitoring.

6.2.1 General recommendations on biodiesel production in India

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. TBOs 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 for all types of value chain organisation, especially those targeting production for wider markets and not only energy use at the village level.

A considerable research effort is needed to increase 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 to make 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 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 outcomes in terms of both 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.

Oil-bearing trees can be used among other species in areas where forest land is assigned for afforestation. It should be considered that Jatropha, be-

ing 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 fix nitrogen in the soil.

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 6.2.2). Community participation ensures that planting and maintenance will be carried out not only for the sake of wages but with a view to obtaining a high-quality harvest. The beneficiaries should not only take care of plantation and maintenance but also have usufruct rights and be able to market their produce freely. These principles should be applied not only on forest land but on revenue and communal land as well.

Government should preferably support ways of cultivation that integrate oil-bearing trees into rural production systems in a way that does not threaten food production. Planting of oil-bearing trees along roadsides, railway tracks, canals and as boundaries should be promoted. For 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.

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 into the farm economy in the form of boundary plantations or by planting on uncultivated fallows in order to generate supplementary income. Here, multi-species approaches and tree species with multiple uses, such as Simarouba and Pongamia, should be given preference on small farms in order to spread risks and provide sources of income in different seasons as well as to maintain biodiversity.

For farmers whose livelihood does not depend on 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 provide soft loans to support private biofuel farming. Subsidies should be back-ended and credit-linked. Government may also wish to encourage agricultural insurance companies to develop suitable insurance coverage for biofuel plantations.

Leasing to corporate investors may be an alternative if it does not threaten traditional sources of livelihood. To avoid land use conflicts, the Panchayat concerned 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.

Independent power generation at the village or block level should be encouraged with a view to 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 SVO and biodiesel. Government plans for grid extension should be transparent to signal to village communities whether they should invest in a separate village system.

6.2.2 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 way of organizing production and trying to bring this about 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.

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.

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 for 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 development 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.

Service providers should be accountable to village committees as well as to funding agencies. Social audits, that is, participatory village gatherings where state agencies provide information about and are held accountable for government programmes should be conducted periodically 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 have been shown to contribute to the empowerment of 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.

6.2.3 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 exempt 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 their existing procurement infrastructure in 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 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. Also, the market should 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), this would help to reduce India's energy trade deficit, provide an opportunity to increase rural income and encourage rural investment.

The 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 is provided for in the Draft Karnataka Biofuel Policy. Government should support knowledge transfer in this regard to all actors of the biodiesel value chain and facilitate access to the CDM application process, especially for small projects.

6.2.4 Coordination

The National Biofuel Coordination Committee and the Biofuel Steering Committee should ensure a coherent and comprehensive policy approach to develop the sector in a socially inclusive and environmentally-friendly way. In addition to demand-side incentives, this would include alignment of centrally-sponsored schemes with the objectives of the biofuels policy. Moreover, the coordinating bodies should represent all relevant stakeholders, including those from the private sector, representatives of the Panchayati Raj, farmer organisations and civil society.[59] They should continuously monitor the overall content and direction of the policy and revise the policy with a view to past performance and 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

59 The Coordination Committee and the Steering Committee envisaged in the report of the Planning Commission were to include no non-governmental actors (Planning Commission 2003, 127 f.). Regarding public participation in the new National Biofuels Policy, no information is available yet.

electrification, implementing capacity of state governments and Panchayats and many other factors.

Close coordination with centrally-sponsored schemes is needed 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.

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ANNEX

Interview partners during the research			
Organisation	Name	Position	Interview date
Delhi			
Center for Alternate Energy Research, University of Petroleum and Energy Studies	Jai Uppal	Senior Advisor	7 Mar. 2008
Confederation of Indian Industry (CII)	Suprotim Ganguly	Deputy Director Biofuels & Energy Efficiency	6 Mar. 2008
D1-BP Fuel Crops India	Samiran Das	Chief Executive Officer	7 Mar. 2008
D1-BP Fuel Crops India	Sarju Singh	Chairman / Managing Director	7 Mar. 2008
Delhi College of Engineering (DCE)	Naveen Kumar	Assistant Professor	6 Mar. 2008
Friedrich-Ebert-Stiftung, India	Dr. Dr. Peter Gey	Resident Representative	11 Mar. 2008
German Embassy	Dr. Andreas Pfeil	Head, Economic Cooperation and Development	21 Feb. 2008
German Embassy	Dr. Heinz Wirth	Science Counsellor	5 Mar. 2008
German Embassy	Ursula Holzhauser	Agriculture Counsellor	5 Mar. 2008
German Embassy	Eva Tiemann	Commercial Officer	5 Mar. 2008
GTZ India	Pamposh Bhat	Director Climate Change	5 Mar. 2008
GTZ India	Dr. Michael Glück	Programme Coordinator, Natural Resource Management Programme (NRMP)	22 Feb. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Delhi (cont.)			
GTZ India	Divya Kashyap	Technical Manager, NRMP	22 Feb. 2008
GTZ India	Anil Misra	NRMP	22 Feb. 2008
GTZ India	Dr. Rolf Suelzer	Country Director	5 Mar. 2008
Humana People to People India / Fences for fuel	Anna Marie Moeller	Partnership Director	7 Mar. 2008
India-Europe-Consultancy / Freie Universität Berlin	Dr. Klaus Voll	Head / Lecturer	8 Mar. 2008
Indian Oil Corporation Ltd. (IOC)	B.B. Choudhary	General Manager Business Development – Biofuels	11 Apr. 2008
Konrad Adenauer Stiftung	Joerg Wolff	Resident Representative to India	29 Feb. 2008
Kreditanstalt für Wiederaufbau (KfW) India	Nand Kishor Agrawal	Programme Officer, Rural Development and Watershed	5 Mar. 2008
Ministry of Environment and Forest (MoEF)	Dr. J.V. Sharma	Deputy Inspector General of Forests	29 Feb. 2008
Ministry of New & Renewable Energy	Ajit K. Gupta	Adviser	7 Mar. 2008
Ministry of New & Renewable Energy	Dr. H.L. Sharma	Scientist F	7 Mar. 2008
Ministry of New & Renewable Energy	Er. J.P. Singh	Scientist D	7 Mar. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Delhi (cont.)			
Ministry of Rural Development (MoRD)	Dr. D. Ramakrishnaiah	Director/Scientist, Department of Land Resources	26 Feb. 2008
Ministry of Rural Development (MoRD)	Vinay Shankar I.A.S.	Former Secretary (Retired)	29 Feb. 2008
National Oilseeds and Vegetable Oils Development (NOVOD) Board	Dr. R. S. Kureel	Director (Production)	7 Mar 2008
National Rainfed Area Authority (NRAA)	Dr. J. S. Samra	Chief Executive Officer	6 Mar. 2008
Navdanya	Dr. Vandana Shiva	Head	9 Apr. 2008
Nova Bio Fuels Pvt. Ltd. / Biodiesel Association of India	Rajeev Gulati	Vice President/Vice President	26 Feb. 2008
Research and Information System for the Developing Countries (RIS)	Dr. Sachin Chaturvedi	Fellow	25 Feb. 2008
Society for Promotion of Wastelands Development (SPWD)	Vijay K. Sardana	Executive Director	28 Feb. 2008
Society for Promotion of Wastelands Development (SPWD)	Ajay Bhan Singh	Senior Programme Officer	28 Feb. 2008
Society for Promotion of Wastelands Development (SPWD)	Pramod Tyagi	Programme Director	28 Feb. 2008
The Energy and Resources Institute (TERI)	Dr. Alok Adholeya	Director, Biotechnology & Management of Bioresources	22 Feb. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Delhi (cont.)			
TERI University	Jai Kumar	Student	8 Apr. 2008
Winrock International India	Aditi Dass	Coordinator Climate Science Group	10 Mar. 2008
Winrock International India	Produyt Mukherjee	Program Officer (Energy & Environment)	10 Mar. 2008
World Bank	Vikram K. Chand	Senior Public Sector Management Specialist	10 Mar. 2008
Andhra Pradesh			
Department of Rural Development	K. Nirmala	Commissioner of Rural Development	31 Mar. 2008
Department of Rural Development	C. H. Rangarano	n.a.	8 Apr. 2008
Forest Department	Ramesh G. Kalaghati	Chief conservator of Forests	8 Apr. 2008
Forest Department	B. Murali Krishna	Addl. Prl. Chief Conservator of Forests	8 Apr. 2008
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)	Suhas P. Wani	Principl Scientist and Regional Theme Coordinator Asia	1 Apr. 2008
Rainshadow Areas Development Department	R. S. Goel	Principal Secretary	29 Mar. 2008
Roshini Biotech	Anil Reddy	Chief Executive Officer	2 Apr. 2008
Southern Online Bio Technologies Ltd.	N. Satesh Kumar	Managing Director	3 Apr. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Andhra Pradesh (cont.)			
The Energy and Resources Institute (TERI)	Sandeep Arora	Manager	5 Apr. 2008
The Energy and Resources Institute (TERI)	Pramod G.	Research Associate	4 Apr. 2008
The Energy and Resources Institute (TERI)	V. V. V. Satyanarayana,	Field Forest Expert	5 Apr. 2008
The Energy and Resources Institute (TERI)	Syed Arif Wali	Research Associate, Forestry and Biodiversity	4 Apr. 2008
The Energy and Resources Institute (TERI)	Kamlesh Shukla,	Research Associate, Centre for Mycorrhizal Research	4 Apr. 2008
Chhattisgarh			
Chhattisgarh Renewable Energy Development Agency (CREDA) / Biofuel Development Authority (CBDA)	Dr. S. K. Shukla	Director of CREDA/ Executive Director of CBDA	20 / 25 Mar. 2008
Chhattisgarh Renewable Energy Development Agency (CREDA)	Rajeev Gyani	Executive Engineer	24 Mar. 2008
Chhattisgarh Biofuel Development Authority (CBDA)	Anil Ambast	Technical Officer	24 Mar. 2008
D1-BP Fuel Crops	Sumit Sarkar	Regional Manager	17 Mar. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Chhattisgarh (cont.)			
D1-BP Fuel Crops	Manoj Sharma	Senior Executive – Plantation	19 Mar. 2008
Department of Agriculture, Cooperation, Animal Husbandry and Fisheries	P. R. Kridutta	Director in the Directorate of Agriculture	24 Mar. 2008
Department of Panchayat Raj and Rural Development	R. P. Mandal	Secretary	25 Mar. 2008
State Planning Board	Dr. D. N. Tiwari	Vice-chairman	18 Mar. 2008
Winrock International India	Jay Chand Shiv	Project Officer	25 Mar. 2008
Karnataka			
Agriculture Department	Dr. K. V. Sarvesh	Agriculture Commissioner	2 Apr. 2008
BAIF Institute of Rural Development	Dr. GNS Reddy	Director	29 Mar. 2008
Biodiesel Society of India	Bharat Thakkar	Secretary General	28 Mar. 2008
Channabasaveshware Oil Enterprises	Ohileshwara Swamy	General Manager	29 Mar. 2008
Finance Department	K. Amaranarayana	Addl. Secretary (former Deputy Commissioner of the District of Chitradurga)	31 Mar. 2008
Forest Department	A. K. Varma	Principal Chief Conservator of Forests	2 Apr. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Karnataka (cont.)			
Forest Department	Mr. Kanwerpal	Chief Conservator of Forests	2 Apr. 2008
Government of Karnataka	Sudhakar Rao	Chief Secretary	2 Apr. 2008
Government of Karnataka	V. Balasubramanian	Retd. Additional Chief Secretary	28 Mar 2008
Indian Institute of Science, Department of Mechanical Engineering	Prof. Udipi Shrinivasa	Professor	28 Mar. 2008
Institute for Social and Economic Change	K. V. Raju	Professor and Head of the Centre for Ecological Economics and Natural Resources	28 Mar. 2008
Karnataka State Road Transport Corporation (KSRTC)	Ananda Rao P. S.	Chief Environment Officer	1 Apr. 2008
Mahathma Gandhi Regional Institute of Rural Energy and Development, Government of Karnataka	Ritu Kakkar	Executive Director	1 Apr. 2008
National Bank for Agriculture and Rural Development (NABARD)	C. V. Reddy	Assistant General Manager	3 Apr. 2008
National Bank for Agriculture and Rural Development (NABARD)	Sangeeta Prasad Mehra	Manager	3 Apr. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Karnataka (cont.)			
Samagra Vikas	Ramakrishna Y. B.	President	29 Mar. 2008
University of Agricultural Science Bangalore	Prof. Balakrishna Gowda	Professor	29 Mar. 2008
University of Agricultural Science Bangalore	S. Joshi	Retd. Professor	1 Apr. 2008
Uttarakhand			
Centre for Technology and Development	Rajeev Choudhury	n/a	3 Mar. 2008
Indian Council of Forestry Research and Education / Forestry Research Institute / Arid Forest Research Institute	Dr. Negi	Director	4 Mar. 2008
Indian Council of Forestry Research and Education/ Forestry Research Institute/ Arid Forest Research Institute	Dr. Rabindra Kumar	Deputy Director General	4 Mar. 2008
Indian Council of Forestry Research and Education / Forestry Research Institute / Arid Forest Research Institute	Dinesh Kumar	Researcher	4 Mar. 2008
Uttarakhand Biodiesel Ltd.	Atul Lohia	Chief Executive Officer	3 Mar. 2008

Interview partners during the research (cont.)			
Organisation	Name	Position	Interview date
Uttarakhand (cont.)			
Uttarakhand Biodiesel Ltd.	Pawan K. Agrawal	Chief Financial Officer	3 Mar. 2008
Uttarakhand Biofuel Board (UBB)	Capt. (I.N.) (Retd) Vinod Vaish	General Secretary	3 Mar. / 11 Apr. 2008
Uttarakhand Forest Development Corporation	Dr. S. D. Singh	Regional Manager	1 Mar. / 10 Apr. 2008
Tamil Nadu			
D1 Mohan Bio Oils Ltd.	S. Udhanayan	Senior General Manager	7 Apr. 2008
D1 Mohan Bio Oils Ltd.	M. Manivaasan	Zone Officer	8 Apr. 2008
Department of Agriculture	S. Rajasekaran	Agricultural Officer in Pudukottai District	8 Apr. 2008
Department of Agriculture	V. Bumpath Kumar	Agricultural Officer in Pudukottai District	8 Apr. 2008
Farmer in Perambalur District	Mr. Duraisamy	Farmer	7 Apr. 2008
Farmer in Perambalur District	Mr. Manisundaram	Farmer	7 Apr. 2008
Farmer in Perambalur District	Mr. Roweligam	Farmer	7 Apr. 2008
Farmer in Pudukottai District	Mr. Keeranur	Farmer	8 Apr. 2008
Tamil Nadu Agricultural University	Prof. Sridhar	Professor	8 Apr. 2008

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