CHAPTER 7

Jatropha for pro-poor development

While the aim of pro-poor development is to increase economic benefits to the poorer members of society, such development should not unduly threaten food or water security, reduce access to land or create poor working conditions. Pro-poor development should be specifically pro-women in order to address the gender imbalance of access to economic opportunities, health and education in developing countries. Pro-poor development has to be sustainable, including the need for environmental sustainability.

This chapter examines the importance of biofuels and the potential of jatropha for poverty reduction, together with the risks jatropha biofuel development presents to the livelihoods of the rural poor and to the environment. It further characterizes jatropha production systems and concludes with the conditions required for jatropha to make a meaningful impact on pro-poor development.

BIOFUELS – AN OPPORTUNITY FOR THE RURAL POOR

Almost 2.5 billion people in developing countries earn their livelihoods from agriculture. Of these, 900 million live below the poverty line of USD 1.00 a day. In addition, agriculture directly employs 1.3 billion people, or 40 percent of the global labour force, yet agriculture only contributes around 4 percent of global GDP (some USD 1.6 trillion).

The first issue is whether, if these people stay in agriculture, the agricultural basket of commodities and products is large enough to improve their incomes and lift them out of poverty. As this is unlikely, the only possibility is to reverse the long-term decline in food prices and expand the basket (Figure 10 shows the general decline in food prices of major commodities from 1900 to 2008). Of the several price peaks in the past century, the 2007–2008 food price peak was the most extreme. It was due largely to higher oil prices and the parallel increased demand for biofuel feedstocks being addressed through the use of food crops such as maize.

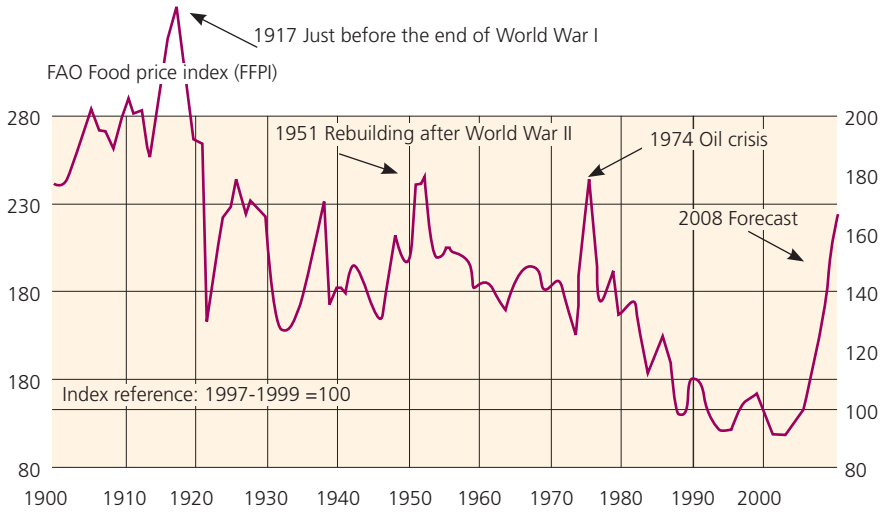

FIGURE 10: **Food prices 1900 – 2008.**

Source: UNEP/GRID-Arendal (2009): Hugo Ahlenius, Nordpil.

The second issue is whether these people could move out of agriculture. If half the agricultural labour force moves out of agriculture in the next 20 years, it is unlikely that these 650 million people can be absorbed into other sectors in developing countries. This is a large number compared to the GDPs of the OECD countries and the numbers of people employed. In 2008, the USA had a USD 14 trillion economy with a labour force of 153 million and an unemployment rate of 5 percent. At the same time, the EU had a USD 16 trillion economy with a labour force of 222 million and an unemployment rate of 9 percent. However, in the USA and EU,

15 to 20 percent of the labour force is employed in activities related to agroindustry and agricultural services.

The agricultural basket is small and, unless it is expanded through new commodities and related agro-industries and agricultural services, the prospects for reducing poverty through development of the agriculture and associated sectors remain bleak. However, prospects improve when the agricultural basket is expanded to include biofuels, because the energy market is so much larger. This underscores the importance of biofuels in alleviating poverty. However, any effort to do so must be undertaken responsibly, addressing both food security and environmental concerns.

CHARACTERIZATION OF JATROPHA PRODUCTION SYSTEMS

Jatropha production systems are beginning to emerge that can be differentiated by scale, ownership and objective. Some differentiation is attempted here, by describing the main characteristics and their relative contribution to potential poverty reduction. These production systems are (see Figure 11 on page 81):

- plantation
- plantation on wasteland areas
- outgrower schemes
- plantation + outgrower schemes
- smallholder production
- livestock barrier hedges

Plantation: These schemes are in excess of 5 ha, under either public or private ownership. In 2008, plantations represented around 20 percent of the area planted to jatropha, with governments being the main drivers. This sector is expected to see the greatest growth in the next five years. By 2013, it is anticipated that nearly 50 percent of jatropha planting will be large scale, of which more than 20 percent will be plantations in excess of 1 000 ha.

Growth of plantation schemes will be driven by investments from the major oil companies and international energy conglomerates (Gexsi, 2008) with the objective of jatropha oil production. There is little expectation of further investment for the local production of biodiesel.

Plantation schemes have the least potential to enhance rural development but they increase rural employment opportunities, and their development investment and risk are borne by private financial and state institutions rather than by farmers.

Plantation + outgrower schemes: This model places the investment risk of growing jatropha onto the farmer. The upside is support in the form of improved planting material, inputs and agronomic advice. The potential of this type of scheme for pro-poor development will depend on the level of support from the central organization and the terms of contract. Smallholder outgrowers play a significant part in growing jatropha, more so in Africa and Asia than Latin America. There have been reports of failures of outgrower schemes, which may shift the concentration of future growth to plantations (Gexsi, 2008).

Outgrower schemes: As above but there is no association with a commercial plantation. Outgrowers are smallholder producers who are contractually linked to a central organization for seed purchase and oil extraction.

Smallholder production: With smallholder production, small farmers do not have contractual purchase agreements but, instead, sell seed to local middlemen. NGOs support small farmers' groups by providing technology and advice for the local production and use of jatropha oil, allowing more added value to be retained in the local community. This leaves small farmers able to pursue their own objectives, such as more sustainable production systems with less risk through permanent intercropping with food and other crops.

Livestock barrier hedges: This system of jatropha production and utilization is most evident in dry regions, especially in Mali. Jatropha hedges provide soil erosion control, increase water entrapment and infiltration, and protect crops from wandering livestock as well as oil production for local use.

The extent to which these production models can contribute to pro-poor development is summarized in Figure 11.

CONTRIBUTION TO PRO-POOR DEVELOPMENT							
Jatropha production systems	Improves household and regional food security	Promotes and increases energy services in the local community	Generates the largest value added in the local community	Contributes and enhances the sustainability of smallholder farmers	Includes and benefits farm workers and landless farmers	Enhances environmental resources	Prioritizes local use vs. urban or export use
Plantation							
Outgrower							
Plantation + Outgrower							
Smallholder production							
Community plantation wasteland areas							
Livestock hedges – dry areas							

Low direct contribution to pro-poor development; potentially high indirect contribution to pro-poor development nationally

Medium direct contribution to pro-poor development; potentially medium indirect contribution to pro-poor development nationally

High direct contribution to pro-poor development; potentially low indirect contribution to pro-poor development nationally

FIGURE 11: The relative extent to which jatropha production systems are likely to directly contribute to pro-poor development.

JATROPHA – AN OPPORTUNITY FOR THE RURAL POOR IN SEMI-ARID REGIONS

The opportunities for agricultural activities are limited in the dry areas of the world where intensive agriculture is difficult and there is increasing environmental degradation. Biofuel production can be especially beneficial to poor producers, particularly in remote areas far from consumption centres, where inputs are more expensive and prices lower, thus making food production, by and large, non-competitive. In areas that are both dry and remote, there is little opportunity for alternative farming strategies. Niche products can be developed, but relatively few people will benefit due to limited demand. Jatropha offers a potential opportunity in such regions to strengthen rural livelihoods.

OPPORTUNITIES FOR POVERTY REDUCTION

Poverty springs from a lack of income and assets, and particularly a lack of empowerment that limits livelihood options. The cultivation of jatropha for seed production expands livelihood options with the opportunity to earn income for smallholder growers, oil mill outgrowers and members of community plantation schemes or through employment on private-enterprise jatropha plantations.

Women especially can benefit, because milling machines powered by diesel engines fuelled with jatropha oil reduce the amount of tedious work they must do. Using jatropha oil as a replacement for traditional biomass cooking fuels is also healthier, as cooking is done in a smoke-free environment, and women do not have to spend time gathering fuelwood. The decreased need for fuelwood also relieves pressure on forest resources.

Small businesses in the rural non-farm sector can become more efficient with availability of a cheaper and more dependable fuel source, for example to power cutting and grinding machinery. Using jatropha oil to fuel irrigation pumps and two-wheeled tractors can increase agricultural efficiency.

Addressing energy poverty by growing jatropha and using its oil within rural communities for diesel-powered electricity generation offers benefits for health, education and information, because:

- healthcare improves with provision of power for refrigeration of vaccines,
- education benefits from better light for extending studying hours,
- information access improves when electricity can power cell phones, computers, televisions and radios, and
- health and education professionals are more likely to live and work in remote rural areas if living conditions are made more comfortable through the provision of electricity.

There is an opportunity to increase the value of the natural resource asset base of the rural poor by utilizing jatropha's ability to grow on poor and saline soils in dry regions.

The use of seed cake as fertilizer and jatropha's potential to reduce erosion can halt or reverse land degradation. The use of seed cake for livestock feed is a potential opportunity to improve the efficiency of rearing livestock, if non-toxic varieties are developed. However, if seed cake is used for feed or energy production instead of fertilizer, the capacity of jatropha growing for land reclamation will be lessened. An assessment will be needed of the values of alternative products that minimize the opportunity cost.

As elaborated earlier, there are larger scale jatropha production systems that also offer pro-poor development opportunities through, for example, wage employment, contract farming leading to increased productivity and incomes, and reduction in local consumer price of biodiesel.

Further opportunity for poverty reduction in the form of carbon payments for liquid biofuel production – which will be possible through Clean Development Mechanism (CDM) procedures – are designed to enable applications by small producer groups. The CDM enables industrialized countries to finance low carbon emission technologies in developing countries as an alternative to more costly technologies for reducing GHG emissions in their own countries. Box 6 (see page 84) highlights appropriate strategies for pro-poor development of jatropha.

Apart from the opportunities, there are risks to the sustainability of jatropha bioenergy production in terms of economic viability. There are also risks to the environment and to society.

BOX 6. **Pro-poor strategies for jatropha development**

- Contribute to household and regional food security.
- Increase energy services in the local community.
- Generate the largest value added possible.
- Enhance the sustainability of smallholder farmers.
- Include farm workers and landless farmers.
- Enhance environmental resources.
- Prioritize local use *vs*. urban or export use.

ECONOMIC RISKS

Feedstock production, particularly the harvesting costs of jatropha, may prove excessive. Jatropha growing could prove uneconomical if higher oil-yielding and non-toxic varieties are not forthcoming. The level of economic returns that would attract and retain investment by the private sector may not be attainable on degraded lands. Figure 12, which compares the returns to labour for jatropha to other biofuel feedstocks, shows that jatropha compares poorly to sugarcane and oil palm, but much depends on the level of yield. There is an urgent need to improve jatropha yields through breeding and by addressing the knowledge gaps in jatropha feedstock production.

Low mineral oil prices will depress the biofuel market without price support. With a trend of long-term increases in the price of fossil oil prices, there will be fluctuations in the ability of biofuel feedstocks to compete with mineral oil. However, long-term price supports may not be a sustainable option for many countries.

Bioenergy from jatropha could become obsolete as second and third generation technologies reach commercial scale. Measures should be considered to ensure that value chains have the means and resources to adapt to emerging opportunities as these new technologies come on-stream.

Potential earnings from carbon emission reductions (CERs) may be jeopardized by intensive production systems that seek to maximize yields but which also may reduce savings in GHG emissions.

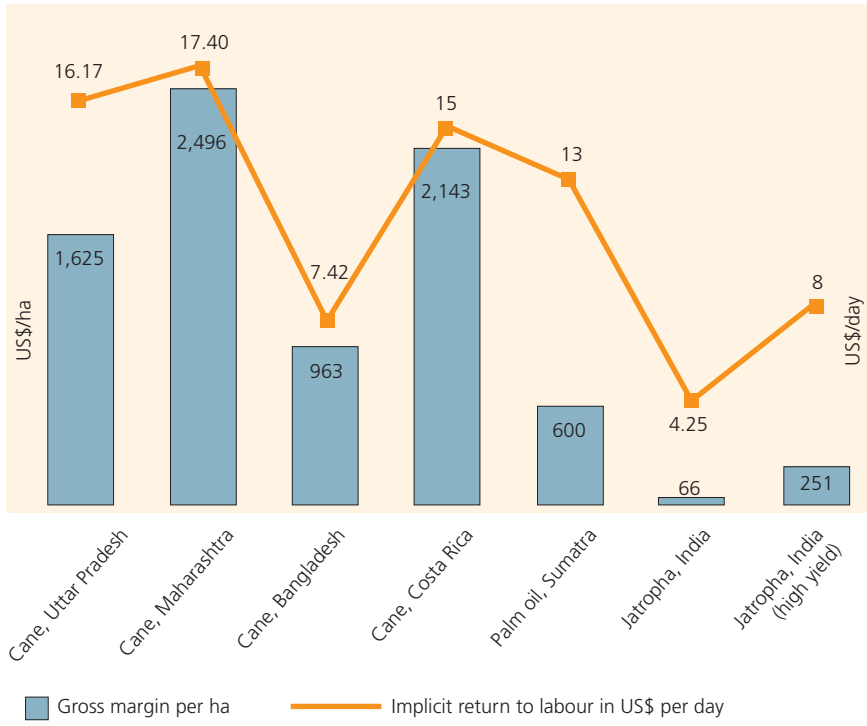

FIGURE 12: **Gross margins, returns to labour in biofuel feedstock production.**

Source: Gallagher (2008).

ENVIRONMENTAL RISKS

Negative impacts on biodiversity are to be expected where jatropha cultivation replaces natural ecosystems. To some extent, this may be mitigated by mixed species cropping with other biofuel crops, food or fodder crops, or timber species. Where jatropha is planted on degraded land, the risk to biodiversity is likely to be small.

Detailed life-cycle analyses of GHG emissions from jatropha biofuels are not available, but there is strong evidence that net GHG emissions will be lower if there are less intensive production systems, if feedstock production is on lands marginal for agriculture and if use of nitrogen fertilizer is avoided or kept to a minimum. In addition, the use of by-products for energy will increase the GHG savings. On the other hand, there will be less GHG emission savings if the oil is processed to biodiesel and if it is shipped to overseas markets.

Research is required to establish good farming practices for jatropha production by small producers as well as by large producers. Conservation agriculture practices under both extensive and intensive systems can help to optimize input use and offer higher productivities and returns with minimal environmental risks. It is likely that large-scale commercial production may have to be located in subhumid ecologies on soils with good production potential.

The effect on the environment of applying large quantities of seed cake fertilizer is unknown and research is required to ascertain whether this presents a risk. Mexican varieties are considered non-toxic, but they still contain curcin and residual levels of phorbol esters. There is also the risk of jatropha becoming a nuisance weed and threatening more fragile ecosystems by competing with and predominating native species.

RISKS TO SOCIETY

The economies of scale favoured by biofuels encourage the acquisition of large areas of land by private concerns. This threatens access to land by the poor in rural areas where land tenure systems are weak. Improved land administration systems that harmonize formal and customary land tenure will be required.

While large-scale production will create jobs in rural areas, these will be mainly low-skilled and seasonal. The labourers face the possibility of poor employment conditions and unsafe working practices for which government and pro-poor civil society institutions will need to establish checks.

Outgrowers under contract to supply large processors may face unfair business practice with lack of legal redress in the event of reneged contracts. Small farmers will have little negotiating power for settling sales terms and conditions with large private concerns unless they form effective cooperatives and producer organizations.

Jatropha cultivation is unlikely to reduce access to water supplies, as jatropha uses little water compared to other biofuel crops. However, large-scale biodiesel production will create a local water demand that may create conflict with other water users. Accidental pollution of potable water may also be a concern, given the large quantities of methanol required in the biodiesel production process.

Pre-existing gender inequalities may be sustained by biofuel development policies. Policies will be needed that promote gender equality and women's empowerment.

Using land to grow jatropha in place of food crops may threaten local food security if there is an absolute shortage of land. This risk will be reduced by using land unsuited to food crops for jatropha cultivation. However, there will be a tendency for private concerns to utilize better land to increase the return to capital invested and to situate plantations in areas with better transport links, neither of which are pro-poor in a production sense. Yet, they can contribute to poverty alleviation and rural development through on-farm and off-farm employment generation and by lowering the price of biodiesel, thereby making it more accessible to both rural and urban poor.

The toxicity of the seeds, oil and seed cake is a potential risk to human health, although clearly manageable if given proper attention.

The outlook is for more large-scale plantations to grow jatropha with increasing ownership by the private sector, which may contribute little directly to pro-poor development – but may do so indirectly through employment generation and reduction in the price of biodiesel. Therefore policies are needed that take into account the risks and benefits that can result from jatropha production and can guide jatropha development towards more equitable mix of production models.

POLICY CONCLUSIONS

At the global level, there is a need for coordination of biofuel development and an international food reserve system to protect the vulnerable poor. To meet pro-poor objectives, international support for research into jatropha agronomy and genetic improvement is needed. The development of non-toxic varieties should be a priority. CDM methodologies and certification to support sustainable jatropha production systems need to be accessible by the rural poor.

Taking advantage of the opportunity jatropha presents for rural development will require developing countries to address the policy, regulatory and public investment constraints that generally affect their agricultural development. Biofuels need to be integrated within a broader framework of investment in rural infrastructure and human capital.

Large-scale plantation type schemes should be promoted as part of the pro-poor development strategy to generate employment and incomes, and make biodiesel affordable to the poor.

Too much regulation of the biodiesel industry in the early stages could exclude small producers. Small feedstock producers can be assisted by legislation that sets quotas, requiring the large oil processors to source minimum quantities from small farmers.

The expectation that jatropha can substitute significantly for oil imports will remain unrealistic unless there is an improvement in the genetic potential of oil yields and in the production practices that can harness the improved potential. For the present, the main pro-poor potential of jatropha is within a strategy for the reclamation of degraded farmland along with local processing and utilization of oil in a way that can improve and diversify rural livelihoods, particularly for the disadvantaged rural poor in semi-arid regions. In addition, by providing physical barriers, jatropha can control grazing and demarcate property boundaries while at the same time improving water retention and soil conditions. These attributes, added to the benefits of using a renewable fuel source, can contribute in an even larger way to protecting the environment.

BOX 7. **Pro-poor jatropha policies and practices**

- Ensure strong commitment to pro-poor development. Pro-poor models will only succeed if guided in that direction.
- Target areas that are remote, have poor transport links or high costs for imported fuel.
- Target areas that are marginal for agriculture but also those marginal areas that can enhance food security and incomes.
- Integrate development of locally owned off-grid power and multi-functional platforms with jatropha production and processing in remote areas.
- Integrate the reclamation of degraded agricultural land with jatropha production, using the seed cake as fertilizer and employing conservation agriculture practices.
- Support large-scale jatropha production schemes that do not compete for land with food crops, in order to promote food production while increasing rural employment and access to biodiesel.
- Support research for better jatropha varieties and improved agronomic practices, including conservation agriculture and integrated pest and nutrient management.
- Support research and development of new uses of jatropha oil and its by-products.
- Promote responsible public-private partnerships to drive product development and address issues along the value chain.
- Legislate for large oil mill companies to purchase minimum quantities from small producers where large plantations predominate.
- Safeguard land and property rights, including communal property, of the rural poor.
- Be specifically pro-women, to address the gender imbalance of access to economic opportunities, health and education.

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Jatropha: A Smallholder Bioenergy Crop
The Potential for Pro-Poor Development

This publication presents a compilation of information on key practical issues affecting jatropha for pro-poor development. The information, presented by specialists from around the world at the International Consultation on Pro-Poor Jatropha Development held in Rome, Italy in April 2008, is based on the knowledge available from research reports and ongoing unpublished research material.

This document provides a brief overview of biofuels, their growth drivers and their potential impacts on poor societies. It also summarizes the most recent data on the cultivation, seed harvesting, processing, uses and genetic improvement of jatropha, and gives an overview of experiences with jatropha production from case studies in sub-Saharan Africa and South Asia.

The information is provided to increase knowledge of jatropha throughout subtropical and tropical areas. It will also contribute to strengthening policies and strategies that recognize the potential of jatropha with regard to pro-poor development, sustainable rural income and improved livelihoods in developing countries.

This publication will interest a wide range of readers including government and institutional policy- and decision-makers, international and multilateral development organizations, donors, NGOs, the private sector and foundations as well as researchers, advisors, teachers and professionals in agriculture.

ISBN 978-92-5-106438-2 ISSN 1020-4555

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I1219E/1/10.09/1200