


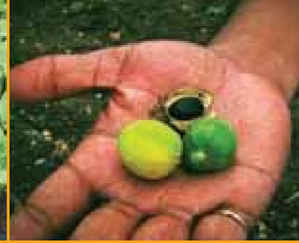

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Jatropha: A Smallholder Bioenergy Crop

The Potential for Pro-Poor Development

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The Potential for Pro-Poor Development

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FOREWORD

As developing countries face increasing local demand for energy in rural areas, they also must deal with both economic and environmental pressure on agricultural lands in general. The possibility of growing energy crops such as *Jatropha curcas* L. has the potential to enable some smallholder farmers, producers and processors to cope with these pressures.

Jatropha is an underutilized, oil-bearing crop. It produces a seed that can be processed into non-polluting biodiesel that, if well exploited, can provide opportunities for good returns and rural development. In addition to growing on degraded and marginal lands, this crop has special appeal, in that it grows under drought conditions and animals do not graze on it.

However, many of the actual investments and policy decisions on developing jatropha as an oil crop have been made without the backing of sufficient science-based knowledge. Realizing the true potential of jatropha requires separating facts from the claims and half-truths.

This review is based on the records of the International Consultation on Pro-Poor Jatropha Development held in April 2008, in Rome, Italy, and hosted by the International Fund for Agricultural Development (IFAD), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Foundation (UNF) and the Prince Albert II of Monaco Foundation. The consultation was designed to support activities aimed at developing appropriate technologies for sustainable intensification of biofuel feedstock production, studying the economics of bioenergy for rural needs and assessing its impact on rural poverty.

The review provides a brief overview of biofuels, their growth drivers and their potential impacts on poor societies. It looks at how jatropha, which originated in Central America and then spread across Africa and Asia, has become widespread throughout the tropics and subtropics. It also builds upon technical and scientific information on key issues affecting jatropha for pro-poor development that was presented during the Consultation by specialists from around the world.

The review also summarizes the most recent data on the cultivation, seed harvesting and processing, uses and genetic improvement of jatropha, and it offers an overview and case studies of experiences with jatropha production in sub-Saharan Africa and South Asia. It concludes with viewpoints gathered from the Consultation's group discussions and roundtables that recognized the importance of biofuels and the potential of jatropha biofuel development for poverty reduction, but also emphasized the need to consider potential risks to food security, the environment and livelihoods of the rural poor.

This publication seeks to contribute to strengthening jatropha policies and strategies in developing countries – policies that recognize the potential of jatropha to contribute towards pro-poor development, sustain rural income and improve livelihoods. We trust that it will provide valuable guidance to government and institutional policy- and decision-makers, and that it will be a valuable source of information for programme managers, international and multilateral development organizations, donors, NGOs, the private sector and foundations as well as researchers, advisors, teachers and professionals in agriculture.

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Photo: FAIDUTTI

CONTENTS

ACRONYMS AND ABBREVIATIONS

B5	Blend of 5 percent biodiesel with mineral diesel
Ca	Calcium
CDM	Clean development mechanism
CGIAR	Consultative Group on International Agricultural Research
CO_2	Carbon dioxide
CPR	Common property resource
Cu	Copper
DAP	Diammonium phosphate
DM	Dry matter
DWMA	District Water Management Agency
E5	Blend of 5 percent bioethanol with petrol
EMPPO	European and Mediterranean Plant Protection Organization
ET	Evapotranspiration
ETBE	Ethyl Tertiary Butyl Ether
FACT	Fuels from Agriculture in Communal Technology
FAO	Food and Agriculture Organization of the United Nations
Fe	Iron
GDP	Gross Domestic Product
GHG	Greenhouse gas
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HH	Household
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
JME	Jatropha methyl ester
K	Potassium
K_2O	Potassium oxide
Kcals	Kilocalories
Kg	Kilogram
kW	Kilowatt
LCA	Life cycle analysis
LIFDC	Low-income food-deficit country

MFP	Multifunctional platform
Mg	Magnesium
mg	Milligram
MJ	Megajoule
Mn	Manganese
N	Nitrogen
N_2O	Nitrous oxide
n.d.	No date
NGO	Non-governmental organization
NOVOD	National Oilseeds and Vegetable Oils Development Board
OECD	Organisation for Economic Co-operation and Development
P	Phosphate
RME	Rape methyl ester
R	Indian rupee
S	Sulphur
SSP	Single super phosphate
SVO	Straight vegetable oil
TZS	Tanzanian shillings
ULSD	Ultra low sulphur diesel
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
VOME	Vegetable oil methyl ester
Zn	Zinc

EXECUTIVE SUMMARY

Declining reserves of fossil fuels plus recognition that growing carbon dioxide emissions are driving climate change have focused world attention on the need to reduce fossil fuel dependence. In turn, this has increased interest in promoting bioenergy, including biofuels, as a renewable energy source.

Liquid biofuels have the potential to help power the transportation sector. Considering that transportation is responsible for some 30 percent of current energy usage and that biofuels can be used in transportation with only few changes to the existing distribution infrastructure, biofuels become an extremely important form of bioenergy. Producing liquid biofuels from food crops using conventional technology is also being pursued as a means of farm income support and for driving rural development. However, the debate around biofuels is creating a lot of uncertainty and will continue to do so until it can be shown that biofuels can be low-cost, low-carbon and sustainable, and do not endanger food security.

Given the sheer size of the energy market compared to the market for agricultural commodities, the potential for biofuels alone to address climate change and energy security is quite limited. However, the increased demand for biofuels does create a huge new market for agricultural products. Liquid biofuels generally require large-scale production and processing to be viable, although this is less true where the end product is straight vegetable oil rather than either bioethanol or biodiesel.

Interest in *Jatropha curcas* as a source of oil for producing biodiesel has arisen as a consequence of its perceived ability to grow in semi-arid regions with low nutrient requirements and little care. The seed typically contains 35 percent oil which has properties highly suited to making biodiesel. Unlike other major biofuel crops, jatropha is not a food crop since the oil is non-edible and is, in fact, poisonous. It is a low growing oil-seed-bearing tree that is common in tropical and subtropical regions where the plant is often used in traditional medicine and the seed oil is sometimes used for lighting. The tree is occasionally grown as a live fence for excluding livestock and for property demarcation. The rooting nature of jatropha allows it to reach water from deep in the soil and to extract leached mineral nutrients that are unavailable to many other plants. The surface roots assist in binding the soil and can reduce soil erosion.

In 2008, jatropha was planted on an estimated 900 000 ha globally – 760 000 ha (85 percent) in Asia, followed by Africa with 120 000 ha and Latin America with 20 000 ha. By 2015, forecasts suggest that jatropha will be planted on 12.8 million ha. The largest producing country in Asia will be Indonesia. In Africa, Ghana and Madagascar will be the largest producers. Brazil will be the largest producer in Latin America.

Jatropha has a number of strengths: the oil is highly suitable for producing biodiesel but can also be used directly to power suitably adapted diesel engines and to provide light and heat for cooking, it is fast growing and quick to start bearing fruit, and the seed is storable making it suited to cultivation in remote areas. Jatropha could eventually evolve into a high yielding oil crop and may well be productive on degraded and saline soils in low rainfall areas. Its by-products may possibly be valuable as fertilizer, livestock feed, or as a biogas feedstock, its oil can have other markets such as for soap, pesticides and medicines, and jatropha can help reverse land degradation.

Jatropha's chief weaknesses relate to the fact that it is an essentially wild plant that has undergone little crop improvement. Its seed yields, oil quality and oil content are all highly variable. Most of the jatropha currently grown is toxic which renders the seedcake unsuitable for use as livestock feed and may present a human safety hazard. Fruiting is fairly continuous which increases the cost of harvesting. Knowledge of the agronomy of jatropha and how agronomic practices contribute to yield is generally lacking. Furthermore, there is an unknown level of risk of *Jatropha curcas* becoming a weed in some environments.

Optimum growing conditions are found in areas of 1 000 to 1 500 mm annual rainfall, with temperatures of 20°C to 28°C with no frost, and where the soils are free-draining sands and loams with no risk of water-logging. Propagation is typically from seed. Cuttings offer the benefit of uniform productivity with the disadvantage that they do not generally develop a tap root. The production of clonal and disease-free plants using tissue culture is not yet a commercial reality. Attention to crop husbandry and adequate nutrition and water are essential to achieving high yields. Pruning is important to increase the number of flowering branches.

Crop improvement is at an early stage. Increasing oil yield must be a priority – an objective that has only recently been addressed by private enterprise. Genetic variation among known *Jatropha curcas* accessions may be less than previously thought, and breeding inter-specific hybrids may offer a promising route to crop improvement. Jatropha displays considerable genetic–environment interaction, meaning that different clones may appear and perform very differently under different environmental conditions. Short-term goals should aim at producing superior clonal plants using cuttings and/or cell culture techniques, with longer term goals aimed at developing improved varieties with reliable trait expression and with a seed production system that ensures farmer access to productive and reliable planting materials.

In terms of its viability as a cash crop, experience with jatropha production in sub-Saharan Africa and South Asia has found that yields are marginal, at best. Reported yields have been between 1 and 1.6 tonnes per ha. Holistic schemes that embrace jatropha production, oil extraction and utilization in remote rural communities appear the most viable, particularly where its other benefits are recognized, such as reversing land degradation. Jatropha production systems can be characterized in terms of their direct or indirect potential contribution to pro-poor development. It is expected that large plantations developed by the private sector will predominate in the future and that smallholders may be contract farmers for such commercial enterprises.

Jatropha biofuel production could be especially beneficial to poor producers, particularly in semi-arid, remote areas that have little opportunity for alternative farming strategies, few alternative livelihood options and increasing environmental degradation. While there are various possibilities for utilizing the by-products of jatropha – which would add value for the producers and reduce the carbon cost of the oil as a biofuel – there is an important trade-off between adding value and utilizing the by-products as soil ameliorants to reverse land degradation. Local utilization of jatropha oil is one of a number of strategies that may be used to address energy poverty in remote areas and could be part of production systems or part of a "living fence" to control livestock grazing.

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 the oil and by-products. 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.


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