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**Using *Jatropha Curcas* (physic nut) as an  
Energy Crop for Land Rehabilitation and  
Enhancing Biofuel Energy in**

**KENYA**

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**For the Ministry of Environment and  
Natural Resources and Ministry of  
Energy, Supported by the World Bank**



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## Abbreviations & Acronyms

A.S.L	Above sea level
ALRMP	Arid Lands Resources Management Programme
APVC	Agricultural product value chain
ASALs	Arid and semi-arid lands
BSC	Biofuel Steering Committee
BTF	Biofuel Trust Fund
CAPs	Community action plans
CBD	Convention on Biological Diversity
CDF	Constituency Development Fund
CDM	Clean Energy Development Mechanism
DMP	Desert Margins Project
EMCA	Environmental Management and Coordination Act
ERSW&EC	Economic Recovery Strategy for Wealth and Employment Creation
ESDA	Energy for Sustainable Development -Africa
EU	European Union
FAN	Forest Action Network
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gases
GIS	Geographical information systems
GNP	Gross national product
GOK	Government of Kenya
GTZ	German Technical Cooperation
ICIPE	International Center of Insect Physiology and Ecology
ICRAF	World Agroforestry Center
IFAD	International Fund for Agricultural Development
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KAPP	Kenya Agriculture Productivity Project
KARI	Kenya Agricultural Research Institute
KBDA	Kenya Biofuel Development Authority
KBPA	Kenya Biofuel Producers Association
KEBS	Kenya Bureau of Standards
KEEP	Kenya Energy-Sector Environment Program
KEFRI	Kenya Forestry Research Institute
KENGEN	Kenya Electricity Generating Company
KFMP	Kenya Forestry Master Plan
KFS	Kenya Forestry Service
KIRDI	Kenya Industrial Research and Development Institute
KPC	Kenya Pipeline Company
KPLC	Kenya Power and Lighting Company
KSH	Kenya shillings
KTDA	Kenya Tea Development Authority
LATF	Local authority transfer fund
LEA	Lafarge East Africa
M&E	Monitoring and evaluation
MDGs	Millennium Development Goals
MENR	Ministry of Environment and Natural Resources

MFC	Mali Folk Center
MKEPP	Mount Kenya East Pilot Project
MOE	Ministry of Energy
MSEs	Micro and small-scale enterprises
NALEP	National Agriculture and Livestock Extension Programme
NBDC	National Biodiesel Committee
NBFC	National Biofuel Committee
NBFRCL	National Biofuels Research and Certification Laboratory
NEPAD	New Partnership for Africa's Development
NGOs	Nongovernmental organizations
OP	Office of the President
R&D	Research and development
SGP	Small Grants Programme
SRA	Strategy for Revitalizing Agriculture
SWA	Sector-wide approach
TBP	Tree Biotechnology Project
TCN	Tree Crops Research Network Africa
TOFNET	Trees on Farm Network
TORs	Terms of reference
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VDF	Vanilla-Jatropha Development Foundation
VI-SCC	VI Skogen – Swedish Cooperative Center
WETPA	Western Kenya Tree Planters Association
WKCDD/FM	Western Kenya Community Driven Development and Flood Mitigation
WTO	World Trade Organization
WWF	World Wildlife Fund

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All tons are metric tons.

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## EXECUTIVE SUMMARY

### Potential for *Jatropha* as an energy crop

**This study analyzes the formulation of a biofuel strategy, action plan, and policies related to the improved management of *Jatropha* for the economic development of the country, including major interventions in arid and semi-arid lands (ASALs).** The full impact of the interventions is expected to impact target beneficiaries in about three years. This is likely to be expressed through a more efficient management of natural resources in the ASALs and improved livelihood opportunities for the beneficiaries. Some of the proposed interventions involve:

- Strengthening of community investments and institutional frameworks
- Stimulation of biofuel demand by local users
- Formulation of a biofuel strategy and action plan
- Enhancement of environmental benefits through rehabilitation of degraded lands in the catchments and livelihood investments
- Development of production, processing, storage, and distribution systems for biofuels
- Establishment of a certification and quality control laboratory to provide linkages to production, research, and product development
- Enhancement of synergies through coordinated research, training, production, and provision of extension services
- Promotion of national, regional, and international cooperation for technology transfer.

### Scope and status of *Jatropha* activities

**The main stakeholders in the biofuel and *Jatropha* development activities are the Kenya Forest Service, Ministry of Energy, Vanilla Development Foundation, Green Africa Foundation, and KENGEN.** The opportunities for feedstock development are mainly in the vast ASALs.

**Over 30 institutions are working on biofuels and *Jatropha*-related activities, including government ministries, public and private companies, nongovernmental organizations (NGOs), community-based organizations (CBOs), and research and training institutions.** At the policy level, the Ministry of Energy (MOE) is the principal actor with the key mandate and responsibility to facilitate the provision of secure and sustainable supplies of energy to support the country's socioeconomic development. At the feedstock level and in the area of

environmental rehabilitation, the Kenya Forest Service (KFS) is the key actor; its main mandate is to sustainably develop and conserve forest resources in the country. Major energy consumers like KENGEN and KTDA are strategically placed to stimulate local demand for biofuel from *Jatropha* through fuel-switching-related interventions. Others are the various local authorities who have jurisdiction over large tracts of lands where considerable degradation has taken place through extraction of fuelwood and other tree products. The Ministry of Special Programmes—through the Arid Lands Resources Management Programme (ALRMP)—has immense opportunities for the integration of *Jatropha* investments and value addition to ongoing natural resources management projects and activities in over 28 ASAL districts. ALRMP has used a participatory process to develop a comprehensive draft ASAL policy strategy and action plans that are very elaborate regarding district-specific NRM activities.

**Other important stakeholders include the regional development authorities and several NGOs.** Institutions with relevant mandates include the six regional development authorities across the country—that is, the Kerio Valley Development Authority (KVDA), Coast Development Authority (CDA), Tana and Athi Rivers Development Authority (TARDA), Lake Basin Development Authority (LBDA), Ewaso Nyiro North Development Authority (ENNDA) and Ewaso Nyiro South Development Authority (ENSDA). At the community level, the Vanilla Development Foundation (VJGF), Green Africa Foundation (GAF), and other NGOs are the main players in Western Kenya and the southern rangelands of Ukambani respectively. Lafarge, a private company, and UNDP-GEF-SGP have started some activities in Coast Province.

## **Economic and policy interventions**

**There is a favorable policy and institutional framework in the country.** The overall development policy environment and institutional framework in the country is favorable for the formulation of a biofuel strategy and action plan. For example, it is fully provided for in the Sessional Paper No.4 of 2004 on Energy. This is in addition to the ongoing work by the National Biofuel Committee and the biodiesel task force initiated by MOE, TOFNET and VDF respectively. The proposed future interventions focus on formulating a biofuel strategy and action plan that is in line with sector-specific needs and national development plans, including Vision 2030.

**There are expanded opportunities for strengthening partnerships emerging from the forest sector reforms and new institutional arrangements.** The Forests Act 2005 (including PFM draft rules and regulations) and draft forest policy provide for elaborate mechanisms for public-private sector participation in the management of dryland forests, as well as identifying investment opportunities for nonwood forest products. This is also highlighted in the ASAL draft policy and will certainly be included in the future work plans for the new KFS. While the formulation of a national biofuel policy is expected to promote investment opportunities for *Jatropha* and other biofuels, its absence is not in the short term a major deterrent for promoting *Jatropha*-related activities. As the consultations with KEN GEN, KTDA and others indicate, there is no major constraint within the framework of the current laws and policies that limit users and other stakeholders from embracing biofuels for carbon sequestration, fuel-switching, or to provide specific energy needs to communities for poverty alleviation interventions such as off-grid electricity generation, soap and candlemaking, or other environmental rehabilitation uses. The bottom line is that there is merit in mainstreaming ongoing pilot actions and biofuel strategy formulation options hand in hand with practical activities that add value to the community and private investments.

**The National Biofuel Committee needs to be expanded and its work plans elaborated. MOE needs to provide budgetary support as well as strategic leadership.** The membership of the NBFC needs to be expanded and transformed to a strong biofuel steering committee (with clearly defined deliverables) and supportive strategic framework that will enable it to effectively steer the strategy formulation and implementation process, as well as lobby for *Jatropha*-based investments and other energy crops. This will reenergize ongoing activities and stimulate public/private sector investments on *Jatropha*. Some information gaps exist on the most suitable market outlets, cost benefit analysis, institutional framework, feedstock supply chain, standards, quality control, and provision of extension services. Some scoping assessments need to be conducted to adequately inform the strategy formulation process and the implementation of current and future pilot activities. It is critically urgent to harmonize the roles and responsibilities of the NBDC, NBF, and other pilot activities in order to avoid duplication. Some systematic activities have been recommended in the biofuel strategy formulation roadmap in order to unlock the process of action planning for biofuel investments in Kenya. This will ultimately lead to the establishment of a quasi-government organization, the Kenya Biofuel Development Authority (KBDA), a Biofuel Trust Fund (BTF), and a nationwide producer-led association, the Kenya Biofuel Producers Association (KBPA), which will deal with feedstock issues. The study recommends that the action planning process prepare TORs for each structure.

**As a start, KENGEN and other local enterprises can guarantee a market for *Jatropha* feedstock.** Initially, MOE and other stakeholders can help stimulate the production of *Jatropha* feedstock from local producers by guaranteeing its use by state corporations where it makes business sense (for example, KENGEN, KTDA, KPLC, KPC, and Kenya Railways Corporation). It is imperative that government agencies and state enterprises start to make biofuel their preferred choice. This can be done through incentives such as an exemption of the excise tax on biofuels. Stimulation of the local biofuels market is good for the sector, as farmers who are at the bottom of the value chain cannot sustain a market risk for a long time.

### **Biofuel Trust Fund and sustainability**

**Establishing a Biofuel Trust Fund and forming a biofuel program in the Forest Conservation Fund should be explored.** The study recommends the establishment of a Biofuel Trust Fund (BTF) based on the lessons learned from other trusts such as tourism, water, and biodiversity. The proposed BTF will have a mandate to extend financial resources to institutions such as AFC and microenterprise finance agencies, which have nationwide infrastructure and long experience in accessing credit in a competitive manner to farmers and other stakeholders. The trust fund would provide seed and venture capital to upcoming biofuel enterprises. It would also (a) develop business models for biofuels development and financing options for household energy development and consumption; (b) support training, research, and development; and (c) formulate an enabling policy and legislation. BTF funds could be augmented with those from the Forest Conservation Fund (FCF) and development partners, Constituency Development Fund (CDF), Local Authority Trust Fund (LATF) and the Youth Enterprise Fund among others. The Japanese Social Development Fund has expressed interest in supporting some programs with the FCF. The process of establishing the BTF should be implemented alongside that of formulating the biofuel strategy and action plan. To secure a sustainable supply of *Jatropha* feedstock, production could be based on nuclear estates with

outgrower schemes, could be fully serviced by small-scale farmers (similar to the KTDA), or could be a combination of both.

### **Technology transfer and learning from others**

**A knowledge transfer visit should be organized for the key stakeholders to a destination country with relevant experience in team building and technology validation.** In order to enhance adoption and mitigate risks in the *Jatropha* value chain, the Biofuel Steering Committee (BSC) should undertake a technical study visit to Mali Fork center or any other country with relevant experience. The objective of the visit would be to share knowledge and experience of best practices in *Jatropha* business enterprises and community investments with a view to validating them for the Kenya situation. It is prudent for key players to learn from best practices in other countries so as to accelerate adoption of the *Jatropha* value chain technology. There are good experiences elsewhere in Africa; for example, Zambia's experience with smallholder farming of *Jatropha* for improved livelihoods through lighting, cooking and small-scale electricity generation. Undoubtedly, the visit will also help prepare the BSC team to effectively address the opportunities and challenges, as well as providing business information to off-shore investors.

### **Cost –benefit analysis**

**Preliminary estimates by GAF indicate that one hectare with 1,100 *Jatropha* trees can yield 6 tons of seed at year four—at an estimated establishment cost of Ksh.50, 000 (\$750)—with a potential oil yield of 2,000 liters.** There is an urgent need to undertake systematic cost-benefit analysis based on proven business models of *Jatropha* in order to make the transition from pilot establishment of *Jatropha* to commercial levels within a competitive market niche. KEFRI/KARI/KIRDI and the universities should build the case for *Jatropha*'s potential benefits with empirical data on silvicultural/agronomic management regimes, oil content, yield, inputs, pricing forecasting, enterprise business models, gross margin analysis (including benefits from carbon sequestration), fuel-switching, and natural resource management. This will allay some of the anxieties and uncertainties encountered during the study.

The screening of high-oil-yielding **provenances** and varieties for the various agro-ecosystems and regions and mass-production techniques need to be undertaken. Some of the critical research priorities identified include (a) systematic collection of *Jatropha* germplasm from the center of origin; (b) identification of **provenances** with desirable characteristics through characterization and evaluation for drought resistance, desired growth habits, seed yield, oil content, nontoxicity (for fodder), or high toxic content (for use as a pesticide).

### **Fears and challenges**

**Scaling up *Jatropha* activities requires a social and environmental impact assessment to gauge its acceptability to stakeholders, particularly pastoralists, regarding their concerns about the plant's invasiveness and its potential to poison livestock.** These fears mainly arise from the controversy generated by recent experience with *Prosopis juliflora* (“mathenge”), which will undoubtedly influence public acceptance of any large-scale introduction of *Jatropha* and other biofuel crops, especially in the ASALs. It is important to address these fears through enhanced public awareness and community training to avoid negative lobbying and advocacy. These risks are minimal in the southern rangelands, the coast, and western Kenya areas, where the communities are more agrarian and generally more receptive to land use changes.

**The promotion of *Jatropha* should not endanger food security and environmental concerns.** Experience with other agricultural commodities shows that pioneers normally reap maximum rewards, but when supply expands much more rapidly than demand, prices get depressed. Care must therefore be taken that small-scale farmers who take up *Jatropha* do not entirely replace all their other enterprises, especially those linked to food production. Some commercial trials need to be established to enhance the confidence of venture enterprises on the viability of *Jatropha* across the value chain. Some of the land-use related risks include:

- Mismanagement of common resources, including forests on land set aside for *Jatropha*.
- Lack of favorable credit facilities.
- Unsustainable management of natural resources in the dryland areas due to expansion of crop/tree farming in vulnerable ecosystems in the marginal areas, including (a) land clearing for food production aggravated by the continuing population increase due to immigration into the ASAL regions; (b) charcoal production for cash income; and (c) recurring droughts, which render the environment vulnerable to degradation by livestock and other land uses.
- The process of building sustainable capacities (training, awareness-raising) for participatory forest management in local authorities and other categories of forests as provided in the law can be a complicated and time-consuming exercise. For example, putting in place an enabling environment (strategies, guidelines, and institutional framework) and implementation for participatory forest management may prove to be a much slower process than anticipated.

## **Development strategies and interventions**

**The development of silvicultural and agronomic models for *Jatropha*/vanilla enterprises for the various agro-ecological zones needs to be elaborated.** The *Jatropha*/vanilla option is particularly feasible in the Coast province, southern rangelands and western Kenya.

### **Establishing a biodiesel standards, quality and certification laboratory**

**It is important to establish a one-stop national resource center for research, training and information sharing on biofuels.** The proposed laboratory and training center will be used for establishing standards for biofuels, including (a) training, certification, and quality control systems; (b) determining the industrial uptake of biofuels; (c) promoting their use; and (d) establishing a marketing and distribution system. This is in addition to coordinating relevant demand-oriented silvicultural and agronomic research, training, and capacity building to raise the yields of biofuel crops and domesticate them in new areas.

## I. BACKGROUND/INTRODUCTION

**Pressure on natural resources is increasing.** Kenya's population in 2007 is estimated at 32 million people. This is calculated from the 1999 census, which recorded 28.8 million people with an annual growth rate of around 2.1 percent. Population exerts enormous pressure on the natural resources of the country, including widespread soil erosion, an alarming rate of deforestation, and significant biodiversity losses, which together pose serious challenges to the sustainability of the rural economy and most importantly to sustainable environmental management, especially in the fragile ecosystems in the nation's arid and semi-arid lands (ASALs).

**Poverty is a major constraint in the ASALs.** Poverty levels are highest in the ASALs, which are characterized by overdependence on subsistence farming and livestock, making them more vulnerable to recurrent droughts and floods. Successful interventions in areas such as sustainable energy and environmental management are directly linked to poverty, food security, and issues of equity in integrated rural development.

**The nation's oil import bill is rising.** The increased consumption of fossil fuels and petroleum products is a matter of great concern for the country due to the huge import bill that competes with other national requirements for scarce foreign exchange. For example, while Kenya's GDP stands at approximately KShs. 1,273,217 billion, over KShs. 95,188 billion was spent on the importation of petroleum products in 2005–06. This is equivalent to 7.4 percent of GDP and over 25 percent of the nation's foreign exchange earnings, or half the foreign exchange earnings from tea per year. This is an industry that has the potential to benefit from the *Jatropha* value chain. Diesel accounts for up to 60 percent of the total oil imported into the country.

**Global trade is in favor of clean energy sources.** The escalating global demand for energy in the country offers many challenges as well as opportunities for possible substitution of fossil fuels for both economic and environmental benefits. Globally, biofuels continue to generate a lot of interest in light of the substantive increases in fuel prices in recent years.<sup>1</sup> Research and development initiatives are focusing on biofuels as alternative and renewable sources of energy for improved livelihood opportunities. Biofuels could help mitigate degradation of fragile ecosystems, reduce reliance on imported oil, and revitalize rural economies.

**The reform process in the forest, energy, and related sectors are favorable.** Since 2000, a lot of effort has gone into reforming national policies in the energy, forestry, agriculture, and industry and trade sectors as an attempt to respond to different national demands and goals, as well as mainstreaming national commitments to international protocols like UNFCCC, UNCBD, and UNCCD.<sup>2</sup> All these efforts provide an enabling environment for the promotion of biofuels in general—and *Jatropha* in particular—in ongoing and future development projects.

**Numerous plant oil resources are underutilized and unexploited.** These plants include both edible and nonedible crops. The inedible crops include *J. curcas*, castor oil (*Ricinus communis*), and *Croton megalocarpus*. Others like coconut (*Cocos nucifera*), sunflower, and corn (*Zea mays*) are edible; their production for biofuel has the potential to adversely affect food security. Among other oil crops grown in the country—for example, soya beans, avocado, sunflower, castor, maize, corn, sesame, cotton, groundnuts, palm tree and copra—*J. curcas* has a competitive advantage due to its wide climatic adaptability in marginal areas, degraded sites, or wastelands, as well as its diverse uses (biodiesel,<sup>3</sup> medicine, food, lipids, wax, and poison). It also promotes intercropping, erosion control, soil improvement, barrier support, and nitrogen fixing. Other biofuel candidate oil crops include the Neem tree (*Azadirachta indica*) and *Aloe vera* and *Croton megalocarpus*.

***Jatropha* has been naturalized in Kenya for over 400 years through subsistence cultivation and has multiple benefits.** *Jatropha* as a tree crop is known for its potential to produce biofuel.<sup>4</sup> It originated in the Caribbean area and was probably distributed by Portuguese seafarers via the Cape Verde Islands and former Portuguese Guinea (now Guinea Bissau) to other countries in Africa, including Kenya and Asia. Over time, it has been cultivated in most tropical and sub-tropical countries to provide protection hedges around homesteads, gardens, and fields. In India, the plant is being promoted as a means of economic empowerment, social improvement, and poverty alleviation within marginalized communities. Oil derived from its seed has other derivatives apart from the biofuel that could be the driving force to the development of rural enterprises and to strengthen the economic position of the locals. *Jatropha* is easy to propagate, has rapid growth, and exhibits a wide environmental tolerance and adaptability. This allows for rapid expansion of the existing plant population and establishment of new ones. It has the potential to offer alternative livelihoods in ASALs as well as addressing issues of land degradation and climate change in a practical and strategic manner.

**There is a wide range for growing *Jatropha* in Kenya.** The areas suitable for growth of *Jatropha* range from the coastal lowlands to the vast ASALs and the country's midlands (<1,600m above sea level; for example, the lower Tana catchment, which is the main focus of the NRM project). Although the potential benefits for its cultivation are enormous, there are some country-specific knowledge gaps, including the screening of high oil yielding **provenances**, cost-benefit analysis of fuel switching, and carbon sequestration. This is in addition to developing efficient techniques for processing and elaboration of the supply and distribution infrastructure among other environmental issues. Other issues include understanding the potential of *Jatropha* to become an invasive species and toxicity to livestock during drought.<sup>5</sup> These issues require attention and need to be addressed by KEFRI, KARI, KIRDI and the universities to inform decision makers during the strategy formulation process.

**The promotion of *Jatropha* in ASALs and other fragile ecosystems presents remarkable opportunities to smallholder, medium, and large-scale farmers.** Moreover, potential fuel-switch users like KTDA and KENGEN could not only produce and process biofuel and diversify livelihood sources, but also could help mitigate against land degradation, which arises mainly from the removal of vegetation and overstocking. In the ASALs, the destruction of vegetation has not only contributed to soil erosion and loss of biological diversity, but also to adverse denudation of water catchments. There are numerous opportunities for promoting and strengthening private-public sector partnerships to help the integration of *Jatropha* among rural enterprises.

## **Rationale for the study**

**The main purpose of the study is to identify pilot activities for *Jatropha* that will expand the opportunities for improved livelihoods in the ASALs.** The study comes at an opportune time, when most of the land-use-based policies are being reformed or implemented.<sup>6</sup> It aims to (a) examine the potential for using *Jatropha* as a multipurpose energy crop and to promote rehabilitation of degraded lands; (b) identify investment options across the *Jatropha* value chain focusing on improving livelihoods of the poor; (c) review the current scope and status of *Jatropha* (pilot) activities in Kenya; (d) promote subsistence (small-scale farmers) biofuel growing and refining using *Jatropha* feedstock; (e) support the government's efforts to develop a biofuels strategy and private sector participation; and (f) identify opportunities to enhance carbon sequestration in Kenya's vast arid and semi-arid areas.

**Jatropha has multiple benefits.** One of the greatest advantages associated with biofuels, especially *Jatropha*, is the capacity to reduce greenhouse gas (GHG) emissions and the potential to mitigate against climate change. The basic argument is that *Jatropha* use has a zero-sum emission as it operates as part of the fixed carbon cycle.

Biofuels can lead to greater economic gains, rural development and poverty reduction, and reduced GHG emissions compared to other fossil fuels.<sup>7</sup> Links between biofuels and sustainable development are varied and complex. Experiences in India indicates that biofuel promotion results in improved energy security, economic gains, rural development, and greater energy efficiency.

The MOE-led National Biofuel Committee (NBFC) has identified the key benefits<sup>8</sup> as the main drivers for future biofuels programs and projects (Kituyi 2006). The potential benefits were also highlighted during the first national conference on *Jatropha* value chain development held at ICRAF in July 2006, as well as the ESDA-organized biodiesel conference in March 2007.

**Overall, there is an enabling policy environment and institutional framework for promotion of *Jatropha* and biofuels.** Many initiatives and policies are favorable to *Jatropha*, including Vision 2030,<sup>9</sup> the draft ASAL policy (2006), Forest Policy (2005), Energy Policy (2004), and the Strategy for Revitalizing Agriculture (SRA). These documents place major emphasis in the country's development agenda on community empowerment through poverty alleviation and creation of employment opportunities. Preliminary steps to formulate a biofuel policy have been initiated by the MOE. Moreover, under the existing policy framework most stakeholders can still realize multiple benefits such as cleaner heating, land rehabilitation, use of the seed cake as a fertilizer, and for cooking and lighting in off-grid areas. The recommended systematic formulation of a biofuel strategy and implementation framework provides for partnerships and widens access to the poor through (a) reduced oil imports and foreign exchange savings; (b) improved energy security that is reliable, affordable, economically viable, socially acceptable, and environmentally sound; (c) reduced GHG emissions and formulation of new projects under the CDM and carbon trading; (d) reduced air pollution (lead, SO<sub>2</sub>, and CO<sub>2</sub>); (e) improved vehicle performance (ethanol as octane enhancer); (f) improved global trade and opportunities for exports to the E.U. and United States; and (g) improved adaptation to climate change.

## Why biofuels?

**Biofuels have the potential to positively affect household income, the national economy, and the environment.** In terms of household income, the opportunities include (a) significant savings on household energy budgets for cooking and lighting and other environmental health benefits; (b) relatively easy use in standard diesel engines without the need for significant modifications to the fuel system; (c) home manufacture that is much cheaper than petroleum or diesel fuel; and (d) reduced wear and tear on engines.

In terms of the national economy, the opportunities include (a) reduced reliance on fossil fuels, whose prices are making biodiesel competitive in the market; (b) distribution using existing infrastructure.

In terms of the environment, the opportunities include (a) reduced pollution compared to petroleum fuels (biofuels are biodegradable and nontoxic and have significantly fewer emissions—particular CO<sub>2</sub> and SO<sub>2</sub>—than petro-diesel when burned; and (c) reduced CO<sub>2</sub> emissions by more than 75 percent.

In addition, biodiesel is safer to manufacture and handle since it has a high flash point of 160 °C (320 °F) and does not require fuel preheating and filtration.

**There are some promising experiences in nontransport applications of *Jatropha* oil in Africa.** Some developing countries like India, Brazil,<sup>10</sup> China, Mali, Zambia, Burkina Faso, Cameroon, Ghana, Lesotho, Madagascar, Malawi, and South Africa are exploring the potential of *Jatropha* as a large-scale biofuel source. Some of the immediate beneficiaries of the promotion of *Jatropha* for biofuel and other uses are (a) crop and livestock subsistence farmers, pastoralists, and agro-pastoralists in the 28 ASAL districts under the ALRMP, large fossil fuel users (KTDA, KENGEN, cement factories), and other stakeholders in the value chain; and (b) technology users through research and development in the target areas arising from technology transfer and new frontiers of knowledge.

**The interventions and strategies at the policy level should aim to stimulate local demand for biodiesel.** Other advantages are capturing environmental benefits, developing the production and distribution systems, expanding feedstock supplies; subsistence utilization, and enhancing trade opportunities while supporting participatory research and development. According to Parson (2005), the processing of crude oil into biodiesel would add a further 15 percent to *Jatropha*-based biodiesel sales in Africa. He further notes that *Jatropha* is thought to have the highest energy balance of any biofuel. Unlike maize or sugar cane, *Jatropha* is a perennial, yielding oil seed many decades after planting. It can grow without irrigation in arid conditions where other crops could never thrive; the land requires little fertilizer or water.

## II. ANALYSIS AND LINKAGES TO THE POLICY ENVIRONMENT AND OPPORTUNITIES FOR *JATROPHA CURCAS*

**The policy and institutional framework is enabling for *Jatropha* development.** The following policy documents are relevant to the development of a biofuels strategy and the development of *Jatropha* and other allied products: Vision 2030, the Economic Recovery Strategy for Wealth and Employment Creation (ERSW&EC) (Government of Kenya 2003),<sup>11</sup> Poverty Reduction Strategy Paper (PRSP) (Government of Kenya 1999), Draft Forestry Policy 2006 (Government of Kenya 2006a), and Energy Policy (Government of Kenya 2004d). Other important documents include the Draft National Policy Framework for the Sustainable Development of Arid and Semi-arid Lands of Kenya (2006) (Government of Kenya 2006b), Kenya Rural Development Strategy (KRDS) (Government of Kenya 2001), and the 2004 Strategy for Revitalizing Agriculture (SRA) (Government of Kenya 2004c).

**The Energy Act (2006), which is due for implementation in July 2007, and the Energy Policy (2004) provide a good basis for the formulation of a biofuel strategy within the framework of other policy instruments.** The Kenya Rural Development Strategy states: “In order to attain sustainable livelihoods, the Kenyan economy must grow consistently at a rate significantly higher than the population growth rate.” In the PRSP and other subsequent documents, agriculture and the rural development sector were ranked as the top national priorities. The key subsectors are crop development, rural water, livestock development, food security, lands and settlement, environmental management, forestry, and fisheries. All these have a direct or indirect bearing on biofuel/*Jatropha*-based interventions. The government’s Economic Recovery Strategy (Government of Kenya 2003) and poverty reduction efforts envisage viable interventions to reverse environmental deterioration and natural resource degradation. The Environmental Management and Co-ordination Act (EMCA) 1999 (Government of Kenya 1999), under which the National Environmental Management Authority (NEMA) was established, addresses environmental issues before and after project implementation. This is significant, since all large-scale *Jatropha* investments have to undergo an environmental impact assessment and systematic post-establishment audits.

**The Energy Act and Policy (2004) provide a framework for *Jatropha* development.** The Ministry of Energy in 2006 developed a work plan with a budget of Ksh 40 million proposing activities to mainstream the processes for the establishment of the biodiesel industry in Kenya. The draft proposal sets a target under which biodiesel would account for 5 percent of all diesel fuel by 2012. The momentum to improve the draft seems to have slackened, as has communication and synergies among different actors and stakeholders.<sup>12</sup> The enactment of the Energy Act and policy provides a framework for formulating a biofuel strategy and action plan. In early 2007, MOE and the parastatals<sup>13</sup> under it prepared an inclusive Ksh. 50million 10-year Kenya Energy Sector Environment Program (KEEP) centered on energy and environment conservation, fuelwood, watershed management, training, and publicity and awareness creation.

**In the last two years two international conferences on *Jatropha* have been organized by VDF jointly with other partners.** In 2006, ICRAF through TOFNET and VDF organized the first national conference on *Jatropha*. The main outcome was the formation of a national biodiesel task force. A second conference organized by TOFNET and VDF on *Jatropha* took place in May 2007.

## Policy Framework in the Arid and Semi-Arid Areas

**The ASALs constitute over 80 percent of the country, host over 10 million people, and support over 70 percent of the country's livestock with an estimated value of Ksh.70 billion.** They are home to over 90 percent of wild game, which supports tourism. They have enormous mineral potential, which earns the country over Ksh.50 billion. Interventions with *Jatropha* and other biofuel crops must take cognizance of the primary livelihood opportunities in these areas, which are traditionally livestock-based, and must be seen to add value and not compete with them.

**The national policy for the sustainable development of Kenya's Arid and Semi-Arid Lands was prepared through a consultative and participatory process.** The policy and plan provide for an investment plan with a basket of choices focusing on community involvement and emphasizes drought prevention and increased livelihood opportunities. The policy's major emphasis is on revitalization. In the short term, the policy envisages that, through the proposed interventions, the vulnerability of poor people to climatic shocks will be reduced and capacities strengthened to respond to climatic change. In the past, there was a piecemeal approach to ASAL policy formulation. Policies were disaggregated in many sectors, especially livestock and agriculture, leading to their marginalization. The current policy, to which *Jatropha* can expand opportunities, recognizes the potential of the ASALs in livestock, mining, tourism, and biodiversity conservation. The main conclusion of the policy is that the country will not achieve effective sustained growth on the national economy as long as these areas and their enormous resources are not factored into planning and national development.

The ASAL policy recommends the following:

- (a) Restructure the ASAL economy over time so that the key inputs are accessed through the market as opposed to kinship and social networks, as is the case today.
- (b) Reduce reliance on livestock through human capital and natural resources development and diversification of the sources of income.
- (c) Improve natural resources management and utilization by reviewing existing land use policies and tenure systems.
- (d) Improve pastoral productivity through conservation of the environment, domestic animal genetic resources, and other biodiversity.
- (e) Improve markets and provide social services to mobile pastoralists.
- (f) Provide financial services to nomadic pastoralists.
- (g) Reduce and manage risks such as droughts and floods, which often reduce assets and increase food insecurity

**Future interventions in ASALs with *Jatropha* and other biofuels are likely to face a lot of weather vagaries exacerbated by drought, famine, livestock epidemics, and human conflicts.** The draft ASAL policy and strategy emphasizes the immense opportunities for investments that have not been exploited over the years largely because of long years of neglect and lack of enabling policies. In both policy and strategy, the government has committed itself to a long-term development approach in the ASALs, as opposed to the piecemeal implementation of discrete short-term donor-funded relief and development projects. Hence there is a need to mainstream the *Jatropha* value chain initiatives to ongoing activities in the ASALs.

**The ASALs area extends across all of Kenya's borders into neighboring countries, where the same groups sharing common borders face similar constraints.** The constraints and

opportunities related to natural resources conservation are therefore of regional strategic interest. The greatest of the environmental problems is land degradation arising from removal of vegetation and overstocking. The destruction of vegetation has not only contributed to soil erosion and loss of biological diversity but also to adverse denudation of the water catchment areas. There are several “hot spots” that can be rehabilitated using *Jatropha*, since it is not browsed by livestock. For example, Scott and Wilson (2006) have summarized the vagaries of soil erosion in the Tana catchments as follows: “Very few people outside of the hydropower industry have any idea of the consequences of soil erosion for electricity supplies and very few realize that hydropower generation in the Tana cascade is not sustainable indefinitely and may ultimately cease. Many people considered that the dams can be dredged and the sediment removed. However, when it is explained that Tana can transport over 100,000 tons of soil to Masinga in a single day from divisions in the districts of Central Province (as measured in 1976 at Masinga Dam site), that some 240 Mm<sup>3</sup> of soil has probably already been deposited in Masinga, and that the next 240 Mm<sup>3</sup> (and much more) is waiting to be delivered, it is more readily understood that desilting is not a practical proposition.”

**The biological production potential of ASALs is varied.** This is expressed by the ecological and economical carrying capacity of humans and livestock in the over 28 ASAL districts. Production potential varies enormously, from moderate to extremely low. Likewise, the socio-cultural differences are vast between farming, agro-pastoralists, and nomadic pastoral groups occupying different parts of the areas. Poverty and exclusion are the root causes of conflicts in these areas and are endangering the stability and security of too many people.

**Through the natural resource management component of ALRMP, each of the 28 districts has developed a comprehensive strategy.** The work plans are rich in opportunities for integrating *Jatropha*. It is important to take into account these initiatives and the institutional synergies developed over time. The work plans/investments have been developed and are therefore owned by the communities; any changes would have to be negotiated with them.<sup>14</sup>

**In the agricultural sector, the Strategy for Revitalization of Agriculture (SRA) 2006 emphasizes the agriculture product value chain (APVC).** This involves (a) developing business linkages through new extension approaches among producers, suppliers, and processors with a view to providing alternatives like *Jatropha* and other candidate species as a competitive livelihood option in the ASALs; (b) emphasizing a holistic multisectoral approach rather than a traditional intervention through “projects” and “programming;” (c) promoting improved land use through production from negotiated markets; and (d) staying relevant to UNCBD, IFCCC, and UNCCD, as the KARI/KEFRI DMP project is trying to address

**The AOP sites in Samburu, Isiolo, and Marsabit districts offer certain lessons based on the Vallerani technology** (Muga 2006). The problem and challenges in the rehabilitation of ASAL landscapes include (a) protection of the planted sites from livestock and wildlife damage (*Jatropha* is not prone to livestock damage); (b) low and erratic rainfall; (c) adoption of promising technologies is affected by high levels of vulnerability due to poverty and drought, which reduces their uptake; (d) poor infrastructure in the ASALs result in undeveloped markets activities for products and high costs in implementation and monitoring of projects; (e) predominantly pastoralist communities are averse to crop cultivation and tree planting, which impairs technology based on promises of some future benefits; and (f) the communal land tenure system affects ownership and responsibility over enclosed areas.

Collaboration, enhanced partnerships, and harmonization of approaches among different projects/institutions working in the target areas should not be assumed, but should be based on mutually

agreed upon modalities to avoid conflicts during project implementation. Roles and expectations of each stakeholder must be clearly defined. More effort should be put into community mobilization to achieve ownership of the project activities through mobilization of communities.

**The ALRMP has undertaken extensive community consultations in the 28 ASAL districts.** The following districts have mainstreamed the vision and strategy in the workplans.<sup>15</sup>

- i. Upper Eastern, Moyale, Marsabit, Isiolo
- ii. North-Eastern: Mandera, Wajir, Garissa, Ijara, Tana River
- iii. Rift Valley: Turkana, West Pokot, Baringo, Samburu
- iv. Southern Rangelands: Narok, Trans Mara, Kajiado
- v. Mt. Kenya Region: Laikipia, Kieni West (East and West), Tharaka, Mberere
- vi. Ukambani: Mwingi, Kitui, and Makueni

**Each district has specific NRM plans.** Each district and specific site provides a unique entry point and institutional arrangements for the promotion of biofuels. For example, KEFRI/KARI has been undertaking performance trials on *Jatropha* in Kibwezi and Kitui centers through the DMP project. Similar facilities are available in Agroforestry Energy Centers under the MOE. *Jatropha* is particularly suitable in areas around Busia, Kitui, and Mtwapa Energy Centers. In terms of human and physical resources, these stations and sites provide a good opportunity for training in pilot cottage-based industries emanating from the *Jatropha* value chain.

**The promotion of *Jatropha* can be used as an entry point to integrated rural development.** This can be done within the context of ALRMP and other national frameworks. Future initiatives should be tailored along the following broad objectives:

- a) Select pilot sites, one per district for each region, and rehabilitate degraded lands using *Jatropha* and other biofuel crops based on ALRMP institutional structures, priorities, and work plans
- b) Strengthen the capacity of key partner institutions/projects and producers through technology transfer to effectively improve land rehabilitation, productivity, and livelihoods in drylands using *Jatropha* and other candidate species
- c) Support local community initiatives through empowerment for increasing productivity, value addition through processing and marketing and trade opportunities of piloted activities. When communities are empowered, they can demand accountability and also monitor development activities.
- d) Promote information dissemination and technology transfer within the country and share relevant experience from other countries.
- e) In collaboration with relevant national and international research institutions, conduct applied research and development on challenges and opportunities related to sustainable management and utilization of *Jatropha* and other dryland resources.

**The ASALs have a positive policy environment and ongoing pilot projects.** They can provide benchmark experience for integration of *Jatropha*, which has a competitive advantage in mitigating against land degradation and improving the livelihoods of inhabitants.

## **Challenges and Fears**

**Some stakeholders perceive *Jatropha* as having invasive potential and being poisonous to livestock.** During the interactions with ASAL stakeholders drawn from a wide diversity of

institutions in Nakuru and Garissa—brought together by the National and Livestock Extension Policy (NALEP) <sup>16</sup>—the following fears and concerns against *Jatropha* were raised:

- a) The plant has the potential to poison livestock during times of extreme drought. Though this has not been documented, their fears should be addressed.
- b) The plant has the potential to become an invasive species like the *Prosopis juliflora*, “mathenge.” To determine the authenticity of these concerns, it is necessary to carry out extensive community consultations, exchange tours for community leaders, and *Jatropha* pilot projects supported by EIAs in areas that have established the tree crop.
- c) Sustainable livelihoods are unlikely to be fulfilled by one technology or intervention. A proper mix of *Jatropha* with other packages—such as drought-resistant crops, forages, and grasses—should be considered.
- d) Irrigation is not a viable option due to the negative implications and conflicts over use of limited water resources. There is also the option of the **Vallerani technology** at the AOP sites.
- e) Environmental projects are by nature controversial and do not enjoy immediate political and policy support at all levels; there is therefore a need to engage local leadership in dialogue at all stages.

The processing of *Jatropha* oil for lighting, seed cake, and candle-making is likely to provide some income for poor households to meet other livelihood needs. With the soon-to-be-established Forest Conservation Fund, communities in local-authority forests in ASALs may be able to use these resources to establish *Jatropha*.

## **Forestry Legislation and Policy Framework**

The process of drafting new forest legislation started in 1994 with the publication of the Kenya Forestry Master Plan (KFMP) and culminated with enactment of the Forests Act 2005, which led to the establishment of KFS in February 2007. This document clearly demonstrated that the country needed a new forest policy and law in order to manage forest resources on a sustainable management basis. Subsequently, at least five drafts were prepared in 1996, 1998, 2000, 2003, and 2004. The last one, submitted as the 2004 Forests Bill, was rejected by Parliament. Eventually, it served as the basis of the Forests Act 2005, which was passed by Parliament in July 2005 and signed by the president on November 18, 2005.

While the new forest law and draft policy were being prepared, forest resources experienced extensive degradation. Some indigenous forests—such as Arabuko Sokoke, the “five water towers” of Mt. Elgon, the Mau Forests, and Mt. Kenya, Cherangani and the Aberdares—were being invaded or threatened by squatters and/or illegal harvesting of tree products. At the same time, however, broad support from different sectors—including different government ministries, civil society organizations, the private sector, international organizations, and development partners—arose for the preparation of a new forest law to regain control over forest assets. This background provides enormous opportunities for forest restoration—and *Jatropha* in particular—to be integrated in PFM and other activities aimed at rehabilitating degraded sites on different types of forests, as provided by the Forests Act 2005.

**Dryland forests<sup>17</sup> occupy about 30 percent of the country and are a major area of emphasis in the new forest law, draft policy, and extension strategy.** Although these are poor in density,

rich in species diversity, and slow in growth rate, they are an important source of livelihoods to the rural communities. The threats to dryland forests are often characterized through the deforestation of the small but localized hilltops scattered all over the country.<sup>18</sup> *Jatropha* interventions have the potential to mitigate against destruction of dryland forests in the ASALs through programs that promote joint forestry management.

**Farmlands and settlements are estimated to cover 9.5 million ha.** This category of land use contains an average of 9.3 m<sup>3</sup>/ha of wood biomass, which has been increasing annually at the rate of 0.5 m<sup>3</sup>/ha/yr.<sup>19</sup> The public-private sector partnership, where small outgrower *Jatropha* farmers supply a nuclear estate, is another possibility.

The contribution of Kenya's forest sector to the nation's gross domestic product is not well-articulated in national accounts. This is because the direct and indirect economic contribution of forests to the livelihoods of rural people—and to the ecological protection of water resources and agriculture—is not taken into consideration. Statistics from a Food and Agricultural Organization (FAO) publication—*State of the Worlds Forests*—indicate that Kenya's forests account for at least 19 percent of GDP. On the contrary, Kenya's Economic Surveys for various years indicate that the sector has been contributing only 1.1 percent to GDP. This is because they neither take into account earnings from informal trade in charcoal, firewood and medicinal herbs, nor the environmental benefits that accrue from forests. The trade in charcoal for instance, generates over 40 billion shillings to the economy annually. The new forestry dispensation promises new opportunities for the sector and biofuels.

## Enabling Institutional Framework

**The KFS provides a platform for mainstreaming *Jatropha* in new programs like NRM and WKCDD/FM.** Inevitably, a fundamental shift from FD to KFS in terms of organizing activities and building partnerships is required if the intent of the new act—and the whole reform strategy in the forestry sector—is to be fully realized. This calls for a sector-wide approach (SWA) to planning for biofuels<sup>20</sup> and implementation that will accommodate new opportunities like those offered by energy crops such as *Jatropha*. Moreover, the promotion of *Jatropha* will help the KFS realize one of its strategic objectives: “to promote sustainable management of forests in the drylands for production of wood and non-wood forest products and biodiversity conservation.” This will be attained through initiatives such as the commercialization of tree growing, provision of appropriate incentives and technologies, adoption of forest principles, empowerment of tree growers, and promotion of efficient utilization of dryland forestry resources.

**There seems sufficient commitment on the part of the government and other partners to pursue and implement the reforms provided in the Forests Act 2005.** The main changes in the new law that are favorable to the promotion of *Jatropha* include (a) devolution of some management and authority to forest conservation committees and community forest associations; (b) creation of a forest conservation fund where *Jatropha* growers, processors, and researchers can draw resources on a competitive basis with other stakeholders (the FCF will complement but not compete with the proposed BTF); (c) provision for participatory forest management with user rights to forest-adjacent communities, including ASALs and other categories of forests that were not subject to application of forest management principles before the new law; and (d) provision for the conservation and management of water catchment areas with linkages to the agriculture and water sectors.

**The KFS proposes to undertake the following activities that will open opportunities for promoting *Jatropha*:**<sup>21</sup> (a) building capacity in areas such as tree growing, management, and efficient utilization of NTFP; (b) developing and promoting dryland forest extension packages; (c) mapping dryland forest resources; (d) rehabilitating and protecting dryland forests; (e) promoting nature-based enterprises; (f) promoting the development of networks among tree growers, industries, markets, and financial institutions; (g) facilitating preparation of forest management plans; and (h) supporting forest-based community action plans.

This initiative should also include other candidate tree crops like *Croton megalorcarpus*.

Taking cognizance of the new law and using *Jatropha* and other candidate biofuel species, the forestry sector interventions will be directly involved in poverty alleviation at the grassroots through developing sustainable, broad-based, and participatory forest land management in communal lands, trust land under local authorities, and private farms. Some of the interrelated activities of the interventions will include (a) community empowerment and capacity building; (b) land rehabilitation through water harvesting and conservation; (c) soil improvement through the use of nitrogen fixing trees/shrubs and mulching; (d) increasing productivity of degraded forest land through the introduction of trees for fuelwood, construction material, timber, and non-timber forest products (NTFPs) such as leaf-fodder, fodder grass, fruits, honey, resins, and medicinal plants; and (e) income-generating activities such as seedling and charcoal production (once the charcoal rules and regulations are gazetted), primarily based on forest products.

## National Energy Policy and Legislation Framework

**The Energy Act (2006) and Energy Policy provide a broad platform for integrating *Jatropha* during the formulation of a biofuel strategy.** The Ministry of Energy has put in place the Sessional Paper no.4 of 2004 on Energy, whose vision is “to promote equitable access to quality energy services at least cost while protecting the environment.” The mission is “to facilitate provision of clean sustainable and secure energy services for national development while protecting the environment.” The policy seeks to encourage wider adoption of renewable technologies and thereby enhance their role in the country’s energy matrix. On biodiesel, the policy endeavors to provide additional land resources to be set aside for production of energy crops.

**MOE has initiated activities to formulate a biodiesel policy.** In addition, it has put in place the multisectoral National Biofuel Committee to support the development of a biofuel policy. The commercial energy sector is dominated by petroleum and electricity as the prime movers of the modern sector of the economy, while fuelwood provides the energy needs of the traditional sector, including rural communities and the urban poor. At the national level, fuelwood and biomass sources account for 68 percent of the total primary energy consumption, followed by petroleum at 22 percent, electricity at 9 percent, and others at 1 percent.<sup>22</sup> Biomass energy sources include farmlands, closed forests, bushlands, and agricultural and industrial residues. These sources, including fuelwood (firewood and charcoal) account for 68 percent of primary energy consumption.

**In 2006, the MOE constituted a National Biofuel Committee** (see annex v). The NBFC requires expansion of membership, as well as budgetary and strategic transformation into a biofuel steering committee to guide the strategy formulation and action planning process in the country. In 2007, the MOE and its state corporations developed the Kenya Energy-Sector Environment Program (KEEP), whose main activities are energy conservation, tree growing, watershed management, training, and publicity and administration. This mechanism should help integrate *Jatropha* initiatives in the energy sector and the participation of the private sector. In addition, to effectively advance the development of the *Jatropha* value chain in Kenya, a task force with diverse representation was constituted as an outcome of the TOFNET/VDF 1<sup>st</sup> *Jatropha* conference in 2006 (see Annex vi) (Njui 2007).

**There is a need to develop synergies between the NBFC and NBDC.** During the course of the study, MOE expanded the membership of the NBDC with a view to harmonizing activities of different actors and development of a strategic plan and action plan specifically on biodiesel. MOE has identified gaps—including the resource base, technologies, stakeholder capacities, and economics of production and consumption—that need to be addressed before the finalization of the strategy. Some of the segments of the biofuel industry include feedstock supply, processing, distribution, and utilization. While there may be immediate challenges in having biodiesel adopted in the transport industry immediately, there are immense opportunities that can contribute to improved livelihood activities like candle-making, soap-making, and lighting for poor households, and most importantly land rehabilitation. Some of the areas that require more technical interventions include (a) screening of high-yielding **provenances** of *Jatropha* and other oil crops; (b) establishing local industrial capacity for biofuels in order to guarantee a market for the feedstock; (c) establishing biofuel marketing systems and distribution; (d) strengthening mechanisms and creating conditions for ensuring the industry benefits from carbon finance; and (e) creating an enabling policy environment that ensures that biofuels are competitive through appropriate tax regimes.

### III. STATUS OF *JATROPHA CURCAS* ACTIVITIES IN KENYA

**Over 30 institutions have been involved in different aspects of *Jatropha*.** Since 2000, there has been a significant increase in pilot activities at various levels aimed at promotion of *Jatropha*. The different activities can be grouped into (a) biofuel policy formulation initiatives; (b) feedstock production for lighting and cottage industries as livelihood improvement ventures; (c) processing of biofuels; and (d) training, research, and development.

#### **Biofuel Strategy Formulation Activities**

**Initiatives by MOE to entrench biofuels into a broader renewable energy strategy require strengthening and elaboration.** Among the specific energy policy objectives, the following stand out as relevant to the development of a liquid biofuel industry: (a) enhancing security of supply; (b) promoting indigenous energy resources; (c) utilizing energy as a tool to accelerate economic empowerment for urban and rural development; (d) promoting energy efficiency and conservation as well as prudent environmental health and safety practices; (e) providing sustainable quality energy services for development; and (f) providing an enabling environment for the provision of energy services.

**The Ministry of Energy has established the NBFC task force to oversee the development of liquid biofuels.** The NBDC was the outcome of the first national *Jatropha* conference, which was organized by the Vanilla Development Foundation (VDF), Trees on Farm Network (TOFNET), and Henrich Böll Foundation in July 2006. TOFNET, VDF and other stakeholders have put the NBDC task force in place to coordinate the promotion of *Jatropha* and development of biodiesel. The conference also recommended establishment of a biofuel development authority and a biodiesel producers association.

**Other countries in the region—like South Africa, Uganda, and Tanzania—are at various stages of developing a biofuel policy.** Although unsuccessful due to inadequate supportive information, there were previous attempts to prepare a draft a biodiesel policy. These initiatives need to be revitalized through government budgetary support to NBSC in the 2007–08 financial year. The World Bank and other development partners could consider providing support to fast track these processes within the framework of ongoing projects like NRM, ALRMP, and WKCDD/FM. Prefeasibility studies conducted by the NBDC are expected to produce preliminary results to help fast track the effort.

### Box 1. Dryland Forests and Forests Act 2005

Hitherto, the dryland forests were held in trust by the county councils and were virtually unmanaged. The requirement for sustainable management of Local Authority forests under article 24 (1) of the Forest Act 2005 provides for sustainable management of dryland forests for the provision of various goods and services, including support of livelihood through biofuels for the local community. This sets the stage and a framework to legalize and regulate the charcoal business. In the long run, this will translate to royalties for the local authorities, reduce illegal cutting of trees from dryland forest reserves, allow charcoal producers to organize themselves so they can get a better price for their labor, and enable and encourage the use of more efficient kilns that help make tree farming competitive. The exchequer will also benefit from an increased tax base. Although *Jatropha* cannot produce charcoal, it has the potential to rehabilitate degraded lands arising from charcoal extraction and also create opportunities for alternative livelihoods.

**Source:** Government of Kenya (2005b)

#### Kenya Forest Service (KFS)

**Since February 2007, the new KFS under a 16-member board has been put in place.** KFS has a dryland forestry program with a mandate to mainstream dryland forest resources and products into the national economy. The dryland program and the new biofuel unit requires capacity building in terms of human resources and infrastructure to adequately respond to the challenges and opportunities provided by the renewed interest in biofuels. KFS has initiatives to support enterprise development, land rehabilitation, and promotion of NTFPs. The policy explicitly supports carbon sequestration activities that are promising in ASALs.

**KFS has provided strategic leadership to finalize the charcoal rules and regulations.** This will help mainstream the charcoal subsector into the national economy. The lessons learned from this approach can help integrate biofuels in the forestry extension strategy and investment framework. The GOK/JICA-supported Social Forestry Intensified Project is working with some farmer groups—organized under the framework of farmer field schools in Mbeere, Embu, and Tharaka districts—who have the potential to integrate *Jatropha* into the smallholder farming systems and thus provide opportunities for catchment rehabilitation, conservation, and improved livelihood opportunities.

#### National Bio-Fuels Research and Certification Laboratory (NBRCL)<sup>23</sup>

**A modern laboratory to address training, quality assurance and control, as well as technology validation issues of biofuels has been needed for a long time.** The JKUAT-based IIEET (Institute of Energy and Environmental Technology), working in collaboration with KIRDI and KEBS, can host this lab.<sup>24</sup> The main purpose for the NBRCL will be to (a) providing services as a biofuel standards certification center; (b) determining fuel performance in engines; (c) testing and developing better methods with regard to cost and efficiency; (d) testing environmental impacts for biofuels production; (e) training and providing resource center facilities for practitioners in the biofuels industry; (f) promoting pilot projects and educational

activities in remote agricultural areas; and (g) undertaking demand-oriented studies to fill emerging gaps in the formulation of a biofuel strategy and action planning.

The estimated cost for strengthening the research and demonstration facilities at JKUAT is KShs. 17m. The proposed BTF or any other partner can provide seed money, while the government can finance the recurrent costs and equipment costs.<sup>1</sup>

### **Energy for Sustainable Development-Africa (ESDA)**

**Established in 1993, ESDA is a Nairobi-based consultancy firm, and an active member of the NBFC.** Jointly with GTZ and the Finnish Embassy, they hosted a one-day conference on biodiesel in March 2007. Some of the issues raised were the formulation of a biofuel policy, marketing of biodiesel, and the choice and site matching of bio-energy species.

**ESDA believes that *Jatropha* plantations and outgrower schemes hold the key to sustainability, livelihood enhancement, and equity.** Other issues of significance to ESDA are whether farmers and other communities are both aware and willing to take up some interventions along the *Jatropha* value chain without a guaranteed market. ESDA recommends the implementation of a cost-benefit analysis through commercial pilot trials in order to generate empirical data for decision support. ESDA has experience in undertaking energy performance audits for business enterprises committed to corporate social responsibility like KTDA (Kenya Tea Development Agency), Rift Valley Railways, Magadi Soda, and Athi River Mining. The energy audits can identify biofuel crop intervention points in the business cycle. These energy audits can be used for decision support to stimulate local demand for biofuels and create jobs and incomes for vulnerable rural communities. The options for feedstock to provide industry with biofuels should either adopt the KTDA model based fully on small-scale growers or a combination of the nuclear estate plus small-scale growers of *Jatropha*.

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## Feedstock Supply and Community Empowerment

### Vanilla Development Foundation (VDF) and other Partners

**VDF is a nonprofit, nongovernmental organization that uses vanilla and *Jatropha* as an entry point to improving the livelihoods of rural farmers, who are mainly women.** It is based at KIRDI, Nairobi, with other offices in Mtito Andei, Oyugis, and Kisumu. The foundation aspires to provide a regional platform to strengthen the capacity of vanilla-*Jatropha* stakeholders in the production-consumption value chain by (a) providing leadership in policy advice and advocacy; (b) developing and disseminating production technologies and innovations; (c) providing post-harvest and marketing services; (d) facilitating information and knowledge management and documentation; and (e) enhancing capacity building of stakeholders and industry partnerships and linkages.

**VDF is a major promoter of *Jatropha*/vanilla systems in Kenya.** It provides production technology for the establishment and cultivation of *Jatropha*/vanilla combinations and was a leading partner in the first and second national *Jatropha* conferences held in Nairobi in 2006 and Mombasa in 2007. VDF has a competitive advantage in *Jatropha*/vanilla systems because of its community, research, and industry networks. The foundation works mainly with women in rural areas and has some ongoing activities in the Southern Rangelands of Ukambani and western Kenya. Some of the partners who have worked with VDF include the Agha Khan Foundation, KAPP, South Nyanza Community Development Project, Christian Childrens Fund, and World Vision. Through these partnerships, VDF has reached over 2,000 farmers mainly in the Southern Rangelands and Nyanza Province.

### UNDP-GEF Small Grants Programme (SGP)<sup>25</sup>

**The SGP in Kenya was established in 1993 in an estimated 200 communities.** The program has nationwide distribution. It awards grants to communities that link livelihoods to the reduction of pressure on utilization of natural resources. Having worked with over 30 groups throughout the country, the UNDP-GEF-SGP has many lessons to offer in benefit-sharing, grant administration, synergy, and integration of biodiversity conservation in rural communities. The program has launched two clusters in Malindi and Kwale districts involving communities in the growing of *Jatropha* as boundary hedges on farms in combination with vanilla. The interventions addressed through this initiative are the prevention of land degradation, mitigation of climate change, and the conservation of the biodiversity of coastal forests through establishment of *Jatropha* buffer zones around them. The objectives of both geographic clusters include (a) extraction of oil from seeds for lighting to replace consumption of kerosene; (b) reductions in greenhouse gas emissions; (c) establishment of a suitable market structure by linking farmers to the private sector; (d) improvements in income and living standards in the local communities through the sale of *Jatropha* products like candles and soap; (e) increased vegetation cover, thus minimizing soil erosion and land degradation; and (f) reduction of crop loss caused by wild and domestic animals through planting hedges.

**Community groups in Malindi are set to grow *Jatropha* a support for vanilla vines.** Based on preference, selected farmers will grow *Jatropha* seedlings and cuttings as live fences for barriers. With the participation of over 380 individual farmers, the target is to plant over **239,400 *Jatropha* trees**. The project expects to harvest 133,000 kg of seeds producing 26,600 liters of oil after two years. The groups in Kwale will grow *Jatropha* seedlings, cuttings, and seeds in the form of hedges but also on wasteland as buffer zones around seven threatened coastal forests. Five

community groups living adjacent to the threatened forests will implement the project. The processing of these seeds will be done by a multipurpose processor unit belonging to WWF, which is currently being used for the production of neem oil. The project expects to plant **100,000 trees** as hedges, on wasteland, and adjacent to vulnerable forests.

## Community Development and other agencies

The establishment of community-based *Jatropha* projects in the Coast Province through the GEF-funded Critical Ecosystems Partnership Fund is an ongoing activity. The main objectives of the project are (a) improving energy security; (b) protecting the environment and local biodiversity through mitigating against climate change; and (c) enhancing agricultural productivity. The *Jatropha* oil is targeted for replacement of kerosene in homes, production of soap, seed cake fertilizer, and eventually biodiesel.

## Groups with *Jatropha* activities in the Coast

**Table 1. Community participation in *Jatropha* activities in the Coast**

District	Groups
Kwale	<ul style="list-style-type: none"> <li>• Golini, Hwalugange Wildlife Community</li> <li>• Msulwa Tree Nursery Organization</li> <li>• Mrimandizo Forestry Association</li> <li>• Kaya Muhaka Forest Conservation Organization</li> <li>• Kaya Mrima Forest Conservation Group</li> <li>• Lima Group</li> </ul>
Malindi	<ul style="list-style-type: none"> <li>• Goshi Farmers Cooperative Society</li> <li>• Magangani Butterfly Farmers</li> <li>• Genda Farmers Cooperative Society</li> </ul>
Kilifi	<ul style="list-style-type: none"> <li>• Maya Village Development Board</li> <li>• Songea Development Fund and Forest Conservation</li> <li>• Roka Community Development Committee</li> <li>• Dida Forest Adjacent Area Association*</li> </ul>

\*Note: The group has oil processing machines.

Source: TCN (2006) Unpublished Mimeo.

**Table 2. Institutions and Organizations engaged in *Jatropha* activities in the Coast**

Name of Institution	Type	Area	Location
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Nature Kenya	NGO	Not available	Malindi
Forest Department	GoK	Not applicable	All districts
KEFRI	GOK	Not applicable	Kilifi
LAFARGE Ecosystems*	Private	40 acres	Kilifi
Robertson	Private	400 trees	Malindi
Victoria Vanilla** (K) LTD	Private	4 acres of <i>Jatropha</i>	Malindi
KAFU	NGO	Not available	Kwale

Notes: \* Subsidiary of Bamburi Ltd. \*\* Van Englem, the director, has over 30-year-old trees with expected seed yield of 4000kg/ha

Source: Help Self Help Center (2006) Mimeo

### Green Africa Foundation (GAF)

**GAF is a Kenyan nongovernmental organization established in 2000.** The initial activities were started in Kitui District but have now spread out to other ASAL areas in the country. The focus is on environmental conservation aimed at improved livelihoods of those in vulnerable positions in the ASALs. Using the business development value chain approach, GAF's main focus is on community-based integrated development and uses sports to raise awareness of environmental issues, with one of the main activities being growing of *Jatropha* for Japanese markets. For example, GAF was one of the cosponsors of the recent World marathon championships hosted in Mombasa. It uses participatory approaches to get the maximum impact on the environment by partnering with people through sports organizations, line ministries, churches, schools, universities and colleges, companies and international agencies. GAF's planting target for *Jatropha* is more than 500 hectares in Ukambani and adjacent rangelands. Some of the partners for GAF include KEFRI, NEMA, Hiroshima University, Kenya Airports Authority, Safaricom, and KWS. Working closely with these partners, the foundation has distributed over 1.3m seedlings, mainly in the Southern Rangelands.

### Acacia Operation Project (AOP)

**Since 2004, FAO has been supporting two projects that are being implemented in synergy in the framework of the Network for Natural Gums and Resins in Africa (NGARA).** The regional office in Kenya is at KEFRI-Karura. The projects has partnered with DMP, KARI, and KEFRI to establish pilot sites for *Jatropha* in Kibwezi District, where the trees were planted using a mechanized Vallerani water harvesting technology for comparison with other techniques of *Jatropha* planting. In 2006, the project just completed the formulation of a 5-year phase, which is being bridged to the pilot phase through a 12-month program. There are opportunities at community program and policy levels to integrate NRM activities with *Jatropha* interventions and AOP to test the performance of the Vallerani water harvesting technology on *Jatropha*.

Local communities and agencies in 16 project sites (covering over 500 ha) have been mobilized in Marsabit, Samburu, Isiolo and the Southern Rangelands of Ukambani. Mapping, and biophysical characterization of the pilot sites has been carried out and a database has been established. This baseline data can be **accessed** to monitor the effect of *Jatropha* on degraded sites. AOP has signed a memorandum of understanding—with KARI, ALRMP, ENNDA, WFP,

Terra Nuova, and Food for the Hungry International (FHI), among other institutions that can form the basis for scaling-up *Jatropha* activities. The Gums and Resins Association (GARA) has been involved in the formation of producer associations within the project area. There is potential to use AOP's pilot sites to integrate *Jatropha* cost effectively in the drylands using the existing sites and infrastructure as entry points.

### **Arid lands Resource Management Project (ALRMP)**

**ALRMP is a GOK/World Bank-supported project that aims to enhance food security and reduce livelihood vulnerability.** The project focuses on drought-prone areas and marginalized communities in 28 arid and semi-arid districts in Kenya. The project has several components:

- *Component 1: Natural Resource & Drought Management.* The strategic context for all NRM activities has been set through the development of a vision, strategy, and district-specific action plans for the ASALs. The elaboration of the process—conducted in a participatory manner—shows in a clear format how the residents and their leaders view the future and the opportunities for government and other agencies to respond to the challenges identified. This framework has been translated into an ASAL strategy that outlines procedures to guide natural resource management operations in the area. In the areas covered by ALRMP, it may be possible to integrate biofuels without necessarily formulating new projects. The ALRMP work plans, both nationally and in the districts, are based on improved natural resource tenure and control, information and awareness creation, institutional strengthening for NRM, multisectoral natural resource planning and management, and discrete development areas (DDAs).
- *Subcomponent 1.2: Drought Preparedness & Management.* This subcomponent entails expansion and enhancement of the early warning systems, strengthening drought preparedness and contingency planning, district drought preparedness, and the drought contingency plan. This intervention will enhance synergies with biofuel energy crop activities, as farmers will have a source of livelihood when they are most vulnerable. It is for this reason that investment opportunities for biofuels within ALRMP should be analyzed for possible integration in the work plans.

The selection of pilot sites should be based on one district for each region (i.e. Upper Eastern, North Eastern, Rift Valley, Southern Rangelands, Mt. Kenya Region, and Ukambani). To avoid duplication, these degraded lands will be rehabilitated using *Jatropha* based on ALRMP and other the institutional structures, priorities, and work plans of other agencies.

### **Southern Nyanza Community Development Project**

**This is an integrated development project supported by GOK and IFAD and managed by a project coordination unit (PCU).** The project covers Nyanza, Rachuonyo, Migori, Kuria, Homa Bay, and Suba districts. The project's main objective is poverty reduction and improved livelihoods of communities in the project area. The project has four components implemented under various ministries, namely (1) community empowerment (Ministry of Gender and Social Services), (2) primary health care (Ministry of Health), (3) domestic water supply (Ministry of Water and Irrigation), and (4) agriculture and livestock (Ministry of Agriculture and Ministry of Livestock and Fisheries Development). This component represents an opportunity to integrate *Jatropha* in the project.

**IFAD supports other projects in Kenya.** For example, MKEPP and the Central Kenya Drylands Project can be used to promote *Jatropha* and other biofuel tree crops. The project is a

collaborating partner in the *Jatropha* project supported by KAPP. This is a proposal awarded on a competitive basis to VDF and other partners to pilot the production and commercialization of *Jatropha* oil.

### **Food Link Resources International**

**This organization provides valuable expertise in structuring marketing channels and trade arrangements for *Jatropha* oil and associated products.** In the KAPP *Jatropha* project, Foodlink Resources provides leadership in the identification of marketing strategies, including packaging, advertisements, and product presentation.

### **Bioventures and Tree Crops Network Africa (TCN)**

**Bioventures and TCN are NGOs that promote organic agriculture.** *Jatropha* is one of the candidate crops farmers are encouraged to plant. They also educate farmers on the uses of the products. TCN has oil pressing and soap-making activities in Ngurumani in Kajiado **District**. This site has potential for promoting candle and soap-making for subsistence and commercial uses.

### **Nyumbani Eco-village in Kitui**

**This is a home that cares for AIDS orphans.** The founder set out to create a model eco-village to house 1,000 orphans and 250 elders (grandmothers, usually) who would care for and mentor the children. The goal is a sustaining community in terms of food production, energy, and use of local resources. It has planted some 400 *Jatropha* trees and has plans for more. It has also negotiated markets for the products.

### **Kenya Association of Forest Users (KAFU)**

**KAFU is a national association of forest users.** It was formed to promote sustainable production and utilization of non-timber forest products and can assist in capacity building and awareness creation in communities. It has *Jatropha* as one of its technologies in its Coast Province project sites.

### **The Kenya Wildlife Service (KWS)**

**The main mandate of KWS is the conservation of wildlife in the national parks and reserves.** It protects wildlife from the community and the adjacent communities from destruction. *Jatropha* is a candidate crop for the establishment of buffer zones between the local farmers and wildlife-designated areas. In addition to its livelihood benefits, KWS has taken up the *Jatropha* tree crop as a life fence in most its community projects to address human/ wildlife conflicts.

### **Research and Training Institutions**

**The Universities of Nairobi, JKUAT, and Kenyatta are carrying out different aspects of research work on *Jatropha* and biofuel.** Some preliminary policy work on development of the formulation of a biofuel policy as part of the NBFC has been initiated.

Chemistry Department, University of Nairobi

**The Chemistry Department at the University of Nairobi provides biofuel policy leadership to the National Biofuel Committee.** The proposed road map for the biofuel strategy/policy is mainly based on this work (Kituyi 2007). It is important to expand the membership of the NBFC and also strengthen its strategic leadership through the Ministry of Energy so as to comprehensively address the broad issues that entail the process of biofuel strategy/policy formulation. Without MOE acting as a champion, biofuel policy and strategy formulation will be nonstarters and will end up as disjointed activities without any impact at the national level

### **Jomo Kenyatta University of Agriculture and Technology (JKUAT)**

**The university undertakes joint research in collaboration with industries and other institutions such as Kenya Organic Products Ltd.** JKUAT has the capacity to undertake analysis of *Jatropha* oil and its byproducts so as to provide guidelines for production and utilization. For example, based on sunflower data from South Africa, a study has found that a plant capacity of 8,000 liters per day will require about 16 tons of feedstock per day (Thuku et al. 2006). This amount could be supplied by 800 farmers cultivating 5-ha plots, which would create 16,000 field jobs and 15 plant jobs per day. Consequently, the 1.8 **million** liters required to meet 4 percent of diesel consumption per day has the potential to generate 16,150 jobs. This study recommends a validation and assessment in the case of *Jatropha* and other candidate biofuel crops.

**Some of the main activities at JKUAT include biodiesel trials on tractor engines.** Other activities include:

- Development of laboratory facilities for biodiesel studies, including fuel quality and engine performance tests. It has been proposed that this could be upgraded to serve as a national biofuels test center.
- Discussions with the Ministry of Energy regarding support for the biofuels industry, including formation of the National Biofuels Steering Committee.
- Capacity building through training and research. The IEET in the faculty of engineering has a three-week international training program for serving officers in the energy and environmental sectors. There are a number of ongoing research activities on biofuel production, utilization, and vegetable oil sources, including crop agronomy. It is also necessary to design a regional biofuel course whose curriculum responds to emerging opportunities for middle-level practitioners. The course would be administered jointly by both the universities and users as a way to enhance technology transfer and capacity of practitioners in the public and private sectors.

**JKUAT is also involved in small-scale production and pilot plants/projects.** Some of the future activities at the proposed center include:

- Pilot generation of electricity for communities outside the main grid using biofuels as a tool to alleviate poverty.
- Demonstration of use of seed cake fertilizer from *Jatropha* oil and its use for lighting and cooking so as to improve the livelihoods of the vulnerable.
- Small-scale batch production units necessary for the production of fuel for laboratory tests and standardization of the production and extraction process.
- Engine performance tests.
- Laboratory, durability, and pilot production tests.
- Private sector partnership promotion to promote high production of *Jatropha* oil so as to meet future demand for transport-based uses.

**JKUAT can establish partnerships with other key stakeholders in both the public and private sectors.** It has a competitive advantage in the following areas, which have been identified as gaps by the national biofuel committee.

- Market-driven scoping studies on technical, environmental, and socioeconomic issues affecting the biofuels industry. These studies could provide a sound basis for the formulation of a comprehensive policy framework for the establishment of a vibrant biofuel sector.
- Development of a strategic framework and a comprehensive implementation plan, with clear medium and long-term production and utilization targets and capacity benchmarks for the biofuels industry.
- Developing pilot studies on the full cycle of biofuel value chain, including farming, oil production, processing, and commercial utilization.
- The establishment of the National Biofuels Research and Certification Laboratory (NBFRCCL).
- Empirical research on biofuel crop agronomy, silviculture, and processing.
- Participatory monitoring, evaluation, and documentation of ongoing initiatives in Kenya.

### **Kenya Forestry Research Institute (KEFRI)**

**KEFRI was established in June 1986 by an act of Parliament to undertake forestry research and development (R&D).** The institute implements its research through four research programs: farm forestry, natural forests, dryland forestry, plantation forestry, and one service program dealing mainly with information documentation and dissemination. KEFRI has six research centers at Muguga, Karura, Kitui, Gede, Londiani, and Maseno. KEFRI/KARI has been undertaking performance trials on *Jatropha* in Kibwezi and Kitui centers through the DMP project. In terms of human and physical resources, the infrastructures in these stations provides a good opportunity for training in pilot cottage-based industries emanating from *Jatropha*.

The institute has been providing leadership in the identification of superior **varieties** of planting materials for establishment within the various eco-regions in the country. In addition, it is providing support for domestication and management of *Jatropha* trees, as well as supplying seed to potential growers.

KEFRI/KARI/KIRDI and the private sector need to provide leadership on integrated biofuel research rather than isolated activities through the establishment of a biofuel unit that has capacity for pilot processing training and piloting venture linkages for the validation of business models.

### **The Kenya Agricultural Research Institute (KARI)**

**KARI is the leading national agricultural research institution in the country.** It brings together research programs in food crops, horticultural and industrial crops, livestock and range management, land and water management, and socioeconomics. KARI promotes sound agricultural research, technology generation, and dissemination for food security through improved productivity and environmental conservation.

KARI Katumani Center in Machakos is involved in germplasm collection, evaluation, and agronomic research, as well as multiplication and scaling up of *Jatropha*. Conservation efforts by KARI have led to the preservation of five accessions—from Nyanza, Makueni, Kajiado and Marsabit—into the National Gene Bank of Kenya.

KARI is hosting the World bank/GOK-supported KAPP, which is managing a competitive research grant facility. KAPP is funding the Ksh.8 million *Jatropha* development proposal with VDF as the lead partner. Other partners are Food Link International, KEFRI, TOFNET, and KIRDI

### **Other *Jatropha* Activities in Kenya**

**Other pilot activities are at Magadi Soda (Tata).** The list is not exhaustive but includes:

- Magadi Soda Company has initiated a process of developing a nuclear *Jatropha* plantation of 10 hectares for possible use in an energy switching program together with an outgrower scheme where communities will grow *Jatropha* for use by the firm.
- KIRDI is working closely with VDF in validating and developing prototypes for processing *Jatropha* biodiesel.
- The Help Self Help Center (HSHC) in Naromoru is promoting *Jatropha* in the rangelands and running an oil press resource center, in addition to making candles and insecticide soap.<sup>26</sup>

**Most *Jatropha* activities are not known outside the project sites.** In most of the projects, the following is distinctively notable about biofuels and *Jatropha* in particular:

- Lack of up-to-date information by the public and most government, commercial and industrial energy officials about the availability, costs, and benefits of biofuels. In most cases, there is no empirical data to support the popularized attributes of *Jatropha*, making the cost-benefit analysis a most urgent issue.
- Lack of knowledge by project initiators and managers of the social and energy-related needs of rural communities. Target beneficiaries are often uninvolved. Most of the pilot projects are hardly known beyond the project sites.
- Failure to get the prices of inputs right, particularly distorting the energy market where fossil fuel energy sources are compared to biofuels and other renewable energy options, as well as failure to value all resources on a life-cycle-cost basis, taking into account externality costs to society.
- Discrimination against untested alternative energy sources such as *Jatropha* and other candidate technologies by users in the public and private sector in favor of conventional fuels.
- Lack of personnel trained in the installation, operation, and maintenance of renewable energy equipment, particularly *Jatropha*.
- Lack of knowledge and personnel trained in financing mechanisms available to support biofuel energy projects, such as import duties on appropriate equipment and other barriers to foreign investment.
- Limited R&D effort and funding devoted to improving biofuel and *Jatropha* technologies.

## IV. POTENTIAL FOR USING *J. CURCAS* AS A MULTIPURPOSE ENERGY CROP

Many people working in the land use, forestry, and energy sectors are increasingly aware of the potential of *Jatropha*. This and other energy crops have the potential to contribute not only to the energy household energy budget but also act as a source of biofuel for the industrial and transport sectors. This awareness has resulted in attracting investments in new opportunities for carbon mitigating projects for afforestation and re-afforestation. In Kenya, the tree crop has over the last two years received some minimum attention from the line ministries and NGOs, but its potential lies largely unrecognized by extension agents.

### Land Degradation and the Multiple-Use Benefits from *J. curcas*

*Jatropha* grows well in a wide range of soils and climatic conditions and is highly adaptable.

Table 3. Characteristics of ASALs Based on Agro-ecological Zones

Characteristics	Arid Lands	Semi Arid Lands
Agro- ecological zone	6&7	4&5
Area of Kenya	352,000km <sup>2</sup>	114,00km <sup>2</sup>
Rainfall	200–500	550–850
Agricultural Production System	Zone5–6 Transition Sorghum, millet, cowpea & green gram with community grazed herds	Zone 4 Maize, beans & cotton, with cattle, goats, sheep & poultry
	Zone 6–7 Pastoralism dominant with goats & camels dominant; mobility high	Zone 5 Maize, cowpea & pigeon peas
Production Constraint	Erosion, infertile soils, and inadequate rainfall	Inadequate rainfall, pests, Soil erosion, low fertility & frequent droughts

Source: Jaetzold and Schmidt.(1983).

Some potential applications of *Jatropha* that require interventions include utilization in rural communities (a) for provision of domestic energy services, including cooking and lighting; (b) as an additional source of household income and employment through markets for fuel, fertilizer, animal feed, medicine, and industrial raw material for soap, cosmetics, etc; (c) for environmental benefits, including protection of crops or pasture lands, as a hedge for erosion control, or as a windbreak; and (d) for carbon sequestration and trade.

***Jatropha* is easy to propagate.** It has been demonstrated successfully through various pilot projects that *Jatropha* is easy to establish, grows relatively quickly, and is hardy. Being drought-tolerant, it can be used to reclaim degraded areas, as well as form barriers as a boundary fence or live hedge in the ASALs. *Jatropha* is not browsed, for its leaves and stems are toxic to animals, but after detoxification, the seeds or seed cake could be used as an animal feed. Being rich in nitrogen, the seed cake is a rich source of plant nutrients. Various parts of the plant have medicinal value. Its bark contains tannin and the flowers attract bees, so the plant has honey

production potential. Like all trees, *Jatropha* removes carbon from the atmosphere, stores it in the woody tissues, and assists in the buildup of soil carbon.

**There are some promising experiences in other countries such as Mali.** The oil from *Jatropha* is environmentally safe and is a promising substitute for Kerosene and diesel. Seedlings are susceptible to competition from weeds during their early development; weed control, either mechanical or with herbicides, is required during the establishment phase. Satisfactory planting widths are 2 x 2 m (2,500 plants per hectare), 2.5 x 2.5 m (1,600 plants/ha), and 3 x 3 m (1,111 plants/ha). Under good rainfall conditions, nursery plants bear fruit after the first rainy season, while directly seeded plants bear for the first time after the second rainy season. With vegetative propagation, the first seed yield is higher. At least 2–3 tons of seeds/ha can be achieved in semi-arid areas. Similar observations have been made by GAF (Green Africa Foundation 2007) in the various sites in the country. These need to be scaled up and validated by scientific trials by KEFRI/KARI/KIRDI and the various universities.

The most important factors/questions favoring the promotion of biofuels and *Jatropha* as multipurpose energy crop include:

- Interdependence and vulnerability of oil supply and the urgent need for security of supply
- Climate change (CO<sub>2</sub>) and the urgent need for reduced emissions
- Agricultural problems (market risks) and the need for diversification
- Regional development and the urgent need for new economic activities
- High cost of imported oils and the need for low-cost energy sources.

## **Opportunities For Carbon Offset Schemes in Kenya's Vast Arid And Semi-Arid Areas.**

***Jatropha* provides an opportunity to sequester carbon in the ASALs.** The Kyoto Protocol's Clean Development Mechanism (CDM) is anchored on the emerging voluntary markets for carbon offset programs in developed countries, which have opened opportunities for communities to benefit from conservation efforts. Kenya has acceded to the Kyoto Protocol and has established a Designated National Authority (DNA) for CDM within the National Environmental Management Authority (NEMA). The country has also submitted the Initial National Communication (2002) and has in addition communicated its definition of a forest to the United Nations Framework Convention on Climate Change (UNFCCC).<sup>27</sup> The country can therefore host afforestation and reforestation projects under the CDM.

**The Sessional Paper No.7 of 2005 on the new Forest Policy for Kenya and the new Forest Act (2005) state the desire of the government to promote tree planting and land rehabilitation for carbon sequestration.** The government further undertakes to explore opportunities available in carbon trade for conservation and management of forests while at the same time endeavoring to take advantage of appropriate international forestry-related instruments and agreements.

Two projects are currently in the initial stages of developing carbon offset schemes that will allow farmers and community groups to benefit from conservation activities that involve afforestation and reforestation of degraded areas in the Aberdares and Mt. Kenya forests under the Greenbelt Movement and farm holdings in parts of Meru and Laikipia districts under TIST. These attempts are laudable and need to be replicated in other areas to promote conservation efforts while improving livelihoods in the rural areas.

**The ASALs provide over 80 percent of the best sites for carbon offset programs.** These sites are generally fragile ecosystems inhabited by poor households. Continuous cropping in these fragile ecosystems and extensive vegetation clearing has resulted in severe land degradation. Most of these areas have also witnessed an unprecedented influx of people from high-potential areas in search of more farming land.

## **Current Interventions to Address Land Degradation Issues**

**The Kenya Forest Service has a fully fledged forestry extension program.** If strengthened, this can support the promotion of forestry activities outside the traditional gazetted forest areas. This program has been in existence since 1973, when an afforestation extension scheme was initiated targeting farmers and community groups for purposes of increasing the supply of forest products and services that are provided at the farm level. This in effect releases the pressure on gazetted forests and allows them to contribute more to the provision of environmental support services and conservation goals.

Until recently, interventions have concentrated on establishment of trees, with most resources being directed to nursery establishment. In the past, there have been limited attempts to link established tree resources to potential markets for the final product. However, most farmers are not conversant with the pricing mechanism for their products. Trees have therefore continued to fetch very low prices. Farm forestry activities are recognized as instrumental in providing various environmental services, and extension packages have attempted to capture them.

## **Possibilities for Carbon Offset Programs in the Drylands**

**Dry lands present the best opportunities for carbon sequestration programs.** This is due to factors such as land availability, incentives, forestry reforms, and research initiatives.

### **Land availability**

**Expansive dry lands offer the greatest opportunity in terms of forestry investments and diversification of agricultural incomes.** These areas are prone to persistent crop failures. Incorporation of trees within cropping systems has the advantage of conferring some security on farm incomes. Trees and particularly *Jatropha* have the added advantage of exploiting environmental resources over a wide area and may not suffer the same shocks as annual crops.

### **Incentives**

**Forestry-related technologies and incentives for productive and conservation forestry are envisioned in the Forests Act (2005).** The act requires the KFS to provide demand-driven extension services to individuals and communities while exploring mechanisms to maximize tree benefits. In this case, tree-based small and micro enterprises will be promoted and *Jatropha* becomes a promising candidate species of choice.

### **Forestry Reforms**

**The current forest policy dispensation has articulated the importance of private sector participation in forestry investment and management.** Private forest investors will be supported to invest in forestry through appropriate incentives like technical backstopping and

linkages with markets and industries. The act also provides for the establishment of a Forest Conservation Fund from which venture linkages in the sector can draw resources.

### **Research Initiatives**

**Research in tree biotechnology has pushed the frontiers of commercial forestry by increasing productivity.** Fast-growing tree species have been developed, and massive tree seedlings can be produced through tissue culture. *Jatropha* is particularly easy to propagate and the Tree Biotechnology Project has started multiplying the tree species. The country has a pool of experienced and trained manpower in R&D whose services will be necessary at different stages of the *Jatropha* value chain

### **Comparative Advantages of Using *Jatropha* in Carbon Offset Programs over other Tree Species**

**Tree farming presents an appropriate opportunity to raise land productivity and arrest land degradation in the ASALs.** All opportunities should be explored to raise land productivity, restore ecosystems, and improve the livelihoods of the inhabitants. However, smallholder adoption of tree growing as an economic activity is determined by available opportunities for income generation. *Jatropha* establishment interventions are justifiable in light of competing household demands and land capacity. Carbon sequestered by growing trees has been recognized as a tradable environmental output of tree growing among other tree products, and can be employed to add value and income levels from the tree component of farm forestry systems.

Programs that incorporate carbon as a product for CDM participation require sufficient consideration at the initial stages to guarantee success and sustainability, since carbon benefits accrue in the long term and investors should be assured of the permanence of carbon stocks within the farm holdings. In view of the high transaction costs associated with carbon offset schemes, project areas also need to be carefully selected to ensure that opportunities exist to promote communal efforts or other similar community efforts are in place within which carbon schemes can be anchored.

**Biofuel crops, particularly *Jatropha*, offer significant possibilities for reducing greenhouse gas emissions when they replace fossil fuels in energy systems.** If well-implemented, the carbon balance of producing biofuel is positive, so replacement of fossil-fuel-derived energy with biofuel crops reduces emissions. Biofuel systems also have the potential to enhance carbon sequestration since short-rotation crops established on unproductive land act as carbon sinks by accumulating carbon in the vegetation and soil. Establishing long-rotation woody crops on a sustainable basis for fossil fuel substitution provides long-term carbon benefits, as it has an irreversible mitigation effect by reducing carbon dioxide at the source.

*Jatropha* presents some of the most promising pathways to arrest extensive land degradation in the arid and semi-arid areas by combining livelihood improvements and environmental conservation goals. *Jatropha* oil is an important product from the plant for meeting the cooking and lighting needs of the rural population. It serves as boiler fuel for industrial purposes and is a viable supplement for diesel. The cooking option provided by the oil will not only alleviate the problems of deforestation, but also improve the health of rural women who are subjected to indoor smoke pollution from cooking by inefficient fuel and stoves in poorly ventilated spaces.

## Potential CDM Entry Points for *Jatropha*

***Jatropha* already fits well as a tree within the official Kenya definition as communicated to the CDM executive board.** Farmers and communities will therefore benefit directly from carbon stocks that accumulate within the biomass of growing trees. These stocks are likely to be significant as the tree allows for very close spacing, especially when planted as a hedge crop. Carbon offset programs in developing countries are required to demonstrate sustainable development and environmental conservation. These benefits can easily be identified under a *Jatropha* system.

Oil from *Jatropha* is likely to trigger energy-switching activities within the industries—for example, KTDA and KENGEN—that are willing to “green” their products and benefit from CDM. While farmers may not directly draw CDM benefits from an energy switching program, the demand for oil generated by the industries will translate as more benefits to them by creating demand for oil products.

### Potential Roles in a CDM Scheme for major stakeholders

**Kenya Forest Service could play the role of an “aggregator” of carbon stocks.** KFS is in a position to secure the required extension services to produce the very substantial amount of seedlings required and to distribute them among farmers. The farmer field schools offer a good institutional platform for such extension work. KFS’s strong linkages with KEFRI and other international institutions allows it access to research findings and use its extension network to disseminate findings to farmers and communities. KFS could set up a program within the forest management and conservation fund for forest conservation and forest-based social development, such as forest-based micro enterprises, acquisition of technologies, processing of NTFPs, and rehabilitation of degraded land. Promotion of *Jatropha*-based micro enterprises would be fully in line with the intended focus of the fund.

### Kenya Electricity Generating Company LTD (KenGen<sup>28</sup>)

**This is the main energy generating company in the country with potential to guarantee the *Jatropha* feedstock.** This can be done through planning for a purchase guarantee. KenGen is a key player in the Kenya Energy Sector Environmental Programme (KEEP), a joint program of the MOE and all parastatals under the Ministry of Energy. One of the planned activities is the establishment of a 50ha *Jatropha* plantation with 100,000 seedlings.

### Kenya Tea Development Agency (KTDA)

**KTDA with 54 tea factories is another potential major buyer of biodiesel.** So far, KTDA factories rely mainly on furnace oil, fuelwood, and electricity from the national grid or its own generators. In addition to electricity required for lighting and driving motors and withering fans, an average tea factory needs 12,000 m<sup>3</sup> of wood. Alternatively, it requires 1.6m liters of furnace oil valued at KShs. 50m/year. The agency represents 92,000 ha of tea plantations (yielding 60 percent of the Kenyan tea production, an equivalent of over 700 million tons of green with an input of 615,000m<sup>3</sup> of fuelwood.

It is evident from the consultations with stakeholders that, as long as it is done on a small-scale basis, the development of *Jatropha* within the ASALs is feasible, economically sound, environmentally sustainable, and socially acceptable. Dissemination and scaling up of the domestication of this important tree species is needed for the benefits to be enjoyed by tea farmers and other stakeholders in the sector.

## V. APPROACHES TO DEVELOPING BIOFUEL FEEDSTOCK SUPPLY SYSTEMS

**Many good projects have failed to meet their objectives because of poor implementation.** In considering approaches for piloting biofuel projects, it is important to recognize that:

- While the potential of biofuel in energy substitution and poverty alleviation is enormous, indigenous biomass resources and especially forests are under great pressure. Further use of these resources without replenishment is unsustainable. Therefore any large-scale uptake of biomass fuels would require the development of an environmentally sustainable supply chain. There are vast lands in the ASALs to undertake this.
- If well-implemented, energy crops are likely to present a more viable option in the ASALs in terms of land use. It is prudent that the site/crop selection procedure should be carefully undertaken. This is particularly suited for *Jatropha* development for the pro-poor models, since the poor cannot afford costly inputs. Two broad approaches are possible in Kenya, either in pure form or in various combinations depending on prevailing conditions. These are the large-scale plantations or nuclear estates and small-scale out-grower schemes. In considering either scenario, there is a need to study the peculiarities of each system.

### **Plantations**

**The establish of plantations is a capital-intensive project (Mutimba 2007) characterized by:**

- High capital investment outlay, which has the potential to yield high production and profits
- Efficiency (economies of scale allow for mechanization)
- Concerns on whether land and other resources will always be available
- Livelihood concerns and the effect of profits at the expense of livelihoods
- High ability to attract investments because of the potentially high returns

**Small-scale outgrower biofuel schemes are characterized by:**

- Low investment
- Efficiency; small units are easy to manage
- Empowerment and equity benefits to the vulnerable
- Resistance to corruption
- Sustainability; inputs are few and easy to provide
- Potential to enhance livelihood opportunities to the majority of adopters
- Low capital requirements.

### **Pro-poor Biofuel Production Schemes: Community /Public-Private Sector Participation**

**Biofuel and *Jatropha* development can be used to strengthen partnerships in the energy and forestry sectors.** An international review found company-community-forestry-partnerships in 23 countries, with 57 examples that cover outgrower schemes, supplemental company-grown fiber, and tourism and timber concessions, joint ventures, processing, and plantation protection services (Mayers and Vermeulen 2002). According to the review, companies are eager to seek alternative

sources of wood due to the decreasing availability of natural forests, greater restrictions on high-conservation-value and endangered forests, increased public scrutiny on investor and company activities in natural forested areas, and reforms by the public sector on government concessions. The review notes that companies are seeking opportunities to secure access to land and labor, as well as a steady supply of biomass. Communities are seeking new markets and access to credit, technology, and employment. This is highly relevant to anyone interested in investing in a biofuel production system in Kenya based on the new forestry dispensation.

**Community involvement in biofuel production systems is crucial for the success and sustainability of the program.** Community involvement offers (a) security to the growing trees by ensuring that there are reduced risks from theft, fire risks, cattle grazing, etc.; and (b) relatively cheap and reliable labor. In addition, the biofuel projects are able to enhance investors' image and their corporate social responsibility.

**To accrue the above benefits from a community, an investor must come up with mutually beneficial ways and means of ensuring their participation.** Generally, there are four ways this can be done by engaging community members (a) as employees on both a permanent and casual basis; (b) as partners in biofuel systems production; and (c) as outgrowers complementing the biofuel system.

**Various partnerships models have already been tried by a number of organizations.** For example, Lafarge East Africa (LEA, formerly Bamburi Cement) has some partnership models for incorporating the local community in biofuel production (ESDA 2006). The proposed model consists basically of an integrated nuclear estate and an outgrower scheme, based on the Kenya Tea Development Authority (KTDA) partnership with small-scale tea farmers.

#### **KTDA Model: Small Scale Outgrower schemes**

**The KTDA model in Kenya consists basically of groups of small-scale farmers managing common resources—tea, and sometimes woodlots—covering thousands of hectares.** This is owned by the farmers with a processing plant, which is owned by farmers themselves. The outgrowers are supplied with inputs such as fertilizers, seeds/seedlings, and extension services in some kind of loan arrangement. In exchange, the farmers commit to tend the crop and supply the produce exclusively to the company/investor. Payments are made at agreed intervals and farmers may form cooperatives to leverage financing and lobby for other issues affecting them.

This scheme can only succeed if the investor can acquire finance and invest in a nursery for seedling production, a nuclear estate, and a processing plant. The investor must also first demonstrate that the scheme works. The investor should also provide answers to questions regarding yield, planting, and tending techniques, and set up collection and delivery infrastructure from the farmer to the factory and from the factory to the market (Mutimba 2007). To diversify and maximize markets, it is also crucial to demonstrate additional benefits other than biodiesel, such as soap, seed cake, and medicines.

#### **Larfge East Africa (Bamburi Cement)**

**Lafarge East Africa (LEA) a major energy consumer in the Coast region, is a major cement manufacture in the East African region.** Like all cement producers, LEA uses large quantities of energy in its production process, which at present mostly comes from fossil fuels. In its ongoing initiative to substitute fossil fuels with renewable energy, LEA intends to use its vast reserve lands to produce biofuel for use in its cement kilns. LEA has consequently unveiled a program that will not only rehabilitate the quarries and secure the mining reserve lands, but also

provide alternative and affordable energy for the cement plant. LEA has already demonstrated willingness to purchase any biofuel, including biodiesel, if the supply is consistent. It is in the process of establishing *Jatropha* biofuel plantations, but can also benefit from outgrower schemes by local farmers and thus has a potential incentive for piloting *Jatropha* production in the Coast region. If this model succeeds, it can be replicated to rehabilitate degraded sites that occur all over the country where quarrying is going on through a private sector and farmer partnership.

### **Southern Rangelands: Athi River mining plus outgrower schemes around Kibwezi, Emali, and Makueni (ASALs)**

**Partly owned by Bamburi Cement, Athi River Mining Company is another cement manufacturer and high-energy consumer.** The factory has the potential to provide a market for biofuel produced in the Ukambani region. This is a region that is mostly arid and semi-arid. The development of a biofuel market would fit in very well with the proposals of the draft ASAL policy, which seeks to diversify economic activities to address poverty.

**Magadi Soda Nuclear Estate and the natural *Jatropha* stands around Ngurumani.** There are natural stands of *Jatropha* around Lake Magadi. The company is in the process of establishing a *Jatropha* biofuel estate of over 10 ha for experimenting on a viable production system. The company intends to use the natural stands to form the basis of its biofuel activities. The area is endowed with large areas of land that could be used to develop a successful outgrower scheme.

### **Other Forms of Partnerships in the Context of New the Forestry law**

**As another form of partnership, community forestry associations have the potential for good results.** Such partnerships take advantage of the provisions of the new Forest Act 2005 and Draft Forest Policy, which provide for participatory forest management and private sector participation. The Forests Act 2005 provides for the establishment of a Forest Conservation Fund that is envisaged to finance farmers and other investors to grow trees for commercial purposes and to carry out trade in forest products. The policy and legislation provides space for farmers to grow trees on their land for commercial purposes. Kenya also now has an enabling policy and legislative framework for participatory natural resources management in the environment, forest, and water sectors.<sup>29</sup> However, in the past, farmers were advised to grow trees, which they could not sell once the trees matured. This is because they did not grow trees with the market in mind.

### **Partnering through the Forest Action Network**

The Forest Action Network (FAN) has some experience in identifying farmers who are willing to plant trees on part of their land. FAN has mobilized tree-growing farmers in Western Province and other parts of Kenya who are willing to form associations for the purpose of partnerships with the private sector. In Western Kenya, it has resulted in the formation of an association called WETPA (Western Tree Planters Association) with the objective of entering into partnerships to supply fuelwood to the companies.

In an effort to test the application of the provisions of the Policy and the Forests Act 2005, FAN in 2006 initiated a commercial tree-planting partner arrangement among the private sector, tree farmers, and civil society. The partnership sought to (a) turn tree growing into a business like any other permanent crop; (b) create jobs and income for rural communities; (c) provide material for forest-based industries; and (d) use the pilots as demonstration sites for individuals and communities interested in tree growing.

**Lessons of the FAN partnership.** As a result of the private sector meetings organized by FAN in wattle tree (*Acacia mearnsii*) growing areas, FAN was able to negotiate with the Kenya Vegext (EPZ) Ltd for better markets for the farmers in the North Rift and Western Kenya (Lugari, Nandi South, Trans Nzoia and Uasin Gishu districts). Kenya Vegext (EPZ) Ltd. is a private company that manufactures vegetable tanning extract in powder form. It was established in 2002 and is now already experiencing a shortage of raw material (wattle bark). In 2006, the farmers supplied about 60 tons of bark to the Kenya Vegext (EPZ) Ltd, which resulted in an income of KShs. 180,000 to the farmers (Lipwoni 2006).

**In the recent past, FAN embarked on a pilot tree farmer outgrower scheme in six districts in the North Rift and Western Kenya.** The scheme targets possible consumers like the tea factories under KTDA and Pan Paper Mills in Webuye. The criteria used in selecting participating farmers included (a) proximity to a possible market (Pan paper mills or tea factory); (b) willing to place at least **0.5 acres** under trees; (c) willingness to sign a partnership agreement with FAN or the private sector; (d) appropriateness of land for growing a selected tree species; (d) availability of other land to grow food crops; and (e) willingness to use the *shamba system* for the initial years of establishment.

Important lessons that FAN has learned in its pilot programs are that:

- i. It is possible to grow trees for the market on individual farms.
- ii. It is an expensive venture for most farmers to grow trees on-farm due to the high cost of establishment.
- iii. Promoters of tree growing should be ready and prepared for new lessons in this area.

There is a need for a long-term funding mechanism to support farmers to grow trees supported by donors and the private sector. This model can easily be modified for biofuel production, which has a shorter gestation period.

### **Partnering through the VI-SCC Agroforestry Programme**

**The VI-SCC program has a longer presence in the country than FAN.** The core objectives of VI include poverty alleviation and sustainable natural resource use, among others. So far around 1 million people (almost one out of 30 persons in the Lake Victoria basin) have been reached. VI-SCC also aims to strengthen markets for products produced by farmers. Integration of sustainable biomass energy production activities into SCC-Vi agro-forestry systems—to further strengthen the livelihood of farmers through increased income from the sale of sustainable energy products—is now a priority. It is capable of helping achieve the three core objectives of the program, namely to achieve increased food production, energy availability, and income in selected regions in a period of 1 to 5 years.

### **Nuclear Estates**

**A pure nuclear estate involves market guaranteed investments through existing major consumers.** It attracts those who have shown interest in clean and efficient energy development mechanisms. There is no shortage of such potential consumers—virtually any of the high-energy consumers that could benefit from renewable energy, such as Rift Valley Railways, LEA, Kenya Breweries Limited, or Safaricom. However, there is a need for specific case studies to spearhead the process and address issues such as the form this energy would take (e.g. Safaricom could

benefit from using biodiesel to off-grid small power generators to power its telecommunications installations in remote areas). In a pure nuclear estate, the local community would benefit from the project through employment in the estate. As permanent or casual employees, community members feel and become part of the biofuel program and are therefore obliged to ensure that the program is successful.

## **Partnerships with Public Institutions/Government**

**The shamba system or nonresidential cultivation is a method successfully used in the country.** This system entails neighboring communities assisting in the establishment of forest plantations while growing their own crops such as maize or beans for about two years depending on the tree species grown. Although it has come under criticism at times, new research has shown that the system is an affordable way of forest establishment if well-implemented. The guiding principles of this method are that the community takes good care of growing seedlings, and if during extension monitoring this is found not to be the case, individual farmers are punished through exclusion. Such a partnership is beneficial as it ensures relatively cheap labor for the investor and food security for the community. To succeed, the method needs supervision and extension monitoring on a continuous basis. Since *Jatropha* and the other energy crops will be planted in the ASALs, it is possible to have a modification of the shamba system depending on each specific site. This gives an opportunity for piloting the PFM guidelines provided under the Forests Act 2005.

## **Outgrower Schemes**

**The community can be involved in the biofuel production system by encouraging them to form an outgrower scheme.** This can be used to complement the company's biofuel crops. This means that the community is encouraged to grow similar crops grown by the parent company on their own land. The investor enters into some contractual agreement with the community to buy their products at a given time. Care is taken to ensure that communities do not use their whole land in such ventures at the expense of cultivation of crops. Such a system ensures a certain amount of sustainability of supply at all times. It is also a way to spread risks in case of fires or disease or crop failure due to localized hazardous conditions. The community gains by enhancing livelihoods through increased and diversified income. A community participating in an outgrower scheme could also benefit from carbon finance under provisions of the Kyoto Protocol whereby individual community projects capable of generating 15 kilotons of carbon-dioxide equivalent annually qualify.

## **Contractual Obligations**

**Partnerships take time to grow and gain trust and that needs to be incorporated into the project from the start.** It is important to remain realistic about the impact of these partnerships on the culture of the community and the company. Whatever form of community involvement and participation, it is obligatory that contractual agreements are made, monitoring and extension services are agreed, and the deliverables to the investor and community benefits are clearly spelled out. Such contracts must clearly spell out that the investor guarantees a market for the products at existing market rates, while the outgrower community is obliged to sell to the investor alone. Under the contract document, the following key issues are agreed upon:

- That the farmer agrees to grow an agreed species of tree on his/her farm in line with the market demand.

- That the farmer agrees to let the partner (a community group with a track record in this case), other farmers, and visitors to access the land planted with trees, provided the farmer is given the agreed notice. This is for monitoring and purposes of transparency.
- That the partner will provide the farmer with resources to prepare land for planting trees.
- That the farmer agrees to use the agreed management system (*shamba* system in the case of FAN) to establish the trees.
- That the farmer agrees to let the crop remain on his or her land until harvesting.
- That the farmer allows the private sector extension staff to offer advice on how best to manage the trees.

## Linking Communities and Industrial Partners in Implementation of Biofuel Projects

**The role of institutions with experience in the implementation of partnerships is very crucial.** To successfully implement such projects, there is a need to partner with organizations with overriding mandates regarding biofuels. Such partnerships must be built on a common understanding of the goals and objectives with long-term vision and a joint programmatic approach to implementation. This will assist in cutting costs, avoid exhausting available limited human resource capacity, and ensure that each partner focuses on their core business. The investor's role in such partnerships will be to provide overall leadership by clearly outlining the work program, subdividing the work into parcels that can be contracted out to partners, developing a work-plan of events, including implementation details, and clearly defining roles and responsibilities of all the parties involved. Lastly, cooperation with partners in assessing and reviewing achievements on a periodic basis to evaluate, analyze, and document results will add value to the project. An investor's main business is the production of specified products. Biofuel production, on the other hand, is a supply function, whose drivers include—besides reduction of fuel costs—the need to substitute fossil oil with cleaner alternatives and in the process benefit the environment, with possibilities of gaining carbon credits, and poverty alleviation among the surrounding communities as part of the investor's corporate social responsibility. Organizations such as VDF, GAF, VI-SCC, and others with long-term experience in forging such links can help achieve this. For example, experience in performing energy audits will help the companies identify areas where better alternatives could be more useful. Alternatives like sustainable biofuels could be recommended, and a successful biofuel supply partnership forged with another stakeholder. For ease of selecting partners, the following activities are important in biofuel production:

- *Development of management and implementation plans.* This is crucial as it gives the actual calendar of events, costs, and a road map to successful completion of the project. It can be carried out by the investor and certified by a specialist with commercial forestry experience.
- *On-farm management.* Management includes weeding, thinning, pruning, pest, and disease control. The community should work with an extension forester, who makes regular supervisory visits to ensure that the crops are not compromised by community activities and checks to ensure that there is no pest and disease outbreak. Farmers are sensitized on the type of diseases and pests to monitor.
- *Monitoring and Evaluation.* Some of the issues to monitor closely include soil fertility improvement, survival count, growth rates, symptoms of pest and disease outbreak, and fire outbreak potential, etc.
- *Biomass and energy yields monitoring.* Determining mean annual increments, modeling biomass and energy yields. Specialists on an annual basis are needed to ensure that predicted energy yields are achieved.
- *Harvesting, transport, and storage.* Provides continuous advice on low-impact harvesting and transport.
- *Mobilization of community for biofuel outgrower partnerships.* Outgrower schemes will go a long way in ensuring that biofuel and energy yields are filled.
- *Extension service.* Capacity building of the community for tree establishment and management.

## Some Challenges in Enhancing Industry-Community Partnerships

**Before entering into any contractual agreements with local communities, it is important to take into account past lessons in related initiatives.** This will enable the investor to make informed decisions. Some of these challenges include:

- Conflicts based on benefit-sharing between partners can lead to financial losses or litigation. This can be avoided through clear contractual agreements.
- Environmental degradation where natural forests are cleared for biofuel plantations, or where plantations are badly managed and promote the spread of invasive species. There is a need to carry out an EIA before such undertakings are done.
- Uncontrolled *Jatropha* plantations can result into competition between trees and crops and pose a threat to food security. These contractual obligations should provide for silvicultural and agronomic treatments based on authorized prescriptions.

## Some Obligations of the Investor for Successful Partnerships

**Partnerships can be difficult and costly to establish.** When they work, they can bring mutual benefits to both parties. The initiator of the partnership must make most of the initial investment. This means that the initiator of *Jatropha* projects must bear most of the risk associated with new venture investments before benefits can accrue. Some of the elements include:

### Awareness Raising and Community Mobilization

**The way forward for new *Jatropha* sites is to develop community participatory programs that embrace ownership.** This includes an awareness raising campaign with goals and objectives for the biofuel production system, the rights of each party, and the benefit-sharing mechanisms. Communal benefits such as poverty reduction, local enterprise development, improved environment, reduced pollution, and enhanced microclimate must also be considered.

Depending on the outcome of the awareness raising campaigns, the next step will be to mobilize the community into groups that are capable of entering into a contractual agreement with the investor. This could be CBOs, cooperatives, or associations. The investor and the communities can take advantage of the mandate of KFS as an aggregator to help address issues of common interest.

### Training, Monitoring, and Extension Services

**Initiatives promoting *Jatropha* will be identified through community action plans (CAPs).** Depending on the community involvement option and mechanisms, such organization will be given training on *Jatropha* and other species propagation techniques, management, land preparation skills, tree management, and tips on how to maximize oil yields and other benefits. Partnerships should involve the following elements: (a) awareness creation and community mobilization; (b) community empowerment in the management of associations, which may include cooperatives or credit organizations; (c) capacity building of communities in biofuel production management; (d) the investor purchases feedstock and provides quality seedlings, and the community sells all the feedstock to the investor in exchange; and (e) the community is involved in managing hazards and risks.

In the case of the pilot sites for *Jatropha*, most of these steps have been undertaken through community action plans when implementing other projects. A rapid rural appraisal can suffice .

## **Biofuel Non-transport-based Applications and Opportunities**

**The main driving force for biofuels and *Jatropha* in the developed world is mainly for climate change mitigation and clean energy.** Although this is also true for less developed countries in the long run, the promotion of *Jatropha* will be based on a different motivation. In developing countries, *Jatropha* is being promoted as a means of economic empowerment and social improvement linked to poverty alleviation targeting vulnerable communities. Apart from the obvious biodiesel for automobile applications, the oil has also other derivatives that could be a driving force in the development of rural enterprises and rural economic growth. In addition to its products, the *Jatropha* plant itself is a valuable multipurpose crop that can help mitigate soil degradation, desertification, and deforestation.

### **Pro-poor Approaches – lighting and remote area/off-grid power generation**

**There are many non-transport-based benefits from *Jatropha* oil.** For example, In the Coast region, a feasibility study by ESDA found that the predominant use for *Jatropha* currently is not for oil production but for medicine to treat snakebites and other traditional unspecified uses, or as a live hedge (ESDA 2006). A 2006 study by UNDP in the same region found that *Jatropha* oil has the potential to improve rural livelihoods in ways other than transport applications. With kerosene prices increasing without a corresponding increase in incomes, *Jatropha* oil can be a substitute for kerosene in many domestic applications. A recent MoE-commissioned study showed almost a 100 percent usage of kerosene in Kenya's rural and low-income households; substituting *Jatropha* oil could have benefits for such households (MoE/GoK 2002). Apart from creating a domestic entrepreneurship opportunity, the oil is cleaner with less toxic fumes. In fact, UNDP is working with partners to develop appropriate lamps and stoves that will use *Jatropha* oil rather than kerosene.

**Biofuels can be used to run stand-alone diesel power generators.** The connectivity to the power grid in rural Kenya is only on average about 3.6 percent. The potential impact is attractive. Access to power will improve the quality of life for women—for example, no toxic kerosene fumes, and less firewood usage will free women for other tasks. In addition, school children would have more opportunities for study, and power will boost prospects for local small-scale industry. Additional studies are needed to support the provision of these potential benefits with empirical data.

### **Local Industry, Clean Energy, and Export Opportunities**

**There are immense opportunities for creating employment through biofuels.** An MoE energy baseline study by Kamfor (2002) showed that small-scale local industries and service establishments are significant energy consumers. These enterprises employ up to 50 workers; micro enterprises employ up to 10 workers, while small enterprises employ between 10 and 50 workers. The study estimated their total number in the country as 1.3 million and reported that the MSEs employed 2.3 million people much higher than those employed in the public and private sectors.

**The majority of micro and small enterprises are located in rural areas (66 percent).** Apart from generating employment, MSEs produce goods and services for trade and for use in the domestic market. Some of the manufactured products are also exported to neighboring countries. The survey found the cottage industry subsector to be a major consumer of all types of energy. The industries include brick making, tobacco curing, milk processing, fishing and fish smoking, jaggery , bakeries, restaurants, **poshomills**, and the tea industry.

**Most cottage industries have energy as one of their main production costs.** There is therefore great potential in creating awareness and stimulating the interest of farmers through demonstration of the use of a blended mix of diesel and *Jatropha* oil in stationary diesel engines used locally for electricity, water-pumping (for irrigation and domestic use), or maize milling applications.

The production of biodiesel itself is a potential rural industry. The oil can be used locally or sold to other users after value addition. After oil extraction, the byproducts can be used in the production of soap and seed cake.

### Cost –benefit Analysis

**The direct and indirect net benefits from 1 hectare of *Jatropha* are immense and need to be documented systematically.** In an economic analysis, the ESDA study showed that after two years, 50 ha of *Jatropha* (the minimum economically viable land area) would produce an average of 150 tons of seeds, which can generate \$16,160 in net cash income when the oil is extracted and the products are sold. The economic viability of the venture was calculated as:

- i. Estimated seed yield at the end of two years from 50 ha is 150,000 kg=3,000KG/ha
- ii. Estimated oil yield from 150,000 kg of seed is 30,000 liters=0.5l/kg of seed
- iii. Estimated press cake from 150,000 kg of seeds is 112,500 kg
- iv. Estimated sediment from 150,000 kg of seeds is 7,500 liters

The net income averages \$323.3/ha (KShs 22, 624/ha). If 1 hectare were available per household, this provides a mean net income of \$323.3/household at the end of year 2 after planting. This could increase in subsequent years when the crop attains maximum productivity. The sale of byproducts such as soap and seedcake could create an entirely new industry with practically no limits. *Jatropha* soap has potential for export. With good marketing, it could occupy a niche like the popular Neem and Aloe Vera soap currently found even in major supermarket shelves. As shown in Table 4, preliminary observations by GAF (2007) indicate that a hectare will accommodate 1,100 plants at a spacing of 3 x 3m, yielding 3–4kg per season of seed at peak production twice per year.

**Table 4. Cost-Benefit Analysis Using *Jatropha curcas* System<sup>30</sup>**

#### Costs

Item	QUANTITY	COST PER UNIT	TOTAL COST
Seed procurement	1kg	1,500.00	1,500.00
Cost of raising seedlings (15/= per seedlings)	1,100	15	16,500.00

Land preparation from clearing to planting	1 ha		28,000.00
Total			46,000.00

### Benefits

PRODUCT	YR.1	YR.2	YR.3
No. Of plants	1,100	1,100	1,100
Seed harvests (kgs.)	2,200	4,400	6,600
Seeds (revenue) (Kshs.)	22,000.00	44,000.00	66,000.
Average Annual Bio diesel oil production in liters	730	1,460	2,190
Revenue per year (Kshs,)	18,250	36,500	54,750
Carbon credit	6,200	6,200	6,200

*Notes:* These observations assume that 1 hectare is equivalent to 1,100 plants; that each plant will yield 1 kg/season/year, 2kg/season/2<sup>nd</sup> year, 3-6kgs/season/3<sup>rd</sup> year; that seeds will be bought at Kshs. 10.00/kg.; that biodiesel oil will be bought at Kshs. 25.00; and that carbon credit benefits, an added advantage, will be constant depending on the number of Jatropha plants planted.

## **VI. FORMULATING A BIOFUEL STRATEGY FOR KENYA**

**The current energy act and policy are enabling for the elaboration of a biofuel strategy.** A public policy is a statement by government of the guiding principles and goals in addressing a major public issue. A public policy is not a law and therefore cannot be enforced through the courts. However, policies can exist without the law and vice versa. It is the conclusion of the study that it is not necessary to formulate a new biofuel policy as this is covered by the Energy Sessional Paper no.4 of 2004. What is required is the elaboration of a biofuel strategy and action plan within the framework of existing policies.

The Sessional Paper No.4 of 2004 on Energy is the guiding document for the overall development of the energy sector in the country. This paper was the culmination of a fairly comprehensive consultative policy formulation process that started way back in 1981. The Sessional Paper provides an enabling policy framework, which is necessary for the realization of the potential benefits from the sector

**There is a need to expand the National Biofuel Committee and provide a budget with strategic support.** The proposed set of activities will help facilitate the formulation of a biofuel strategy while including as many stakeholders as possible and taking care to mitigate against foreseeable risks and threats. If handled efficiently, a biofuel strategy can be finalized within one or two years. The proposed initiative is an attempt to fast track and add value to the ongoing efforts by NBFC and NBDC.

### **Rationale for the Biofuel Strategy**

**There is consensus on the need to formulate a biofuel strategy within the next year with the Ministry of Energy as the “champion.”**

The following are the main reasons for a biofuel strategy:

- i. The Energy Policy and the MOE strategic plan are explicit on the need for a biofuel policy.
- ii. The current institutional framework<sup>31</sup> and environment is very supportive. For example, the reform agenda—as espoused by the ERSEWC, Energy Policy, draft ASAL Policy 2006, draft Forest Policy 2006, Forests Act 2005, and Vision 2030—is enabling for development of a biofuel strategy. There is willingness at the highest policy level in the relevant ministries and departments to formulate the strategy.
- iii. The Sessional Paper on Energy No.4 of 2004 recognizes that the potential for biofuels has not been fully realized. The action plan in the short term 1994–2007 provided for drawing up of plans for biomass resource assessment and surveys and in the medium term (2004–12) recommends the review and update of biomass development plans. In the drylands, the draft Forest Policy provides for the establishment of forest-based micro-enterprises. Establishment of biofuel-related enterprises fits well within this provision. Similar opportunities have been recognized by the ASAL draft policy.
- iv. The need to embrace global and regional trends, commitments, and obligations such as the East African Community, NEPAD, COMESSA, UNFCCC, and Kyoto Protocol.

**The mandate of NBFC formed in 2006 was the finalization of the biofuel policy. Some very useful and commendable work has already been done.** There is, however, a need to enhance more synergy from the key actors through fast tracking the current momentum by providing and strengthening strategic leadership. During the *Jatropha* conference in 2006, the Ministry of Energy said that 2009 was the target for finalizing a biofuel policy.

### **Box 2. Driving forces of a Biofuel Strategy**

Domestic policies to support biofuel production respond to different policy goals associated with biofuel production. Earlier experiences such as those of the U.S. and Brazil were mainly motivated by pressure to reduce the import bill and increase energy security, though rural support appeared as an important driver in a later stage of these experiences. Today a new policy interest is added, driven by the potential of biofuels to contribute to ameliorating the problem of global warming. All this implies that these policies cover a range of sectors, typically including energy, agriculture, industry, and trade.”

**Source:** Jurgens et al. (2004).

### **Expected benefits from the formulation and implementation of a biofuel strategy**

**There are business opportunities at the biofuel value chain that depend on the formulation of a biofuel strategy.** Some of the potential benefits from the formulation of a biofuel strategy include: (a) creating new jobs and income opportunities in agriculture and rural development; (b) reducing oil imports/foreign exchange savings; (c) improving household and national energy security; (d) creating new industries; (e) improving vehicle performance; (f) reducing air pollution; (g) preserving biological diversity; (h) promoting intra-generational and inter-generational equity; (i) adding natural-resource-based products through processing, branding and aggressive marketing (for example, greening the Kenyan tea); (j) reducing vulnerability in nasals; (k) accessing multiple benefits; (l) demonstrating CDM mechanisms; (m) encouraging joint ventures between producers, manufacturers, and consumers; and (n) developing a code of conduct for producers, manufacturers, and consumers.

**The Sessional Paper no. 4 on Energy and the proposals for the draft strategic plan for the KFS 2007–12 recognize the opportunities from biofuels.** These can be realized from a synergistic approach toward increasing biomass at the farm level, which will result in reduced pressure on degraded forests. The vast ASALs expand the opportunities for collaboration between the two ministries.

### **Box 3. Potential of Biodiesel as expressed in the Energy Policy**

“Biodiesel is currently not in use in Kenya; however, the potential for its production from locally grown *Jatropha* and other tree species and crops exists. There is therefore need for research and development on the potential for the exploitation of this energy supply option, learning from the experiences of other countries that have succeeded in the implementation of this technology. Given the shortage of arable land in Kenya, as well as climate variability and high dependence on rainfed agriculture, the challenge is to develop crops suitable for production of biodiesel in low and medium potential lands.”...Kenya has no experience with use of biodiesel, although potential for its use exist...need to undertake research and development of biodiesel as a motor blend in the medium to long term.....and harmonization of land use policies with energy policy.

*Source:* Unpublished Ministry of Energy Memos

## **National Biofuel Strategy Formulation Process**

**Kenya has a lot of experience in policy formulation; the challenge is in commitment to implementation.** The government has the Kenya Institute of Public Policy Analysis (KIPPRA), which could be brought on board to help with the process at an opportune time. In the mean time, the following steps are recommended in order to fast track the ongoing initiatives. The key intervention focus is to keep policy makers fully involved if the ownership has to be retained. It is very important to have a biofuel strategy that is easy to implement by getting as many stakeholders involved as possible.

**Table 5. Outline of the Biofuel Strategy Formulation Process**

<b>ACTIVITY</b>	<b>BY WHOM</b>	<b>WHEN</b>
Step 1: Strategic orientation meeting of key stakeholders by KFS and MOE	Director KFS and Director Renewable Energy	July 07
Step 2: Briefing the relevant implementers - Energy, Environment and ASALs. Elaboration of the problem and key underlying issues	Steering Committee	July 07
Step 3: Proposing, constituting and developing TORs for the Biofuel Steering Committee (BSC)	Steering Committee	July 07
Step 4: Review, technical review on the outcome of the and study implementation of recommendations key stakeholders	Steering Committee	August 07
Step 5: Exchange visit to areas with relevant experience and team building of BSC	Steering Committee	Sept. '07
Step 6: Launching of the reconstituted NBFC	Ministry of Energy	July '07
Step 7: Launching of the reconstituted National Biodiesel Committee	Ministries of Energy & Environment, Natural Resources	August '07
Step: 8 Identifying thematic team leaders	Biofuel Steering Committee	July '07
Step 9: Review of thematic papers	Biofuel Steering Committee	Sept 07
Step 10: Collation of draft strategy	Biofuel Steering Committee	Oct. 07
Step 11: Stakeholders' workshop on Draft strategy- Dialogue and inputs	Biofuel steering committee	Oct 07
Step 12: Review of draft strategy by BSC	Biofuel Committee	Feb'' 08
Step 13: Presentation of draft strategy to the implementing agencies	Biofuel Steering Committee	March '08
Step 14: Presentation of Strategy to the Parliamentary Committee on Energy	Biofuel Steering Committee	April '08
Step 15: Feedback to Stakeholders in a Workshop (s)	Biofuel Steering committee	July '08

### **Strengthening Institutional and implementation arrangements**

**The formation of an expanded and strengthened biofuel steering committee will guide the formulation of the biofuel strategy.** The biofuel strategy formulation process will be informed by a Biofuel Steering Committee (BSC) comprising of the following members:

- i) Department of Renewable Energy
- ii) Kenya Forest Service
- iii) Arid Land Resources Management Project
- iv) University of Nairobi
- v) Vanilla Development Foundation
- vi) Green Africa Foundation

The BSC will report on a regular basis to the two permanent secretaries and every effort shall be made to coordinate with other relevant agencies.

The committee will be empowered by the permanent secretaries in energy and environment to oversee the formulation of a biofuel strategy by 2008 as well as other the activities of the NBFC and NBDC.

It is recommended that the GOK and development partners (coordinated by World Bank) provide support to implement the biofuel strategy road map once the work plans are approved.

### **Finalization of Selected Thematic Papers**

**The knowledge gaps on biofuel and *Jatropha* can be addressed through scoping studies.** It is recommended for the purpose and benefit of harnessing the institutional memories and competencies in place that the current situation—where the lead author has been identified by the NBFC—remains. However, the authors for the thematic groups of fuelwood, biodiesel, and gaseous will be objectively selected and TORs formulated in consultation with the NBFC and NBDC. The steering committee will have the final responsibility of approval of the authors of the papers and the quality of the output. The BSC will define the targets and mandate of each of the following thematic papers:

- A study of production of feedstock support and strengthening mechanisms and creating conditions for ensuring that industry benefits from CDM.
- A study of market and consumption support and other certification requirements for biofuels; that is, establishing standards for biofuels and a system to enforce the standards.
- A study of GOK /private sector partnerships within the framework of supportive laws, policies, and incentives for wider adoption of biofuels.

### **Pillars for the Biofuel Strategy**

**Principles of the biofuel strategy**<sup>32</sup>. These include:

- Enhancing investment opportunities
- Supporting research and development
- Institutionalizing frameworks for lobbying policy
- Domestication of international conventions and treaties to which the country subscribes
- Support to achievement of national development goals

### **Strategy for stimulating demand for biofuels**

In order to stimulate local demand, the following interventions are recommended:

- Setting national targets using biofuel obligations (initial blends of upto 5–10 percent biofuel may not require any engine alterations).
- Ensuring sustainable production through the formation of a national biofuel association, which will lobby the members, government and industry.
- Incentives linked to environmental performance of individual fuels through (a) Eco-labeling of biofuel products; (b) price differentiation through emission charges and product levies; (c) public education and information; (d) tax concessions to promote public procurement of clean and efficient vehicles using high blends of biofuel; and (e) capturing environmental benefits.

## VII. CONCLUSION AND RECOMMENDATIONS

### Conclusion

**Over the last two years, in various activities over 30 agencies have promoted *Jatropha* in Kenya**. The enthusiasm is mainly due to the pressure from the renewed interest on green energy globally and the potential benefits presented through the CDM. However, these activities require coordination and support to deliver the expected benefits while ensuring sustainability. The ministries of energy and environment and natural resources and agriculture urgently need to provide leadership to guide development in this area. The policy and legislative reform process, particularly in the forestry and energy sectors, is favorable and supportive of private and community/private sector participation. KFS is already developing charcoal rules and regulations to guide the process and needs to include other biofuels.

**Formulation and implementation of a biofuels strategy requires strategic leadership by the Ministry of Energy.** This is important, as the biofuels targeted will operate in a competitive environment where other energy sources are available. The process also requires supportive information on liquid, gaseous, and wood fuels through specialized studies. There are many opportunities for business investment in the ASALs, but guidelines need to be identified through a participatory process that considers the ASAL investment plan and the opportunities presented within the World Bank-supported NRM and WKCDD/FM projects.

**Fears that the market may fail to respond to a build-up of *Jatropha* stocks seem misplaced.** KENGEN and KTDA represent two of the best opportunities for absorbing any oil produced from *Jatropha*. KENGEN has already ventured into carbon-offset activities and is willing to “green” its products further through participation in activities that promote environmental conservation. KTDA has over the years been aspiring to switch from diesel to fuelwood, but a sustainable supply cannot be guaranteed. *Jatropha* presents a viable substitute for fuelwood. Lafarge Cement Company and Magadi soda have also expressed interest in establishing a nuclear estate and an outgrower scheme to supply *Jatropha* oil.

### Recommendations

**There are short- and medium-term economic and policy interventions required to spur development in the biofuels sector and *Jatropha* activities.**

#### Production, Processing, and Utilization Technologies

**Establishment of nuclear estates with outgrower schemes.** Major companies that are willing to venture into *Jatropha* oil production should be encouraged to establish nuclear estates to confer confidence to communities and private entrepreneurs who would then participate in outgrower schemes. The Kenya Forest Service should provide technical assistance to this process, as well as high-quality planting materials. The firms could provide simple oil extraction machines at the community level. There is already an indication of willingness to partner with the farmers from industries such as KENGEN, KTDA, Athi River Mining, Bamburi, Safaricom, and Magadi Soda, among others.

This process should be complemented with concrete data on agronomic/silvicultural recommendations under different management practices and ecological zones; examples include *Jatropha* monoculture, *Jatropha* with vanilla, and other combinations.

## **Resource mobilization and strengthening partnerships**

**Current efforts at production, processing, and marketing require coordination for efficiency and higher impact.** Possibilities to be explored include forming cross-sectoral linkages among producers, consumers, and regulators and a trust fund as a key outcome of the strategy formulation and implementation process. This is necessary to promote sustainability, reduce duplication, and strengthen strategic leadership and technical support. Through this process producers will be empowered with better access to inputs, financial services, and technical support.

The partnerships should be geared to support improvement activities in energy crops and value addition opportunities. This will help explore ways in which farmers can integrate *Jatropha* into diversified farming enterprises and systems

## **Enterprise Development Strategies and Interventions**

**The *Jatropha* value chain requires interventions at various levels.** The main issues required for enterprise development for *Jatropha* and other biofuels include:

- Development of business plans for biofuel enterprises
- Establishment of credit facilities through the proposed Biofuel Trust Fund
- Promotion of village cottage enterprises like soap- and candle-making, plantation establishment, and processing
- Training of service providers.

## **Biofuel Technology Development and Marketing**

**The Sessional Paper no. 4 on Energy Policy aims to raise the contribution of renewable energy sources to the country's total energy budget.** A knowledge transfer study tour to Mali Folkecenter (MFC)<sup>33</sup> or Nigeria should be arranged for a team of key stakeholders to share best practices at the production, processing, and marketing levels. There are some promising experiences in Mali that demonstrate use of high-quality germplasm and commercial production and would therefore form an ideal technical study tour destination venue.

Similar visits should be conducted in Tanzania and Zambia, which have demonstrated use of *Jatropha* oil as a diesel fuel substitute in small-motorized grain mills and village electric generators, as well as in soap production.

## **Cost-Benefit Analysis**

**The scaling up of *Jatropha* needs to be informed by science and technology.** There is a need to demonstrate in a simple and practical manner to producers, processors, and other investors how to access the expected benefits (qualitative and quantitative) of *Jatropha* and other biofuels. Generating empirical data on yield, inputs, pricing forecasting/ enterprise budgeting, and gross margin analysis at every stage of the value chain can help.

## **Technical Information to Support the Development of a Biofuel Strategy**

**There is a need to fast track the current activities on the formulation of a biofuel strategy.** This can be done through reconstituting the TORs for the NBFC, NBDC, and the establishment

of a steering committee. Budgetary support should also be provided to support activities that generate decision support information from specialized studies. It is also necessary to initiate structured policy dialogue at the highest levels of government with the relevant ministries and corporate players in the energy sector—such as KPLC, KPL, KENGEN, and the private sector—with opportunities for feedback to other stakeholders. Biofuel strategy formulation should not take more than one year.

#### **Awareness raising and advocacy**

**The scaling up of *Jatropha* and biofuels requires policy and political leadership as the country positions itself through Vision 2030 toward middle-income status.** There should be awareness raising, lobbying, and advocacy at all levels. Coordinated training, education, and information sharing could enhance adoption and support of *Jatropha* and other biofuels within communities. Potential entrepreneurs should be sought with ICIPE, which has some experience in commercializing plant-based biofuel products.

## Annex I. Names of Persons Met

Name	Institution & Designation
1. Christian Peter	World Bank, Senior Natural Resource Management Specialist
2. Christine Cornelius	World Bank, Lead Operations Officer Rural Social & Environment. Operations. EA& the Horn
3. David Muturi	GAF, Seed Specialist
4. Dr. Anthony Esilaba	KARI: Assistant. Coordinator DMP
5. Dr. Ben Chikamai	KEFRI/NGARA-Head Partnerships and Collaboration Programme &Coordinator
6. Dr. Cheruiyot	DMP-KARI- Consultant
7. Dr. Daniel Nyamai	ICRAF/TOFNET-Trees on-Farm Network
8. Dr. Evans Kituyi	University of Nairobi-Senior Lecturer, Chemistry Department and member National Biofuel Committee
9. Dr. George Keya	KARI, Head ASALs
10. Dr.Samuel Muigai	KARI-KAPP Coordinator,
11. Dr. Phanuel Oballa	KEFRI -Coordinator Farm Forestry.
12. Dr. Timm Tennigkeit	UNIQUE Forestry- Consultants
13. Dr. Antii Erkila	Counselor- Forestry, Finnish Embassy
14. Dr. Jochen Statz	Unique Forestry -Consultant
15. Dr. William Omondi	Kenya Forestry Research Institute-Principal Research Officer
16. Eng. James Wahogo	KENGEN- Chief Manager, Corporate Planning
17. Eng. Jennifer Gache	KENGEN, -Mechanical Engineer
18. Eng. Pius Kollikho	KENGEN- Engineer,
19. Eng Isaac Maina	KENGEN-Engineer
20. Eng. Kiremu Magamba	Ministry of Energy-Renewable Energy Consultant
21. Eng. Isaac Kiva	Ministry of Energy-Ag.Director, Department of Renewable Energy
22. Eng. Joel Ngugi	KENGEN-Chief Manager-Kiambere
23. Fritjof Boerstler	UNDP-GEF-SGP-Bamburi Mombasa
24. Isaac Kariuki	KENGEN-Engineer
25. John Kioli	GAF-Director
26. M/s Faith Odongo	Ministry of Energy, Senior Renewable Energy Officer
27. M/s Juma Nenakari	Ministry of Livestock Development and Fisheries Development-ADB-ASAL Livestock Project
28. M/s Lucy Mungai	Gender Sensitive Initiatives, Coordinator
29. M/s Myra Mukulu	GTZ-Project Assistant, Regional Energy Advisory EA
30. M/s Nancy Chege	UNDP, Coordinator SGP
31. M/s Rose Makena	Kenya Forest Service, Tree Biotechnology
32. M/s. Yuko Kurauchi	World Bank, Long Term, Consultant Nairobi

33. Mr. Antony Maina	Kenya Forest Service, Head Drylands Branch and Chairman Reform Secretariat
34. Mr. Alfred Gichu	Kenya Forest Service, Drylands Forestry Programme, Head Biofuels and Bi- Carbon Unit
35. Mr. Anthony Ochino	Forest Action Network -Programme Coordinator
36. Mr. Benson Kanyi	Kenya Forest Service, Tree Biotechnology Project
37. Mr. David Mbugua	Kenya Forest Service- Ag. Director
38. Mr. Earnest Mbogo	Ministry of Livestock and Fisheries Development (MOLFD)- Participatory Technology Coordinator ADB-ASAL Livestock Project
39. Mr. Emmanuel Ekakoro	ESDA- Consultant
40. Mr. Ephraim Muciri Mwai	Kenya Forest Service Senior Deputy Director
41. Mr. Felix Kamau	MOLFD-Deputy Director Livestock Production
42. Mr. Henry Rotich	Ministry of Energy, Assistant Engineer,
43. Mr. Isaac Mulogoli	Coordinator, Nalep-Sida-M&E
44. Mr. James Njuki	Ministry of Energy-Nalep-Sida-M&E
45. Mr. John Kimani	Ministry of Agriculture-NALEP-Sida
46. Mr. Joseph Ng'ethe	Small-scale Farmer -Juja Farm
47. Mr. Linus Wekesa	KEFRI- Senior Research Officer
48. Mr. Meshack Muga	KEFRI-National Coordinator AOP
49. Mr. Mohamed Halakhe	ALRMP- NRM Officer
50. Mr. Nelson Manyeki	MOE-Assistant Director Renewable Energy
51. Mr. Norman Gachathi	KEFRI-Senior Research Officer
52. Mr. Patrick Kariuki	KFS-Intensified Social Forestry Project
53. Mr. Samuel Muriithi	KFS, Planning Branch
54. Mr. Stephen Mutimba	ESDA- Managing Director
55. Mr. Ben Ithagu	NEMA-Forestry Specialist
56. Mr. David Newman	Endevu Energy-Consultant
57. Mr. Ernest Mbogo	MOLFD-Training & Participatory Development Coordinator- ASAL-ADB
58. Mr. Isaac Mulagoli	NALEP -Coordinator,
59. Mr. John Kimani	NALEP-Agroforestry
60. Mr. Obeid Kariuki	KENGEN -Environmental Technician
61. Mr. Robert Muhia	KTDA-Senior Planning Officer
62. Mrs. Esther Wang'ombe	KFS-Drylands Forestry Programme
63. Mrs. Sheila Sheffo Mbiru	NGARA -Data base Expert

64. Mrs. Elizabeth Kimenyi	Deputy Director, Agribusiness. MOA
65. Mrs. Lorna Omuodo	Vanilla Development Foundation- Coordinator
66. Mrs. Rose Makena	KFS-TBP-Marketing
67. Mrs. Fatuma Abdikadir	ALRMP- National Coordinator
68. NALEP ASAL stakeholders	Over 100 in Nakuru and Garissa
69. National Biodiesel Committee	Over 20 members at the Ministry of Energy
70. Takayuki Hagiwara	NRM-FAO/World Bank Investment Center

## Annex II. Profile of Institutions Working on *Jatropha*/Biofuels

Name of Institution	Area of Operation	Contact Person and Address
<b>Kenya Forest Service</b>	Expanded mandate in the management of all types of forests. Involvement of forest-adjacent communities and other stakeholders in forest management and conservation. Forest management planning will be based on an ecosystem approach. Appropriate incentives will be provided to promote sustainable use and management of forest resources.	Mr. David Mbugua-Ag. Director, KFS Mr. Anthony Maina-Head Dryland Forestry 254 20 2014663 <a href="mailto:ccf@wananchi.com">ccf@wananchi.com</a>
<b>Ministry of Energy</b>	The ministry's policy on renewable energy technology is very supportive and has a paragraph that specifically articulates support for biodiesel. Main aim is to get information on what is the status of <i>Jatropha</i> in Kenya. A draft biodiesel working paper available. There is a BNC.	Eng. Kiva-Head of Renewable Energy & Faith Odongo Senior Renewable Energy Officer 254 20310112
<b>KARI</b>	KARI has a DMP project dealing with promotion and testing the growing of <i>Jatropha</i> in different sites of the country. The project mainly aims at strategically using <i>Jatropha</i> to rehabilitate degraded lands and as an alternative source of livelihood, and also training the locals on its viable utilization.	Dr. Anthony Esilaba 254-204183303
<b>ICRAF/TOFNET</b>	TOFNET has a mandate to promote and support agroforestry and tree crops research for development in the ASARECA member countries. The Vision is "Enhanced tree crops management for improved livelihoods and provision of environmental services," while its Mission is "To contribute to productivity, profitability and sustainability of agricultural systems and conservation of natural resources in eastern and Central Africa, through an integrated natural resource management approach based on integration of trees in farming and related land use systems in the region."	Dr. Daniel Nyamai 254 207224252 <a href="mailto:d.nyamai@cgiar.org">d.nyamai@cgiar.org</a>
<b>ALRMP</b>	ALRM is a unit within the Ministry of Special Programmes in the office of the President. Supported by GOK/World Bank, it is a one-stop center for ASAL information in Kenya. ALRMP has a strategic plan 2005/06–2008/09(with an investment plan) that describes lessons learned and investment opportunities in the 22 ASAL districts. <ul style="list-style-type: none"> <li>• Coordination of the formulation of and implementation of policies and institutional framework of drought management</li> </ul>	M/s Fatuma Abdikadir, Mr.Halake Mohamed Tel: 254 20227496

	<ul style="list-style-type: none"> <li>• Coordination of the mobilization of resources for drought management</li> <li>• Coordination of all stakeholders in drought disaster risk reduction and management</li> <li>• Monitoring and evaluation of the drought disaster management program</li> <li>• Empowering communities to effectively manage their own development</li> <li>• Creating an enabling environment for ASAL development</li> </ul>	
<b>JKUAT, Chemistry. Department &amp; IEET</b>		G.T. Thiongo, P. N. Kioni and G. Njoroge and Eng.Njeri
<b>Kenyatta University (KU)</b>	Research on the chemistry of biodiesel	
<b>Green Africa Foundation</b>	A Kenyan NGO started in 2000 with activities on <i>Jatropha</i> , mainly in the Southern Rangelands. GAF has strong links to Japan.	John Kioli kioli@greenafricafoundation.org Tel: 254 020248846
<b>Vanilla Development Foundation (VDF)</b>	<p>Nonprofit nongovernmental organization targeting the improvement of lives of rural farmers. It is an organization that promotes the development of vanilla and <i>Jatropha</i> in Kenya. VDF is three years old. It provides a regional platform to strengthen the capacity of vanilla-<i>Jatropha</i> stakeholders' in production-consumption value chain by:</p> <ul style="list-style-type: none"> <li>• Providing leadership in policy advice and advocacy</li> <li>• Production technologies and innovations</li> <li>• Post-harvest and marketing services</li> <li>• Information and communication management</li> <li>• Capacity building and industry partnerships and linkages</li> </ul>	Lorna Umuodo 254 020603842, <a href="mailto:rukiahb@yahoo.com">rukiahb@yahoo.com</a>
<b>Heinrich Boll Foundation</b>	Keen to support promotion of <i>Jatropha</i> due to its ability to reduce poverty for farmers in ASALs.	Henry Gikanga
<b>Ministry of Agriculture</b>	RSA, oil crop development, NASEP, and NALEP	Simon Muhindi
<b>Energy for Sustainable Development Ltd (ESDA)</b>	(ESDA) is a international consulting firm specializing in rural electrification, renewable energy policy development, and climate change work.	Stephen Mutimba Tel: 25420 3871027 <a href="mailto:smutimba@esda">smutimba@esda</a>

		<a href="http://www.co.ke">.co.ke</a>
<b>Ministry of Planning and National Development</b>	Working in the rural areas where they are currently in charge of poverty eradication work. They operate closely with UNDP, UNEP in collaboration with NEMA and the Ministry of Environment.	John Nyangena
<b>Kenya Bureau of Standards</b>	No standards for biodiesel because the costs involved are high and the clients are few. To successfully develop biodiesel standards, it is important to involve the Kenya Bureau of Standards so that they can have a document to work with when they are requested to. Other stakeholders include the National Environmental Management Authority (NEMA), Motor Vehicle Industry (dealers and buyers), Kenya Pipeline Corporation, Ministry of Environment and Natural Resources (MENR).	Raymond Michuki, Head of the Import/Export Department and Coordinator of Petroleum Standard Monitoring Unit. Responsible for standardization of products.
<b>Ministry of Trade and Industry</b>	Responsible for the chemical sector, which includes petroleum products. The main agenda is to promote the industrial sector. There are opportunities to promote agro-based industry, which adds value to commodities grown locally. Jointly with JICA, there is an initiative to develop an industrial Master Plan that identifies priority sectors for investment. The ministry is keen to have a clear policy on blending of ethanol with fuel.	Gregory Muia
<b>Agricultural Finance Cooperation (AFC)</b>	AFC is responsible for providing credit to both small-scale and large-scale farmers. There is competition from micro finance institutions Farmers receive a lot of contributions from SMEs. AFC has noted with concern that NGOs introduce projects to the farmers and when they exit, there is no follow-up. This is where the MOA should come in and manage so that there is continuation and a sustainable project exit strategy. The AFC has a 5-year strategy targeting 1 million clients by 2010.	Allan Mutea
<b>LAFARGE ECOSYSTEMS</b>	A subsidiary of Bamburi Cement Ltd with a large presence in Kilifi, Malindi, & Kwale. Keen to support community projects aimed at enhancing the environment and alleviating poverty. The company uses <i>Jatropha</i> for land rehabilitation.	
<b>UNDP Small Grants Programme-Community Projects on</b>	<ul style="list-style-type: none"> <li>• Launched in 1992</li> <li>• Funding from the GEF</li> <li>• Implemented by UNDP on behalf of UNEP and WB</li> </ul>	Nancy Chege & Fritjof Boerstler UNDP GEF S 254 020 7624473

<b>Jatropha in the Coast</b>	<ul style="list-style-type: none"><li>• Has worked with over 6,500 CBOs and NGOs across the world</li><li>• Special attention to gender concerns and indigenous communities</li><li>• Maximum grant is \$50,000, but average is \$30,000</li></ul>	<a href="mailto:nancy.chege@undp.org">nancy.chege@undp.org</a> <a href="mailto:fritjof.boerslen@undp.org">fritjof.boerslen@undp.org</a>
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**Annex III: The Biofuel National Committee Proposed Activities for Biofuel Strategy Formulation**

<b>Activity</b>	<b>Objective</b>	<b>By Whom</b>
Fact finding missions and technology sourcing missions	Visit biodiesel industries India & Brazil	MOE and others
Bio-prospecting and resource mapping	Preliminary survey of potential of different crops (trees Croton & Jatropha and food crops-jojoba nut, soya, avocado)	MOE + Consultant
Inventory of extraction and processing capacity	Determine seed crushing and extraction equipment	MOE +Consultants
National capability Evaluation	D existing skills and facilities determine the required (CCR, CDM)	MOE& consultants
Market Study	Determine the local and international markets for the biodiesel and evolve a marketing strategy and policy	NOCK &Consultants
Environmental Impact study	To provide environmental impact baseline information	MOE& consultants
Pilot plant and resource center	To develop a capacity to provide quality control and dissemination of technology To demonstrate and train stakeholders on the use biodiesel	JKUAT &Consultants
Stakeholders workshops	Awareness Raising among stakeholders	MOE stakeholders

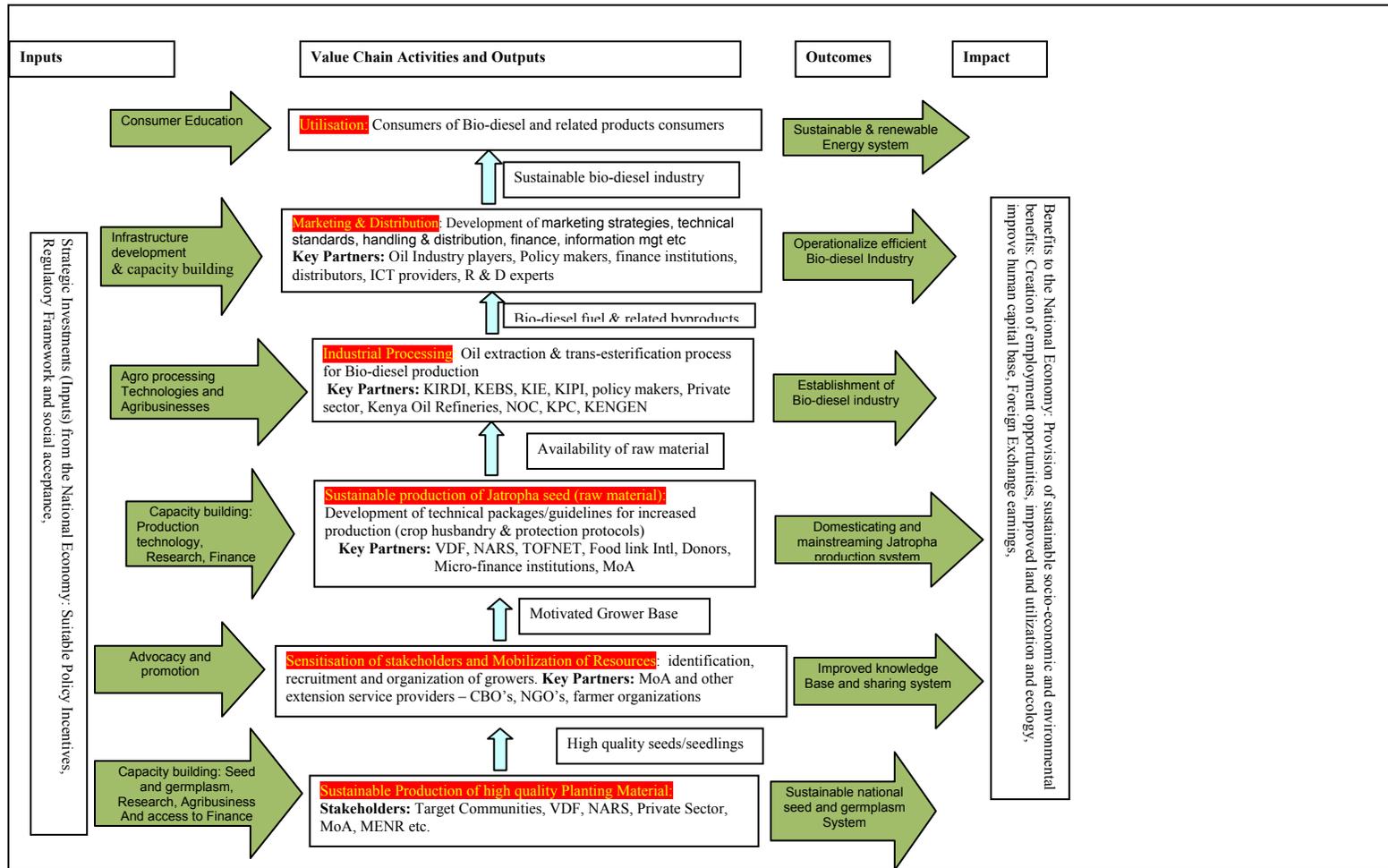
#### **Annex IV. Membership of the National Biofuel Committee**

- 1) Permanent Secretary, Ministry of Energy including: Renewable Energy Department and the Petroleum Monitoring Unit.
- 2) Director General, National Environmental Management Authority (NEMA)
- 3) Permanent Secretary, Ministry of Water and Irrigation
- 4) Permanent Secretary Ministry of Finance
- 5) Permanent Secretary Ministry of Cooperative Development
- 6) Managing Director, National Oil Corporation
- 7) Chairman, Tana Water Services Board
- 8) Chairman of Regional Development Authorities Boards
- 9) Jomo Kenyatta, University of Agriculture and Technology
- 10) Kenya Organic Products Ltd
- 11) Chanka Oils
- 12) Total Kenya Ltd
- 13) Kenya Revenue Authority

#### **Annex V. Terms of Reference of the National Biodiesel Task Force**

1. To develop, review and improve the mandate, operating rules structure, and performance of the National *Jatropha* Task Force
2. To define a workable process for soliciting high-quality suggestions and guidelines for supportive policy for *Jatropha* development from all stakeholders
3. To provide the stakeholders with:
  - Production status report (periodically) of biodiesel in the country
  - Synthesize documents needed to lobby and advocate when discussing with the government
  - To work with stakeholders to (a) formulate a legal framework to guide the biofuels industry; (b) facilitate acquisition and development of best technological practices; (c) introduce financial incentives for entrepreneurs, such as tax exemptions; and (d) set up a framework to gather data on the progress, problems, and success of the biofuel industry in Kenya
4. To create a link with the National BioFuel Task Force Committee

## Annex VI: Future Intervention Options for Jatropha Value Chain



Source: Kassim (2006)

## Literature Cited

- Akotsi, E.F.N., and M. Gachanja. 2004. "Changes in Forest Cover in Kenya's 'Five Water Towers' 2000–03."
- Avishi, J., J.M. Mutie, and D. Walubengo. 2005. "Economic Potential of Forests in Kenya. FAN (2006): Draft Strategic Plan." Kenya Forest Service (unpublished Forest Department report).
- Boerstler, F. 2007. "An Overview of the UNDP-GEF-SGP Biofuel Cluster in the Coast Province, Kenya." Paper presented during the ESDA Biodiesel Conference, Nairobi, Kenya.
- Dufey, A. 2006. "Issues Emerging from the debate on biofuels production, trade and sustainable development."
- ESDA (Energy for Sustainable Development-Africa). 2006. "Biofuel Production on Mining Reserve Land and in Rehabilitated Quarries of Lafarge East Africa (LEA): Feasibility Study of Bamburi, Mombasa." Final Report.
- FAO (Food and Agriculture Organization of the United Nations). . *State of the World's Forests*. Rome: FAO.
- Forest Department, **Government of Kenya**. 1994. Kenya Forestry Master Plan (KFMP) (unpublished report).
- Forest Department, **Government of Kenya**. 2006. "KFS Draft Strategic Plan 2006" (unpublished mimeo).
- Government of Kenya. 1999.*Environmental Management Coordination Act (EMCA)*. **City**: Government Printer.
- Government of Kenya. 1999.*Poverty Reduction Strategy Paper (PRSP)*. Nairobi: Government Printer.
- Government of Kenya. 2001.*Kenya Rural Development Strategy (KRDS)*. Nairobi: Government Printer.
- Government of Kenya. 2003.*Economic Recovery Strategy for Wealth and Employment Creation (ERSW&EC)*. Nairobi: Government Printer.
- Government of Kenya. 2004a. *Forest Bill 2004*. Nairobi: Government Printer.
- Government of Kenya. 2004b. *National Livestock and Extension Policy (NALEP)*. Nairobi:
- Government of Kenya. 2004c. *Strategy for Revitalizing Agriculture*. Nairobi: Government Printer.
- Government of Kenya. 2004d. *Sessional Paper no.4.Energy Policy*. Nairobi: Government Printer.

- Government of Kenya. 2004e. *Strategy for Revitalizing Agriculture (SRA)*. Nairobi: Government Printer.
- Government of Kenya. 2005a. *Forest Act 2005*. Nairobi: Government Printer.
- Government of Kenya. **2005b** *Draft Forestry Policy 2006*. Nairobi: Government Printer.
- Government of Kenya. 2006. *Draft National Policy Framework for the Sustainable Development of Arid and Semi-arid Lands of Kenya (2006)*. Nairobi: Government Printer.
- Green Africa Foundation. 2007. *Farmers Guide*. Nairobi.
- Help Self Help Center. 2006. Mimeo
- Jaetzold, R., and H. Schmidt. 1983. *Farm Management Handbook for Kenya, Vol. IIB*, Nairobi: Ministry of Agriculture.
- Jurgens, I., G. Best, and L. Lipper. 2004. *Bioenergy for Climate Change Mitigation: Eligibility, Additionality and Baselines*. Rome: FAO.
- KAMFOR . 2002. *Ministry of Energy baseline study*.
- Kassim, O. 2006. "Future interventions options for the Jatropha value chain."
- Kengen (**spell out**). 2006. *Annual Report*. **city: publisher**.
- KIFCON . 1990. "Kenya Indigenous Forest Conservation Project." Various Reports.
- Kioni, et al. 2006. "A Proposal for the National Bio-Fuels Research and Certification Laboratory (NBRCL)."
- Kituyi, **E**. et al. 2001. "Biofuel availability and domestic use in Kenya."
- Kituyi, E. 2006. "The Development of a national biofuel strategy and the organization of a biodiesel conference." A proposal to GTZ.
- Lipwoni, V. 2006. "Presentation on piloting of new forest Act 2005." Nairobi: FAN.
- Mayers, J., and S. Vermeulen. 2002. *Company-Community Forestry Partnerships: From Raw Deals to Mutual Gains?* London: IIED.
- MoE (Ministry of Energy), Government of Kenya. 2002. "Study on Kenya's Energy Demand, Supply and Policy Strategy for Households, Small Scale Industries and Service Establishments." Final Report. Nairobi: Kamfor Company.
- Muga, M.O. 2006. "Lessons learned from the AOP pilot Phase." Unpublished report.
- Mutimba, S. 2007. "Exploring opportunities, identifying challenges and opportunities in Biodiesel production and marketing." Paper presented during the Biodiesel Workshop, Nairobi,

Kenya, March 17, 2007.

Njui, A. N., ed. 2007. *Report of the conference proceedings of the 1<sup>st</sup> National conference on *Jatropha curcas* Chain Development in Kenya*. Nairobi: ICRAF.

Nyamai, et al. 2006. "Resource Mapping and Species Distribution of *Jatropha* in Sub-Saharan Africa with Particular Reference to East and Central African Region." In Njui, A. N., ed. *First National Conference on *Jatropha curcas* Chain Development in Kenya*.

Odongo, F. 2007. "Strategic and Economic Justification for the Development and Promotion of Biodiesel in Kenya." Ministry of Energy, Kenya. Unpublished Report.

Parsons, K. 2005. "Jatropha in Africa fighting the desert and creating wealth." *Ecoworld*. Available at: [www.ecoworld.org/home/Articles2.cfm?TID=367](http://www.ecoworld.org/home/Articles2.cfm?TID=367).

Scott and **initial** Wilson. 2006. "Rehabilitation and Upgrading of Hydro power stations." Kenya Tana Catchment Rehabilitation Report.

## Notes

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<sup>1</sup> The European Union has set a 2010 target for biofuels to comprise at least 5.75 per cent of its transport fuel supply and to have in place a policy framework for the energy sector to boost competition and protect climate change by cutting CO<sub>2</sub> and greenhouse gas emissions using renewable sources of energy in which biofuels are a key element. In the United States, interest and investment in ethanol production from maize grain and agricultural wastes is expanding at an unprecedented rate, with a growth rate of 30 percent in 2005.

<sup>2</sup> These include the UN Convention to Combat Desertification (UNCCD) (signed on June 24, 1997); the Convention on Biological Diversity (CBD) (signed on July 26, 1994); the UN Framework Convention on Climate Change (UNFCCC) (signed on August 30, 1994); and the Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests (and Chapter 11 of Agenda 21).

<sup>3</sup> Biodiesel or vegetable oil methyl ester (VOME) is produced from the reaction of vegetable oil with ethanol or bioethanol in the presence of a catalyst to yield mono-alkyl esters and glycerine, which is then removed. The oil can be produced from oily crops or trees such as rapeseed, sunflower, soya, palm, coconut, or *Jatropha*. It can also be produced from animal fats, tallow, and waste cooking oil (IEED 2006).

<sup>4</sup> Biofuels can be defined as liquid fuels produced from biomass for either transport or burning purposes and are mostly produced from agricultural and forest products, and the biodegradable portion of industrial and domestic waste.

<sup>5</sup> These concerns were raised during community consultative meetings for ASALs stakeholders organized by NALEP in Garissa and Nakuru.

<sup>6</sup> The draft Land Policy has been finalized and is currently awaiting feedback from the stakeholders.

<sup>7</sup> Thiong'o et al. (2006) emphasizes the importance of biofuels as the most attractive renewable energy alternatives in Kenya as they are carbon dioxide-neutral by virtue of being direct plant derivatives.

<sup>8</sup> The National Biofuel Committee—with representatives from GOK, academia, research institutions, civil society, and the private sector—was constituted in February 2006 and has held five meetings. The committee organized a one-day biodiesel conference in March 2006.

<sup>9</sup> The overarching vision for Kenya is to be a globally competitive and prosperous nation with a high quality of life by 2030 and sustained growth rate of 10 percent per annum over the next 25 years.

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<sup>10</sup> The biomass produced in Brazil largely results from an ethanol fuel production program started in 1975 from sugar cane crops grown specifically for fuel use, presently occupying 2.7 million hectares of land and employing about 350 distilleries. It has saved the country over \$40 billion in oil imports, excluding the costs of the program.

<sup>11</sup> During the ESDA meeting on March 15, 2007, it was clear there was a need for more consultations between agencies involved with various *Jatropha* pilot activities to avoid duplication

<sup>12</sup> During the ESDA meeting on March 15, 2007, it was clear there was a need for more consultations between agencies involved with various *Jatropha* pilot activities to avoid duplication.

<sup>13</sup> Electricity Regulatory Board (ERB), Kenya Electricity Generating Company (KENGEN) Limited, Kenya Power and Lighting Company (KPLC), National Oil Corporation of Kenya (NOCK), Kenya Pipeline Company (KPC) and Kenya Petroleum Refineries Limited (KPRL).

<sup>14</sup> Personal Communication. Mohammed Halake NRM Coordinator, ALRMP

<sup>15</sup> Republic of Kenya, Ministry of Special Programmes ALRMP 11 (2005) Draft. Asal Vision and Strategy

<sup>16</sup> The National and Livestock Extension Policy (NALEP) has worked in the agriculture sector for over 20 years but not in ASALS and is particularly interested in lessons learnt in extension approaches and improved livelihood opportunities in the areas. If “suspensions” over *Jatropha* were addressed they are willing to try it.

<sup>17</sup> The dryland forests types are estimated at 2.1m ha of woodlands, 2.8m ha of bushland and 10.7m ha of wooded grassland (KFMP, 1994).

<sup>18</sup> The hilltops are distinct from the main water towers—such as the Cherangani, Aberdare, Mau, Kenya and Elgon—**and (ok?)** are usually not protected as “forest reserves” at national level and could be around 50 ha.

<sup>19</sup> Unpublished KFS Draft Strategic Plan (2006) proposals

<sup>20</sup> The SWA is the approach to planning whereby all significant efforts and investments follow a well-identified and coordinated strategy and are based on an investment plan that has been developed and owned by the key stakeholders and institutions responsible for the sector.

<sup>21</sup> Kenya Organic Products in Odongo (2006) estimates that a 60,000 ha plantation project can provide 15 percent of the country’s annual diesel requirements at current levels, which would translate to 420,000 ha for self-sufficiency (equivalent to \$272million per year).

<sup>22</sup> Republic of Kenya (2004). Ministry of Energy Sessional Paper No.4 of 2004.

<sup>23</sup> See Kioni (2006)

<sup>24</sup> JKUAT is well-placed between the industrial hub of Thika and Nairobi and has a core technical competence to undertake the task.

<sup>25</sup> See Boerstler (2007).

<sup>26</sup> Bernard Muciri, personal communication.

<sup>27</sup> Gichu, personal communication—  
forest area: 0.1 ha; tree height: 2 meters; canopy cover: 30 percent.

<sup>28</sup> The company represents 80 percent of the electricity generated in Kenya, which was 5.697 million kilowatt hours in 2006. It generated a pre-tax profit of Ksh. 3.721million. The company is committed to energy and environmental efficiency in the use of electric energy, water and fuel consumption and CDM and CSR. See the KenGen Annual Report (2006).

<sup>29</sup> The NRM project for the Upper Tana Catchment and Western Kenya Community Driven and Flood Mitigation provides opportunities to pilot some of these activities.

<sup>30</sup> These observations by GAF need to be backed by systematic trials on input-output for establishment of *Jatropha* by KEFRI-KARI-KIRDI and the various universities.

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<sup>31</sup> The successful reforms in the water sector and the accrued gains by the public and other stakeholders is a source of inspiration to the proposed formulation of the biofuel policy as part of the reform strategy.

<sup>32</sup> These pillars or principles are mainly based on the BFNC as reported by Kituyi (2007) based on three previous workshops and the biodiesel workshop held in Nairobi March 2007.

<sup>33</sup> The Mali Folkcenter has planted more than 200 hectares of *Jatropha* with superior varieties, fruiting in 8months and has used *Jatropha* to power generators of 375KW (Enos Esikuri, Personal Communication)