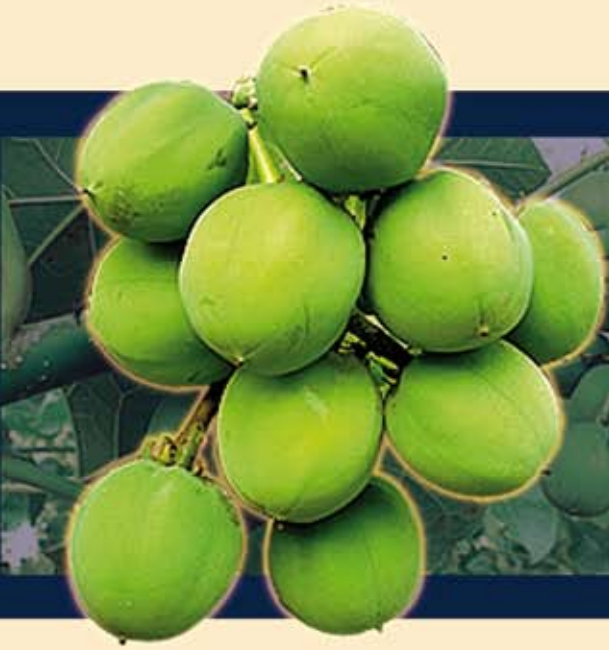
Jatropha curcas-Derived Biofuel Industry in Africa



Conference Proceedings

22–23 February 2010, Hilton Hotel, Nairobi

Follow-up of the InterAcademy Council (IAC) report recommendations and financially supported by the InterAcademy Panel (IAP)

The African Academy of Sciences

Jatropha curcas-Derived Biofuel Industry in Africa

Conference Proceedings

22–23 February 2010, Hilton Hotel, Nairobi

Follow-up on the InterAcademy Council (IAC) report recommendations and financially supported by the InterAcademy Panel (IAP)

Jatropha curcas-Derived Biofuel Industry in Africa

Published by:

icipe Science Press
P.O. Box 72913-00200 Nairobi, Kenya
Tel: +254 (20) 8632000
Fax: +254 (20) 8632001/2
E-mail: isp@icipe.org
Home page: www.icipe.org

Editorial assistance: Dolorosa Osogo
DTP, graphics and cover design: Irene Ogendo
Printing: KulGraphics Ltd.

Contents

Acronyms and Abbreviations v

Executive Summary 1

Opening Ceremony

Welcome Remarks, *Shem Arungu-Olende, Secretary General, AAS* 2

Opening Remarks, *Jacqueline Olang, Network Coordinator, NASAC* 5

Presentation of the IAC Report, *Shem Arungu-Olende, Secretary General, AAS* 7

Status of *Jatropha* Cultivation in Africa: Challenges and Opportunities

Overall Africa Perspective, *John Kioli, Green Africa Foundation* 12

Status of *Jatropha* Plantations in Ghana: A Case Study of Jatropha Africa's Plantation, *Ohene Akoto, Jatropha Africa* 14

Status of *Jatropha curcas* Cultivation in Africa: The Tanzania Perspective, *Lillian Mkony, Jatropha Products, Tanzania* 15

Status of *Jatropha curcas* Cultivation in Africa: Challenges and Opportunities in Zambia, *Petrus Snyman, Thomro Biofuels* 16

Jatropha curcas as a Source of Biofuel: Opportunities and Challenges

Biofuels for Developing Economies: Current Scenario and Issues, Challenges and Opportunities, *James Onchieku, KEFRI* 19

Utilisation of *Jatropha* Waste for Energy Production: Opportunities and Challenges, *David Yuko, Institute of Research in Sustainable Energy and Development (IRSEAD)* 22

Strategies for Developing Creative and Innovative Business Models, Accessing Venture Capital and Penetrating Local and International Markets

Developing Creative and Innovative Business Models for the Bio-fuel Industry in Africa, *Suresh Patel, Kridha Ltd and Representative, KAM* 25

Commercialisation of *Jatropha curcas*-based Biofuel Production System for Integrated Rural Development and Energy Provision in Kenya, *Lorna Omuodo, Vanilla Jatropha Development Foundation* 29

Innovative Business Model for Biofuel Production in Africa: The Case of Mali Biocarburant, *Hugo Verkuijl, Mali Biocarburant SA (MBSA)* 31

Identifying Ideal Conditions and Locations for Biofuel Crops

Agronomy of *Jatropha* and How to Identify Suitable Areas, *Alex Nabiswa, Jatropha Support Programme* 34

German Technical Cooperation (GTZ) Work on *Jatropha* in Africa, *Myra Mukulu, GTZ* 37

Policy Innovation Systems for Clean Energy Security (PISCES),
Bernard Muok, PISCES 40
Key Recommendations 44
Closing Remarks and Vote of Thanks
Shem Arungu-Olende, Secretary General, AAS 45
Appendix 1: Programme 46
Appendix 2: List of Participants 48

Acronyms and Abbreviations

AAS	African Academy of Sciences
ACTS	African Centre for Technology Studies
AGRA	Alliance for a Green Revolution in Africa
ATPS	African Technology Policy Studies
BMZ	German Federal Ministry for Economic Cooperation and Development
COMESA	Common Market for Eastern and Southern Africa
DEG	Deutsche Investitions–und Entwicklungsgesellschaft
DFID	Department of International Development, UK
ECOWAS	Economic Community of the West African States
EU	European Union
FAEE	Fatty Acid Ethyl Ester
FFA	Free Fatty Acid
GDP	Gross Domestic Product
GHG	Green House Gases
GIS	Geographic Information Systems
GTZ	German Agency for Development Cooperation
HBFHA	Heinrich Böll Stiftung
IAC	InterAcademy Council
ICRAF	World Agroforestry Centre
IPM	Integrated Pest Management
IRSEAD	Institute of Research in Sustainable Energy and Development
KAM	Kenya Association of Manufacturers
KARI	Kenya Agricultural Research Institute
KBDA	Kenya Biodiesel Development Association
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KPLC	Kenya Power and Lighting Company
LED	Light-emitting Diode (Lamp)
MBSA	Mali Biocarburant SA
MDGs	Millennium Development Goals
NASAC	The Network of African Science Academies
NGO	Non-governmental Organisation
PPP	Public Private Partnership
PREEEP	Promotion of Renewable Energy and Energy Efficiency Programme
ProBEC	Programme for Basic Energy and Conservation in Southern Africa
PSDA	Private Sector Development in Agriculture
R&D	Research and Development
SADC	South African Development Community
SMEs	Small and Medium Sized Enterprises
S&T	Science and Technology
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

The challenge to ensure the availability of sustainable energy is a complex task. Its dimensions are social, technological, economical and also political. The momentum behind the current energy trends is enormous given the rising demand of energy-related services around the world. There are high-levels of consumption in many industrialised countries, continued population growth and rapid industrialisation which have put pressure on the existing energy infrastructure. In light of this, there have been, inevitably, growing environmental and energy security risks that have helped to shift the game to renewable energy. The world's energy supply mix is currently dominated by fossil fuels with coal, petroleum and natural gas supplying 80% of the global energy demand. Traditional biomass, nuclear energy and large-scale hydropower account largely for the remainder. Achieving sustainable energy will call for a shift in the current mix of supply resources towards a much larger role of low carbon technologies and renewable energy sources including bio-fuels. Producing electricity using wind, solar, hydropower and biomass represents an important opportunity for displacing conventional petroleum based energy whereby crude prices keep escalating.

"Lighting the Way" report, establishes the best practices for a global transition to a clean, affordable and sustainable energy supply in both developing and developed countries. The report developed by the IAC reached nine major conclusions along with actionable recommendations formulated within a holistic approach to the transition towards a sustainable energy future. This IAC report formed the basis of the *Jatropha curcas* conference organised by AAS and NASAC and had representation from over 7 countries in Africa. Various case studies on *Jatropha* production and processing were shared and what came out clearly was the lack of support from the respective governments. Development of biofuels will not produce the desired outcomes unless the policy and regulatory framework, instruments, price signals, market incentives and standards are in place. In addition, the governments' support is vital in creating an enabling environment for *Jatropha* development.

In any investment done, the aim is to get a return on the investments made. Several presentations were done on various business models that can maximise returns. The best model would be one that financially rewards everyone in the supply chain and not just benefits a few. Critical to the success of biofuels development in Africa will be the relentless pursuit of the most promising technology that can deliver solutions by uplifting the living standards of the people who are engaged in the supply chain. All in all, all efforts must be geared towards achieving a sustainable energy future.

Facilitator: Jasper Kirika

Welcome Remarks

Shem Arungu-Olende, Secretary General, AAS

Distinguished participants;
Ladies and gentlemen;

On behalf of the African Academy of Sciences, and the Network of African Science Academies, I wish to welcome you all to Nairobi to participate in this important conference.

Energy is at the core of socio-economic development and environmental protection. It powers industry and transport, lights buildings and is a major input into agricultural production. At the individual level, energy satisfies basic human needs. Lack of access to modern and sustainable energy is a major cause of poverty, underdevelopment and environmental degradation.

Increased use of energy in the form of fossil fuels—coal, petroleum and natural gas—has been associated with adverse impacts on climate change in the form of global warming. Increased energy efficiency and more widespread development and application of renewable energy have been recognised as areas requiring attention and concerted effort worldwide.

Biomass is by far the most abundant renewable energy; nevertheless, most of biomass used has been in traditional forms with attendant wastage and adverse health as well as environmental impacts.

Transportation is the fastest growing sector worldwide, more so in the developing countries, including Africa. Todate petroleum has been the main source of transport energy. But, as we are all aware, petroleum is a finite resource whose production will peak and begin to decline, sooner than later. An added headache is the uncertainty about future petroleum prices, which have, in any case, been increasing steadily in recent years.

Interest has, therefore, steadily grown on liquid biofuels as viable alternatives to petroleum. The potential for liquid biofuels for transportation is vast; indeed, world biofuel production has been growing steadily, most of it bioethanol. The main benefits of biofuels for transportation are improved energy security, reduced greenhouse gas emissions and emissions of particulates, improved octane rating and enhanced rural development (creation of new jobs, generation of income and creation of other development opportunities).

The subject of this meeting is *Jatropha curcas*-derived biofuel industry in Africa. This is a commendable initiative, given the potential of biodiesel fuel in Africa and worldwide and the increasing use of *Jatropha curcas* as a feedstock for the production of biodiesel. I urge you not to focus only on *Jatropha curcas* biodiesel

production, but also to examine its potential multipurpose uses. These include, (i) oil as raw material (for making soap or for illumination), (ii) alkaloids for medicinal purposes, (iii) raw material for dye, (iv) oil cake for soil enrichment and (v) feed, e.g. for silkworms.

I am sure that many of you are also interested in other feedstock for biodiesel production, such as algae, oils or fats, soybean oil, mustard seed oil, rapeseed, sunflower, copra, palm, cottonseed and avocados. I hope you will continue to develop these too, as part of a comprehensive strategy.

Let me now mention a number of contentious issues associated with large-scale production of biofuels. Chief among these are land requirements and availability impacts, and food production. Actual requirements for, and ready availability of, land are among the touchy issues surrounding major biofuel production. Producing biofuels on a large-scale could require huge tracts of land if traditional crops are used.

The "food versus fuel" subject is controversial and complex. Food and biomass require the same resources for production, i.e. land, water and agrochemicals. In the ideal situation, both food and fuel are important requirements that need not compete, particularly when there is careful planning to ensure ecological conservation and sustainability of production methods. Nevertheless, a raging debate on competition for land resources between biofuel and food production continues. The debate should be of interest to African countries which wish or plan to embark on large-scale production of biofuels.

I should now like to mention a number of broad issues that directly impact on the future development and application of biofuels in Africa and which, therefore, demand attention. These include policies, knowledge, standards, investment and trade.

In the African continent an outstanding feature is the dearth, and in most cases, the complete lack of policies on biofuels. The need to develop and implement policies in this subject is critical and urgent. For many African nations, access to land resources is of crucial importance. Land resources provide the basis of most human activities, including the management of soil, water and energy. A sound land-use policy, with improved land tenure structures, is an essential step.

Even in those countries where biofuel policies exist and even in cases where the policies are glaringly deficient, experience with such policies as well as those in other sectors clearly indicates the need for implementation of policies and strategies.

The policies must be broad and all inclusive, reflecting the link between biofuel production and other activities. They must address the development of energy, agriculture, forestry, industrial development, environmental protection, all in an integrated manner, aimed at maximising biofuel related benefits while minimising social costs. To be viable, successful policies require robust legal, regulatory and institutional frameworks, which would also ensure effective implementation of the policies.

High quality data are of crucial importance in providing valuable information and knowledge for informed and effective policy making in biofuels. The key issues in this context are the value and reliability of the data, given the sensitive nature of the problems at hand. The quality and usefulness of information are enhanced through painstaking collection, processing and analysis of data. In the case of biofuels, relevant cross-sectoral data—involving transportation, forestry, energy, agriculture and environment—will be required. Estimating and projecting the demand for biofuels for domestic and global markets would involve, among others, the development and application of suitable methodologies.

Current information on the demand for biofuels in respective African countries is inadequate. So is the proper knowledge of the biofuel resources and production, including the most appropriate feedstock. There is, therefore, need for an assessment of biofuel resources and their methods of production to acquire suitable data and information in this area. This would involve the development of resource database and building the capacity to effectively manage such a database.

There is a need to adopt and enforce common standards for biofuels in Africa that are compatible with international ones. The main problem is that there are no international standards, thus making it difficult to reach the global market. At the moment there are, for example, different standards in the US and in Europe.

Availability and adequacy of financial resources are critical in the current and future large-scale biofuel development. To be sure, interest is growing worldwide in investment in the development of biofuels; for many African countries there are opportunities for obtaining funding from international institutions such as the World Bank. Opportunities also exist in regional development banks, e.g. the African Development Bank, as well as sub-regional banks such as COMESA. Other development partners are also ready to participate in viable projects. There are also opportunities for sourcing funds from the private sector through public–private sector partnership.

Trade in biofuels within African countries has so far been minimal. For example, the small quantities of bioethanol fuel produced in respective countries have been for domestic consumption. The potential for such trade—within African countries, and between Africa and the rest of the world—is, however, huge.

Lastly I wish to thank the InterAcademy Panel for the generous support for this conference.

These are but a few of the issues I wanted to share with you. I wish you success in your deliberations. Thank you.

Purpose and Goals of the Conference from the Network of African Science Academies (NASAC) Perspective

Opening Remarks

Jacqueline Olang, Network Coordinator, NASAC

NASAC was founded in December 2001 as an independent forum for African science academies to "provide authoritative science advice on policy formulation towards economic, social and cultural development in Africa". NASAC has a membership of science academies from 15 countries namely Cameroon, Sudan, Ghana, South Africa, Kenya, Tanzania, Madagascar, Uganda, Morocco, Zambia, Mozambique, Zimbabwe, Nigeria, Mauritius and Senegal. Additionally, two more academies are expected to join NASAC from Egypt and Ethiopia.

NASAC's objectives are to:

- Encourage establishment of academies where none exist;
- Empower existing academies;
- Create an independent platform for credible science advice; and
- Project a unified voice of science in Africa.

NASAC has carried out a number of activities and participated in world forums. Recently, they circulated a joint statement on "Brain Drain in Africa" to G8 + 5 Summit in June 2009 and also a statement on Sustainable Development to G8 Summit in Japan in June 2008 among many others. They have also developed publicity materials and a website (*www.nasaconline.org*) which serves as a link to the rest of Africa. The organisation has formed an expert group comprising of social scientists that provide oversight and foresight to NASAC's activities. In addition, NASAC has held various awareness workshops for its members and has developed guidelines and strategies for creation of new academies. The Network encourages best practices to use as benchmarks and foresees the academies as being the science advisers and partners for and in Africa.

It was noted that the academies in Africa face challenges. Among these challenges include limited resources, slow inclusion of younger scientists who academically merit membership, academies act locally and in isolation even on common critical problems therefore no collective action and lastly majority of the academies need transformation to dynamic organisations. There exist opportunities for NASAC to partner with regional and international bodies with considerable commitment to science which include SADC, ECOWAS, among others. Currently, African Governments acknowledge the need to support science and technology from their GDP and NASAC uses the millennium development goals as reference point for its activities. Moreover, there is increased global focus and interest on African issues and hence an opportunity to seek support.

As the case for renewable energy is important and urgent action is required, scientists must come together and provide research solutions in this area. With the unmet world energy demand, climate change and rising cost of crude oil, the

conference will therefore create awareness on biofuels as alternative sources of fuels.

Further, the conference will deliberate on the IAC Report on Energy that was produced by a study panel of 15 world-renowned energy experts. It is entitled, "Lighting the Way: Toward a Sustainable Energy Future". The meeting will further discuss best practices in production and commercialisation of *Jatropha* as a biofuel source and influence policies that govern exploitation of *Jatropha* at national level. The forum will create a networking platform where the participants will share experiences and exchange ideas on biofuels.

At the close of the conference, participants will identify the challenges and opportunities for *Jatropha* in the energy sector; create sustainable networking among *Jatropha* entrepreneurs and researchers, and determine the next steps to seek subsequent funding support for identified priorities.

Presentation of the IAC Report "Lighting the Way: Toward a Sustainable Energy Future"

Shem Arungu-Olende, Secretary General, AAS

Commissioned by the governments of Brazil and China, this report identifies a scientific consensus framework for directing global energy development. It lays out the science, technology and policy roadmap for developing energy resources to drive economic growth in both industrialised and developing countries while also securing climate protection and global development goals. The report was produced by a study panel of 15 world-renowned energy experts, co-chaired by Nobel Laureate Steven Chu, Director of the Lawrence Berkeley National Laboratory in the United States, and José Goldemberg, former Secretary of State for the Environment for the State of São Paulo, Brazil.

The report acknowledged that making the transition to a sustainable energy future is one of the central challenges humankind faces in this century. The concept of energy sustainability encompasses not only the imperative of securing adequate energy to meet future needs, but doing so in a way that: (a) is compatible with preserving the underlying integrity of essential natural systems, including averting dangerous climate change; (b) extends basic energy services to the more than 2 billion people worldwide who currently lack access to modern forms of energy; and (c) reduces the security risks and potential for geopolitical conflict that could otherwise arise from an escalating competition for unevenly distributed energy resources.

"Lighting the Way" establishes the best practices for a global transition to a clean, affordable and sustainable energy supply in both developing and developed countries. The report addresses incentives that can accelerate the development of innovative solutions, provides recommendations for financial investments in research and development and explores other transition pathways that can transform the landscape of energy supply and demand around the globe.

In addressing mitigation of the environmental impacts of energy generation and use, "Lighting the Way" informs global action on climate change, such as implementation of the Kyoto Protocol, agenda setting for the Asia-Pacific Partnership on Clean Development and Climate, and ongoing multinational talks on future global action to reduce greenhouse emissions. "Lighting the Way" also confronts the unequal access to energy experienced by one-third of the world's population without access to basic energy services, and makes recommendations for addressing this disparity as well as for promoting national and global energy security.

The conclusions and required actions drawn from the report were:

Conclusion 1: Meeting the basic energy needs of the poorest people on this planet is a moral and social imperative that can and must be pursued in concert with sustainability objectives.

Needed actions:

- Given the international dimension of the problem, multinational organisations like the United Nations and the World Bank should take the initiative to draw up a plan for eliminating the energy poverty of the world's poor. As a first step, governments and NGOs can assist by supplying data on the extent of the problem in their countries.
- The private sector and the S&T community can help promote the transfer of appropriate technologies. The private sector can, in addition, help by making appropriate investments.
- The media should make the general public aware of the enormity of the problem.

Conclusion 2: Concerted efforts must be made to improve energy efficiency and reduce the carbon intensity of the world economy.

Needed actions:

- Governments, in dialogue with the private sector and S&T community, should develop and implement (further) policies and regulations aimed at achieving greater energy efficiency and lower energy intensity for a great variety of processes, services and products.
- The general public must be made aware, by governments, the media, and NGOs of the meaning and necessity of such policies and regulations.
- The S&T community should step up its efforts to research and develop new, low-energy technologies.
- Governments, united in intergovernmental organisations, should agree on realistic price signals for carbon emissions and make them key components of further actions on reducing the carbon emissions.
- The private sector and general public should insist that governments issue clear carbon price signals.

Conclusion 3: Technologies for capturing and sequestering carbon from fossil fuels, particularly coal, can play a major role in the cost-effective management of global carbon-dioxide emissions.

Needed actions:

- The private sector and the S&T community should join forces to further investigate the possibilities for carbon capture and sequestration and develop adequate technologies for demonstration.
- Governments should facilitate the development of these technologies by making available funds and opportunities (such as test sites).
- The general public needs to be thoroughly informed about the advantages of carbon sequestration and about the relative manageability of associated risks. The media can assist with this.

Conclusion 4: Competition for oil and natural gas supplies has the potential to become a source of growing geopolitical tension and economic vulnerability for many nations in the decades ahead.

Needed actions:

- Governments should introduce (further) policies and regulations aimed at reducing energy consumption and developing petroleum alternatives for use in the transport sector.

- The private sector and the S&T community should continue developing technologies adequate to that end.
- The general public's awareness of sustainability issues related to transportation energy use should be significantly increased. Again, the media can play an important role in this effort.

Conclusion 5: As a low-carbon resource, nuclear power can continue to make a significant contribution to the world's energy portfolio in the future, but only if major concerns related to capital cost, safety, and weapons proliferation are addressed.

Needed actions:

- Given the controversy over the future of nuclear power worldwide, the UN should commission—as soon as possible—a transparent and objective re-examination of issues that surround nuclear power and their potential solutions.
- The private sector and S&T community should continue research and development efforts targeted at improving reactor safety and developing safe waste management solutions.
- Governments should facilitate replacement of the current aging reactors with modern, safer plants. Governments and inter-governmental organisations should enhance their efforts to remedy shortcomings in existing international frameworks and governance mechanisms.

Conclusion 6: Renewable energy in its many forms offers immense opportunities for technological progress and innovation.

Needed actions:

- Governments should substantially facilitate the use—in an environmentally sustainable way—of renewable energy resources through adequate policies and subsidies. A major policy step in this direction would include implementing clear price signals for avoided greenhouse gas emissions.
- Governments should also promote research and development in renewable energy technologies by supplying significantly more public funding.
- The private sector, aided by government subsidies, should seek entrepreneurial opportunities in the growing renewable-energy market.
- The S&T community should devote more attention to overcoming the cost and technology barriers that currently limit the contribution of renewable energy sources.

Conclusion 7: Biofuels hold great promise for simultaneously addressing climate-change and energy-security concerns.

Needed actions:

- The S&T community and the private sector should greatly augment their research and development (and deployment) efforts toward more efficient, environmentally sustainable technologies and processes for the production of modern biofuels.
- Governments can help by stepping up public research and development funding and by adapting existing subsidy and fiscal policies so as to favour the use of biofuels over that of fossil fuels, especially in the transport sector.

Governments should pay appropriate attention to promoting sustainable means of biofuels production and to avoiding conflicts between biofuel production and food production.

Conclusion 8: The development of cost-effective energy storage technologies, new energy carriers, and improved transmission infrastructure could substantially reduce costs and expand the contribution from a variety of energy supply options.

Needed actions:

- The S&T community, together with the private sector, should focus on research and development in:
  - Potential new energy carriers for the future, such as hydrogen.
  - Improved energy storage technologies, either physical or chemical, that could significantly improve market prospects of intermittent renewable resources.
  - Continued improvements and cost reductions in technologies for transmitting electricity over long distances.

Governments can assist by increasing public funding for research and development and by facilitating needed infrastructure investments.

Conclusion 9: The S&T community—together with the general public—has a critical role to play in advancing sustainable energy solutions and must be effectively engaged.

Needed actions:

- The S&T community must strive for better international coordination of energy research and development efforts, partly in collaboration with the private sector.
- Governments (and inter-governmental organisations) must make more public funding available to attract more scientists and engineers to work on sustainable energy problems.
- The why and how of energy research and development should be made transparent to the general public.

The S&T community itself, inter-governmental organisations, governments, NGOs, the media and the private sector should be actively engaged in educating the public about the need for these investments.

The full report can be accessed from – http://www.interacademycouncil.net

Discussions

Concerns were raised regarding the perceived reluctance by the private sector to join in the renewable energy discussions which led to low investment in ventures arising from these discussions. The participants were advised to ensure that the biofuel ventures make business sense and are packaged lucratively to attract investors. Another concern raised was that governments did not seem to be supportive to the investors through provision of subsidies, facilitation of technology, research and development or even in policy development. Government representatives encouraged innovators and entrepreneurs to involve them in ongoing debates and present credible scientific facts to facilitate policy development.

Another concern raised regarded the fact that *Jatropha* as a source of biofuel had been under discussion since 2004 yet recommendations arising from those discussions had not been fully achieved. The meeting was advised that developments on recommendations would only happen if a multi-faceted approach were taken. It would take some time to translate scientific breakthrough into viable business enterprises as well as ensure that Governments come up with a policy framework that will help the entrepreneurs, farmers and investors invest in development of biofuels. In the absence of policy framework, no support would be received from the Government for example in terms of incentives. Given Africa's infrastructure the best vision for the biofuel market would be development and production of biofuels that can find local and international markets.

Overall Africa Perspective

John Kioli, Green Africa Foundation

Introduction

Kenya and Africa at large, rely heavily on biomass fuels in form of charcoal or wood, followed by petroleum fuels used in transport and the industrial sector, while electricity and renewables take a smaller fraction. In Kenya, the sources of biodiesel were reported to be palm, castor, soybeans, sunflower, sugarcane and *Jatropha curcas*.

The uses of *Jatropha curcas* were named as follows:

- Used as fuel: Biodiesel to run engines and for domestic use in place of kerosene.
- Soil fertility uses: Residue cakes are rich in nitrogen, phosphorus and potassium (NPK).
- Use in the soap manufacturing sector: The *Jatropha* oil has high saponification value in soap manufacturing.
- Land rehabilitation uses: Soil erosion control and dune shifting.
- Medicinal purposes: Latex is used as anticancer agent externally applied for skin diseases in humans and livestock. Its roots are used as antidote for snake bites.

Kenya was seen to have opportunities in the development of *Jatropha* because of land availability in the semi-arid areas. These areas are known to have good climate for *Jatropha* cultivation. In addition, there is availability of both unskilled and skilled labour, which will be able to meet the huge market demand for local and international markets. However, there were challenges singled out in the development of *Jatropha* in Kenya. The major one being the choice of crop — between agroforestry trees and food crops. Food crops like soya and corn mature faster than agroforestry trees hence the dilemma. There is also high investment costs associated to large-scale plantation. A common limitation is lack of extraction and processing technology to process the finished products.

The participants were notified that policy and guidelines on biofuels were yet to be put in place in the East African region. The policy instruments would touch on subsidies, trade tariffs, blending targets, production, marketing and land provision. With the strained energy resources, there are factors that have triggered the production of alternative sources of energy:

- Decentralised use of bioenergy to reduce the cost of transmission. There is high cost of rural energy transmission.
- Carbon trading: There are a few registered projects in Africa that are signatories of the Kyoto protocol.
- Rising cost of fossil fuels.

The Kenya Case Study: Mpeketoni Model in Lamu

The case study revealed that over 10,000 farmers have planted *Jatropha* with acreage of 1ha per farmer. They are registered under a cooperative society which is funded by the Norwegian Church AID. They carry out intercropping hence maximise land use and income streams. The Mpeketoni Model has been able to create a growing market for biofuel with companies such as KPLC purchasing it.

Conclusion and recommendations

The speaker concluded the session by recommending the production and utilisation of biofuels in Africa. Biodiesel would be an attractive alternative fuel with a huge potential and once exploited will lead to the improvement of the general well-being of a big section of Africa's population. Certain factors were perceived to enable such transition: How to manage this change properly with a view to economics, technology, and structure and ownership of industry and creation of a knowledge base. A comprehensive programme for the introduction of this biodiesel industry was seen as a requirement. Key to the success would be the Government support in policy formulation.

Status of *Jatropha* Plantations in Ghana: A Case Study of Jatropha Africa's Plantation

Ohene Akoto, Jatropha Africa

Oil shock in the 1970s and early 1980s forced the government of Ghana to encourage the use of biodiesel at the national level. It ended when world oil prices declined in late 1980s. At present, interest in biodiesel has been rekindled in Ghana with focus on the use of *Jatropha*. Due to the good climate, soil and rainfall pattern in Ghana the plant grows almost everywhere. The country saw the need to diversify its energy resources because of the high world crude oil prices, legal mandate, and geopolitical tensions in Iraq, Iran, Nigeria and other oil producing countries. Further, the emergence of new economic powers like China, and the Kyoto Protocol on the reduction of greenhouse gases and global warming were seen as contributing factors to its development. *Jatropha curcas* is a perennial tree, found in the tropics. It has known advantages. It can be cultivated on land not suited to food crops and its oil has good properties, e.g. low waxing temperature, and low sulphur and can be used as direct fuel (with additives) in engines.

Jatropha Africa is an organisation that is both British and Ghanaian owned that produces biodiesel feedstock. The organisation has its own improved seed called *Jatropha* Africa and has 500 ha of existing plantation. In the past, shea butter oil was used for biodiesel in Northern Ghana for lighting lanterns. Jatropha Africa's plantations have good soil profile coupled with prevailing agro-climatic conditions. The project carries out intercropping by combining *Jatropha* with suitable species like shea butter, peanuts, tubers and vegetables. The advantages of intercropping include helping to boost cash flow, weed control, provision of shade, and availing nutrients because *Jatropha*'s root system is deep. The organisation has also found it useful to run other projects like bee-keeping and fish farming to make maximum use of the resources available.

The project encounters problems of funding, lack of a regulatory framework and insufficient scientific data, and information on biofuel. Given the escalating crude prices and constraints on the available energy resources, alternative sources of energy is a profitable business but profits can only be realised by having the correct business model and government support.

Status of *Jatropha curcas* Cultivation in Africa: The Tanzania Perspective

Lillian Mkony, Jatropha Products, Tanzania

Jatropha Products Tanzania Ltd (JPTL) is a nonprofit organisation whose objective is to link research and development in areas of knowledge, skills, and technology transfer to smallholder farmers and small and medium enterprises interested in the *Jatropha* plant and its products. JPTL helps small-scale farmers to improve their livelihood and alleviate poverty by selling and utilisation of *Jatropha* products, oil and by-products. The organisation operates in five regions in Tanzania.

JPTL focuses on *Jatropha* crop system as an integrated rural development approach through:

- Increase in household livelihood by restricting *Jatropha* cultivation in hedges, farm boundaries and on marginal lands. The farmers are trained on how to intercrop *Jatropha* with other food crops.
- Encouraging and training farmers on harvesting, storage and processing of seeds for the market.
- Biofuel from *Jatropha* seeds — training small-scale farmers on the best farming practices for quality and high seeds yield.
- Farmers are trained on the simple methods of extracting oil from *Jatropha* seeds, by the use of locally made hand press machine; oil produced is applied for their daily usage.
- JPTL provides training on how to make and use *Jatropha* oil lanterns.
- JPTL also carries out research on local cook stoves, lanterns, improved seed cake stove and medicinal value of *Jatropha* herbal soap.

The participants were informed that there has been concerted effort on *Jatropha* growing, processing, trading and other related activities in Tanzania. Through the government, relevant guidelines and policy have been formulated, and also investment facilitation and monitoring through various ministries. Institutions like the University of Dar es Salaam and Muhimbili University have provided guidelines on best farming practices, pest control, environment, medicinal value of *Jatropha* and certification of *Jatropha* products. NGOs have promoted seeds for planting, processing to production of *Jatropha* products. The land is allocated to the NGOs by the local government. It was noted that processors and companies such as Diligent Ltd engage in buying seeds from farmers and processing them into oil for export and for production of other products such as soap.

In concluding the session, the presenter mentioned the challenges the organisation faces. Low awareness among farmers, propaganda against *Jatropha* plant from some sections of the society, limited funding, need for policies on biofuels and uncertainty in the sustainability of the *Jatropha* chain linkage (demand and supply) were some of the challenges highlighted. JPTL sees opportunities despite these numerous challenges. The escalation of crude oil prices and climate change will cause Tanzania to make a shift towards biofuels in the near future.

Status of *Jatropha curcas* Cultivation in Africa: Challenges and Opportunities in Zambia

Petrus Snyman, Thomro Biofuels

Introduction

The presentation focused on the Biofuels Association of Zambia, an association of firms, companies and individuals who are producers or service providers in biofuels industry in Zambia. The Association was registered under the Societies Act of the Laws of Zambia, with the support of Government through the Ministry of Energy and Water Development. The Association dialogues with Government and other stakeholders to promote the interests of the biofuels industry. In support of biofuels there are government policy, statutory instrument and standards for biodiesel and bioethanol. There are others at pre-draft stage namely biofuels regulatory framework, technical guidelines on production, storage, transportation and retailing of biofuels, and blending ratios.

The best feedstock should be one that empowers all players across the board. Monopolistic feedstocks are a possible breeding ground for unsustainable biofuels industry. Every Zambian has an opportunity to participate and there is great potential for SMEs and village level involvement as part owners of the industry, in biofuels value chain business and by offering services to the biofuels industry. Unlike other industries, biofuels industry in Zambia is participatory and has a 100% internal value chain. It was reported that *Jatropha* plantation in Zambia is done in the field, as a garden plant, as a hedge and intercropped. The farmers use simple technologies to press to extract and filter oil.

Benefits of a well developed Jatropha *industry*

A well developed and managed biofuels industry in Zambia has potential to reduce deforestration, enrich soils and improve food security, reduce poverty, reduce greenhouse gas emissions and trigger industrialisation.

Challenges

The following were the challenges identified to be associated with the planting of *Jatropha*:

- The farmers lack the knowhow on how to establish a nursery and plantation management in a cost effective manner.
- Disease identification and management of *Jatropha*.
- *Jatropha* value chain opportunities especially through by-products.
- Financing and available market for *Jatropha* oil because it is a new alternative source of energy.
- Lack of professional courses on *Jatropha*, training and extension services to the farmers.
- Lack of fuel blending ratios which define the national volume of business.

Outcomes

Despite the challenges, the presenter had confidence that if Zambia embraces the biofuel technology there will be advantages accrued by the country:

- Be self-sufficient in all basic energy forms;
- Accelerate development especially in the rural areas and enhanced job opportunities, rural electrification and infrastructure since *Jatropha* is to be grown in the country-side;
- Reduce poverty levels in both rural and urban areas;
- Enhance food security;
- Net reduction in environmental degradation;
- Country-wide industrialisation.

In conclusion, Zambia considers *Jatropha* industry as a turn-key to the country's development. She is geared to go beyond her potential and turn the wheels into action because of the conducive agro and investment climate for the industry.

Discussions

There was discussion on Ghana and the recent discovery of fossil fuel and its effect on the development of biofuels. Ghana will soon be a major oil exporter hence the gains made in biofuel development will be swept away. It was mentioned that the government is still reluctant to empower *Jatropha* production which is still largely 70% foreign owned and 30% locally owned. The participants concurred that it is a good investment opportunity to enhance development especially at the grassroots level even after the discovery of oil reserves that will only benefit a few.

A clarification was made that in Tanzania, the Government has set guidelines on the production of biofuels in relation to food crops. The major problem is that the market is deregulated and the buyers dictate the prices thereby taking advantage of the farmers. This requires sensitisation of the farmers in the marketing of the products. The other advantage Tanzania has is that the Government owns the land and large tracts can be set aside for the development of *Jatropha*.

The participants acknowledged that more research needs to be done to know the true economic value of *Jatropha*'s by-products. The waste makes very good fertilisers because it is rich in nitrogen, phosphorous and potassium. Further, the participants concurred that the production and processing of *Jatropha* should be done in the respective country and then exported as finished products. This will help in creating more opportunities for development and empowering Africa.

There was a general consensus that the standards of *Jatropha* processing have not been developed in a majority of the countries and there are issues regarding its safe packaging. Like any other flammable fuel, it was advised that *Jatropha* should be stored in proper jerricans that will withstand its properties and also be safe to store.

Biofuels for Developing Economies: Current Scenario and Issues, Challenges and Opportunities

James M. Onchieku, KEFRI

Introduction

Biofuels are produced from biomass, which are organic materials, e.g. plants, fruits or seeds. There are two types of biofuels: 1st generation also called conventional biofuels derived from crops grown purposely for biofuel production, e.g. ethanol produced from sugar plants, and 2nd generation fuels produced from agricultural and forestry wastes and residues. The main biofuels feedstock is divided into two categories: annual crops which are sunflower, soybeans, canola, cotton and groundnuts, and perennial crops which include *Jatropha curcas,* palm oil, avocado, croton and castor. Currently the main focus is on *Jatropha curcas*, *Croton megalocarpus* and castor.

The presenter pointed out that biofuels provide an opportunity to develop Africa's economies with the increasing global demand for energy. Fossil fuels reserves, as mentioned earlier, are slowly depleting and are heavy contributors to greenhouse gases. Moreover, with the escalating fossil fuel prices, Africa has a chance to produce biofuels thereby contributing to its own development. However, a World Bank report indicates that rising biofuel production is the main cause of food shortages and rising food prices in the developing countries.

Characteristics of Jatropha

The characteristics of *Jatropha* that make it a suitable alternative source of energy for Africa are:

- Resistance to drought (can be planted even in the desert climates), and it thrives on any type of soil, grows almost anywhere; in sandy, gravelly and saline soils.
- *Jatropha* needs minimal input or management.
- *Jatropha* is not browsed by cattle or sheep.
- *Jatropha* propagation is easy, from seed and cuttings.
- *Jatropha* growth is rapid; forms a thick live hedge after only a month.
- *Jatropha* starts yielding from the second year onwards and continues for 40 years.
- The meal after extraction is an excellent organic manure (38% protien N:P: K ratio 2.7:1.2:1).
- *Jatropha* quickly establishes itself and will produce seeds all year round if irrigated.
- Other than extracting biodiesel from *Jatropha curcas* plant, the leaves and bark are suitable for various other industrial and pharmaceutical uses.

- Localised production and availability of quality fuel, restoration of degraded land over a period of time.
- Approximately 31 to 37% of oil is extracted from the *Jatropha curcas* seed. It can be used for any diesel engine without modification.

Uses of Jatropha

The presenter gave details on *Jatropha* uses that include the following:

- *Jatropha* oil has a very high saponification value and is being used for making soap in some countries and is known to have medicinal characteristics.
- Used as an illuminant as it burns without emitting smoke.
- Medicinal plant: The latex of *Jatropha curcas* contains an alkaloid known as 'jatrophine' which has anti-cancer properties.
- Raw material for dye: The bark of *Jatropha curcas* yields a dark blue dye which is used for colouring cloth, fishing nets and lines.
- Soil enrichment: *Jatropha curcas* oil cake is rich in nitrogen, phosphorous and potassium, useful for organic manure.
- Feed: *Jatropha* leaves are used as food for silkworms.
- It has many rural applications (used in lamps and cook stoves or substitute fuel in modified engines; unmodified engines for B10 and B20 blends).
- Seedcake is used for briquettes, fertiliser or input in biogas plants.

Rationale for biofuel production

Production of biofuels would contribute towards the achievement of Vision 2030 and the millennium development goals through enhanced security of energy supply by reducing dependence on fossil fuels. In addition, this will contribute immensely to global warming mitigation. Further, it will contribute to poverty reduction by diversification of income sources and employment creation.

Legal and policy framework

The session advised that government support in developing alternative sources of energy and creating an enabling environment for *Jatropha* production will help a great deal in making Kenya self-reliant in terms of energy sources.

Jatropha *and the millennium development goals (MDGs)*

In line with the UN MDGs, the following benefits were associated with the *Jatropha curcas* production system:

- MDG 1: Reduce extreme poverty and hunger: Income generation, foreign exchange, improved community livelihoods.
- MDG 3: Promote gender equality and empower women: Women are in the farming business thus their involvement in *Jatropha* cultivation will empower them.
- MDG 4: Reduce child mortality: Child mortality is high in the rural areas where poverty is most prevalent. Improved community livelihoods will reduce child mortality.
- MDG 7: Environmental sustainability: Increased vegetation, land rehabilitation, nitrogen fixation, clean energy.

- MDG 8: Develop a global partnership for development: Through opening up of international markets, partnership with local foreign investors.

Policy framework

As earlier reiterated, policy framework and institutional structures like the Energy Act 2006 and Policy; Forest Act 2007 and Policy; Agriculture Act, among others, are underway to regularise the energy sector. Major milestones that have been achieved so far have been the National Biofuels Committee establishment of a Task Force working on Strategy for Development of Biodiesel Industry and the formation of the Kenya Biodiesel Development Association (KBDA).

Proposed way forward and recommendations

The presenter gave a recommendation on the establishment of model pilot *Jatropha* production, processing and utilisation units in Coast, Eastern, Western and Rift Valley provinces. In addition, support should be offered to interested parties to develop integrated *Jatropha* energy programmes, that is, individual farmers, organisations and government agencies. Lastly, operationalise an enabling environment for the development, marketing and utilisation of *Jatropha* products and by-products.

Utilisation of *Jatropha* Waste for Energy Production: Opportunities and Challenges

David Yuko, Institute of Research in Sustainable Energy and Development (IRSEAD)

Introduction

During this session, the presenter pointed out that there is renewed interest in renewable energy in Africa. Energy use in sub-Saharan Africa has been dominated by biomass (wood, charcoal, bioresidues) and there is low level of access to modern energy services. Africa has the potential to exploit renewable resource base such as hydro, geothermal, solar, wind and biomass. With new challenges of energy security and sustainability around the world today and unsatisfactory performance of conventional energy sector (high cost and unreliable supply due to drought), increasing oil prices compounded by lower export earnings, Africa needs to stand up to the challenge.

Biofuels as mentioned, have a central role as we address the changing patterns in energy supply and demand. Biofuels and bioenergy include those extracted directly or indirectly from organic matter or its derivatives:

- solid (fuelwood, biomass, agricultural waste);
- liquid (bioethanol, biodiesels);
- gaseous fuel (biogas).

Key issues in solid biofuels are indoor air pollution from using fuelwood unsustainably. Women and children are the most affected.

Oil content of different crops and the oil yield per hectare under commercial production regimes

Crop	Oil content %	Oil litre/ ha	% oil remaining in crop	% oil extracted	%oil extracted from the seed	Oil extracted litre/ha	% oil cake
Seed cotton	8	225	6	70	6	157	92
Groundnuts	44	967	6	92	41	893	56
Soy beans	17	467	6	71	12	330	83
Sunflower	40	879	6	91	36	791	60
Sesame	50	611	6	94	47	574	50
Avocado	16	3270	6	69	11	2240	84
Palm	30	5275	6	86	26	4536	70
Jatropha	40	1319	6	91	36	1200	60

The following were presented as factors that limit commercial waste harvesting:

- Grassroots organisation: Who is the producer and who is the buyer, that is smallholder versus large-scale.
- Ensuring continuity of crop development by ensuring prompt and adequate returns to farmers (eliminate exploitation by middlemen).
- Need for technical adaptation and advocacy to promote uptake of the commercial and economic opportunities.
- Lack of proactive policy to encourage and promote use of by-products as the biodiesel component is being addressed.
- The need to create jobs and wealth requires higher returns for the farmer, hence higher costs for the energy produced.

Options and opportunities that accrue from* Jatropha *development:

- Carry out independent studies to document economic opportunities with environmental benefits, and highlight advantages to communities with a view to making them drivers of the process.
- Engaging governments to create opportunities for commercial development of biofuels as a tool for driving environmental protection.
- Highlight gender opportunities: *Jatropha* waste offers prospects for fuel switch to modified/improved cookstoves using briquettes from *Jatropha* and other agricultural waste.
- *Jatropha* offers opportunity to integrate smallholder and large-scale commercial producers. Structures can be borrowed from tea and coffee industries.

Policy framework is the foundation that biofuels requires. The session defined two options that the framework can embed on. These are:

Policy and Institutional Option 1

- Identify opportunities for rationalisation and improved efficiencies.
- Increased use of policy research and project implementation. Use of NGO, private sector and regional research networks.
- Regulatory and fiscal measures to be implemented by local institutions, with involvement of key stakeholders (energy producers, distributors and users).

Policy and Institutional Option 2

- Appropriate pricing scheme to allow cost recovery of energy generation and distribution. Set up and empower local institutions to review and police this arrangement.
- Environmental impact assessment to be carried on all major energy projects, with appropriate weighting for environmental costs.
- Develop least cost strategies that internalise all costs, to minimise forex requirements, develop and diversify local energy resource base.
- Institute proactive advocacy, with regular reviews of past policies, projects and initiatives, and incorporate lessons learned into future projects.

Mobilisation of financial resources and developing regional efforts was seen as a key factor in realising the development. The presenter mentioned the following factors that should be put in place:

- Establish indigenous and reliable sources of funds with low bureaucracy, to provide long term loans for energy projects.
- Involve local banks and financial agencies in energy projects.
- Develop and strengthen cadre of local energy experts capable of undertaking planning and implementation functions.
- Promote regional cooperation in energy resource assessment, development and distribution.
- Encourage efficient use of biomass in households, small- and medium-scale industries in rural and urban areas.
- Promote regional efforts in use of industrial biofuels in the transport sector.

Facilitator: Ishmael Machiya

Developing Creative and Innovative Business Models for the Biofuel Industry in Africa

Suresh Patel, Kridha Ltd and Representative, KAM

Four key assumptions for business modelling are:

- A business concept is based on the demand and supply gap for *Jatropha* oil.
- There cannot be single and practical business model to cover entire *Jatropha* utilisation cycle.
- Business models have been built on specific activities in chain of the development.
- All models to be integrated as a programme for comprehensive success for *Jatropha* oil as biofuel.

The presentation touched on three business models on *Jatropha* oil that linked it to production, processing and consumption. For successful *Jatropha* development, each model has to work efficiently and successfully and will be connected to each other in an overall view. Each model has specific activities among particular stakeholders, specific target, location and specific characteristics.

Models for production

Purpose of the two models A and B is to achieve the following main output which is seed.

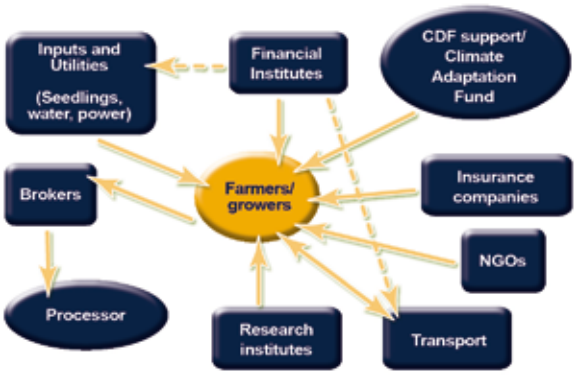
Other complementary outputs – though not comprehensive are:

- Stable output of seeds
- Assured quality of the seeds
- Acceptable price of the seeds
- Protection against uncertainties
- Capacity building for the growers.

Business Model A for production

In this model there is supply of seeds to the farmers and growers who use either Constituency Development Fund or financial institutions to seek financial support. There is also use of brokers or middlemen that link to the processors. In most cases the middlemen have an upper-hand in terms of the pricing structure. Interestingly,

the insurance companies provide for insurance cover to cushion any risks accrued thereof. Please see the diagram below:



Business Model B for production

In this model, it was noted that the farmers and growers are more familiar and comfortable with the model and they are members of the cooperative society. This model is advantageous since the farmers get dividends from the society and other benefits like loan facilities and training. There is an incentive because governments recognise cooperative societies.

See figure below:

Model for processing

The model's purpose as presented is to achieve the main output—*Jatropha* oil—crude/refined/other oil products.

Other complementary outputs include:

- Stable output of oil
- Assured quality of the oil
- Acceptable price of the oil
- Protection against uncertainties
- Capacity building of processors.

At the centre is the processor who receives the output from the co-operatives, brokers, contracted farmers and supplies the end product to the buyers. The

processor gets government incentives and there is a quality management system in place.

See figure below:

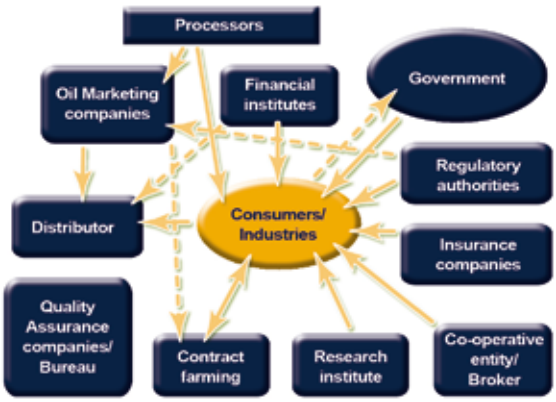
Model for consumption

Under the consumption stage, the purpose of the model was to achieve the main output energy through biodiesel/refined oil—mainly for transportation and power.

Other complementary outputs are:

- Acceptance of blended fuel B5
- Stable demand of the fuel
- Reliable availability of the fuel
- Stable price of the fuel
- Acceptable quality of the fuel
- Protection against uncertainties
- Capacity building of the marketers.

See figure below:



Sustainability of* Jatropha *fuel as business

The key issues which need long term solutions to make *Jatropha* a business to many of the farmers are:

- Food versus fuel impasse, striking the balance
- Political harmony and security to attract investors
- Competition from imports
- Ability to use East Africa as common resource hub
- Market stability especially when there is an economic downfall.

In Kenya, as discussed, the petroleum imports have doubled over a period of six years, i.e. 2003–2008 showing the rising demand of energy by the industries, transport sector, household and the like. This shows that the demand is rising and unmet and therefore the production of biofuels makes a viable business opportunity.

Commercialisation of *Jatropha curcas*-based Biofuel Production System for Integrated Rural Development and Energy Provision in Kenya

Lorna Omuodo, Vanilla Jatropha Development Foundation

Introduction

The project's goal is contributing towards the transformation of Kenya's industrial crops sub-sector into a commercially oriented economic activity for increased household incomes and employment creation for improved livelihoods while utilising the natural resources and biodiversity sustainably.

The project design is aimed at advancing *Jatropha* value chain by promoting the development of production techniques and processing technologies/ innovations, marketing strategies as well as scaling up and increasing uptake pathways in a pluralistic, and demand-driven way by empowered clients.

The following were narrated as the expected project outputs:

- Carry out a situational analysis for sustainable production to consumption of *Jatropha curcas*-based technologies.
- Validate and pilot best-bet field production, processing and marketing *Jatropha curcas*-based technologies.
- Establish and promote appropriate infrastructure for best-bet field production, processing and marketing interventions for *Jatropha curcas* crop and related products.
- Develop and facilitate strategies for information and knowledge sharing for increased uptake and up-scaling for *Jatropha* value chain.

The project was to receive various uptake promotion and support in agricultural, technical, quality assurance, business development, access to market, commercial marketing and project management among others.

The project activities were to be undertaken in collaboration with:

- Farmers and farmer groups
- Key line government ministries – Ministry of Agriculture, Environment, Energy
- Technical and regulatory institutions – KEBS, KARI, KEPHIS
- Non-governmental organisations.

The project benefits

The participants were taken through the project's benefits. The project as planned will benefit the locals through the establishment of a viable and sustainable entrepreneurship base. This will in turn improve the access to energy, development of effective markets, with spin-off effects in rural economies thereby improving the standards of living. At a national level, the partnerships will create new networks for sharing information and exchanging experiences among the stakeholders.

Creation of a new industry

The project partners will work with the government and development partners to promote institutional and social environment conducive for the development and implementation of the *Jatropha* biodiesel industry that would improve both the national economy and rural livelihoods.

The presentation of work plan and the end point for Makueni Zone will be a project that will:

- Establish 4 group nurseries producing high quality planting materials with 5000 farmers accessing high quality *Jatropha* seeds and seedlings.
- Have at least 5000 farmers per project site practising best-bet *Jatropha* production techniques and practices.
- Identify, validate and pilot two best *Jatropha curcas*-based processing technologies.
- Hold *Jatropha* stakeholder consultative workshops on project, policy and institutional innovations.
- Train 60 trainers/group leaders and >2000 farmers on *Jatropha* seed systems, field production techniques, partnerships, collective action, linkages and agribusiness/credit enterprise.
- Train 2 processors on *Jatropha* processing technologies, partnerships and linkages, good manufacturing practices, quality standards, financial strategies and management.
- Conduct exploratory market survey.
- Develop, brand, patent, package and launch at least two *Jatropha* products.
- Plant some 25,000 acres (10,117 ha) with *Jatropha curcas*.
- Operationalise 4 information and knowledge management platforms at project sites.

Status of the project

GIS mapping activities have since started with 5 new innovations. The project has secured markets for rural electrification blending and own processing technologies. However, the project has stalled midstream due to financial disbursement problems since 2008.

Innovative Business Model for Biofuel Production in Africa: The Case of Mali Biocarburant

Hugo Verkuijl, Mali Biocarburant SA (MBSA)

Introduction

MBSA is a private company that works with more than 4000 small *Jatropha curcas* farmers in 3 regions of Mali and 2 regions in Burkina Faso. Sustainability is promoted by integrating *Jatropha* to existing farmer's production systems, especially through intercropping *Jatropha* with food and cash crops. MBSA provides technical assistance to farmers through a network of field staff to improve their agricultural practices, their income and enhance food security.

Contribution to poverty alleviation

It was revealed that the main innovative character of MBSA is that the farmer union owns 20% of the shares of the company. Farmers have direct benefits through the sale of products and they also share in the increased value of the shares as well as dividends that are foreseen. The financial interest sale of *Jatropha* nuts is USD 125 per ha; that is, 1 person earns USD 3 per day. In addition, food security has been enhanced through intercropping from increased yields of associated food crops.

MBSA is the first company in Africa that has contracted its carbon reduction on the Voluntary Carbon Credit market to Trees for Travel who in turn has signed a contract with KIA Motors Netherlands. MBSA promotes a pro-poor carbon offset scheme and reinvested 75% of its 2007 carbon credit income in strengthening the capacities of its farmers. This was an equivalent of USD150,000 that bought agricultural machinery for the farmer's union, sunk boreholes for the community and bought a vehicle for the union leader. In terms of employment creation, 60 jobs have been created and more will come in future.

Protection of the environment

Utilisation of *Jatropha* as a source of biofuel protects the environment in various ways:

- CO_2 emissions are reduced by planting *Jatropha* trees.
- Biodiesel is a cleaner fuel to use as compared to fossil fuels.
- Carbon credit gained through planting of trees and reduction of fumes from fossil fuels contributes in the reduction of climate change.
- Reduced soil erosion and improved water infiltration due to increased vegetation.

Research and development components

MBSA undertakes R&D in various areas with financial support from donors. Areas that are currently under research include:

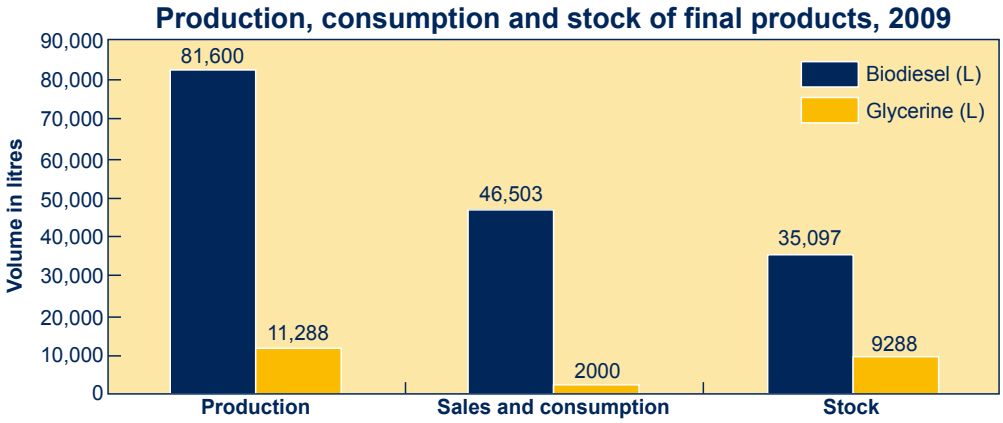
- Improvement of *Jatropha* varieties and management practices—contract financed.

- Testing of growth of *Jatropha* with intercropping—contract with USAID.
- Testing fatty acid ethyl ester (FAEE) production—Fact Foundation funded.
- Add value to by-products: Through processing press cake into animal feed, biogas, or briquettes.
- Multifunctional platforms.

Business Plan 2009–2014

MBSA representative expounded on the firm's 6-year strategic plan. By the end of 2014, MBSA will have purchased *Jatropha* nuts worth USD 6,800,000, created employment opportunities for 140 full time employees and about 15,000 producers. There will also be enhanced food security because of intercropping. In terms of the environment, more than 20,000,000 *Jatropha* plants that fix carbon will be realised as well as 9 million litres of biodiesel produced. All these will play a significant role in poverty alleviation and improved infrastructure.

In conclusion, public private partnership has worked in Mali, through investments done to support farmers to plant *Jatropha*. This will work better if there is an enabling environment with legislation on biodiesel, quality standards, biodiesel mix standards, licences, and tax exemptions to attract investors.



Discussions

It was pointed out that it is very easy to criticise the private sector without knowing what their short and long term strategies are. The multinational oil companies like British Petroleum, Shell, Total and Exxon have a budget for renewable energy spanning into billions of US dollars. They want to remain relevant in the future to ensure business continuity even after the depletion of fossil fuel reserves.

There was a suggestion that best business model or approach to *Jatropha* projects is outsourcing and an approach whereby everybody makes money in the supply chain. Outsourcing will run the production activity in a professional way especially quality and marketing both in local and international markets. Advice was given that we should allow investors to help the locals make money in a sustainable way. It would also be good to include the local oil companies because they are heavily involved in future sustainable energy supply.

In the MBSA project, the participants were told that the union is giving training support on the cultivation of *Jatropha*. The project also sources markets for the food crops as further support. To reduce on logistics costs, there is decentralised oil sites of 15 km at most from the farms that reduces the cost of transportation to the main factory. On quality standards, the project uses its own internal quality systems which tests for water. Every three months, samples are sent to be tested under European Standard Quality because the Mali Bureau of Standards does not have any standards on biofuel as yet. Further, MBSA is in the process of identifying the best business solution of *Jatropha* by-products that will optimise profits, but in the meantime the project makes fertilisers out of the press cake. From MBSA's experience in the *Jatropha* operations, depending on biodiesel alone is not viable in terms of profit making. MBSA has integrated the outputs of *Jatropha* in the following way to maximise on the profits: Glycerine is used to make soap and press cake is used to make fertilisers (but other viable opportunities are being sought) and sale of carbon credits. There are environmental impacts on the waste from the factory which they treat.

Vanilla Jatropha Development Foundation: A clarification was sought on the name of the organisation. Vanilla is the high value spice that is highly marketable. The foundation was to carry out research on the spice.

Facilitator: Aboua Gustave

Agronomy of *Jatropha* and How to Identify Suitable Areas

Alex Nabiswa, Jatropha Support Programme

Introduction

DEG *Jatropha* Support Programme is a private-public partnership funded by nine East African companies and the German Ministry for Economic Cooperation and Development through DEG. The presentation covered what the research project entails, provenance, agronomy (spacing and pruning), agronomy (micronutrient), pests and diseases and economic trials. It will be a three-year research programme that will use 10 hectares test sites that will seek to answer the question: Is it economically viable to grow *Jatropha* as a sustainable biofuel feedstock in East Africa? Pipal Ltd is the overall project manager.

The presenter listed why it is important to know *Jatropha*'s agronomy. It is done so as to:

- Allow *Jatropha* to express its true genotypic potential.
- To gain productivity of a minimum of 4 tons of seeds per ha under rain-fed (<800 mm rain) conditions.
- To gain seeds with >650 mg weight and >35% oil.
- Shell: kernel ratio of 40:60 or less.
- Fatty acid composition of oil as near as that of rape/canola oil.
- Low FFA content in oil <2%.

Nursery preparations

- Prepare the nursery seedbed 2.5 months before the start of rains.
- Test soils to exclude unfavourable ones.
- Plough deep, mix manure, sand, soil and raise the nursery seedbed to 33 cm.
- Sow seeds horizontally at about 2 cm deep but 10 cm away from each other.
- Seeds should be freshly harvested and dried in shade and should weigh about 650 mg and have more than 35% oil content.
- If polybags are used they should be tall enough (minimum 30 cm).
- If temperatures drop to below 20 degrees at night, cover the seedbed with plastic sheet or mulch.
- Keep the nursery bed continuously moist.
- Select seedlings that germinate within 10 days after sowing to use for transplanting.

Factors on field establishments

- *Jatropha* shows variation within and between provenances.
- Marginal areas result in poor growth which translates into poor yield.
- Avoid impermeable soils because they cause 'J root' and the plants appear stunted.
- Optimum pH 6.0–7.0.
- 2 x 2 m to 4 x 3 m spacing and 45 x 45 x 45 cm square planting hole size.
- *Jatropha* responds to fertiliser application usually nitrogen, phosphorous and potassium (NPK) in the early stages of development.
- Other nutrients especially S and Fe are needed for fruit development and oil synthesis.
- Transplant at the start of the rainy season for *Jatropha* to benefit from rainfall for 3 months so as to get vigorous growth. In dry conditions apply at least 5 litres of water per plant per week.
- Mixed cropping is possible especially with cover legumes and other food crops.

The pruning techniques

- Prune just before the start of rains season to avoid rotting due to humid conditions.
- Pruning increases the number of branches which increases the potential flowering sites.
- When pruning consider the plant architecture because shaded branches will not partition biomass effectively.
- Too many branches might overload the plant.
- Learn pruning techniques to minimise plant injury.

Flowering conditions

- *Jatropha* is monoecious.
- The inflorescence is a panicle with female flowers at the apices of the main branches of the inflorescence.
- The ratio of female to male flowers observed on selected number of trees is 2:14.
- The flower morphology encourages cross pollination and easily cross-pollinates with the invasive relatives, e.g. *J. multifida*.
- Both house flies and bees have been observed pollinating *Jatropha* but bees are more effective.
- In the presence of moisture, flowering is continuous.

Conditions set for fruiting and harvesting

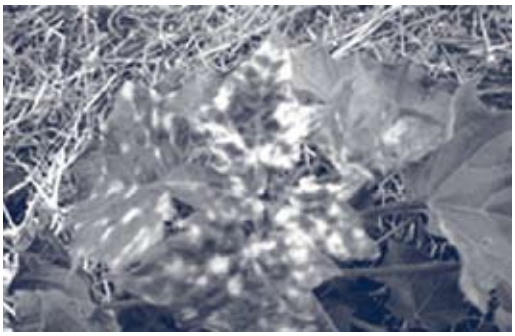
- Some provenances have 4 seeds in each fruit while others 3 seeds in each fruit.
- Harvest when the colour of the fruit is yellow.
- Flowering and fruiting is not synchronised.
- Store harvested seeds in good condition to avoid formation of FFA.
- *Jatropha* shows vivipary.

Pests and diseases as a limiting factor

- A host of pests and diseases have been observed.
- Assessments have been conducted at our sites.
- All insects counted from the branch and damage scored on a four point scale.
- All diseases scored on a four point scale.
- *Jatropha* flea beetles, thrips and web moths are major insect pests observed.
- Powdery mildew and leaf spots have been observed in the trials.
- Another beetle—*Gyponychus cervinus*—has been observed in Kilifi. No clear damage symptoms are associated with it so far.
- Natural enemies including spiders, ladybugs and several unidentified parasitoids have been observed on plants in both sites.
- No chemicals have been recommended for control of pests and diseases attacking *Jatropha*.
- Cultural and IPM methods best for farmers.
- Mixed cropping and natural vegetation buffer helps to control most of pests and diseases.
- Nutrition and proper watering results into robust and vigorous plants that overcome the pest and disease problems.

Example of some *Jatropha* pests and diseases

Leafminers



Powdery mildew

German Technical Cooperation (GTZ) Work on *Jatropha* in Africa

Myra Mukulu, GTZ

Introduction

GTZ is a government-owned corporation for international cooperation with worldwide operations. It is present in more than 130 countries in Africa, Asia and Latin America. GTZ's corporate objective is to improve people's living conditions on a sustainable basis. GTZ provides services that support complex development and reform processes and contribute to global sustainable development. It has more than three decades of experience in international cooperation.

GTZ has supported the development of renewable energy in the following ways:

- GTZ promotes renewable energy and access to modern energy services for sustainable economic growth while reducing extreme poverty in partner countries.
- GTZ draws on renewable energy technologies to ensure that the energy supplied is economically viable, sustainable and environmentally friendly.
- GTZ has put in place the Regional Energy Advisory Platform East Africa (REAP EA) to support its energy initiatives in the region.
- REAP's key objectives are to increase the impact and overall efficiency of these projects and initiatives, to explore and realise synergies, and to provide direct support through targeted services.

GTZ bioenergy activities were stated as to:

- Develop more energy-efficient technologies and dissemination strategies.
- Lobby on the issue of household energy — introduce and disseminate more efficient technologies at local level, e.g. Rocket Lorena stove (Uganda), ceramic jiko (Kenya), and improved mud stoves (Tanzania).
- Supporting its partners in developing and implementing sustainable and replicable models for liquid biofuels usage.
- Providing policy advice on basic energy solutions.
- Research into the viability of sustainable energy production.
- Stimulate the permanent adoption of efficient wood stoves (many African countries).
- Technical and institutional support for biogas (Rwanda, Kenya).

Jatropha projects in Africa

It was mentioned that GTZ's approach to biofuels such as *Jatropha* has concentrated on building capacity, policy support and advice in East and southern Africa. This is through different programmes which include PSDA, PREEEP, ProBEC etc. The following were presented as work GTZ has done through various activities.

- **Kenya**
  Findings: Status of biofuels in Kenya (Kenya road map for biofuels and national oilseed study with ICRAF and KEFRI)
  Jatropha is seen as main feedstock, others are castor, croton.

- **Uganda**
  GTZ facilitated a study conducted by ETC Energy in 2007 to determine the economic viability of substituting fossil fuels with biodiesel using indigenous oil plants.
  The case study was the viability of producing biodiesel from *Jatropha* using the Note Progressive Farmers of Lira district.

- **Tanzania**
  PPP testing plant oil stove.

- **Southern Africa**
  Much work has been done in SADC region especially Mozambique on biofuels and these are not specific to *Jatropha*.
  - Biofuels Assessment report is finalised, biofuels strategy in draft.
  - Working group supported by GTZ is drafting a national sustainability criteria.
  - Few implemented biofuel projects (*Jatropha* inclusive).
  - Implementation of High Conservation Value Concept currently tested in Mozambique by GTZ.
  - Advising the SADC secretariat on how best to monitor biofuels activities and impacts in the region.
  - Has analysed the feasibility for smallholder farmers in being sustainably certified for biofuel potential according to the Dutch Cramer criteria.
  - Providing policy advice to the secretariat of the SADC on basic energy solutions.
  - Focusing on the integration of international sustainability criteria into the policy development for biofuel intervention on SADC level as on individual country level.
  - Building capacity at policy level and civil society organisations to ensure informed and participatory decision making.
  - Ensuring that the SADC Secretariat has improved knowledge on the sustainable production and use of biofuels and its impacts for future initiatives in member states.
  - Developing a system for the monitoring of the impacts of the biofuel sector in member states for the SADC secretariat.
  - Identifying ongoing SADC biofuel activities as well as highlight potential best practices for biofuel production.

Assessment of the economics of* Jatropha *production in Mozambique

It was mentioned that food production has the highest priority and farmers are not tempted by high cash crop prices to compromise on food security. At a farm-gate price of 2.5 MZN/kg *Jatropha* compares favourably with paid employment. Depending on the efficiency of harvesting, income from an eight hour working day is 20 to 60 MZN. Day labourers in the area receive 30 to 35 MZN per day. Harvesting is the most labour demanding operation and tests showed that farmers

can pick at least 5 kg seeds per hour. The main harvesting period coincides with the most demanding months in food production, namely February and March. *Jatropha* oil can easily compete with kerosene for lamps which sells for 20 to 50 MZN/l depending on the location. However, many farmers are switching to cheaper home made LED lamps. It is not clear if *Jatropha* lamps are competitive with LED lamps.

Past GTZ projects on *Jatropha* in other African countries

Country	Project Description	Time
Cape Verde	*Jatropha* project integrated the *Jatropha* plant into the reforestation programme of a regional development project.	1984–1988
Mali	*Jatropha* project integrated within the Special Energy Programme (SEP) of BMZ.	1987–1997
Zambia	Excursion of a group of farmers from the southern province (Lake Kariba region) to the BUN-project in Zimbabwe, organised by GTZ-Zambia. This excursion led to some activities of hedge planting and soap production by farmers and women groups, so that the project decided to invite a consultant to support the improvement of the *Jatropha* activities as an income generating activity.	1998/1999

The GTZ stance on Jatropha

Experiences based on the oilseed study in Kenya among hundreds of farmers growing *Jatropha* show extremely low yields and generally uneconomical costs of production. Furthermore, more research is needed, and GTZ said that they have facilitated GIS mapping with ICRAF on land suitability and availability in Kenya, Uganda, Tanzania, Ethiopia and Rwanda. GTZ has also noted the following constraints on the development of *Jatropha* in Africa:

- Limited information access;
- Pests as a risk, for example all the communities visited during this study revealed that the *Jatropha* plants were infested with pests, especially in the southern region;
- Land conflicts and exploitation of farm labour;
- Other arising issues such as child labour.

In conclusion, there is need to prioritise food production while supporting subsistence farming and cooperative movements. In addition, there is need for assessment of the agronomic and economic viability of *Jatropha* through research and development. Most importantly, develop sustainability criteria for the developing countries on *Jatropha* production. (Germany and GTZ part of this process at EU and global level).

Policy Innovation Systems for Clean Energy Security (PISCES)

Bernard Muok, PISCES

Introduction

PISCES is developing policy approach that can unlock the potential of bioenergy to improve energy access and livelihoods in a 5-year Energy Research Programme funded by DFID. The partners are:

- Lead Partner – African Centre for Technology Studies, Nairobi.
- Main Partners – University of Dar es Salaam, Practical Action, University of Edinburgh, MSSRF.
- Countries – India, Kenya, Sri Lanka, Tanzania.

PISCES goals are to contribute to transferable knowledge and understanding of bioenergy and to policy development in the project countries. In addition, maximise the contribution of bioenergy to clean energy access and livelihoods.

The research theme will revolve around technology, access and delivery, environment and climate.

Vision and mission of the policy

The following was presented as the vision, mission and objectives of PISCES:

Vision: Kenya will increase access to energy through sustainable biofuel production, and reduce the importation of fossil fuels by 25% in volume by the year 2030.

Mission: Explore agro-energetic resources to stimulate the energy matrix diversification, contributing to social and economic development, especially in rural areas.

Objectives of the policy:

- Improve energy security at domestic, national and regional levels;
- Increase the percentage of different renewable energies in the national energy mix without jeopardising food production, forests, water, biodiversity viability and sustainable land use;
- Facilitate access to clean and safe energy for all Kenyans;
- Promote understanding and sustainable use of local energy resources;
- Establish equitable access to Kenya's natural energy resources and the economic opportunities they provide;
- Create income generation, especially in rural areas;
- Support a regulated development of sustainable biofuel value chain that is market driven;
- Promote public and private sector research and development in biofuels;
- Meet the millennium development goals in line with Vision 2030.

PISCES' key principals are transparency, inclusiveness, equitable benefits sharing and gender equity, and environmental and social protection.

How Kenya stands to benefit from the policy

This session brought forward what Kenya stands to benefit if the policy and regulatory framework is put in place:

- Energy security, that is, the country will be self-sufficient through diversification of energy sources. There will be rural access to adequate and clean energy.
- Economic development through improvement of rural incomes, trade balance because of reduction of fuel import making this a huge cost saving.
- Environmental protection because of greenhouse gas emission reduction; replacement of unsustainable use of wood biomass; reforestation of degraded lands and forests, and environmental cleaning through use of municipal and other solid waste.
- There will be social benefits like access to clean, healthy and safe environment, employment creation, development of rural areas and gender, equity and human rights.

Models for biofuel production

PISCES has put forward models on biofuel production—village based and large-scale production:

Village based energy supply and household energy needs

- Village-based biodiesel initiatives based on local production provides off-grid energy for various uses such as running diesel generators for electricity and water pumps.
- Develop valuable by-products during processing such as seedcake for briquettes, livestock feed and biofertiliser.

Larger scale production opportunities

- Small and medium rural based industries—classified as own use.
- Large-scale commercial mono plantation crops for the sole purpose of biodiesel production.

In conclusion, there are certain recommendations that will make biofuel a viable business. These include basing feedstock production on clear agro-climatic and environmental zoning. It is also suggested that farmers need to diversify the feedstock to gain maximum returns.

Discussions

A clarification was sought on the highest oil content yield among the provenances. The oil contents of 8 provenances found in Kenya was between 37–42.4%, 42.4% being the highest viable seed in Kenya. By and large the oil content is genetically and environmentally determined. The weight of the seed should be 625 mg. Quality seeds means quality harvest and KEFRI in Kenya seeks to identify farmers with high yields so that they can buy the seeds from them. There was a general agreement that there is need for a regulation that will ensure that farmers buy quality seeds from appointed organisations or firms.

A point was made that poor *Jatropha* harvest is largely attributed to the planting practice that is done. Cuttings do not do as well as the seedling planting because they get stressed and therefore planting cuttings is not recommended. In the process of planting one should ensure that the tap root is placed well, straight down to avoid J shaped roots hence failure to enjoy nutrients deep in the soil. Available literature indicates that *Jatropha* trees bear fruits even after 50 years of age. An advice was given that it is good to grow *Jatropha* during rainy seasons, because the first 3 months of growth need a lot of water.

In reference to GTZ and facilitation of projects in Africa, it was clarified that GTZ offers technical support and advice on policy matters. They also act as consultants and bring in expertise from Germany to assist in some of the projects. In addition, GTZ has carried out a number of researches which have been published. It was also pointed out that they receive very few requests for assistance from East Africa while a lot of support has been given to the SADC region because they request for assistance.

A question was asked if the by-products of *Jatropha* can be suitable for livestock feed. It was pointed out that research is still being carried out on the existing provenances to find out which one is suitable for livestock feed. *Jatropha* has been growing in some areas for a long time, and 23 provenances have been identified in Kenya, 3 in Uganda, 5 in Tanzania, 1 in India, 16 in Mexico and 3 in Madagascar. Trials in the field should be able to identify the most promising *Jatropha*, though this information is not public yet. However, it must be noted that indigenous research which is country specific is important because a seed can do better in one country and not in another.

When there is correct agronomical practices, the farm can yield 4 tonnes per hectare per season. Temperature and water are the most important factors to consider and *Jatropha* plants at early stages require 5 litres of water per week. In terms of seed selection, heavier and bigger seeds are better provenances. In terms of spacing, wider spacing makes the *Jatropha* grow slowly.

It was discussed that pests and diseases are another menace. Currently, spraying kills the natural predators. The best practices observed were biological and natural control, like intercropping with sweet potatoes and having natural vegetation around the plantation gives the pests substitutes to prey on. Avoiding monoculture is a sustainable, less expensive solution.

It was noted with concern that information on *Jatropha* has not been gathered and compiled. There is need to document all available information, best practice and data to a handbook that will guide farmers and investors on *Jatropha* production.

In most countries, there seemed to be lack of political goodwill to formulate and implement policies and the biofuel agenda. The participants were advised to involve the government at an early stage in developing any policy framework. The reason why most of the policies are not implemented is because all stakeholders involved are not engaged at the initial stages and top down polices are very difficult to implement. Another reason is the change in the government means changes in priority areas. A new regime will discard progress made in certain areas or even start the policy formulation afresh.

Kenya and other countries present at the conference were encouraged to invest in *Jatropha* processing machinery like the one in Mali Biocarburant and Rwanda Research Institute, where positive impact has been realised at the local level. Kenya has similar projects that have been commissioned in Laikipia and Naro Moru.

Clarification was sought on the difference between rule, law and policy. Law is formalised and is passed through the parliament where a bill is passed to make it a law. Rules on the other hand are moral obligations or behaviour that guides people while policy is a statement of intent or action where a public authority tries to respond to a need that will achieve a predetermined objective.

KEY RECOMMENDATIONS

The participants made the following recommendations for follow-up activities:

1. Identification of gaps in the production, processing and marketing of biofuels through:
   (a) Desktop survey on biofuels with the aim to:
      i. Create a database of organisations working on biofuels;
      ii. Come up with a list of countries with or without biofuel policy in Africa;
      iii. Develop stakeholders list;
      iv. Identify alternative and emerging biofuel crops; and
      v. Understand the gender aspects of *Jatropha*.
   (b) Further research on biofuels to cover:
      i. Added value of *Jatropha*.
      ii. Gaps existing in market chain of *Jatropha*.

2. The need to network with key actors such as the entrepreneurs, scientists, policymakers, civil society organisations and the public sector through:
   (a) Holding regular meetings in the near future;
   (b) Disseminating information on biofuels so as to:
      i. Enhance capacity building activities; and
      ii. Engage more with media and develop a documentary on biofuels in Africa.

3. Campaign on biofuels with Academies of Science playing a key role in influencing biofuel policies within their specific countries in Africa.

4. Identify a steering committee/task force to **fundraise** and **implement** the above.

CLOSING REMARKS AND VOTE OF THANKS

Shem Arungu-Olende, Secretary General, AAS

I would like to give a vote of thanks to all the participants for their participation in this conference and enriched discussions. You will all agree with me that it has been an invaluable discussion and there was a lot of sharing of best practice and information that will be useful in your individual areas. It is my sincere hope that the discussions and presentations that took place during the two-day conference covered many issues on *Jatropha*. The hard part now begins and that is the implementation of the recommendations and way forward for the participating countries. We as scientists are better placed to commercialise our research to ensure that it attracts investments and developing *Jatropha* into a viable business opportunity.

Indeed a lot has been done in the *Jatropha* area but there are still some loose ends to be tied. Our mission is to also broaden our research to the development of other biofuels. This calls for concerted efforts from scientists and entrepreneurs to ensure that the development of biofuels is fully commercialised, realising the best yields, developed quality, policy instruments and marketing.

I would like to take this opportunity to express my gratitude to the AAS Secretariat led by Ms Jackie Olang, who have worked tirelessly to make this conference a success and the Hilton Hotel for hosting us.

Ladies and Gentlemen, please extend your stay here in Kenya and visit Kenya's wildlife.

Thank you all!

Conference Objectives

1. To inform participants of the key recommendations made in the IAC Report entitled: "Lighting the Way: Toward a Sustainable Energy Future".
2. To discuss best practices for agronomical, agro-biotechnological, and business-related issues in biofuel production.
3. To increase awareness on various government policies that may lead to investing in the commercial exploitation of *Jatropha* biodiesel in African countries.
4. To explore strategies that academies can employ to advise African governments to promote production of renewable energy through biofuels obtained from non-food sources such as *Jatropha curcas*.

Programme

Date/Facilitator	Time	Activity
22 February 2010		
Facilitator: Jasper Kirika (Network of African Science Academies)	8.00 am – 9.00 am	Registration of participants
	Introduction to IAC report on "Lighting the way: Toward a sustainable energy future"	
	9.00 am – 9.15 am	Self-introduction of participants
	9.15 am – 9.30 am	Welcome Remarks Shem Arungu-Olende, *Secretary General (AAS)*
	9.30 am – 9.45 am	Opening Remarks Jacqueline Olang, *Network Coordinator (NASAC)*
	9.45 am – 10.10 am	IAC report: Lighting the way: Toward a sustainable energy future Shem Arungu-Olende, *Secretary General (AAS)*
	10.10 am – 10.30 am	Discussion
	10.30 am – 11.00 am	GROUP PHOTO/REFRESHMENTS
Facilitator: Felix Luti (Kenya National Academy of Sciences)	Status of *Jatropha curcas* cultivation in Africa—Challenges and opportunities	
	11.00 am – 11.20 am	Overall Africa perspective John Kioli, *Green Africa Foundation*
	11.20 am – 11.40 am	Ghana perspective Ohene Akoto, *Jatropha Africa*
	11.40 am – 12.00 pm	Tanzania perspective Lillian Mkony, *Jatropha Products Tanzania*
	12.00 pm – 12.20 pm	Zambia perspective Petrus Snyman, *Thomro Biofuels*
	12.20 pm – 1.00 pm	Discussions
	1.00 pm – 2.00 pm	LUNCH BREAK

Continued on next page

Continued from previous page

Date/Facilitator	Time	Activity
Facilitator: Mosto Onuoha (Nigeria Academy of Sciences)	*Jatropha curcas* as a source of biofuel—Opportunities and challenges	
	2.00 pm – 2.30 pm	Biofuels for developing economies: Current scenario and issues, challenges and opportunities James Onchieku, *KEFRI*
	2.30 pm – 3.00 pm	Discussions
	3.00pm – 3.30 pm	Utilisation of *Jatropha* biomass waste for energy production: Advantages and disadvantages David Yuko, *IRSEAD*
	3.30 pm – 4.00 pm	Developing creative and innovative business models for the biofuel industry in Africa Suresh Patel, *Kridha Limited*
	4.00 pm – 4.30 pm	Discussions
	4.30 pm – 5.00 pm	REFRESHMENTS
	6.00 pm – 8.30 pm	COCKTAIL RECEPTION
23 February 2010		
Facilitator: Ishmael Machiya (Zimbabwe Academy of Sciences)	Strategies for developing creative and innovative business models, accessing venture capital and penetrating local and international markets	
	9.00 am– 9.30 am	Innovative business model for biofuel production in Africa: The case of Mali Biocarburant Hugo Verkuijl, *Mali Biocarburant*
	9.30 am – 10.00 am	Discussions
	10.00 am – 10.30 am	Commercialisation of *Jatropha curcas* based biofuel production system for integrated rural development and energy provision in Kenya Lorna Omuodo, *Vanilla Jatropha Development Foundation*
	10.30 am – 11.00 am	Discussion
	11.00 am – 11.30 am	REFRESHMENTS
Facilitator: Aboua Gustave (University of Abobo Adjamé, Abidjan)	Identifying ideal conditions and locations for biofuel crops	
	11.30 am – 12.00 pm	Agronomy of *Jatropha* and how to identify suitable areas Alex Nabiswa, *DEG Jatropha Support Programme*
	12.00 pm – 12.30 pm	GTZ work on *Jatropha* in Africa Myra Mukulu, GTZ
	12.30 pm – 1.00 pm	Discussions
	1.00 pm – 2.00 pm	LUNCH BREAK
Facilitator: Amare Gessese (Ethiopian Academy of Sciences)	2.00 pm – 2.30 pm	Roadmap for sustainable renewable energy through policies Nicholas Ozor, *ATPS*
	2.30 pm – 3.00 pm	Policy innovation systems for clean energy security (PISCES) Bernard Muok, *ACTS*
	3.00 pm – 3.30 pm	Discussions
Facilitator: Shem Arungu-Olende (African Academy of Sciences)	3.30 pm – 3.45 pm	Focused discussions on way forward and next steps
	3.45 pm – 4.00 pm	Rapporteur's report
	4.00 pm – 4.15 pm	Vote of thanks and closing remarks
	4.15 pm onwards	REFRESHMENTS

APPENDIX 2

List of participants invited for the AAS/NASAC *Jatropha curcas*-derived biofuel industry in Africa conference held on the 22–23 February 2010 at the Hilton Hotel, Nairobi (Amboseli Room)

Name	Organisation	E-mail	Country
Bernard Muok	African Centre for Technology Studies (ACTS)	b.muok@acts.or.ke	Kenya
Judi Wakhungu	African Centre for Technology Studies (ACTS)	j.wakhungu@acts.or.ke	Kenya
Iba Kone	African Forest Research Network (AFORNET)	i.kone@afornet.org	Kenya
Margaret Mendi	African Academy of Sciences (AAS)	m.mendi@aasciences.org	Kenya
Shem Arungu-Olende	African Academy of Sciences (AAS)	arunguolende@aol.com	Kenya
Joan Kagwanja	Alliance for a Green Revolution in Africa (AGRA)	jkagwanja@agra-alliance.org	Kenya
Maxine Mensah	Altheo Solayon	maxine.mensah@yahoo.fr	Benin
Nicholas Ozor	African Technology Policy Studies (ATPS)	sunny_ozor@yahoo.com	Kenya
Alex Nabiswa	DEG Jatropha Support Programme	agronomist@pipal.com	Kenya
Amare Gessese	Ethiopia Academy of Science	amare.gessesse@gmail.com	Ethiopia
John Kioli	Green Africa Foundation	kioli@greenafricafoundation.org	Kenya
Myra Mukulu	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH	myra.mukulu@gtz.de	Kenya
Hezron Gikanga	Heinrich Böll Stiftung (HBFHA)	hgikanga@hbfha.com	Kenya
James Mwangi	Help Self Help Centre	info@hshc.or.ke	Kenya
Cristel Munster	World Agroforestry Centre (ICRAF)	c.munster@cgiar.org	Kenya
Meshack Nyabenge	World Agroforestry Centre (ICRAF)	m.nyabenge@cgiar.org	Kenya
Miyuki Iiyama	World Agroforestry Centre (ICRAF)	m.iiyama@cgiar.org	Kenya
David Yuko	Institute for Research in Sustainable Energy and Development (IRSEAD)	dnyuko@yahoo.com	Kenya
Ohene Akoto	Jatropha Africa	sales@jatrophaafrica.com	Ghana
Lillian Mkony	Jatropha Products Tanzania	lillacmkony@yahoo.com	Tanzania
James Onchieku	Kenya Forestry Research Institute (KEFRI)	jonchiekukefri@yahoo.com	Kenya
Felix Luti	Kenya National Academy of Sciences (KNAS)	secretariat@knascience.org	Kenya
J. A. Nyang'aya	Kenya National Academy of Sciences (KNAS)	secretariat@knascience.org	Kenya
Suresh Patel	Kridha Limited	business@kridha.com	Kenya
Hugo Verkuiji	Mali Biocarburant	dg@malibiocarburant.com	Mali
Arvinda Kumar Ragen	Mauritius Academy of Science and Technology (MAST)	ak.ragen@uom.ac.mu	Mauritius
Erick Akotsi	Ministry of Energy, Renewable Energy	akotsie@yahoo.com	Kenya
Faith Odongo	Ministry of Energy, Renewable Energy	fahamala@yahoo.com	Kenya
Jacqueline Olang	Network of African Science Academies (NASAC)	j.olang@aasciences.org	Kenya

Continued on next page

Continued from previous page

Name	Organisation	E-mail	Country
Jasper Kirika	Network of African Science Academies (NASAC)	j.kirika@aasciences.org	Kenya
Rahab Gitahi	Network of African Science Academies (NASAC)	r.gitahi@aasciences.org	Kenya
Rose Nyingi	Network of African Science Academies (NASAC)	r.nyingi@aasciences.org	Kenya
K. Mosto Onuoha	Nigeria Academy of Sciences	mosto.onuoha@unn.edu.ng	Nigeria
Sue Canney	Pipal Limited	sue@pipal.com	Kenya
Oscar Kibazohi	Tanzania Academy of Sciences (TAAS)	kibazohi@udsm.ac.tz	Tanzania
Petrus Jakobus Snyman	Thomro Biofuels	piet_lr330@yahoo.com	Zambia
Cedric Essombe	United Nations Environmental Programme (UNEP)	Cedric.Essombe@unep.org	Kenya
Aboua Gustave	University of Abobo Adjamé, Abidjan	gustave_abou@yahoo.fr	Ivory Coast
Lorna Omuodo	Vanilla Jatropha Foundation	vanillajatropha@gmail.com	Kenya
Kalaluka Munyinda	Zambia Academy of Sciences	kmunyinda@unza.zm	Zambia
Ishmael Machiya	Zimbabwe Academy of Sciences (ZAS)	imachiya@yahoo.com	Zimbabwe

Group photo of participants

The Network of African Science Academies (NASAC) was established on 13th December 2001 in Nairobi, Kenya, under the auspices of the African Academy of Sciences (AAS) and the InterAcademy Panel (IAP).

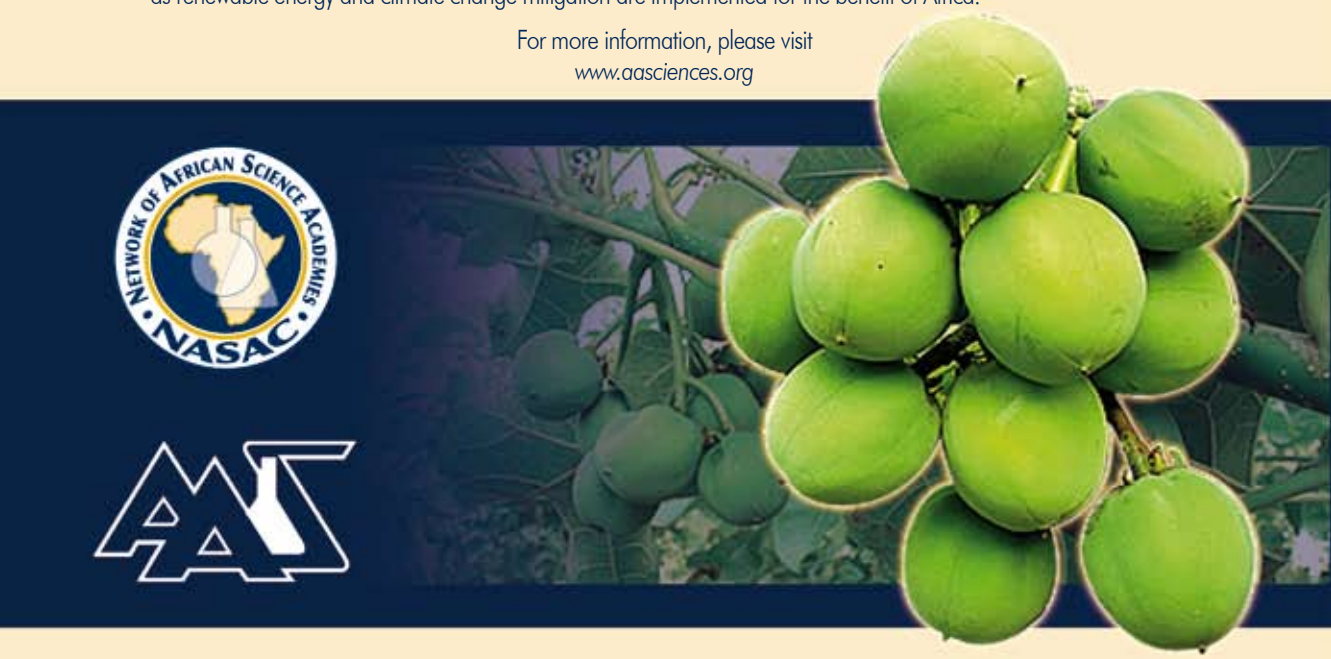
NASAC is a consortium of merit-based science academies in Africa and aspires to make the "*voice of science*" heard by policy and decision makers within Africa and worldwide. NASAC is dedicated to enhancing the capacity of existing national science academies and champions the cause for creation of new academies where none exist.

For more information, please visit
www.nasaconline.org

The African Academy of Sciences (AAS) is an Africa-wide non-profit organisation whose vision is to be the engine driving scientific and technological development in Africa. AAS seeks to honor S&T achievers and facilitate development of scientific and technological capacity for science-led development in Africa, while promoting excellence and relevance.

Founded in 1985, AAS has a membership of 186 fellows (as at January 2010) drawn from varied scientific disciplines that creates a diverse scientific platform through which developmental programmes in pertinent areas such as renewable energy and climate change mitigation are implemented for the benefit of Africa.

For more information, please visit
www.aasciences.org



NASAC and AAS secretariats jointly hosted this conference to discuss development of the biofuel industry in Africa under the recommendations of the InterAcademy Council (IAC) report entitled: ***"Lighting the Way: Toward a Sustainable Energy Future".*** *The conference was made possible through the generous financial support from the InterAcademy Panel (IAP).*

For more information on IAC and IAP, please visit
www.interacademycouncil.net and www.interacademies.net