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Biofuels in Eastern Africa: dangers yes, but much potential as well

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Key points

- Parts of Eastern Africa have great potential to develop biofuels
- Where there is spare land and water, economic returns can be high enough for cane and sweet sorghum grown for ethanol to replace imported fuels with biofuel
- Policy has lagged behind the recent surge of investors seeking land. Government needs to catch up and set clear frameworks for the development of biofuels

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Biofuel production is booming. Worldwide, production of ethanol for fuel has almost quintupled since 2000, while that of biodiesel has risen by almost 25 times (Figure 1).

This is, in part, a response to policies, above all in the US and the European Union, to replace fossil fuels for transport with renewable fuels — in practice, biofuels. Mandates have been set either for a proportion of transport fuels to come from renewable sources, or for a quantity of renewable fuels to be used by a given year, often 2020.

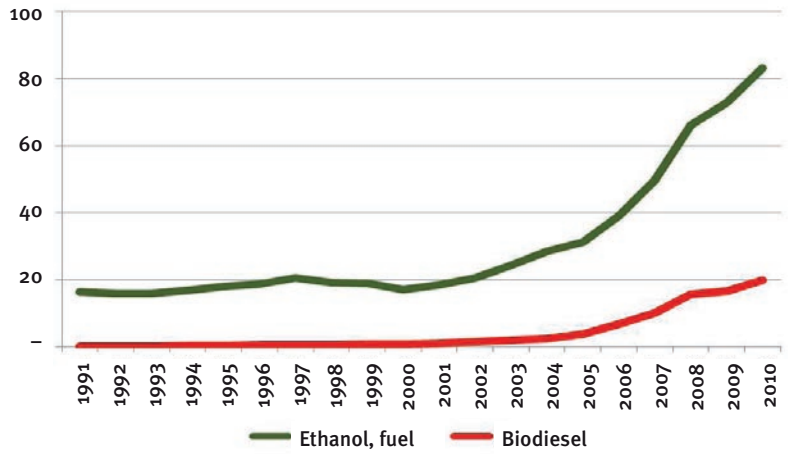
Subsidies and tax breaks have also been offered to producers of biofuels — see Stevens and Keane (2008) for the EU case.

But policy alone is not driving this increase: when oil prices are above a threshold of around $60-70 a barrel, biofuels made from most feedstock become commercially attractive; in early September 2011 Brent crude oil was quoted at $112 a barrel. Returns to tropical feedstock are especially attractive, according to gross margin analyses of returns per hectare. Cassava, sugar cane and sweet sorghum can be distilled to ethanol; oil from palm, sunflower, castor and jatropha can be processed to biodiesel.

For some developing countries, especially those with relatively abundant land and water, biofuels can be produced domestically, allowing them to cut back on increasingly costly imports of petroleum products. Some may also be able to export biofuels, or feedstock, to OECD countries. It is unlikely that the EU, for example, could produce the mandated biofuels within the EU itself, except at high cost and with mass displacement of other crops.

The potential to produce biofuels in developing countries is vast. In 2009, 3,837 million tonnes of petroleum products were consumed worldwide, of which 23.3%, or 3 trillion litres, were motor gasoline, at roughly 1,400 litres of gasoline per metric tonne. To produce that quantity of fuel in tropical areas, at the rate of 4,000 litres per hectare that can be produced from cane or oil palm, would require no less than 750 million hectares to be devoted to feedstock: a figure that can be compared to the 1.5 billion hectares currently under arable and

Figure 1: World biofuel production, 1991 to 2010, billion litres



Source: Earth Policy Institute reporting FO Licht data, with projections to 2010 (www.earth-policy.org/data_center/C23).

permanent crops across the world. There are, therefore, great opportunities to develop new industries, create jobs, and earn or save foreign exchange.

Yet there are significant concerns over large-scale development of biofuels. Either current land use would need to be intensified to accommodate biofuel production, probably driving up costs of production, raising food prices, and hurting poor consumers in a world that is increasingly urban. Or else large swathes of land not being cultivated at present would have to be converted to feedstock, with tropical forests, peat bogs and wetlands the most inviting targets. Yet these are habitats valued for their biodiversity and ecological services. Converting them, moreover, would release huge amounts of greenhouse gas (GHG). Land acquisition to grow feedstock could also see current users, especially those who are poor and have little political power, lose the land that underwrites their livelihoods.

There is, therefore, much interest in the possibilities of growing *jatropha curcas*: a bushy plant whose fruits contain oil that can be used as straight vegetable oil (SVO) or processed to make biodiesel. Jatropha can be grown in semi-arid lands that have low opportunity cost, thereby avoiding many of these problems.

To date, however, the plant has proved to have low yields in semi-arid areas, and yields less than some other oil crops when planted on better land. Right now, economic returns to jatropha are low. This may change with agronomic research.

Global questions, country studies

To understand more about the balance between opportunity and threat represented by biofuels, four countries in Eastern Africa — Ethiopia, Kenya, Mozambique and Tanzania — were chosen for specific study by ODI in partnership with local researchers. Three questions were addressed:

- What has been the recent development of biofuel production? What is known about major investments announced with great publicity?
- What is the potential to produce feedstock? How much for domestic use, how much export, and hence what trade possibilities exist?
- What policies to foster and regulate the industry are in place? How well advanced are schemes to certify production for sustainability?

Findings from Eastern Africa

Limited biofuels development so far, but ambitious plans

Biofuels had been developed only slightly in the region prior to the rise in oil prices that began in 2007. Some sugar mills, although surprisingly not all, distilled molasses, a by-product of sugar refining, to ethanol — largely for industrial use rather than for transport fuels.

Since the cost of imported oil products has risen, the private sector has shown great interest in producing biofuels. In all four countries, but especially in Mozambique and Tanzania, investors have filed many applications for biofuel projects, often involving production of feedstock on large estates.

To date, few of these investments are operating at scale. Most are running trials on small fractions of what land they have been granted. Some have run into problems in accessing this land or in producing feedstock, and projects have been abandoned. It remains to be seen whether the current low realisation of such projects is temporary, as they start up and expertise is developed; or whether there are serious obstacles that will prevent most reaching fruition.

Non-governmental organisations (NGOs) have been similarly active, usually assisting small farmers to grow feedstock for local processing and use. Again, few, if any, of these projects have reached a significant scale.

The practicalities of setting up enterprises for novel products such as biofuels entail significant costs in know-how and finance, exacerbated by uncertainties over underlying levels of demand and returns to investments.

Land exists, returns can be high

Eastern Africa has land that might be developed. Mozambique and Tanzania, for example, have large areas of land that are little used at present that might be cultivated to grow feedstock, although potential in some areas may be limited by lack of water.

Ethiopia also has land to develop, although much of the better potential land is remote with costly access. Kenya has the least unused agricultural land, but nevertheless possesses large areas of semi-arid land that might be used to grow feedstock adapted to such conditions.

Economic returns to biofuel feedstock, assuming oil prices of $90 a barrel or more, can be high for some potential feedstock. As Figure 2 shows, the annual return to sugar cane could be more than $2,000 per hectare, more than $800 per hectare for sweet sorghum, and more than $200 per hectare for cassava.

These returns are many times higher than those obtained by growing maize and beans, the main food crops. Returns to labour on biofuels could similarly be high: well over $10 a day for sugar cane and sweet sorghum.

Cassava and sugar cane are already cultivated widely across the region: sweet sorghum can be grown in semi-arid areas making it particularly attractive.

Although returns to sugar cane as feedstock are high, they may be even higher for sugar itself. This qualification does not apply, however, to cassava and sweet sorghum.

There seems to be some scope to develop ethanol plants using these feedstock, sourced probably from outgrowers, perhaps with a nucleus estate.

The resulting biofuel could then be blended into transport fuels, and replace some of the kerosene currently used for cooking — predominantly in urban areas — and for lighting in rural areas that lack electricity.

Returns to oil crops for biodiesel would be much lower: only oil from the tree *croton megalocarpus* looks likely to top an annual return of $150 per hectare. Returns to jatropha barely break even. That said, both croton and jatropha can be incorporated for shade and hedging within existing farm systems, so that their production costs, once the trees are established, could be very low — just those of collection. Moreover, the value of these oils will be higher when used locally, either as straight vegetable oil or processed to biodiesel to power diesel engines and motors. Indeed, in remote areas where imported fuels are particularly expensive, small-scale biofuel production may be very attractive commercially.

Domestic markets first, but opportunities for export loom

For the moment, it seems that the development of biofuels in Eastern Africa will be focused on domestic use, to replace increasingly costly fossil fuel imports. That said, the European market is growing, with little possibility of meeting demand from domestic sources at acceptable cost.

Most of Eastern Africa enjoys preferential access to the European market, either under the tariff-free privileges of the Everything-but-Arms initiative or under the EAC interim Economic Partnership Agreement. But this also applies to the export of sugar for human consumption, meaning that sugar-based biofuel exports will become profitable only if their price exceeds those for the alternatives.

This access is shared by a large number of other potential biofuel producers but not by the most substantial global producers: Brazil, Malaysia and Indonesia do not have such access.

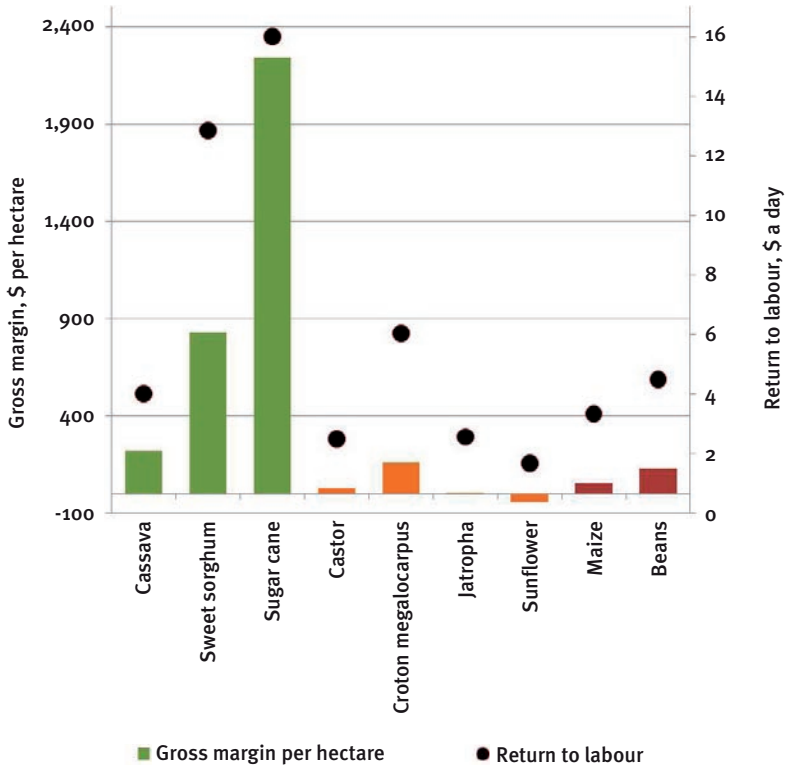
Policy lagging behind

Private initiatives have not had much support from the state, with governments running behind the pace of private investment.

National strategies are only now becoming clear, while rules and regulations to guide infant biofuel industries have yet to be set. These delays have added to the uncertainties faced by large-scale investors, small farmers and industrialists contemplating investments in feedstock and processing plants.

It is easy to see why policy is lagging behind. Biofuel policy crosses at least four administrative remits: agriculture, energy, land tenure and environmental matters, making it difficult to align policy with different sets of objectives, and get agreement on lead agencies. Uncertainty clouds the impacts of biofuels; there is great concern, often voiced by civil society, about the potential harm of unwise development to the physical environment, to the rights of poor rural people to land, and to food crops and security.

Figure 2: Returns to growing biofuel feedstock in Eastern Africa



Source: Data from country studies, mainly Kenya.

The policies drafted in recent years have, in general, laudable aims of stimulating growth and jobs. In content, however, regulations to prevent undesirable developments dominate. There is less than might be expected in setting out a framework for the positive development of biofuels. Policy also tends to focus on large-scale investors and, correspondingly, says less about smaller-scale initiatives. In some cases, large-scale investors seem favoured because of their capital and know-how.

One aspect that has lagged is definition of standards to be met if countries are to export feedstock or biofuel to OECD countries, the European Union in particular. Fortunately, international fora such as the Roundtable on Sustainable Biofuels are developing standards and methods of certification to meet demanding EU requirements for imports. While this could potentially benefit developing countries – including those in East Africa – who may be able to adopt such standards, the challenges of meeting the criteria are stiff.

Civil society in all four countries takes great interest in biofuels, acting partly as a watchdog against possible abuses by large-scale investors. The issues that biofuels raise, however, are as contentious as they are substantial. Much is at stake, yet given the complexity of the systems within which biofuel developments take place, outcomes are uncertain. Public debates on biofuels are, therefore, likely to be divisive: finding ways to create a broad public consensus is a challenge.

Conclusions

More information needed ...

Much public debate on biofuels focuses, unsurprisingly, on prominent issues such as land rights and food security, but the technical understanding of agronomy, economics and markets is incomplete. The agronomy of promising feedstock such as sweet sorghum and *croton megalocarpus* needs testing, adaptation and dissemination: more extensive trials in different areas on farmers' fields are needed to confirm their potential. Although the economics of jatropha do not look promising, work is needed to discover the agronomic potential of the crop — this may change the economics.

To date, economic and market analysis gives broad guidance; but more precise and specific estimates, for different locations, are needed.

... to fuel public debate and policy

With more accurate information, it should be easier for policy-makers and stakeholders to discuss options and reach agreement. The priority is to set out a consistent, clear and credible strategy for biofuel development. This would indicate the degree to which biofuels might be used for transport and other energy uses, the ambitions if any for exports, and measures such as taxes, subsidies and trade rules that will be used to encourage development.

Further detail would cover standards for biofuels and their enforcement, regulations on transporting and storing fuels, setting blending levels and limits, and setting consistent policy for pricing, taxing and trade in both biofuels and competing petroleum products. A clear framework would not only help stimulate development of biofuels, but would also help clarify the risks and how these can be monitored and minimised. Current schemes for sustainability standards try to address a wide range of risks, with little or no distinction between those that are more or less likely, and the more or less serious. This probably creates unnecessary work and contributes to complicated and confused debate. Although some elements could be borrowed from these schemes, so too could others from schemes designed to develop biofuels as part of a rural development strategy as has been in the case of Brazil.

If taken, these measures would help Eastern African countries seize what this research suggests may be an opportunity to develop new industry, create jobs, improve the trade balance and reduce dependence on imported energy.

Don't ignore small farmers

East African small farmers have produced many cash crops successfully, such as tea, coffee, cotton and sisal. While there may be economies of scale in the processing and distribution of biofuel, it is unlikely that this applies to growing feedstock. Contract farming schemes are probably a better option than large estates. And they will surely have more chance of spreading the benefits.

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Resources:

Stevens, C. and Keane, J. (2008) 'Biofuels and development: Will the EU help or hinder?'. ODI Briefing Paper 32. London: Overseas Development Institute.

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Project Information:

The research was carried out under the consortium Bioenergy in Africa (BIA) — opportunities and risks of jatropha and related crops. Led from the Institute of Geography in the University of Bern, the BIA consortium includes EMPA [materials science and technology] [CH], Plant Research International, Wageningen Agricultural University [NL], Austrian Bioenergy Centre, Roundtable on Sustainable Biofuels, CIRAD [F], Overseas Development Institute [UK]; together with partners from Belize, Ethiopia, Kenya, Mexico, Mozambique and Tanzania. ODI leads on global policy and trade within the consortium.

For more information see: www.bioenergyinafrica.net

The overall objectives of the consortium are 'to provide an enhanced information and knowledge basis upon which sustainable and pro-poor bioenergy development strategies and policies can be designed and implemented by developing country policy-makers, development partners and governments'.

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