

# Sustainable Biofuels Crops and Access in Developing Countries

## Summary

**G**lobal biofuel production tripled between 2000 and 2007 and is projected to double in the next four years. A growing number of developing countries have now enacted new, pro-biofuel national strategies. The cultivation of biofuels could be instrumental in long-term poverty reduction in developing countries, but the sudden interest of wealthy investors can bring problems, especially in the marginalisation of the rural poor who often rely on land their livelihoods. Large-scale and small-scale biofuels production can co-exist and even work together to maximise positive outcomes for rural development, however, but pro-poor models will only succeed if they are designed to be cost-effective and competitive.

The rising demand for biofuels has sparked a debate over the threat that

energy security poses to food security, but there are very few available studies into the impact of biofuel production on the availability of food domestically. The demand for biofuels has potentially serious effects on the environment, and without proper mitigation guidelines, energy crop cultivation will likely further threaten the high concentrations of globally endemic species in these areas.

Bioenergy crop production can be a suitable alternative if designed in a participatory manner with those whose livelihoods will be affected. Providing

benefits at the local level will require engaging with communities and understanding the current uses of the land. The successful promotion, sustainable production, and marketing of bioenergy require strong policy and institutional support.



*Young girl with improved stove*

## Introduction and Policy Context

**W**ith the unstable price of oil – that has now slumped from close to an all time high in 2008 – and the increasing concern with climate change, biofuels are seen by many as a possible solution to the need for alternative energy sources. The United States, the European Union, Brazil and a few other countries are actively supporting the production of liquid biofuels from agriculture, usually maize or sugarcane for ethanol, and various oilseed crops for biodiesel. Other developing countries, including India and East African coun-

tries, are planting and exploring opportunities for oil seed crops such as *jatropha curcas*. On the face of it biofuels promise numerous social, economic and environmental benefits, mitigating climate change, generating rural employment and contributing to energy security. Brazil has an active and well-developed bioenergy sector producing ethanol from sugarcane, and several foundations in India and East Africa are promoting the development of large oil seed plantations.

Not only are oil prices rising however, food prices



increased by 140 per cent between January 2002 to February 2008 and staples such as grains and oil seeds have doubled in price in just the past year. Several reasons have been cited, including the price of oil; changes in food production and consumption; the exchange rate of the dollar (and related world macroeconomic factors); and growth of the world population (Abbott *et al* 2009; Neves 2008).

Biofuels have been cited as another factor, although published analysis diverges widely on the extent of the impact of biofuels on food prices. In May 2008 the US Secretary of Agriculture claimed that analysis showed that biofuel production contributed only two to three per cent to increases in food prices (New York Times 30 May 2008). However, in July 2008 a leaked World Bank document calculated that biofuel production was responsible for seventy-five per cent of the increase in food prices between 2002 and 2008. Increased biofuel

production was said to have led to increased demand for food crops, which in turn led to large-scale land use changes which reduced supplies of crops such as wheat (Mitchell 2008).

According to the World Bank (2008), rising food prices have forced approximately 100 million more people into poverty. Meanwhile the United States and Europe have made efforts – with varying degrees of success – to progressively increase the portion of biofuels that are blended into petrol. The promise and risks of biofuel production highlight the uncertainties inherent in mapping the full range of possible impacts from the implementation of complex technologies in wide ranging social and economic contexts. Careful thought is needed about how we analyse and assess future impacts to best ensure that impacts are positive and benefit those most in need, particularly as more and more developing countries invest in biofuel production and consumption.

## Framing Biofuels

PISCES conceptualises *biofuels* as a component of bioenergy alongside *bioresources* (from natural sources, including trees, bushes, grasses, etc.), and *bioresidues* (from existing agriculture, industry or forest practices)  
 Clements, R. 2008. *Scoping study into the impacts of bioenergy development on food security*. Practical Action Consulting, Rugby.

'Biofuels' are fuels that are directly derived from renewable biological resources, especially from purpose-grown energy crops. Virtually all of the commercially-available biofuels are 'first generation' energy crops that are produced from starch or sugar-rich crops such as sugarcane or maize (for bioethanol), or oilseeds such as rapeseed, soy, palm or jatropha (for biodiesel). Many of these oilseed crops are edible which, in part, has prompted research into non-edible biofuels that can pose less of a threat to the production of food crops. These 'second generation' biofuels are created from processes that convert cellulosic agricultural and forestry wastes (for bioethanol) or lignocellulosic substances (for biodiesel) into energy.

Second generation biofuels are still at the experimental stage and have

not yet reached an acceptable level of economic viability, but they do hold the potential for many more species of plants to be used as sources of energy (Doornbosch & Steenblik 2007; ENDA 2007: 1; Hazell & Pachauri 2006; Mol 2007: 298; Raswant *et al* 2008: 3).

Biofuels, and bioenergy more generally, are nothing new to developing countries. 2.5 billion of the world's poorest people rely on bioenergy every day, and biofuels have long been used at the local level in Asia and the Pacific Islands. Biofuels are often more closely associated as a mass-produced alternative to fossil fuels for transport, however, particularly bioethanol and biodiesel produced at scale in Brazil and the United States (Hazell & Pachauri 2006) for consumers in rich nations. But biofuel production has been practised for some decades in Africa, especially in Mali where jatropha

has been widely used (ENDA 2007).

Global biofuel production tripled between 2000 and 2007 (Clements 2008: 8) and is projected to double again by 2011 (FAO 2007: 3). There are several reasons for this sharp rise, one of the main causes – briefly mentioned above – being the growing interest in renewable energy alternatives to fossil fuels, especially as a perceived solution to the transport sector's dependency on oil. Other reasons include the enforcement in 2005 of the Kyoto protocol (an international agreement setting targets for industrialised countries to cut their greenhouse gas emissions), and the increasing implementation of national biofuels targets. The United States' former vice-president Al Gore's campaign around his Oscar-winning movie *An Inconvenient Truth* in 2006 also served to raise the profile



of related environmental issues with a new and powerful mass audience (Mol 2007: 299).

Policymakers and researchers in both developed and developing countries are showing greater interest in biofuels. Two main interest groups of countries and companies are jostling for a favourable position within the global energy market. On one side are fossil fuel-importing nations that are seeking to reduce their growing energy expenditures, and who also see biofuels as a technical option to respond to climate change. On the other side are countries that are currently biofuels exporters or are interested in exporting biofuels in the future (ENDA 2007: 1). The United States is a powerful actor among the fossil fuel importing nations; and Brazil, Mexico and Malaysia are key players among biofuels exporters.

Many oil-importing developing countries with tropical climates that are suitable for growing energy-rich biomass now seek to produce biofuels on a large scale, as part of a strategy for either export-led or rural-based development. To these ends, a growing number of developing countries have now enacted new, pro-biofuel national strategies, among them Colombia, Ecuador, India, Indonesia, Malawi, Mali, Mauritius, Mozambique, Nigeria, Senegal, South Africa, Zambia and Zimbabwe (ENDA 2007; FAO 2007: 3). Some have joined the Pan-African Non-Petroleum Producers Association, aimed in part at developing a robust biofuels industry for the continent (FAO 2007: 4). Mauritius is seeking to reach 40 per cent of its energy needs through cogeneration using bagasse coming from the commercial production of cane sugar, and is also aiming to develop the processing of sugarcane for bioethanol production. Nigeria, the world largest producer of cassava, aims to work with Brazil to produce

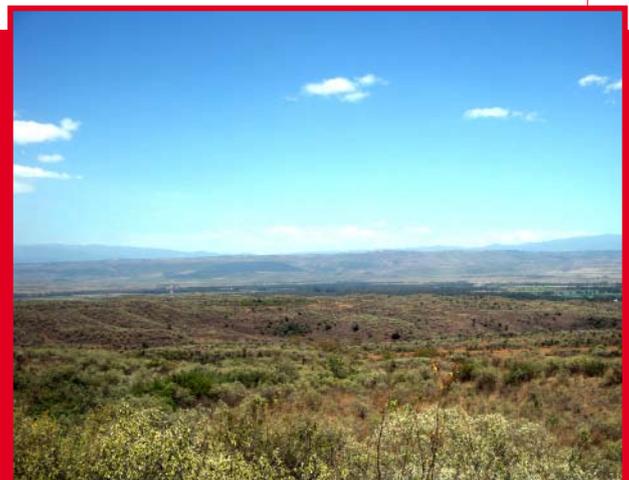
US\$150 million worth of cassava ethanol annually, and to establish a US\$100 million 'biofuel town' near Lagos where 1,000 bioenergy experts — primarily from Nigeria, but also from other African countries and Brazil — will work on novel technologies to improve bioenergy production. The Brazilian influence is also apparent in Mozambique, which is developing a sorghum and sugarcane-based biofuel sector funded by US\$700 million set aside for biofuel research, production and promotion (Chege 5 December 2007).

Some developing countries are participating in joint ventures with investors. In an initiative that could boost the livelihood of 5,000 smallholder farmers through contract farming, the Mozambique government has teamed with The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and Rusni Distilleries Ltd, a private Mozambican company. Their US\$30 million investment will establish a facility capable of producing 100,000 litres of sorghum ethanol annually (Chege 5 December 2007).

The domestic opportunities that biofuels offer come with trade-offs. In moves that have raised accusations of neo-colonial behaviour, some wealthy countries are now rapidly acquiring vast tracts of agricultural land in poorer nations, especially in Africa, to grow biofuels and food for their own consumption. Daewoo Logistics of South Korea, for example, has recently leased 1.3m hectares of farmland — about half the size of Belgium — from Madagascar's government to farm maize and palm oil (Blas 9 November 2008; Jung-a *et al* 19

November 2008) (although the status and details of this agreement are currently unclear and obscured further by political violence in the country, in which rhetoric linked with the supposed land deal has been employed by the main opposition group). In Tanzania foreign companies are growing sugar cane for bioethanol so that European countries can meet their European Union targets (Mackenzie 2008).

While there are distinct advantages to biofuel investment in developing countries, especially in rural areas, the sudden interest of wealthy investors can also bring problems. For example,



*Harsh climatic conditions in some parts of Africa*

where competing resource claims exist among local resource users, governments and incoming biofuel producers, these 'land grabs' can further marginalise the rural poor who rely on it for their livelihoods (Cotula *et al* 2008: 2). In some cases the agreement is to grow biofuels on 'idle' or 'marginal' land under the assumption that the unoccupied land is never used, which ignores groups such as nomadic herders who depend on land at certain times of the year. Those with a more permanent presence on the land are also at risk since they generally have little negotiating power against large private entities. Under pressure from power-

## Biofuels and livelihoods in developing countries

The cultivation of biofuels can be instrumental in long-term poverty reduction in developing countries that have a high dependence on agricultural commodities, with benefits in the form of employment, skills development and secondary industry (Cotula *et al* 2008: 2).

The employment opportunities range from highly skilled science, engineering and business-related jobs, to medium-level technical staff and unskilled agricultural work in farming, transportation and processing in rural communities (FAO 2007: 15). These opportunities are often associated with large-scale plantations owned by private companies that aim at gaining economies of scale (ICRISAT 2007: 15), but which are sometimes accused of displacing people and of poor labour conditions (FAO 2007: 15).

Large-scale and small-scale biofuels production can co-exist and even work together to maximise positive outcomes for rural development (Cotula *et al* 2008: 2). The technologies involved in modern biofuel production are basically simple oil-pressing and alcohol distillation processes that are well-known at the village level and are easily replicable. Foreign firms can contract local small farmers to grow crops for them, providing farmers with more security and predictability than from simply selling crops on open markets (Mackenzie 2008). Price squeezes by middlemen or large-scale processors will probably still apply, however, and small-scale farmers may need to form commodity associations and cooperatives to protect themselves (ICRISAT 2007: 15). New pro-poor contract-farming relationships are emerging that may better serve small-scale farmers (ICRISAT 2007: 15). Pro-poor models will only succeed if they are designed to be cost-effective and competitive, as was the case with the White Revolution (dairy) in India and the CMDT cotton success story in West Africa (ICRISAT 2007: 35).

ful forces offering comparatively large amounts of windfall cash, poor farmers may be tempted to sell their land at low prices or, where land is “*de jure*” owned by the state, may find that their land is simply allocated to investors (Raswant *et al* 2008: 6).

An example of the lack of transparency in foreign biofuel investment is Tanzania, where there appears to be no consistent strategy regarding biofuels

investment or how to regulate it. Oxfam (2008: 23) reports that ‘the emerging picture is one of investment for export with seemingly no requirements on companies to maximise value-addition within country, supply national markets, form links with local companies, adopt production models likely to maximise opportunities for poor people, or work with local communities to increase access to energy’.



*Institutional Biogas plant*

## Biofuels and food in developing countries

The rising demand for biofuels has sparked a debate over the threat that energy security poses to food security. There are three main (inter-related) threads to what has become known as the ‘food-versus-fuel’ debate.

The first is that there is less food available to eat because feedstocks that would otherwise be used for human consumption are being diverted for processing into biofuel—usually for transportation. The second argument is that demand for biofuels has increased competition for land and

water resources that would otherwise be used for cultivating edible crops. A result of these two concerns is the third contention, that more production of biofuels will force food prices up and make it more difficult for poor people to purchase food (Clements 2008: 8-9).

The assumption in all of these arguments, however, is that there will be no increase in the total amount of land cultivated. The earlier point about ‘unoccupied’ land notwithstanding, untapped potentially cultivatable land does exist—depending on the defini-



tions of 'idle', 'under-utilised', 'barren', 'unproductive', 'degraded', 'abandoned' and 'marginal' lands. India's Ministry of Rural Development, for example, reports that, of the 306 million hectares of land, 173 million hectares are under cultivation, with the rest classified as eroded farmland or non-arable wasteland (Raswant *et al* 2008: 6).

Other striking statistics also inform the debate. Oxfam estimates that the livelihoods of at least 290 million people are immediately threatened by the food crisis, and notes that the World Bank estimates that 100 million people have already fallen into poverty as a result (Oxfam 2008: 3). Another commonly used example is the biofuel consumption of large cars. WorldWatch Institute, for instance, offers the comparison that the amount of grain required to fill the 90-litre petrol tank of a 4x4 vehicle once with bioethanol could feed one person for a year, adding that the grain it takes to fill the tank every two weeks over a year would feed 26 people (Thompson 2008: 52).

These headline-grabbing figures are regularly quoted in the food-versus-food debate, but there are very few available studies into the impact of biofuel production on the availability of food domestically. Several initiatives are investigating these issues, including the FAO's Bioenergy and Food Security (BEFS) project looking into the potential effects of biofuel production on food security and land-use in Peru, Tanzania and Thailand (Clements 2008: 16-17). There is an urgent demand to conduct more 'life cycle' studies that assess the energy 'surpluses' or 'deficits' in various biofuel production scenarios; and to produce more analyses of farmer behaviour and investment in biofuel production before we can look beyond rhetoric and begin to understand the relative benefits or disadvantages of widespread biofuel investment in developing countries.

The focus also tends to be on the cultivation of biofuels in developing countries, ignoring an increase in biofuel production in developed countries. This is quite possible, given that the EU is already paying farmers an extra 45 Euros a hectare to grow crops for biofuels (Clements 2008: 19).

The effect here is that it may reduce wealthy nations' food and feed exports, benefiting all producers, including those in developing countries, as world prices rise. Developing country farmers could then expand their production of food and feed, thereby increasing the availability of crop residues available for energy feedstock. On the negative

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side, however, it is argued that higher world prices would lead to higher food prices for the poor. It has however been suggested that this impact might be offset in the longer term by the higher employment and incomes generated by agricultural-led growth (De La Torre Ugarte 2006: 2).

It is in the context of food price rises that—with specific reference to the United States bioethanol derived from maize—the UN Special Rapporteur for the Right to Food, Jean Ziegler, commented that producing biofuels is “a

crime against humanity”. The response from Brazil's President, Luiz Inacio Lula da Silva, was that ignoring the potential of biofuels to lift development would be a “real crime against humanity”. These comments were made as a wave of mass protests over food prices swept across some developing countries. Mexicans demonstrated when *tortilla* prices saw a 100 per cent increase in one week, while in Haiti, protesters chanting “we are hungry” forced the prime minister to stand down. At least 24 people were killed in riots in Cameroon, and in Egypt the army was made to bake and distribute bread. In the Philippines, hoarding rice is now punishable by life imprisonment, while India, Pakistan and Thailand, the world's largest producers of rice, have placed export bans on certain varieties. A number of African countries have also banned the export of food (Versi 2008).

The role of biofuels on food availability and price increases is difficult to disaggregate from a wide range of other temporary and longer-term factors that have combined to create what has been described by Oxfam (2008: 19) as 'a perfect storm'. These contributing factors include increased oil prices, weather-related shortfalls, poor harvests, global population growth and economic growth in emerging economies. Nevertheless, biofuels do deserve some of the blame for the food crisis, and have been identified as a major culprit by the UN, World Bank, and International Monetary Fund (IMF). The use of corn to produce bioethanol in the United States, for example, has increased from 6 per cent of total corn production to 23 per cent over the last three years, and this has undoubtedly contributed to tightening food supplies and rising food prices (Koh & Ghazoul 2008: 2455). What can be said for certain is that biofuel production is a 'new' factor impacting on world food prices (Clements 2008: 28).

## Biofuels in developing countries and the environment

The demand for biofuels – estimated at 277 million tons per year by 2050 – and the resulting impact on food prices has potentially serious effects on the environment—not least by indirectly undermining new incentive-driven systems for environmental conservation (Koh & Ghazoul 2008: 2454).

The potential habitat and biodiversity losses in developing countries are huge, especially since investors usually hunt for the good soils and rainfall that are associated with rainforest areas. One such area is Uganda's Mabira Forest reserve where violent protests eventually influenced the government to reverse a decision to grant the land to the Mehta-owned Sugar Corporation of Uganda Ltd. for a sugarcane plantation (Ejigu 2007). Other threatened areas are the Atlantic forest and Cerrado in Brazil (in the case of soybean) and the Sundaland, Wallacea, and Guinean Forests of West Africa (oil palm) where, without proper mitigation guidelines, energy crop cultivation will probably pose a danger to the high concentrations of globally-threatened endemic species in these areas (Koh & Ghazoul 2008: 2454).



*Pile of firewood used in schools with Energy Saving Stoves*

Few universal conclusions can be drawn about the environmental effects of biofuels, however, since different crops and growing and processing technologies lead to different environmental outcomes in differing ecological contexts (Kartha 2006: 1).

## Which biofuel crop?

Much of the available knowledge on biofuels technology is based on the large-scale farming of sugar cane and corn. Newer energy crops such as jatropha and pongamia are not yet easily accessible for cultivation (Ejigu 2007), but hold considerable promise. Both have the potential to improve soil quality and coverage and reduce erosion, while their oilcakes can provide organic nutrients for improving soil (Kartha 2006: 2). Like second generation energy crops, they will also grow on marginal lands that do not compete with food (Raswant *et al* 2008: 3). Sweet sorghum is a multi-purpose crop from which both food and fuel can be harvested (Fairless 2007).

The extent to which biofuels compete with other uses for water depends on the type and location of the crop being cultivated (Koh & Ghazoul 2008: 2456). Sugarcane, for example, uses a lot of water, but sweet sorghum is drought-tolerant (Raswant *et al* 2008: 5). The advantage of sugar beet is that it can grow in alkaline and sodic soils.

The expansion of biofuel crops can result in the displacement of other crops or threaten ecosystem integrity by shifting from biodiverse ecosystems and farming systems to industrial monocultures (Raswant *et al* 2008: 5) that can have a greater reliance on chemical fertilisers. Feedstocks grown on a small scale, however, have greater possibilities for crop rotation. Switching between sweet sorghum and soybean, for example, can replenish soil nutrients naturally (Ejigu 2007). Yet even those crops that are seen as being more sustainable can have negative environmental impacts if they replace wild forests or grasslands (FAO 2007: 44).

Overall, if the cultivation of biofuels replace intensive agriculture, the impacts can range from neutral to positive; if they replace natural ecosystems or displace other crops into protected areas, the effects are likely to be more negative (Peskest *et al* June 2007: 4).

## Biofuels in developing countries and climate change



*Charcoal balls manufactured from charcoal dust*

**G**reenhouse gas emissions from fossil fuel combustion are the main reason for climate change. Most biofuels, on the other hand, have a much lower net emission of greenhouse gasses when used for energy. Plants used for biofuels absorb carbon as they grow and, when harvested, release only the amount of carbon they absorbed, thus mitigating the effect on climate change (Raswant *et al* 2008: 4). Energy crops' 'well-to-wheel' environmental benefits differ widely (IIED 2008: 1), however, and the results vary depending on

the type of feedstock, cultivation methods, conversion technologies and energy efficiency. Sugarcane-based bio-ethanol saves between 80 and 90 per cent of greenhouse gas emissions per mile as compared to petroleum, while bio-diesel from soybeans can save 40 per cent (Hazell, cited in Raswant *et al* 2008: 4). In general, biofuels from grains have lower performance, reducing carbon emissions by 10 to 30 per cent per mile – or, in some cases, even producing higher emissions than fossil fuels (Raswant *et al* 2008: 4).

Emissions are associated with all stages of their lifecycle, particularly if the crops are grown intensively using nitrogen-based fertilisers and machinery, or if the refining process requires large inputs of (fossil) energy. Nevertheless, biofuels do not have to have zero greenhouse gas emissions to be of benefit; though they must show lower emissions overall than the alternative (Oxfam 2008: 6-7).

Biofuels are not greenhouse gas neutral. The forthcoming 'second generation' of biofuels such as lignocellulosic bioethanol and Fischer-Tropsch biodiesel show potentially impressive reductions in greenhouse gas emissions relative to petrol (IIED 2008: 1; Peskett *et al* June 2007: 5). Maize-based bioethanol still rates poorly (IIED 2008: 1) and, in some cases, the greenhouse gas emissions can be even higher than those related to fossil fuels (Peskett *et al* June 2007: 5).

## Conclusion

**B**ioenergy crop production can be a suitable alternative if promoted and developed in a participatory manner with those whose livelihoods will be affected. Ensuring benefit at the local level will require engaging with communities, understanding current land use patterns, and understanding how people and communities will choose to behave and invest in different scenarios and how institutions and policies can best be shaped to ensure maximum positive impact. A nuanced understanding of the interrelationships, implications and impacts of all components of biofuels systems is central to designing effective policies and institutions. Understanding biofuel production, promotion and impact in a panoptic, systemic way is essential to ensure that maximum efficiency and appropriate developmental impact are achieved.



*Energy saving oven*



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## PISCES

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## Policy Working Group (PWG)

The Policy Working Group (PWG) of PISCES is an expert working group whose objective is to develop a consultative and participatory policy methodology to discuss the policy issues and guide policy statements on bioenergy. The group aims to achieve this by bringing together policy makers, stakeholders and experts to develop a combined methodology on participatory policy dialogue and apply the same in developing bioenergy policy with a focus on Kenya and Sri Lanka.

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