

Biofuels in Malawi: local impacts of feedstock production and policy implications

Key messages

- Poverty alleviation and food security outcomes for those involved in the sugarcane sector vary but appear largely positive. Land use conversion for sugarcane production can have positive or negative environmental impacts. Policy-makers need to evaluate trade-offs across the different socioeconomic and environmental impacts to guide decisions that affect sugarcane development plans.
- Jatropha production has minimal impact on food security and poverty alleviation, whether positive or negative. The low impact of jatropha is unlikely to change unless high-yielding jatropha varieties are tested in real conditions and market options improve. Untested biofuel crops such as jatropha should not be promoted by government, NGOs and the private sector, until sufficient data is available on yields, production costs and market value/demand.
- Due to their potential role in global climate change mitigation, biofuel crops have more complex trade-offs compared to other large-scale land-based development options. However, socioeconomic and environmental trade-offs at the local and national level will tend to be similar to other industrial crops. Before promoting particular biofuel crops and development strategies, policy-makers need to weigh the expected benefits and costs for the short-term and long-term at local and national levels, in relation to their national environment and development goals and international commitments.
- There is a great potential for bioethanol to be used in the household sector as a cooking fuel, but the price has to be competitive with existing energy alternatives. This might be accomplished through regulating the charcoal sector and providing tax incentives to bioethanol producers and users.

Biofuels in Malawi

Malawi is the only African country to fully integrate biofuels into its energy system.¹ Malawi has produced sugarcane ethanol and blended it at proportions of 10-25% with gasoline since the 1980s, in response to the 1970s energy crises and the higher costs of importing refined oil products in their landlocked country.² Since the 1990s, there have been major efforts to integrate smallholders in the sugarcane value chain to enhance rural development.

The sugarcane sector is important to the Malawian economy, with most production concentrated in the Dwangwa and Nchalo sugarcane belts. Sugarcane in Dwangwa is produced mainly in an estate owned by Illovo Sugar, and supplemented through smallholders on irrigated and rainfed farms organised into different associations. EthCo Malawi runs the ethanol distillery using molasses provided by Illovo as feedstock.

In the mid-to-late 2000s, jatropha-based biofuels attracted private sector and government interest in Malawi, just as in many African countries.³ The rationale was similar to bioethanol, but in contrast to other African countries, jatropha oil was only to be used domestically to reduce diesel imports. Jatropha also came to be seen as an alternative cash crop to reduce poverty and stimulate rural development. However, a viable market for jatropha oil could not be established in the absence of government implementation policies.

The most substantial jatropha investment came from BERL Ltd which promoted its cultivation on boundary hedges of small farms. This production model assumes that farm boundaries are underutilised and thus jatropha planting would have minimal impact on food production. In total around 100,000 farmers were targeted throughout



Sugarcane manual harvesting, Dwangwa, Malawi
Photo credit: Carla Romeu Dalmau

the country, but the actual number that took up and maintained jatropha production was much lower.

Aims and approach

In this Policy and Practice Brief, we summarise key local environmental and socioeconomic impacts associated with biofuel feedstock production in Malawi and explore the policy implications. The results are based on a 3-year study in Dwangwa sugarcane area and the jatropha-growing areas of Mangochi district. The research considered how sugarcane and jatropha production can affect:

- land use change
- ecosystem services
- multi-dimensional poverty
- food security.

We used the ecosystem services approach to analyse the local impacts of biofuel crop production.⁴ Ecosystem services refer to the benefits that humans derive directly and indirectly from ecosystems, including provisioning services (e.g. food, fuel, forest products), regulating services (e.g. carbon sequestration, erosion regulation) and cultural services (e.g. recreation, religious values). Changes in the flow of such ecosystem services can have multiple effects on poverty and human wellbeing.

To elicit and differentiate the local impacts of sugarcane and jatropha production across different actors and feedstock production models, we used household surveys, field observations, remote sensing and ecological surveys. In Dwangwa area, we interviewed 104 Illovo workers, 101 irrigated sugarcane smallholders, and 107 rainfed sugarcane smallholders. For comparative purposes, we sampled households not involved in sugarcane production, which served as control groups: 102 households living in close proximity to the sugarcane area and 99 households living further away. In Mangochi area, we interviewed 100 smallholders growing jatropha in hedges, and 101 households not growing jatropha (control group).

Land use change and ecosystem services

The Illovo plantation and the irrigated smallholders have caused significant land use change (Figure 1). Through remote sensing and field observation we found that sugarcane cultivation led to the conversion of low-density forest, high-density forest and agricultural land. Rainfed sugarcane smallholders have also directly converted agricultural land, but it has been difficult to quantify the magnitude of this land use change. The conversion of woodlands may reduce the availability of forest-related ecosystem services such as fuelwood, medicinal herbs, wild food and grazing land for livestock that are important for the livelihoods of local communities.

Land use change has been minimal in Mangochi, as jatropha is overwhelmingly grown as a single-row hedge crop on the margins of family farms. However, the boundary agricultural

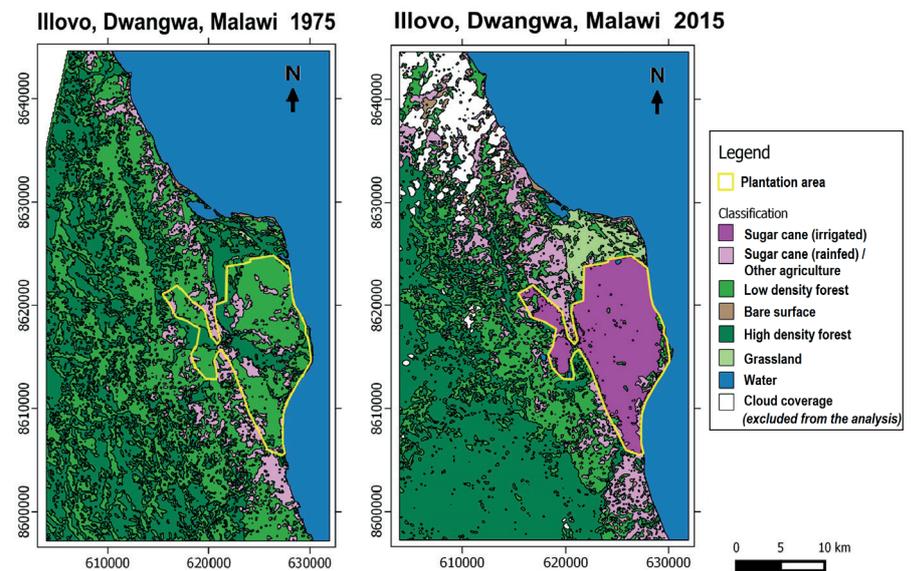


Figure 1: Land use map for Dwangwa area in 1975 and 2015.

land displaced by jatropha may have been used to grow other food crops or trees. A 500-tree jatropha hedge can reduce the area of an average farm by 7% and cause shading and competition for water/nutrients that might further reduce the food production potential, considering the small farm sizes in Malawi.⁵

Sugarcane and jatropha areas sequester more carbon compared to the previous land uses. Net carbon storage over a 20-year period was found to be higher for sugarcane and jatropha areas compared to surrounding land uses.⁶ This is because jatropha trees largely replace perennial crops with low standing biomass. The densely-planted sugarcane crops have higher standing biomass compared to the low biomass of surrounding agricultural and already partly degraded woodlands (e.g. from fuelwood extraction).

Multi-dimensional poverty

To capture poverty alleviation effects, we used the multi-dimensional poverty index (MPI) pioneered by the Oxford Poverty and Human Development Initiative.⁷ The MPI is a composite measure of ten indicators divided across three categories: education, health and living standards.

We found lower levels of multi-dimensional poverty for those involved in sugarcane cultivation and production, compared to those not involved (control groups). Plantation workers and irrigated smallholders have much lower levels of multi-dimensional poverty compared to rainfed sugarcane farmers. All sugarcane groups have lower levels of multi-dimensional poverty compared to the control groups (Figure 2).

Jatropha smallholders have almost the same multi-dimensional poverty levels as those that do not grow jatropha. This may be partly due to the fact that jatropha was grown only for about 5 years in the study area. However, the low jatropha yields and low economic value mean that this situation is unlikely to change unless yields are substantially improved (e.g. by introducing high-yielding jatropha varieties).

Food security

Quantifying the food security outcomes of biofuel feedstock production can be complicated in subsistence agriculture settings, due to the multiple mechanisms at play that can

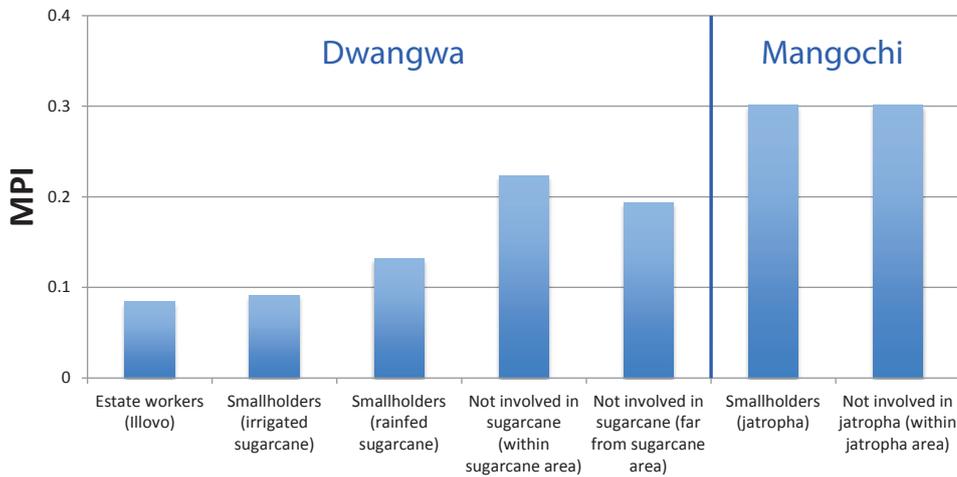


Figure 2: Multi-dimensional poverty (MPI) of households in Dwangwa and Mangochi. Low levels of MPI denote households with lower poverty.

simultaneously affect food security.

For example, the conversion of agricultural land to non-food crops such as sugarcane can reduce the amount of food produced in the wider area. Furthermore, plantation workers and sugarcane/jatropha smallholders invest their labour (and land and agricultural inputs in the case of smallholders) to produce biofuel crops instead of food. At the same time, households receiving income from sugarcane and jatropha production can use it to buy food—or invest in other agricultural inputs, such as fertiliser, to increase their food crop production.

We used two standardised measures of observed food security, the Food Consumption Score (FCS) and the Household Food Insecurity Access Scale (HFIAS). The FCS is a measure of diet diversity in the 7 days prior to the survey,

while the HFIAS captures perceptions of hunger in the 4 weeks prior to the survey.

In Dwangwa, those involved in sugarcane production generally register higher levels of food security compared to control groups under both the FCS and the HFIAS. In Mangochi, there was no significant difference in food security between jatropha growers and non-growers, both in terms of FCS and HFIAS (Figures 3a and 3b).

Evaluating trade-offs

There are some important trade-offs associated with sugarcane production in Dwangwa. There has been extensive land use change at the expense of agricultural land and forest. On the one hand, this means some loss of food production potential and forest products from the wider area,

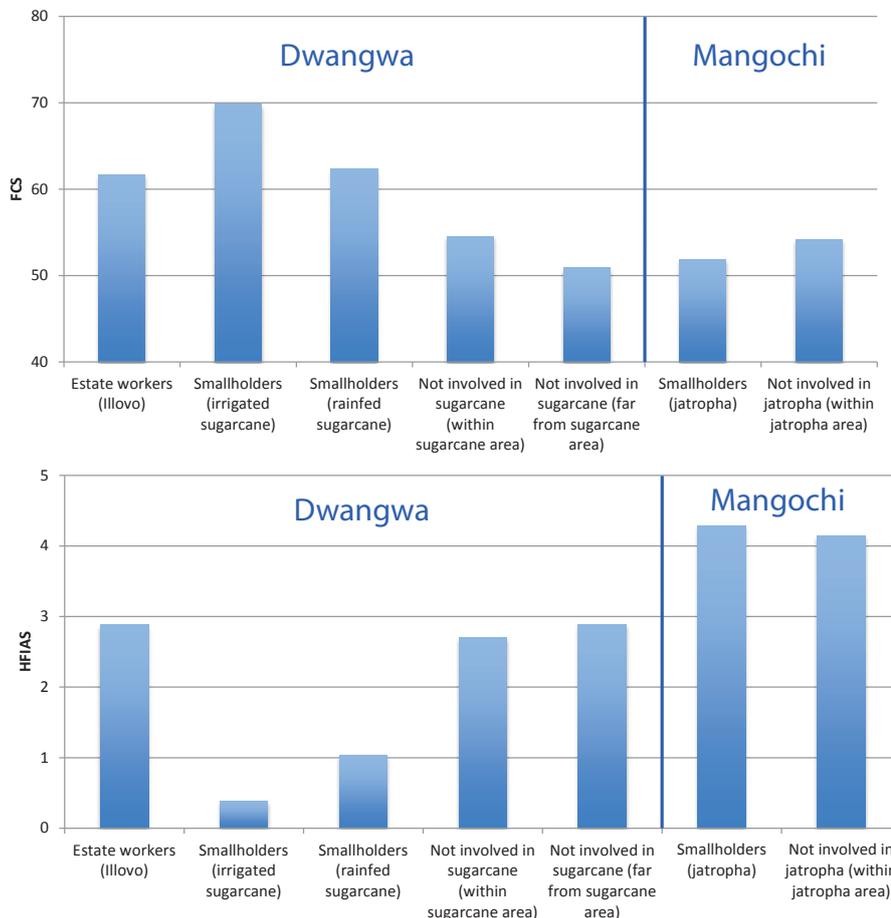


Figure 3a and 3b: Food security levels in Dwangwa and Mangochi; higher levels of FCS and lower levels of HFIAS denote more food-secure households.



Harvested jatropha seeds, Mangochi, Malawi
Photo credit: Carla Romeu Dalmau

which are important for the livelihoods of local communities. On the other hand, larger amounts of carbon are sequestered in sugarcane areas compared to surrounding land uses. Bioethanol made from sugarcane molasses is substituted for gasoline, offering significant carbon savings.

Less significant trade-offs are evident in jatropha areas. As jatropha is grown on the margins of farms it displaces small amounts of farmland and most likely has no effect on surrounding forests. This means that little food crop production is lost from jatropha cultivation. On the other hand, jatropha hedges store larger amounts of carbon than food crops, implying that jatropha cultivated following this production model can enhance carbon sequestration.

Key metrics of poverty and food security confirmed that those involved in sugarcane production are better off compared to those not involved. However it was difficult to conclusively determine whether involvement in sugarcane

led to reduced levels of poverty, or whether those that became involved in sugarcane production were already better off compared to the control groups.

Jatropha growers and non-growers register almost identical levels of poverty and food security, suggesting that jatropha did not improve livelihoods as initially expected.⁵ The poor performance is due to low jatropha yields, low prices of jatropha seeds, market access problems and the fact that it is a secondary livelihood activity for households (in contrast to Dwangwa, where sugarcane is the primary livelihood activity).

Bioethanol has been used only in the transport sector in Malawi, but could also be used to replace charcoal as a cooking fuel. There is evidence of consumer willingness to pay more for bioethanol due to health and environmental benefits.⁸ Nevertheless, the higher cost of ethanol stoves and fuel presents a major barrier and financial incentives would be needed.

Changes in land use and agricultural practices due to the introduction of industrial and/or biofuel crops such as sugarcane and jatropha can create complex trade-offs. Typically some ecosystem services and constituents of human wellbeing are enhanced, while others diminish or remain unchanged. The costs and benefits are also felt at different levels, and across different groups. The loss of agricultural and forest land may be negative for local food production, yet it can be positive for local income generation and for

Endnotes

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Credit

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