Bioenergy in Southern Africa: An opportunity for regional integration?

Channing Arndt a, Giles Henley b and Faaiqa Hartley c

aInternational Food Policy Research Institute, Washington DC, USA; bOverseas Development Institute, London, UK; cEnergy Research Centre, Cape Town, South Africa

ABSTRACT
This introductory paper sets out the rationale for revisiting questions surrounding biofuel futures in Southern Africa and exploring the case for the establishment of a regional market. This contrasts with most research that has focused upon benefits and risks of production and consumption for individual countries. The analysis in this issue suggests that while benefits exist, the key challenges that have stifled production and consumption to date would need to be overcome. Unlocking trade requires relaxing requirements for South African manufacturers to source all their feedstock domestically. Key among factors to encourage production is resolving agricultural investment processes, particularly designing inclusive business models and clarifying land acquisition processes.

KEYWORDS
biofuels; Southern Africa; regional integration

JEL classification
Q16; Q18; R11

1. Introduction

Global biofuel demand has increased significantly over the past decade, rising from 19.6 to 74.8 million tonnes oil equivalent between 2005 and 2015 (BP, 2016). Demand had initially been spurred by country strategies to reduce greenhouse gas (GHG) emissions using blending mandates for transportation fuels in the US and EU. High oil prices in the mid-2000s and again from 2011 to 2014 (OECD-FAO, 2015) have also contributed to the increase in demand for biofuels. Although the recent debate on indirect land use change has suggested that the production of biofuels has resulted in the unintended consequence of higher GHG emissions, and despite the lower oil price since 2014, which has assisted in reducing the price of biofuels (OECD-FAO, 2015), demand for biofuels is expected to increase in the next decade as countries with existing blending mandates increase these and other countries introduce new mandates. Mandates in three major consumers of biofuels – the US, Brazil and China – are set to increase, driving increases in production (Biofuels Digest, 2017).

In African economies, the arguments favouring biofuels that have garnered most attention stem from the potential for domestic biofuel production base to replace oil imports while simultaneously channelling investment into the rural sector and contributing to
poverty reduction (von Maltitz & Brent, 2008; UNCTAD, 2009). As most African countries are oil importers, reducing imports of oil improves the balance of payments and is expected to improve macroeconomic stability by reducing countries’ exposure to price and supply risks. For example, the oil price spike from 2011 to 2014 had major negative impacts on South Africa’s trade deficit, inflation and unemployment and contributed to growing poverty and inequality (Wakeford, 2013, cited in Kohler, 2016). Increasing the share of locally sourced fuel in the fuel mix would reduce this exposure. At the same time, stimulating a local production base in rural areas would benefit farmers growing feedstocks and create jobs in industries along the value chain (FAO, 2008; Arndt et al., 2012; Ferede et al., 2013; Schuenemann et al., 2016).

Critics have argued against the development of biofuels, claiming expansion of the sector would increase food insecurity, either by competing directly with crops that would otherwise enter the human food chain (especially maize and soybean oil) or by diverting inputs away from food production, including land, labour and water (Ferede et al., 2013; Schuenemann et al., 2016). Research from recent years has found evidence of negative impacts of biofuel production on food security to be mixed and country-specific (Zilberman et al., 2013). While Rosegrant et al. (2008) attribute part of the 2000–10 increase in global food prices to biofuel production, studies by Ewing and Msangi (2009), Arndt et al. (2010, 2012), Negash and Swinnen (2013) and Schuenemann et al. (2016) suggest that the potential gains to household incomes would be large enough to offset increases in food prices in the countries being studied.

The aim of this special issue is to revisit the questions surrounding biofuel futures in Southern African countries through a regional lens, i.e. by assuming a scenario in which biofuels are consumed in South Africa but produced in neighbouring countries. We look at potential benefits from establishing regional trade, and its distributional effects. While earlier analysis has investigated gains from trade, much of this assumed African-sourced biofuel would be exported completely or largely outside the region (e.g. Johnson & Matsika, 2006; Mathews, 2007).

We supplement this analysis of the potential benefits of such a scenario to macro-economic growth, employment and poverty reduction, by looking at some of the constraining factors that have prevented the production and consumption of biofuels in the region so far and assess whether these same factors will continue to forestall the emergence of a future regional biofuel market.

While the opportunities and risks of biofuel development have been researched extensively before, the papers presented in this issue provide new (policy-relevant) insights into the topic by employing a combination of data-collection methodologies, economic modelling techniques and project-level research. Combining these techniques allow for the use of a set of common and recent values and assumptions for key variables used across papers.

2. Potential for bioethanol production and consumption in southern Africa

2.1. Production

Global projections of bioenergy production potential exhibit substantial variation, depending upon assumptions made about available cropland, yields, production costs and quality of governance, residues and agricultural inputs (Searle & Malins, 2015).
Southern Africa has been identified as a region with high potential for supplying biofuel, due to its favourable climate, and availability of arable land and water (Smeets et al., 2004; Schut et al., 2010; von Maltitz & van der Merwe, this issue). The availability of resources is believed to permit production in large volumes of crops used as first-generation feedstocks (i.e. that use the starch, sugar or oils from food crops) including maize, sugarcane, sugar beet, sweet sorghum, jatropha, castor beans and soybean oil. While sugarcane-based ethanol is identified as the most feasible first-generation technology pathway for producing biofuels (and is the focus of this issue’s analysis) other feedstocks and emerging technology pathways both offer alternative choices for scaling-up production (von Maltitz & Safford, this issue). However, all are at different stages of development and there are varying levels of certainty over their commercial viability.

Several other factors motivate a focus on sugarcane as a base for biofuel production. Firstly, this has been the crop of choice for most bioethanol feedstock ventures across Africa due to its longstanding use as a bioethanol feedstock in other countries, notably Brazil, its high yield and its long history of cultivation within the region (Braude, 2015; Dubb et al., 2016). An important consideration for biofuel feedstocks given their role in combatting climate change is their relative contribution to carbon dioxide emissions and, while reported figures differ owing to different assumptions, sugarcane is often recognised as the best performer of first-generation feedstocks (European Parliament, 2015). Finally, there is pressure to diversify sugarcane processing into a wider range of end products beyond sugar. While the recent period of falling sugar prices has seen diversification happen on a global scale (OECD-FAO, 2015), the abolition of EU sugar production quotas from 2017 onwards (European Commission, 2016) provides an additional imperative to find new end markets. The abolition of EU sugar production quotas from 2017 has implications for African sugar exports to the EU, which have benefitted from the export of raw sugar to the EU market under the duty-free quota-free access for sugar from these countries.

The scope to produce large quantities of biofuel feedstocks, including sugarcane, varies across different parts of Southern Africa. From a biophysical perspective, the areas that appear most attractive are in the northern parts of Mozambique and Zambia, which have appropriate soils, higher rainfall and better potential access to irrigation (von Maltitz & van der Merwe, this issue; Tostao, this issue).

The scope to produce biofuel feedstocks in South Africa is conversely more limited. While South Africa has the largest area under sugar in the region at 320 000 hectares (Ha), biophysical conditions limit the scope to expand this area further (von Maltitz & van der Merwe, this issue). Estimates from the South African Sugar Association (SASA, 2007, reported in Kohler, 2016) suggest that to replace 2% of the 2013 petroleum consumption with sugarcane-based ethanol would require under 10% of South Africa’s existing sugar area. By diverting all South Africa’s current sugar surplus (i.e. beyond what is consumed domestically), it would be possible to replace 4% of 2013 petroleum consumption. As domestic sugar manufacturers are protected from low international sugar prices by a dollar-based duty on imports (ITAC, 2014), it is highly unlikely that it would be profitable for domestic producers to produce ethanol before meeting the domestic demand for sugar.
2.2. Future demand for biofuels

2.2.1. Consumption of biofuels in Southern African countries
Southern African countries have all considered proposals for blending biofuels with transport fuels, with some in the region like Malawi and Zimbabwe having longstanding bioethanol programmes (Henley, 2014). Malawi has a 10% ethanol mandate in place which depends on availability, while Zimbabwe’s ethanol mandate ranges between 5% and 15% (Biofuels Digest, 2018). Both Mozambique (10% ethanol; Biofuels Digest, 2018) and South Africa have introduced biofuel blending targets more recently, and although Zambia has defined blending ratios, it has yet to introduce a blending mandate (Henley, 2014). Despite these efforts none of the countries consume biofuels in meaningful volumes (REN 21, 2015).

Moreover, for Zambia and Mozambique, the potential market size for fuels is limited in the medium term given the present size of national vehicle fleets, and moderate rates of economic growth and wealth creation (Stone et al., this issue). On the other hand, South Africa consumes much more fuel, and could potentially increase the share of biofuels within its transport sector.

2.2.2. South Africa – an anchor market for biofuels from the region?
In 2014, the South African government announced the introduction of biofuel blending mandates of 2–10% for bioethanol and 5% for biodiesel. While domestic suppliers could meet the requirements set by the mandate in early years with minimal disruption to existing supply chains, plausible rapid future increases in demand could stretch domestic capacity. Stone et al. (this issue) estimate that under a low growth scenario of 2.7% average annual real GDP growth, South Africa’s demand for bioethanol would increase to between 300 and 1400 million litres within 10 years of the blending mandates being implemented. These demand projections do not include the potential use of flexible-fuel cars in South Africa, which – if introduced – could see demand for biofuel increase to around 3 billion litres under a 40% flexible-fuel car penetration rate. These demand projections are therefore sufficiently large for South Africa to be an anchor market for biofuel production within the Southern African region.

The land footprint associated with this elevated level of demand would be substantial. Assuming flexible-fuel cars do not enter the South African market, by 2025 the estimated area of land needed is between 135 500 and 248 286 Ha by 2035 (Stone et al., this issue). This would rise substantially if flex-fuel cars were introduced into the national fleet. As discussed above, diverting sugarcane to ethanol would be economically unattractive, while expanding it is environmentally unfeasible. While by no means insignificant, other countries in the region are more likely to be able to accommodate the expansion of area planted for feedstock crops. Von Maltitz and van der Merwe (this issue) find that significant potential for land expansion for biofuel crop production exists on the eastern side of the region, with northern Mozambique and northern Zambia illustrating good potential for almost all biofuel crops considered.

3. Impacts
The papers in this issue seek to shed light on the potential economy-wide impacts of a regional market in biofuels were one to emerge. The aim of this is to understand
whether a biofuel industry would displace production in other parts of affected countries’
economies, and if these displacement effects would be beneficial or detrimental. It also
aims to understand how benefits would be distributed across different groups in different
countries. The analysis suggests the following effects would be felt.

Firstly, South Africa would benefit from increased incomes in the rest of Southern
Africa, to which it is a key exporter. Approximately 20% of South Africa’s exports are des-
tined for SADC countries (Mozambique accounts for 9% of total exports and Zambia 2%)
(Quantec, 2016). Higher incomes in these economies could therefore translate into
increased exports for South Africa and higher economic growth. Imports from other
biofuel importers such as Brazil, the USA, Argentina or Indonesia would have smaller
positive trade effects as very few of South African products are exported to these countries
(less than 3.5% collectively) (Quantec, 2016). Gabriel and Davies (this issue) develop a
multi-region social accounting matrix (SAM) to assess the level of integration through
trade within the region and between South Africa, Zambia and Mozambique, relative to
the rest of the world. They find that higher demand in Zambia and Mozambique, particu-
larly for manufactured goods, indeed has a positive impact on South Africa as most of their
imports are sourced from South Africa. Higher demand in South Africa, however, has a
very small impact on other countries in the region as most of the countries import
needs are met by the rest of the world. Their results further indicate that trade links
within the Southern African region, particularly trade excluding South Africa, is very
weak and therefore provide an opportunity for growth and development.

Secondly, bioethanol-producing countries would benefit from the development of the
new industry. Hartley et al. (this issue) illustrate that the development of a single product
sugarcane-based biofuel industry in Zambia and Mozambique, at the scale required to
meet potential South African demand, would have a positive impact on economic
growth and employment in these countries. Average annual real GDP growth could
increase by as much as 0.042 and 0.0068 percentage points, respectively. If multiple
value chains were developed around the industry (e.g. electricity production from
waste) the benefits would be significantly larger (0.068 and 0.02 percentage points). The
biofuel industry would furthermore directly create between 55 000 and 260 000 additional
jobs depending on the biofuel crop chosen and farming model followed. The development
of a biofuel industry within these countries was further found to have no significant impact
on food security as increases in household incomes were sufficiently large to offset any
increases in food prices.

Thirdly, a regional sugarcane-based bioethanol market would provide an alternative
market for sugarcane products in the region. Up until recently, Zambia and Mozambique
alongside other developing-country sugar producers have benefitted from preferential
access to sell sugar on EU markets; however, sugar regime reforms which took effect in
September 2017 offer less favourable prices (Mutumweno, 2016). While growing
markets for sugar in southern and eastern Africa will absorb additional production in
the short term, a bioethanol industry could provide an additional market to buffer
demand shocks in the longer term.

Finally, the development of a regional biofuel market may provide an additional set of
incentives to develop infrastructure needed for trade within the region and potentially
reduce non-tariff barrier costs. This would benefit South Africa, which, as mentioned
above, is a large exporter to SADC. It would also have additional positive effects for
intra-trade within the region and has the potential to encourage the development of new value-added chains across the region. The bulk of commodities traded within Southern Africa are transported via road. Road transport costs, however, remain high relative to other regions in Africa and internationally despite the input costs of road transportation being lower, thus making imports from outside the continent more cost competitive. Reducing transport costs by 50% would make regional producers more than 10% more cost-competitive (WIDER, 2016).

4. Current obstacles to overcome

4.1. Ongoing uncertainty surrounding South Africa’s commitment to increase consumption of biofuels

South Africa’s commitment to using biofuels, however, remains uncertain. While the country has had a Biofuel Industrial Strategy and mandates in place since 2007 and a mandatory blending regulation (Henley, 2014), production and consumption of biofuels have not taken off (REN 21, 2014). Letete and Blottnitz (2012) report that failure stems from the strategy’s overambitious aims, which resulted in prioritising crops and farmers to meet social policy objectives, rather than prioritising the production of biofuels. Sorghum is the favoured crop in the Biofuel Industrial Strategy as it could be grown in the poor former homelands and grown by emerging farmers (DoE, n.d.). While manufacturers can also use sugarcane, the sorghum price was proposed as the main index to calculate the subsidy (DoE, n.d.). Despite proving inadequate to promote production, this has remained unchanged.

Although blending was mandated to commence in 2015, the lack of attractive pricing has meant manufacturers have not commenced blending. The South African government had indicated that the price of biodiesel and bioethanol would be exempt from fuel taxes by 50% and 100%, respectively (Kohler, 2016). Kohler (2016) argues that the minimum support from the government to secure bioethanol production in South Africa should be to guarantee a minimum selling price of 95% of the basic fuel price with exemptions from fuel taxes and specific capital investment allowances. Recent analysis (Braude, 2015; Kohler, 2016) suggests that to incentivise production, fuel tax exemptions are needed that are linked to both the price of crude oil and the exchange rate. Moreover, in 2015, the government announced that low oil prices would raise the fiscal burden of subsidy pay-outs to an unacceptable level, and restricted access to subsidies to manufacturers that submitted the lowest bids (Roelf, 2015). The low oil prices, together with concerns around food security and the policy framework, have led to the government temporarily halting the policy development process around biofuels (Canegrower’s Association, 2016).

4.2. South Africa’s openness to regional imports

Current provisions contained within South Africa’s biofuel legislation that restrict the use of imports to exceptional circumstances currently pose a barrier to regional trade (Henley, 2014). As questions revolve around whether these domestic sourcing requirements comply with South Africa’s commitments under its participation in SADC and WTO agreements,
relaxing these may be necessary to comply with trade commitments as well as favouring a trade in biofuels (Henley & Fundira, this issue).

4.3. Neighbouring countries’ commitments to production and consumption

Southern African countries have yet to produce meaningful quantities of biofuels despite the existence of recent or longstanding biofuel mandates (REN 21, 2015). Estimates from Hartley et al. (this issue) and Sinkala et al. (2013) show that, excluding transportation costs, bioethanol from Mozambique and Zambia is cost-competitive. Hartley et al. (this issue) estimate production of bioethanol from sugarcane in Mozambique and Zambia to cost around US$0.32 and US$0.44, respectively. Kohler (2016) estimates that for the period 2010–15, ethanol produced from sugarcane in South Africa would cost around US$0.68 per litre.

Past attempts to start production of biofuels at scale have faced major hurdles, and there have not been successful commercial investments in either Zambia or Mozambique to date (Tostao et al., this issue; Samboko & Henley, this issue). Previous reviews of the failures have identified factors related to availability of credit – particularly in the aftermath of the global financial crisis – and the lack of viability of particular crops such as jatropha (Hofmann & Khatun, 2013; Locke & Henley, 2013; von Maltitz et al., 2014). A major challenge biofuel investors have faced is accessing land in a way that does not face global and local opprobrium. Searle and Malins (2015) find that estimates of available land generally do not consider governance variables in their assumptions, and implicitly assume bioenergy expansion is possible without conflicts.

4.4. Accessing land

Closely associated with the global land rush (Locke & Henley, 2016), biofuel investors have often faced criticism in the way they have acquired land, which has often fallen short of practices associated with responsible investment. These include thorough consultation with households who face physical or economic displacement, paying market-rate compensation for land to affected households and contributing to resettlement packages that ensure affected households are not materially worse off because of their displacement. Operating within environments where rights and obligations of government and investors to local communities are either unspecified or poorly communicated, investors have often been accused of failing to live up to promises of creating employment, providing community facilities or providing inputs and markets for crop production in neighbouring communities.

As the papers on Zambia (Samboko & Henley, this issue) and Mozambique (Tostao et al., this issue) set out, experiences in both countries highlight shortcomings in the processes of land acquisition and broader land governance which contribute to negative social outcomes and risks. While there are examples of scrupulous investors that have set out to minimise negative social impacts through their engagement with local communities (Chu et al., 2015), it cannot be assumed that all investors will be similarly proactive. The production and trade of biofuel feedstocks on a large scale are therefore unlikely to proceed without significant social costs unless practices and expectations surrounding investments in land are clarified and monitored for compliance.
5. Conclusions

This special issue focuses on the opportunity for future growth of a biofuel market in Southern Africa. To explore the viability of a regional market for biofuels, the papers interrogate some of the challenges that face production, trade and consumption in three countries: Mozambique, Zambia and South Africa. Although the current market in South Africa is limited, with adherence to the proposed mandates and, especially, additional demand from flex-fuel technology, bioethanol demand could rise considerably. The papers identify that from a biophysical perspective, producing biofuel feedstocks in Zambia and Mozambique would be preferable to doing so in South Africa, where there is less potential to expand. 

For the success of a regional biofuel market a set of coordinated supportive policies favouring trade within the region may need to be implemented by member countries, at least initially. This would allow producers time to develop their domestic sectors such that a sufficiently large scale of production within the region is able to compete with low-cost outside producers. Investments in infrastructure would also be necessary.

However, serious challenges remain that would need to be resolved before a biofuel market could come into being. On the production side, given the land governance lacunae in both Zambia and Mozambique, particularly in relation to large-scale land investments, there is a need to ensure that increase in production of biofuels feedstocks occurs without deleterious social impacts. Ensuring processes of investing in land are procedurally fair and result in equitable and socially acceptable outcomes is necessary to ensure biofuel production can take place. For trade and consumption in South Africa to occur, changes are necessary to the current framing of biofuel policy objectives, which emphasise domestic social policy goals and prohibit trade.

Given the above, the development of a regionally integrated biofuel market within Southern Africa will ultimately depend on the political will and close coordination among the countries involved.

Acknowledgment

The financial support of the Japan Science and Technology Agency (JST) for the Belmont Forum project FICESSA in the production of this publication is greatly appreciated and acknowledged. The authors would also like to thank the United Nations University World Institute for Development Economics Research for their assistance in this research under the Regional Growth and Development in Southern Africa project.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Channing Arndt http://orcid.org/0000-0003-2472-6300
Faaiqa Hartley http://orcid.org/0000-0001-9799-3923

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