Biofuels: ACP's response to fossil fuel dependence

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ABSTRACT

Advancing the production of biofuels in ACP countries will provide the opportunity for them to partially meet their energy needs, export to the EU and USA, and overall allow ACP countries to improve the competitiveness of traditional agricultural-based industries. Science, Technology and Innovation must play a vital role in advancing the rapid development of any sustainable biofuels sector through using abundant local biomass resources, increasing efficiencies required to maximize crop yield and biofuels production; infrastructure development, increasing research capabilities and stringent environmental management. In developing a sustainable biofuels sector ACP countries will also play a useful role in tackling the issues of climate change.

INTRODUCTION

The cut in prices paid for sugar exported to the EU coupled with the rising oil price have forced many ACP countries to seek innovative ways of meeting energy demands and diversifying agricultural production. Biofuels provide an opportunity for ACP countries to utilise their natural resources to attract the necessary foreign and domestic investment to achieve sustainable development goals. Promoting the use of biofuels and other non fossil energy sources can contribute to energy security, improved quality of life for rural and urban populations, economic development and new opportunities for job creation and poverty alleviation, especially in rural areas.

Biofuels are products from biological origin that have been converted into liquid, solid or gas form, depending on the raw material and the technology employed, for energy generation. Raw materials include renewable plant matter e.g. trees, grasses or agricultural crops; cassava, sugarcane and also animal waste. Bio-ethanol, bio-diesel and pure plant oils are the most common forms of liquid biofuels. Liquid biofuels can be used for heating, cooking, lighting, transport and power generation. Solid biofuels are plant matter such as wood chips, and other solid or woody biomass, that can directly be used as a fuel. One of the most widely used forms of solid biofuels is bagasse, the fibre remaining when sugar cane is crushed to remove the cane juice for sugar production. Bagasse has been used for centuries for electricity generation at sugar mills, and the excess can be sold to the national grid. *Gaseous biofuels* include biogas, which is produced by digesting organic waste, and can be used for cooking, lighting and power generation at the village level.

The sugar cane plant which grows well in most ACP countries is considered the most efficient species of the plant kingdom in terms of biomass production and can be further engineered to produce increased amounts of sugars and higher percentages of fibre. Sugar cane juice and molasses can be fermented to produce ethanol as is happening on a large scale in Brazil.

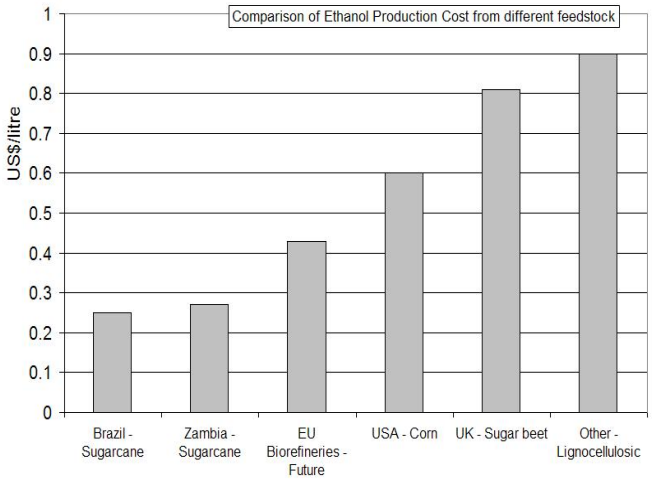
Vegetable oil sources such as palm, coconut and jatropha can be used in their direct form (pure plant oils) or converted into biodiesel, and serve as alternatives to diesel imports. Tallow, a by-product from livestock industry can serve as a raw material for the production of biodiesel.

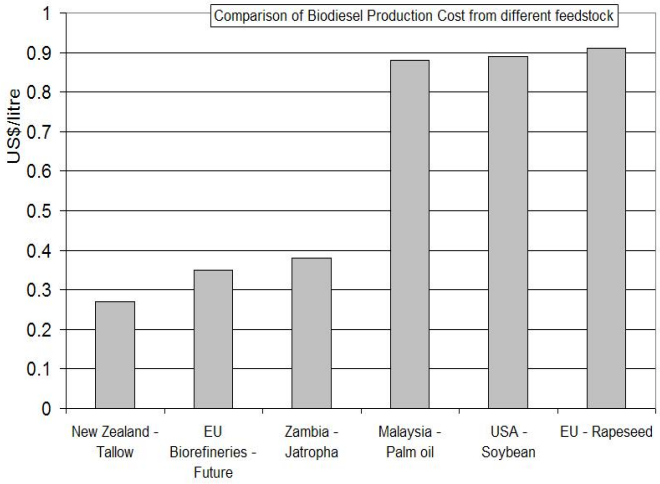
The conversion technologies for producing liquid biofuels from ligno-cellulosic sources such as wood, grass and bagasse are promising but are currently uncompetitive. ACP scientists and engineers must contribute to the global knowledge system that is working to improve the efficiency of the conversion technologies to make biofuels competitive and reduce the conflict of agricultural commodities for fuel versus food; such an approach will help in ensuring adequacy in food supply while safeguarding the environment and the quality of life in rural communities. A concerted effort of governments, scientific community, engineers and society is needed.

Challenges

Market prices of both agricultural feedstock and fossil fuels are the main determinants of biofuels competitiveness. Given that these prices are highly volatile, investing in biofuel requires closer examination of the long term market potential and other determinants to minimize the risks. Economies of scale are crucial for successful implementation of any biofuels programme. In this regard, it is important that knowledge and capacity are available to select the appropriate feedstock and technology to produce biofuels, which are competitive with fossil fuel. Lessons can be learnt from economic analyses undertaken for selected feedstock in various countries.

Fig. 1 and 2: Production cost of ethanol (left) and biodiesel (right) in selected countries *(Source IEA 2004 Energy Outlook, CEEEZ 2006)*





Most ACP countries presently import more than they export and, a recent study by Woodruff (2006) showed that while there are economic benefits to import substitution of fossil fuels in Pacific island countries, this reduces exports of copra, coconut oil and sugar. For example, to replace 10% of imported petrol, 20% of the exported agricultural commodities may be required; therefore, the trade balance (at equal price levels) worsens. In addition, subsidies for market penetration may be required, with further potential negative impact on government coffers. It is thus important that countries consider the total impact of a growing biofuels industry on their economy, including economic resilience, job generation, rural-urban drift and support for local agricultural production and export. There is a strong case for increased economic resilience; Levantis (2007) found that an increase in price of US$10 per barrel of oil on the world market corresponds to a 2% decrease in the average economic growth in the Pacific.

Despite the existence of a range of conversion technologies, the biggest challenge hindering viability of the biofuel industry in many ACP countries is the availability of feedstock in sufficient quantities at reasonable prices. Although a range of feedstock is widely available, economics of transformation are rarely competitive with current prices of fossil fuel. In some cases, the feedstock is not sufficient to produce adequate amounts of biofuel to satisfy

technically acceptable blending ratios, such as 10% ethanol in petrol (E10) or 10% biodiesel in diesel (B10).

ACP countries should aim to produce biofuels from locally grown crops that are well adapted to the local conditions. Thus, in sugar producing countries, bio-ethanol can be obtainable from sugar cane. In vegetable oil exporting countries, pure plant oil or biodiesel can be produced from coconut, palm and jatropha oil among others. Consideration should be given to restricting the use of edible oil and grains for biofuel feedstock to avoid rises in food price as is done by a number of countries including China and India. Another specific concern for ACP countries is that jatropha is a highly invasive species and effective management plans must be put in place. The development of bio-refineries will allow use of a more diverse range of feedstock, including agricultural wastes, grasses and fast growing trees for conversion to bio-ethanol.

With the implementation of the new EU sugar regime (2007-2009), industries started restructuring in an attempt to stay competitive. The common theme among all the restructuring plans was to satisfy industry demand for energy by using bagasse for powering the plants in the first instance and diversifying into ethanol production. Other options include the production of ethanol from molasses for the local or export fuel markets.

In most ACP states, biofuels have not been standardised for use as a recognised fuel or fuel blend, neither have national standards been developed. This reduces the acceptability of biofuels to domestic and industrial consumers. Most EU countries have established standards for the use of both bio-ethanol and bio-diesel, which ACP countries can adopt or modify. The ACP region can also draw lessons from existing biofuels standards in Brazil, Philippines, and Malaysia. Standards for the quality of pure plant oils in adapted engines can also build on the existing German standard for vegetable oils as a fuel in transport and power generation.

Biofuels can completely displace the fossil fuels used in cars, trucks or generators, if these are adapted to accommodate the new fuel, for example, the 100% ethanol flex cars. To avoid the costs of switching or having to make engine adaptations, it is generally simpler to blend the proposed biofuels with the existing fossil fuel, such as is done for E10, or B10 for diesel vehicles thereby avoiding engine modifications for cars manufactured after 1990. The ACP region must put the policy infrastructure in place to accommodate these blends and provide the incentives to encourage oil distribution companies, car manufacturers and other entrepreneurs including farmers to invest.

International trade in biofuels and biofuels feedstock has increased rapidly and is expected to increase further in the coming decade (FAO 2007). Increasing demand for vegetable oil, under pressure of the EU biofuels mandate, for example, has resulted in a rapid increase in vegetable oil prices (Figure 3) with negative impacts on the viability of biofuels and food prices.

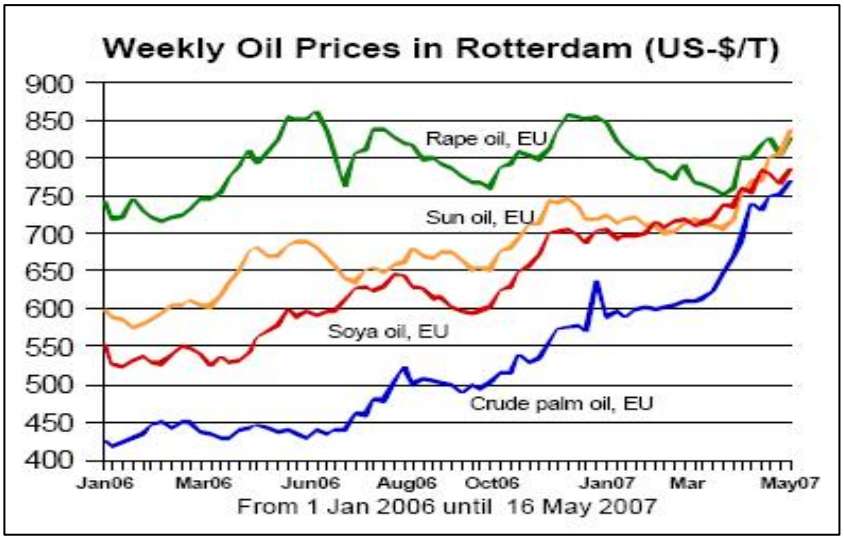


Figure 3: Vegetable Oil prices (source Oil World, May 2007)

Other ways of securing the industrial and financial viability of the biofuels industry would be to increase the production capacity to satisfy local needs and to compete in export markets. Right sizing of the industrial complex is important to the long term success of the industry. In addition, export taxes, transport charges as well as import duties in the targeted countries must be closely examined to guarantee price competitiveness at the delivery site.

Most Caribbean states have updated their energy policy to include renewable energy. Although many other ACP states have an energy policy, some are outdated and do not actively support the use of renewable energy. To support rural communities, many countries subsidise the use of kerosene for lighting, cooking and other diesel for power generation and transport in remote areas. In addition, some ACP countries still offer support mechanisms to stabilise the prices of farmer produce. These mechanisms do not necessarily take into account the role that biofuels can play, especially in remote places, for substituting fossil fuels. Therefore existing energy and rural support policies pose a barrier on the more widespread use of biofuels.

The absence of updated policies, standards and tax incentives to promote biofuels production can lead to failure and or stagnation in the development of the biofuels sector. New energy policies need to address the issue of biofuels and other alternative fuels in a more holistic way, so as to optimise the total net benefits on a national level. There needs to be policy coherence between the different ministries and departments that will have some impact on the biofuels industry as well as coherence between the policies of ACP countries and those of the EU to ensure that there are no barriers to trade and allow for all the opportunities to be grasped.

There is a potential conflict between using land and water for growing crops for food for human consumption and livestock feed, rearing livestock, aquaculture ponds, and growing crops for biofuels. Therefore, the production of crops for biofuels requires improved efficiencies in land and water management practices. Removal of crop residues, such as leaves and stalks, for use in co-generation, can negatively impact on soil structure and promote erosion, thus affecting the

ecosystem. Therefore strategies for managing crop residues must also be developed for eco-system sustainability. In addition, destroying forests for large-scale plantations, for example, palms, in the tropical regions of the world results in loss of biodiversity and livelihoods. The production of biofuels from crops grown on lands which are eco-sensitive would be banned from the EU as these would not meet the sustainability criteria (COM, 2008).

Consideration should be given to using marginal lands to grow crops such as Jatropha. Large scale investment in biofuels in recent years (OD1, 2007) has shown that marginal lands have not yet been used, even though species like Jatropha can be grown there. Stringent management is necessary to achieve high productivity and maximum yield. High prices of fertilisers and failure to employ sound agronomic practices can hinder the proper growth and development of the plant and negatively impact small budget operations. Although the potential of biofuels in poverty reduction appears to be significant, it is also fragile: its success can be undermined by many of the same policy, regulatory or investment shortcomings that impede agriculture (ODI, 2007).

To improve the availability and quality of suitable feedstock produced under local conditions, more data is required on the characterisation and optimisation of feedstock life cycles. In addition, economic analysis on the suitability of feedstock and appropriate technologies for conversion should provide direction towards cost-effective solutions. The use of GIS technology for resource assessment provides opportunities to identify feedstock availability in a comprehensive way. Harvesting and storage of the feedstock raw material requires improvement in compaction/dehydration techniques to increase the energy density.

As an alternative to bio-diesel esterification, requiring imports of extra-ACP methanol, pure plant oil applications in adapted engines should be further investigated as well as other alternatives to esterification. The prospect of joint ventures using methanol from ACP sources should also be considered. Appropriate logistical issues for transporting biofuels must be addressed to ensure compatibility with the existing infrastructure, equipment capacity and capability. National biofuels quality standards may require adaptation to suit local requirements.

To provide answers and to build capacities, greater investments in research and developing human capacity and physical infrastructure are required. However, these are often lacking in ACP countries due to financial constraints.

Opportunities

The largest contribution by biofuels in the energy mix can be obtained through industrial heat and power generation. Several cane breeding stations in ACP sugar producing countries are breeding new high fibre canes which will generate much bagasse after the juice is extracted. Burning solid biomass releases a considerable amount of energy which can be used to fire high pressure steam boilers to produce electricity with steam turbines. New high pressure technology is now available with higher efficiencies of electricity generated per unit of biomass, thus allowing excess electricity to be sold to the national grid. In addition, other biofuels such as woody biomass short rotation crops e.g. willow, eucalypts, poplar and agricultural waste may also be used during the out of crop season, to ensure power generation all year round and thus a good return on investment.

Apart from energy production on an industrial scale, biofuels also have a large role to play in improving quality of life and reducing fossil fuel demand at a household level in ACP countries. Remote areas in ACP countries can competitively use locally available raw material such as palm, jatropha and coconut to produce liquid biofuels for village power generation. Generators that have been adapted for the purpose and agricultural conversion equipment such as mills and filters are needed to complement existing rural electrification programmes, which usually only feature diesel generators.

Biogas can be produced from domestic and agricultural waste through anaerobic biogas digesters. The gas thus obtained can be used for cooking, heating both for households and light industrial applications and power generation. This requires cultural sensitivity analysis to ascertain its acceptability for use in the local context. BioGel is made from low-grade ethanol and mixed with a gelling agent and has the potential to replace wood for cooking, lighting and heating. Its solid form makes it easy and safe to distribute and the widespread use of this fuel will contribute to reduction of forest depletion caused by firewood use.

The use of biofuel can be made fiscally attractive based on the rationale of improving the balance of payments, decreasing dependence on fossil fuels and improving the local air quality by including these externalities into the price of fossil fuels through taxation. In addition, duties on biofuel-related equipment, partial duty exemption for biofuel blends and investment subsidies have been shown to boost biofuel sectors in many countries. Blending ratios are determined by technical, economic and market considerations. For ethanol up to 10% and biodiesel up to 20% blending is possible. However, the final blending ratios are influenced by the market for conventional fossil fuels and availability of feedstocks. To obtain optimal national blending ratios requires research in feedstock characteristics vis-à-vis environmental and socio-economic considerations. In order to support market development, national quality standards are imperative. Locally appropriate standards for a dedicated fleet with adapted engines operating on pure plant oils can also be considered.

CONCLUSIONS

ACP countries can play an important role in biofuel production, because of their natural endowment – climate, arable land and water resources. National strategies can ensure biofuel benefits will accrue not only to importers of biofuels such as the EU and the US but also to the producer countries in the ACP region. This requires ACP governments to take action now, investing in a competitive agricultural sector, taking into account the linkages between biofuel production and agriculture including livestock and fisheries.

ACP Governments must act and increase investment for sustaining science, technology and innovation infrastructure with emphasis on building human resource capacity and physical infrastructure. Such investment is crucial to support the product development and technological breakthroughs that are relevant to a competitive agricultural sector, that can sustain biofuel production. Scientists must be mindful of the linkages between biofuel, agriculture including livestock and fisheries and societal goals of food and nutrition security and economic prosperity. Finally, it is envisaged that through policy coherence for development (PCD), which highlights the EU's commitments to improving the effectiveness of development assistance, ACP national governments should be able to access policy, budgetary and technical support in the areas of environment, energy, agriculture and food security (COM, 2008).

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