Sustainable Liquid Biofuels for Transport

The Context of the Southern Africa Development Community (SADC)

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Content

1. Energy & Economics

The Southern African Development Community (SADC) has evolved in 1992 from the former Southern African Development Coordination Conference (SADCC) existing since 1980. The SADC aims at regional integration, sustainable growth and alleviation of poverty in the member countries. Fourteen countries make up the Southern African Development Community (SADC): Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Biofuels production represents an opportunity for the region to increase energy supply security and to give a boost to rural economies by opening markets for agricultural surpluses, creating jobs and encouraging mechanization of agricultural practices. However, climatic, agronomic, ecological and policy factors can hamper the industry development in the region. In that sense, a clear definition of objectives and a careful implementation that takes into account sustainability as well as socio-economic aspects are much needed from policy makers. Even thought most of SADC's economies presented relatively high growth rates in 2006 (Table 1), exception made of Zimbabwe that presented negative growth, the region is still pervaded by profound inequalities and Millenium Development Goals (MDG's) will be difficult to achieve. In 2006 the combined Gross Domestic Product (GDP) of the region was close to US$379 billions with a predominant percentage of South Africa (67%).

Table 1. Socio-economic indicators for SADC countries

	Population (Millions)[*]	Total GDP Billions of US$[*]	GDP growth rate %[*]	Per Capita GDP US$[*]	HDI[**]
Angola	16.4	44.0	14.6	2686.2	0.4
Botswana	1.8	10.3	4.8	5876.0	0.6
Democratic Republic of Congo	59.3	8.5	5.1	143.9	0.4
Lesotho	1.8	1.5	2.8	827.3	0.5
Madagascar	19.1	5.5	4.9	288.2	0.5
Malawi	13.2	2.2	8.4	169.4	0.4
Mauritius	1.3	6.5	3.5	5147.6	0.8
Mozambique	20.1	7.6	8.5	377.8	0.4
Namibia	2.0	6.4	4.6	3136.4	0.6
South Africa	47.4	255.0	5.0	5380.6	0.7
Swaziland	1.1	2.7	2.1	2353.5	0.5
United Republic of Tanzania	39.5	12.8	5.9	323.7	0.4
Zambia	11.9	10.9	6.0	919.5	0.4
Zimbabwe	13.1	5.0	-4.8	382.9	0.5
SADC Total	247.9	378.9	-	-	-
Brazil	188.7	1068.0	3.7	5659.7	0.8
United States	299.0	13201.8	3.3	44646.0	0.9
Switzerland	7.4	379.8	2.7	50634.7	0.9

Source: [*]World Bank, 2006; [*]Human Development Index ranking, UNDP, 2006

Notwithstanding the fact that the region as a whole is a net energy exporter, energy security is far to be assured for most of SADC countries (Table 2). Fossil energy resources are unevenly distributed throughout the region. Southern Africa net energy exports are Oil from Angola and coal from South Africa (Amigun *et al*, 2006). Crude oil production has quadrupled in Angola over the past twenty years (EIA, 2006) representing 84% of SADC production (other regional producers are South Africa and Democratic Republic of Congo).

Table 2 SADC Total energy balance

	Production Mtoe	Net imports Mtoe	TPES Mtoe
Angola	70.70	-59.34	9.90
Botswana	1.05	0.84	1.89
Democratic Republic of Congo	17.39	-0.42	16.97
Lesotho	0.08	0.07	0.15
Madagascar	0.16	0.92	1.08
Malawi	0.32	0.32	0.64
Mauritius	0.03	1.34	1.37
Mozambique	11.74	-1.53	10.21
Namibia	0.33	1.05	1.38
South Africa	158.59	-28.80	127.64
Swaziland	0.23	0.24	0.47
United Republic of Tanzania	19.10	1.33	20.40
Zambia	6.51	0.67	7.12
Zimbabwe	8.86	0.86	9.72
SADC Total	295.09	-82.45	208.93
Brazil	187.83	25.14	209.53
United States	11630.68	734.87	2340.29

Sources, IEA; 2005; EIA, 2005

Most of SADC refining capacity is concentrated in South Africa which is also responsible of 98% of SADC coal production, having a 5.4% of world recoverable reserves (EIA, 2006). At a local level, coal is mainly used to produce electricity and also for synthetic fuel production. However, as stated before, most of the countries are net energy importers. In addition, they are extremely dependent on inefficient traditional forms of energy with subsequent health and environmental impacts; poverty and traditional biomass use for energy being closely correlated (Amigun et al, 2006). If we add to all this the increasing price of fossil fuels, which affects directly the transportation sector and consequently the infrastructure development, we have a dangerous cocktail for poverty, underdevelopment and exclusion.

Biofuels production offers also opportunities at the international trade level. The demand of biofuels is rapidly increasing especially in industrialised countries where their potential contribution in achieving Kyoto protocol is acknowledged as well as their role in energy and agricultural outputs diversification. On the other side, in developing and emerging countries, interest is gaining in wide scale biofuels production with the aim to cope with insecurity of oil import, capture of biofuels market share in industrialised countries and creation of new socio-economic opportunities. As the biomass potential is higher in this kind of countries with lower production costs than in most of industrialised countries, biofuels trade will develop in the future and may give an impetus to a massive production with the risk of ecological burdens. In many industrialised countries, the perspective of a wide scale production of biofuels in the world raises the fear of environmental, social and economic imbalances. In that sense, sustainability principles are being developed for qualifying suitable biofuels. The Roundtable on Sustainable Biofuels (RSB) can contribute to the convergence of these initiatives at the international level. In Switzerland, a potential importer of biofuels from developing countries, the public authorities are considering favourably their development. In March 2007 the parliament has decided to remove the mineral oil tax on the sustainable biofuels i.e. those where there is no evidence of a global negative ecological balance.

However, evaluating a global ecological balance is not straightforward. Many factors are influenced by local specificities and average values can hide a large variability within a country, a region, a biofuel pathway, etc. In that framework, the SADC has expressed a high interest in developing biofuels in its member countries and realised a feasibility study in July - August 2005 (Takavarasha et al, 2005) that came up with the following recommendations: *Set up an institutional framework to promote biofuels by establishing a Regional Biofuels Development Board to coordinate all aspects of the biofuel programme in the region; study the available international experience in all aspects of biofuels including policies, feedstock, technologies and business models; formulate and adopt holistic and biofuels friendly policies and a workable and practical implementation strategy*. Within the EU SADC Investment promotion programme (€SIPP), a regional policy on biofuels will be established in close cooperation with the stakeholders. That gives a good opportunity for introducing the sustainability principles and their application in the whole region.

2. Early initiatives

Biofuels production has been an alternative for some Southern Africa countries since more than two decades now. Some initiatives including blending obligations have been implemented in the past, always in the spirit of favoring imports substitution by the diversification of energy sources. For instance, *ETHCO Ltd.* (Ethanol Company of Malawi) has operated since 1982, producing ethanol from molasses of sugar industry to comply with a 10-20% blending rate intended to reduce foreign exchange expending. In turn, Zimbabwe's *Triangle Ltd* began ethanol production from analogous source and analogous reasons since 1980, with established blending targets of 8-13%. However, in the early 1990s, a drought largely affected sugarcane production. After the drought, attempts to start again with the blending program were unsuccessful, due to market and competitiveness constraints, such as lack of effective government support and the preference for the rectified spirit's market instead of the internal transportation market (Amigun et al, 2006; Johnson & Matsika, 2006). In the case of Malawi drought related risks are reduced due to the availability of irrigation water from Lake Malawi (Joint UNDP/World Bank, 2005). In South Africa, the synthetic fuels industry is highly developed due to the apartheid related international sanctions that forced a strong governmental support; the feedstock used for this kind of fuels is mainly coal due to the South African large amounts of reserves. However, this technology could be used also to produce second generation biofuels from lignocellulosic materials, provided a substantial cost reduction in the process (EIA, 2006; Johnson & Matsika, 2006).

3. Strategic framework

Although Malawi's and Zimbabwe's blending programs were the first to be implemented, presently it is South Africa that is taking the more serious steps towards establishing a biofuels national program. In South Africa, the White Paper on Renewable Energy (November, 2003) has set a target of 10'000 GWh of energy to be produced from renewable energy sources to be achieved by 2013. In that context, biofuels play an important role. The proposed South African Biofuels Industrial Strategy (December, 2007), aims to achieve a biofuels average market penetration of 2 % of liquid road transportation fuels (petrol and diesel) by 2013. This strategy is an update of a 2006 draft strategy recommending 4.5 % penetration target in the liquid fuel supply. Some biofuel feedstocks such as maize for bioethanol and jatropha for biodiesel were also excluded in the new strategy in consideration of food security concerns. However, according to some sources[1], a process of negotiations started but significant production surpluses must be proved for a crop to avoid being excluded from the strategy. It is expected that the fulfillment of the penetration objectives will require about 1.4 % of arable land in South Africa without compromising existing food markets. The proposed blending ratio is B2 or 2 % biodiesel and E8 or 8 % bioethanol blend However, in this initial or incubation phase, a blending obligation is not envisioned and a deregulation strategy is prioritized, including tax incentives (The World Trade organization rules accept Fuel levy reductions up to 100%), the creation of an equalization fund to protect producers from low oil prices and a licensing system for biofuels producer managed by the Department of Minerals and Energy (DME) of South Africa. Presently, peaking oil prices favor biofuels penetration development without substantial fiscal burdens. A 100% fuel tax exemption is proposed for Bioethanol and an increase of the existing fuel levy exemption for biodiesel from 40% to 50% (a further increasing of the diesel exemption was considered impractical). The strategy is intended to address issues of poverty and economic development by the promotion of farming in underutilized arable land (estimated as 14% of total arable land) mainly in the former homelands. A producer incentive scheme will apply to ethanol produced from feedstock grown on the targeted regions. Given the scale of the strategy feedstock provision could be an important issue. The authors of the strategy acknowledge this fact and recommend strong support for farmers on the under utilized land through existing agricultural support programmes and investment. Some of these programmes is the Comprehensive Agricultural Support Programme (CASP) of the department of Agriculture (DoA) that support activities related to crop productivity enhancement. State-owned entities are also intended to play a leading role in this strategy either in the supply side as investors or in the demand side as large-scale consumers. Between the former entities the Central Energy Fund (CEF) and the Industrial Development Corporation (IDC).

Besides rising oil prices and global warming awareness, the fact that the region is one of the fewest in the world massively using leaded gasoline can be another driving factor favoring large-scale increase biofuel production, particularly of bioethanol either directly blended with gasoline or as ETBE. In that sense, lead phase-out programs can be seen as an opportunity to develop biofuels production. In South Africa, no lead was allowed in petrol from January 2006 (Foster, 2006) under the Cleaner Fuels program which also mandates a reduction in sulphur content in Diesel to a maximum of 0.05%. Zimbabwe, among other countries, is at the moment envisioning going further in that direction in order to revamp its blending program if political instability issues did not hamper the process. In addition, Zambian authorities are reviewing the National Energy Policy of 1994 to ensure that the biofuels sector is specifically mentioned in the new policy. A Draft policy paper proposing 10% blending is being considered (Takavarasha et al, 2005). There is also a rising interest from Namibian authorities envisioning bio-oil blending into diesel[2].

[1] http://www.engineeringnews.co.za/article.php?a_id=123697

[2] http://www.nab.com.na/jdocs/bio_energy_cons.pdf

4. Feasibility and opportunities of biofuels pathways in the SADC countries

In consideration of the heterogeneity inherent to the region regarding the context and the progress of the biofuels production, a country specific approach along with a regional coordination by the SADC is needed for a comprehensive and operational biofuels policy. Takavarasha et al (2005) identified some energy crops presenting high potential for biofuel production in the SADC region: oil palm, sweet sorghum, sugar cane, maize, sunflower seed, soybeans, jatropha, and cassava. Figure 1 shows 7 SADC countries with high potential for biofuels production: South Africa, Zambia, Angola, Mozambique, Zimbabwe, Malawi and Madagascar. In the near future, South Africa aspires to be the major producer of biofuels in the region. 8 anhydrous bioethanol from Maize plants of 155 million litres per year and per unit are being built by *Ethanol Africa*[3] between 2006 and 2012. According to *Ethanol Africa*, the availability of land in Southern Africa is high enough to envisage that the region will become in medium to long term a net exporter of biofuels. The amount of cultivated land for the SADC region accounts for a 6 % of the total land area (Table 3) which is a relatively low value compared to that of other major producer countries and suggesting an unexploited potential for the region. However, objectives and implementation strategies must be clear for policy makers and related authorities. According to a consultancy study from Dutch government (Foster, 2006), there are limited opportunities in South Africa for mass-scale production of biomass intended for biofuels export. Ethanol Africa, however expects satisfying the demand created by the 10% blending targets[4] by 2015. Maize, sugar cane, molasses, sugar beet, sweet sorghum sorghum, wheat, cassava are potential feedstock contributing to the expansion of the ethanol production in the region.

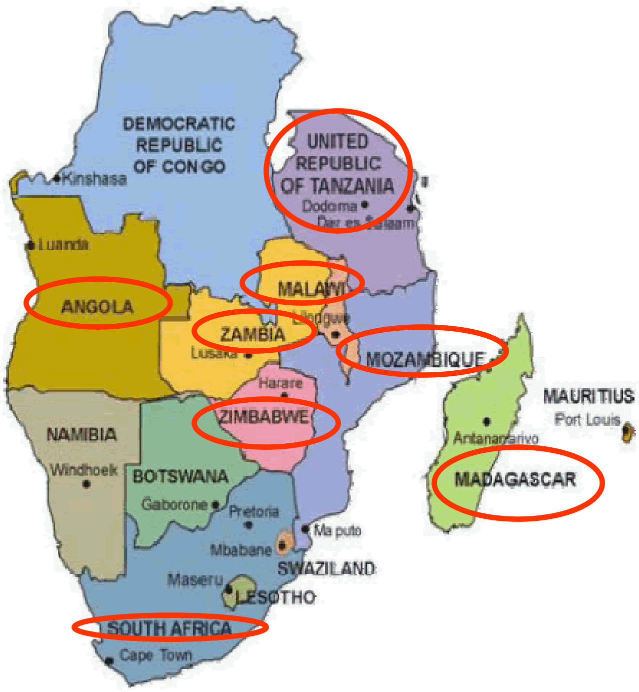

Figure 1. SADC countries with high potential for biofuels production) (modified from: http://www.sadc.int)

[3] http://www.ethanol-africa.com/

[4] http://www.ethanol-africa.com/

Table 3. Land use overview

	Land Area (Mha)	Forest Area (Mha)	Agricultural Area (% Land area)	Cultivated area (%Land Area)
Angola	124.7	56	46	2.9
Botswana	56.7	22	46	0.7
Democratic Republic of Congo	226.7	60	10	3.4
Lesotho	3.0	-	77	11.0
Madagascar	58.2	20	47	6.1
Malawi	9.4	27	47	27.5
Mauritius	0.2	-	56	52.2
Mozambique	78.4	39	62	5.8
Namibia	82.3	10	47	1.0
South Africa	121.4	7	82	12.9
Swaziland	1.7	-	81	11.2
United Republic of Tanzania	88.4	44	54	5.8
Zambia	74.3	42	47	7.1
Zimbabwe	38.7	49	53	8.7
SADC Total	964.1	38	45	5.5
Brazil	845.9	64	31	7.9
United States	915.9	25	45	19.2
Switzerland	4.1	29	37	11

Sources, FAOSTAT; 2000-2005; World Bank, 2000-2006 Johnson & Matsika (2006)

Sugar cane is a feedstock with high potential in the region. Production is steadily growing in the SADC at a rate of 2.5% due to rehabilitation programs in countries such as Tanzania & Mozambique (Johnson & Matsika, 2006). According to IEA (2004), the continent production will be enough to satisfy the demand created by a large scale program to replace lead from gasoline, which would require the shift of only a modest share of sugar production to ethanol production. SADC countries like Zimbabwe, Zambia, Swaziland, and Mauritius could replace lead with ethanol using primarily the sugar by-product, molasses.

At the international trade level there are important changes which could result in new opportunities if adequate measures and policies are followed. Many SADC countries, also members of the ACP[5] group of countries had long enjoyed from preferential prices in the EU market. However, there is an increasing pressure to eliminate market distortions, in the framework of the WTO's Doha round of negotiations, and presently these agreements are under attack (Johnson & Matsika, 2006). In the eventuality of an elimination of preferential prices for sugar, ethanol production from the sugar cane juice route could be favoured. Table 4 compares sugar cane and maize pathways. In general SADC yields of sugar cane are near to the global average, but can be higher, due to climatic conditions and irrigation, if South African values are excluded. However, it must be said that water use and terrestrial transport cost (especially for landlocked countries as Zambia) can highly influence overall performance (FAOSTAT, 2006; Johnson & Matsika, 2006). In the South African maize route, the data provided by Ethanol Africa seems very close in terms of cost to the Brazilian sugar cane route, as presented in Table 4. In addition, after personal communications with Harro von Blottnitz, (senior lecturer at the Department of Chemical Engineering, University of Cape Town) the fossil energy ratio of the maize pathway are higher than that of the US corn pathway, due in part to a somewhat higher content in starch of south African grain and lower fertilizer inputs for native production, notwithstanding lower crop yields.

[5] African, Caribbean, and Pacific (ACP) group of countries.

Table 4. Ethanol pathway comparison

	Crop yield (tons/ha)	Cost US$/l
Sugar cane route (Zambia)	106	0.45
Sugar cane route (Brazil)	74	0.25
Maize route (South Africa)	3.6	0.25
Maize route (US)	9.8	0.32

Sources: FAOSTAT, 2005; Ethanol Africa; Johnson & Matsika, 2006

The capacity of Tanzania, a country with a high potential for biofuels production is underdeveloped. Presently there is no large-scale production of liquid biofuels for transport in Tanzania, notwithstanding the fact that land availability will not be an important constraining factor (GTZ, 2005; Johnson & Rosillo-Calle, 2007). In this country, Ethanol production can be developed either through the sugarcane juice pathway or through the sugarcane juice and molasses pathway. In Tanzania about 1,446 metric tons of sugarcane per hectare are produced and 70 liters of ethanol could be produced from one ton of sugarcane. Sugarcane molasses are among the most promising feedstock for ethanol production in Tanzania but only about 30% of molasses generated in Tanzanian sugar factories is exported or used as animal feed, the rest is treated as a waste stream (GTZ, 2005).

Rainfall patterns are of course of utmost importance for determining sustainability of biofuels production. According to the Namibian Agronomic Board (http://www.nab.com.na/index.php), although Namibia is known as the driest country in Sub-Saharan Africa, it is possible to produce on a limited scale, staple foods such as pearl millet, maize, wheat, sorghum, sunflower and beans. But, as most products are produced under rain-fed conditions, crop failures are quite common, limiting biofuel potential from food crops. However, perennial bio-oil crops such as Jatropha, given its agronomic characteristics, represent an interesting alternative. As stated before, blending program of bio-oil into diesel is being considered by Namibian authorities. Jatropha also offers an opportunity for sustainable bioenergy in Botswana, a country with average annual rainfall of less than 500 mm (Takavarasha *et al*, 2005). On the other hand, the high rainfall belt of Angola, Zambia, Mozambique presents great potential for the development of a large-scale biofuels industry, according to Johnson & Matsika (2006), most areas with sufficient rainfall that are not already under sugar cane appear to be located in Zambia, Malawi, Tanzania, and Mozambique. The Canadian *Energem Resources Inc* of Canada had acquired a 70 per cent of shares in a renewable energy venture in Mozambique that will use jatropha to produce biodiesel fuel. Countries like the Democratic Republic of Congo (DRC) have a great potential for agricultural expansion, but degradation of the world's second largest undisturbed tropical rainforest by extending agricultural borders is an important issue to be considered. Nevertheless, a Chinese company, ZTE International, is to invest US$ 1 billion in an immense 3 million hectare oil palm plantation with the aim to produce biofuels[6]. In any case this seems paradoxical for a country which is a net importer of food and extremely depending on the food aid industry. Biodiversity threats are also an issue for Madagascar; a country recognized

[6] http://biopact.com/2007/07/dr-congo-chinese-company-to-invest-1.html

for its unique biodiversity. Presently, there are projected agreements with nearby Mauritius, in collaboration with Chinese government, for producing biodiesel from palm oil[7]. Table 5 summarizes ethanol production volumes for some SADC countries.

Table 5. Annual World Ethanol Production by Country (Mega liters, all ethanol Grades).

Country	2004	2005	2006
South Africa	416	390	386
Mauritius	23	11	8
Zimbabwe	23	19	27
Swaziland	23	11	19

Source: http://www.ethanolrfa.org/industry/statistics/#E

5. The Food vs. Fuels issue in the SADC context

A crucial question is generally raised about the possible effects of biofuels expansion, given the fact that the high levels of poverty and the underdevelopment of the agricultural potential make the SADC region especially vulnerable: does biofuels production in the world endanger presently and in short term food security? This question cannot be easily answered and a careful and scientific approach is needed to avoid ideological biases. In fact, there is a correlation between the increasing use of agricultural feedstock for biofuels production and the increase of the prices of the corresponding commodities. The general consensus from past analysis and future projections is that biofuels production will raise food prices and consequently will threaten food security, especially in biofuels producing countries and in poor countries where food imbalances prevail (Tokgoz *et al*., 2007; Kojima *et al.*, 2007; OECD, 2007; OECD/FAO 2007; FAPRI, 2007). However, even if biofuels production contributes to reduce in short term the agricultural products available for food; other factors, such as climatic conditions, natural events and political framework may also contribute to food insecurity.

In the SADC region, food security has been endangered by multiple year's droughts in several member countries such as Lesotho, Swaziland and Zimbabwe, the latter country experiencing additionally a deep economic and political crisis. Food security is also affected in food-aid dependent Democratic Republic of Congo, due mainly to civil war and internal refugees' crisis. In addition, short-term effects of oil prices' instability can be significant for poverty-stricken regions given low adaptability and lack of efficient social security nets. In a a middle income country as South Africa for example, a fuel shortage over the 2005 Christmas period, caused transport and infrastructure disruption and exposed the country's energy supply (Foster, 2006).

The share of arable lands used in the world for biofuels production is about 1% (IEA, 2006). In that sense; the picture of the SADC region is at first sight somehow favorable to biofuels production, with a 5% share of cultivated area, especially for countries like DRC, Angola, Tanzania, Zambia and Mozambique, as it was already mentioned. However, land availability is reduced in some producing countries such as the U.S. According to OECD projections (OECD, 2007), while in the in the African continent a 60% of land would be available for energy biomass production by 2050, in the US there would not be land available for energy crops by the same year. This pressure on land availability is liable for raising the price of some agricultural products such as maize, the international market of which the U.S. is the main supplier. According to the *World Bank Maize Commodity Brief* (April 27, 2007), there was a surge on the maize price in 2006 mainly due to the increased use for ethanol production in the U.S. that accounted for 20% of the maize produced in the country. However, the increase of the maize demand in the U.S. due to bioethanol did not cause a decrease of the U.S. export

[7] http://www.ecoage.net/madagascar-biocarburant-produit-avec-maurice.htm

of maize. That export in 2006/2007 reached a record compared to the last three years. However, the U.S. stock of maize decreased sharply from 49968 metric ktons (2005/2006) to 7557 ktons (2006/2007). That is the main explanation of the price surge of the maize on the international market. Even if the maize producers in the U.S. are intended to plant more maize and reduce cotton and soybean areas, about half of the increase of their production will be devoted to the increase of ethanol that will use 25% of the U.S. maize crop in 2007/2008. Therefore the *World Bank* predicted that the maize price will average $ 170/ton compared to an average of $122/ton in 2006. However, the prediction of the *World Bank* for 2007 does not occur thanks to the adaptation of the production in the U.S. and in Latin American countries. The FAO is expecting a record cereal harvest in 2007. The problem rather comes from the impact of poor weather conditions on the wheat production in Europe that has provoked a hike of the international wheat price with a spillover effect on the price of the maize (FAO; international commodities prices). Notwithstanding the high price of the U.S. maize in 2007, that price is still lower than in many developing countries. Table 6 compares the case of U.S. and South Africa. The raise of the maize price in South Africa results jointly from poor yield in 2007, increase of the fertilizers prices as a consequence of the oil price increase and the hike of the international wheat price mainly due to the weather conditions in Europe. It seems clear that when introducing a new demand for the same feedstock or land, its availability will decrease and its price will increase unless the productivity of the agriculture increased enough. That leads to the question if the increase of productivity would compensate the diversion of agricultural areas from food to fuels. Clearly, that will depend on the market share of biofuels in long term and on the precautions taken at international level for prioritizing sustainable biofuels in international markets.

Table 6. Comparison of U.S. with South Africa's Cereals prices for selected dates.

Commodity	One year ago	4 October 2007	**11 October 2007**
	U.S. $ / ton		
U.S. Yellow maize	108.4	134.7	**136.7**
RSA Yellow maize	166	265	**277**
RSA White maize	167	250	**270**
Exchange rate (Rand/$)	7.75	6.89	**6.72**
Oil price ($/barrel)	57.75	78.97	**80.11**

In the region, agriculture accounts for 70-80% of employment, but contributes only about 20% to regional GDP due to low productivity and value added (USAID/RCSA, 2006). Therefore, an increase in productivity is mandatory to take advantage of the agricultural potential of SADC region. Excluding South Africa, 2007 SADC's total outputs of all cereals and maize were estimated to be above the five-year averages by more than one-third and more than one-quarter respectively, even though some differences in particular performances (FAO, 2007). It is expected that the raise of international price of agricultural commodities jointly with the improvement of agriculture performance in developing countries will contribute in the long-term to the reduction of poverty and to the increase of their food security. Furthermore, when the second generation biofuels will become available in the long term and crop productivity will increase, the impact of biofuels production on food security will be significantly reduced (Msangi *et al.*, 2007). Three different scenarios of massive growth of biofuel production and its influence on feedstock prices were analyzed using IFPRI[8]'s International Model for Policy Analysis of agricultural Commodities and Trade (IMPACT) (Braun & Pachauri, 2006). The so-called "aggressive growth scenario" implies 10% of transport fuel production being covered by biofuels in 2010, and 15 % in 2020. The "cellulosic biofuel scenario" relies on well-established large-scale production of second generation biofuels by 2015, causing a decrease in the demand of food-based feedstock crops. The third scenario considers the effect of increased productivity over time along with the development of second generation biofuels. Figure 2 summarizes the results in terms of percentage of change in prices by 2020 for 4 different food-based feedstock of great potentiality in Southern Africa: maize, oilseeds, sugar cane and cassava

[8] International Food Policy Research Institute

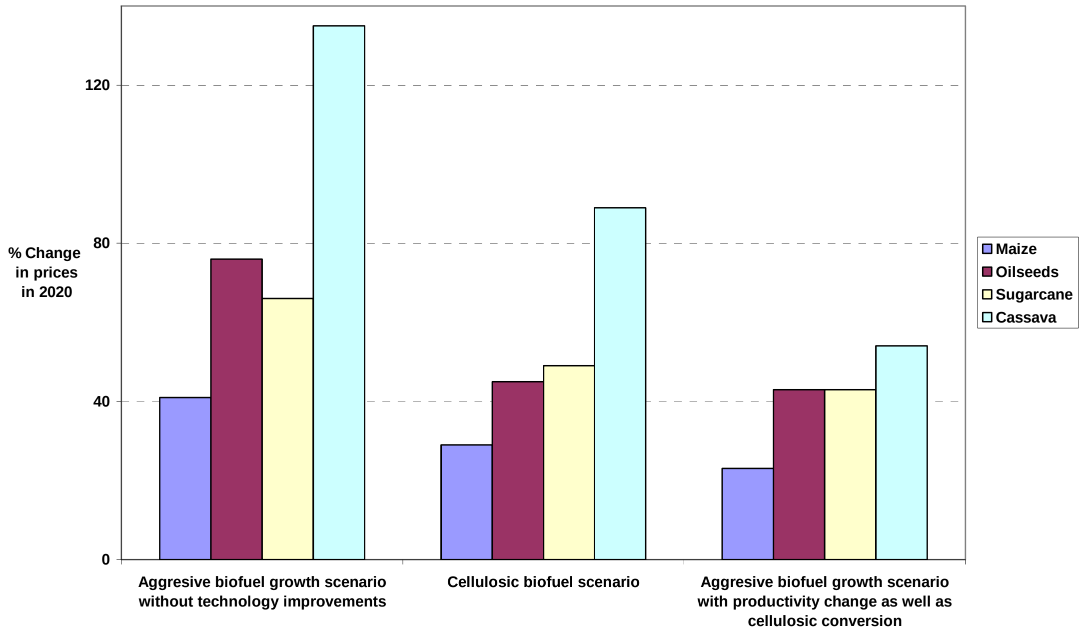

Figure 2. Percentage changes in world prices of feedstock crops under different scenarios using IMPACT Model (source: self-elaboration from IFPRI, 2006)

While food exporting countries (specially developing and emerging economies) may benefit from higher food prices, particular concern raised for net food importing developing countries and poor urban populations, especially in the case of emergency due to civil wars, natural hazards or climate change. These cases come under the food aid and should be treated in a convenient way.

There is increasing concern that the present dominated in-kind food aid hampered the development of agriculture in poor countries and was an indirect way that the donors could use to continue subsidizing their agriculture and dominate the international market. Since June 2005 to February 2006, USAID's Office of Food for Peace has provided more than 380,000 thousand metric tons (MT) of emergency food assistance to insecure populations of Southern Africa valued at nearly $280 million to the U.N. World Food Program (WFP) and the Consortium for Southern Africa Food Security Emergency (C-SAFE), an emergency food assistance program that comprises CARE, Catholic Relief Services (CRS) and World Vision International. Food commodities provided include corn, corn meal, beans, oil, corn soy blend, sorghum, bulgur and wheat[9]. Negotiations are going on within the WTO in order to promote grant and purchase food on the local markets of the beneficiary countries instead of systematic in-kind food aids, this latter kind of aid being reserved to physical shortage in the aided countries. In that sense, CARE USA (2006), an humanitarian organization that manages food aid programs, states: “Purchasing food in the U.S., shipping it overseas, and then selling it to generate funds for food security programs is far less cost-effective than the logical alternative— simply providing cash to fund food security programs”. By favoring the increase of the agricultural commodities prices, the diversion of part of the lands to biofuels in industrialized countries will support development of agriculture both for food and biofuels in developing countries. The sustainability of this scheme depends however on the international regulation of the process. Intelligent solutions must be implemented, including orienting grant to the populations in poor, prevent diversion from food to fuels in countries where food imbalances prevail and give limited in-kind food aid if necessary particularly in the transitional period when agriculture of the poor countries is being adapted and in the cases of physical collapses. The main risk of that scheme, from the viewpoint of the food aid agencies, is the possibly decrease in food aid from industrialized countries such as the U.S. and Europe as a consequence of a high reduction of their cereals stocks and the reluctance of their administration to replace previous in-kind food aids by the required grant.

[9] USAID. Food for Peace program. http://www.usaid.gov/our_work/humanitarian_assistance/ffp/

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Annex 1. Overview of SADC countries potential for biofuels production.

SADC members	Policy aspects	Potential energy crops	Some sustainability and socio-economic aspects
Angola	Increased public and private interest.	Cassava, sugar cane, Maize, Oil palm, Sunflower, Jatropha	Land use dynamics (deforestation), food security
Botswana	Official interest in starting the process.	Mostly perennial drought resistant crops as Jatropha.	Drought related risks, Land use dynamics, food security
Democratic Republic of Congo	Official interest in starting the process.	Cassava, Oil palm, soy bean.	Land use dynamics (deforestation), food security, threat on biodiversity.
Lesotho	Limited interest.	Maize, Sorghum.	Landlocked country, Impact on water resources, rainfall variability, Land use dynamics, food security
Madagascar	Increased public and private interest.	Sugar cane, Palm oil, Cassava, Maize, Jatropha	Land use dynamics (deforestation), food security, threat on biodiversity
Malawi	Blending targets: 20% ethanol in gasoline (10% for unleaded gasoline).	Sugar cane, Maize, Cassava, Sunflower, Jatropha	Landlocked country, Land use dynamics, food security
Mauritius	Energy production from bagasse.	Mostly Sugar cane. Maize, Cassava	Land use dynamics, food security
Mozambique	Increased public and private interest.	Maize, Sugar cane, Cassava, Jatropha	Land use dynamics (deforestation), food security.
Namibia	Interest in perennial crops in view of blending bio-oil into diesel.	Mostly perennial drought resistant crops as Jatropha.	Drought related risks, Land use dynamics, food security.
South Africa	Penetration target: 2% of liquid road transportation fuels by 2013. E8 B2 blending ratios. Fuel Levy exemptions. Incentives to producers on under utilized land.	Sugar cane, Sugar beet, Soy bean, Sun flower, Canola (Maize and Jatropha exclude from previous draft)	Land use dynamics, food security. Drought related risks.
Swaziland	Already producing ethanol.	Sugar cane, Maize.	Landlocked country, Land use dynamics, food security
United Republic of Tanzania	Official interest in starting the process. Recent investments in sugar cane production.	Sugar cane, Maize, Sorghum, Jatropha	Land use dynamics, food security
Zambia	Blending targets: 10 % ethanol in gasoline (proposed). Presently, no ethanol production.	Sugar cane, Oil palm, cassava, Maize, sweet sorghum, Jatropha	Landlocked country, rich soils and 80% available arable land. Land use dynamics (deforestation), food security.
Zimbabwe	Blending targets: 8-13% ethanol in gasoline. Implementation difficulties. L	Sugar cane, Maize, Cassava.	Landlocked country, Drought associated risks, Land use dynamics, food security

Source: Self elaboration from already cited sources.

Annex 2. Stakeholder's List

Annex 2. Stakeholder's List. Academic Institutions.

Organization	Abbreviation	Type of Organization	Country	Website
Centre for Engineering Studies - University of Eduardo Mondlane	CES- UEM	ACAD	Mozambique	www.uem.mz
Renewable Energy and Energy Efficiency Bureau of Namibia	R3E Bureau	ACAD	Namibia	www.polytechnic.edu.na/reinnam
Southern Centre for Energy and Environment	SCEE	ACAD	Zimbabwe	www.scee.co.zw
Center for Energy Environment and Engineering	CEEEZ	ACAD	Zambia	
Harry Oppenheimer Okavango Research Centre - University of Botswana	HOORC - UB	ACAD	Botswana	www.orc.ub.bw
Centre for Environmental Management - Potchefstroom University	CEM	ACAD	South Africa	www.puk.ac.za/opencms/export/PUK/html/fakulteite/natuur/soo/cem
Energy & Development Research Centre	EDRC	ACAD	South Africa	www.edrc.uct.ac.za
Energy Research Institute	ERI	ACAD	South Africa	www.eri.uct.ac.za
Institute for Future Research, University of Stellenbosch	IFR	ACAD	South Africa	www.ifr.sun.ac.za
Bureau for Food and Agricultural Products - Stellenbosch University	BFAP	ACAD	South Africa	www.bfap.co.za
Cape Biofuel- Stellenbosch University	CB - SU	ACAD	South Africa	www.capebiofuel.org
Institute for Futures Research- Stellenbosch University	IFR - SU	ACAD	South Africa	www.ifr.sun.ac.za
Department of Agricultural Economics- University of the Free State	UoFS	ACAD	South Africa	www.uovs.ac.za
Centre for Renewable and Sustainable Energy Studies- Stellenbosch University	CRSES - SU	ACAD	South Africa	http://academic.sun.ac.za/crses
School of Environmental Sciences- University of KwaZulu-Natal	SES - UKZN	ACAD	South Africa	www.geography.ukzn.ac.za
NovAfrica - Centre for Innovation and Development -The Southern African Gender and Energy Network	NovAfrica- SAGEN	ACAD	South Africa	www.novafrica.org.za; http://energia-africa.org
Energy Research Center - University of Cape Town	ERC - UCT	ACAD	South Africa	www.erc.uct.ac.za
Department of Chemical Engineering - University of Cape Town	DCE - UCT	ACAD	South Africa	www.chemeng.uct.ac.za

Annex 2. Stakeholder's List. National and International Associations.

Organization	Abbreviation	Type of Organization	Country	Website
Environment and Development Resource Centre	EDRC	ASSOC	Zambia	www.edrc.kabissa.org
Environmental Council of Zambia	ECZ	ASSOC	Zambia	www.necz.org.zm
Common Market for Eastern and Southern Africa	COMESA	ASSOC	Zambia	www.comesa.int/countries/zambia
African Energy Policy Research Network	AEPRN	ASSOC	Kenya	www.afrepren.org
Renewable Energy Association of Swaziland	REASWA	ASSOC	Swaziland	www.ecs.co.sz
National Institute for Scientific and Industrial Research	NISIR	ASSOC GOV	Zambia	www.nisir.org.zm
Bio-Diesel Agriculture Association	BAA	ASSOC	Malawi	
National Smallholder Farmers' Association	NASFAM	ASSOC	Malawi	www.nasfam.org
Farmers Union of Malawi	FUM	ASSOC	Malawi	www.farmersunion.mw
German Chamber of Commerce and Industry-SA	GCCI – SA	ASSOC	South Africa	www.germanchamber.co.za
Ethanol Producers Association of South Africa	EPASA	ASSOC	South Africa	
Grain South Africa	Grain SA/ GSA	ASSOC	South Africa	www.grainsa.co.za
South African Petroleum Industry Association	SAPIA	ASSOC	South Africa	www.sapia.org.za
Southern African Biofuel Association	SABA	ASSOC	South Africa	www.saba.za.org
African Sustainable Fuels Centre	ASFC	ASOC	South Africa	www.asfc.org.za
African Centre for Energy and Environment	ACEE	ASSOC	South Africa	www.acee.co.za
The Institute for Transportation and Development Policy (ITDP)	ITDP	ASSOC	South Africa	www.itdp.org
Institute of Environmental and Recreation Management (Africa)	IERM	ASSOC GOV	South Africa	www.ierm.org.za
German Agency for Technical Co-operation and Development	GTZ	ASSOC INT	South Africa	www.gtz.co.za
International Council for Science	ICSU	ASSOC INT	South Africa	www.icsu-africa.org

Annex 2. Stakeholder's List. Companies.

Organization	Abbreviation	Type of Organization	Country	Website
Tiangle Limited	TL	COM AGR	Zimbabwe	http ://trianglesugar.com
Zambia Sugar	ZS	COM AGR_BIOF	Zambia	
Marli Investment	MI	COM BUS	Zambia	
D1 Oils Africa	D1	COM BIOF	Zambia	www.d1plc.com
PressCane Ltd. Mphundukwa, James technical operation manager	PRESSCANE	COM SUG	Malawi	www.presscorp.com
D&S Gel fuel Ltd	D&S	COM BIOF	Malawi	www.greenheat.co.za
Ethanol Company Limited	ETHCO	COM BIOF	Malawi	
Farming for Energy for Sustainable Livelihoods	FELISA	COM BIOF	Tanzania	www.farmingforenergy.net
TANESCO	TANESCO	COM BIOF	Tanzania	www.tanesco.com
PRAJ industries Limited	PRAJ	COM BIOF	South Africa	www.praj.net
Climate Change Corporation	C3	COM BIOF	South Africa	
D1 Oils Africa	D1	COM BIOF	South Africa	www.d1plc.com
Ethanol Africa	EA	COM BIOF	South Africa	www.ethanol-africa.com
SASOL	SASOL	COM CHM	South Africa	www.sasol.co.za
Lereko Energy	LEREKO	COM ENERGY	South Africa	www.kerekoenergy.co.za

Annex 2. Stakeholder's List. Consultants.

Organization	Abbreviation	Type of Organization	Country	Website
EECG Consultants Pty Ltd.	EECG	Consultant	Botswana	
Environmental Consulting Services	ECS	Consultant	Swaziland	www.ecs.co.sz
Eco Ltd	ECO	Consultant	Malawi	http ://ecoharmony.com
Geo Pollution Technologies Pty Ltd	GPT	Consultant	Namibia	www.gptglobal.com
C E N Integrated Environmental Management Unit CC.	CEN	Consultant	South Africa	www.environmentcen.co.za
Minerals and Energy Policy Centre	MEPC	Consultant	South Africa	www.mepc.org.za
Wim Klunn Consult	WKC	Consultant	South Africa	
Gwynne Foster	GF	Consultant	South Africa	

Annex 2. Stakeholder's List. Networks.

Organization	Abbreviation	Type of Organization	Country	Website
Community Partnerships for Sustainable Resource Management in Malawi	COMPASS	Network	Malawi	www.compass-malawi.com
Energy Technology Institute	ETI	Network	Zimbabwe	www.sirdc.ac.zw
The Southern African Institute for Environmental Assessment	SAIEA	Network	Namibia	www.saiea.com
Greater Edendale Environmental Network	GREEN	Network	South Africa	www.greennetwork.co.za
International Council for Local Environment Initiatives	ICLEI	Network	South Africa	www.iclei.org
Southern African Gender and Energy Network	SAGEN	Network	South Africa	www.mepc.org.za/content/sagen/sagen.htm
Urban Sector Network	USN	Network	South Africa	www.usn.org.za

Annex 2. Stakeholder's List. Governmental Agencies.

Organization	Abbreviation	Type of Organization	Country	Website
SADC Secretariat	SADC	GOV INT	Botswana	www.sadc.int
SADC Secretariat	SADC	GOV INT	Botswana	www.sadc.int
SADC Food Agriculture and Natural Resources Sector	FANR - SADC	GOV INT	Botswana	www.sadc.int/fanr
Department of Energy Affairs	DEA	GOV NAC	Botswana	www.gov.bw
Department of Energy Affairs	DEA	GOV NAC	Malawi	www.malawi.gov.mw/Mines/Energy
Ministry of Agriculture	MA	GOV NAC	Malawi	www.malawi.gov.mw/Agriculture
Ministry of Industry, Science &Technology	MIST	GOV NAC	Malawi	www.malawi.gov.mw/Industry
Department of Energy - Lesotho	DoEL	GOV NAC	Lesotho	
Ministry of Agro Industry and Fisheries	MAIF	GOV NAC	Mauritius	www.gov.mu/portal/site/moa
Ministry of Environment and National Development Unit- Department of Environment	MENDU	GOV NAC	Mauritius	www.gov.mu/portal/site/menvsite
Ministry of Mines and Energy	MME	GOV NAC	Nambia	www.mme.gov.na
Ministry of Agriculture, Water and Forestry	MAWF	GOV NAC	Nambia	www.op.gov.na
Ministry of Environment and Natural Resources	MENR	GOV NAC	Zambia	www.menr.gov.zm
Department of Energy, Ministry of Energy and Water Development	DEMEWD	GOV NAC	Zambia	
Ministry of Agriculture	MA	GOV NAC	Zambia	
Department of Environment	DE	GOV NAC	Zambia	
Ministry of Transport and Communications	DTC	GOV NAC	Zambia	
Department of Minerals and Energy	DME	GOV NAC	South Africa	www.dme.gov.za
Department of Agriculture	DA	GOV NAC	South Africa	www.agric.za
Department of Minerals and Energy	DME	GOV NAC	South Africa	www.dme.gov.za
Department of Science and Technology	DST	GOV NAC	South Africa	www.dst.gov.za
Central Energy Fund -Energy Development Corporation	CEF - EDC	GOV NAC	South Africa	www.cef.org.za

Annex 2. Stakeholder's List. Non-Governmental Organizations.

Organization	Abbreviation	Type of Organization	Country	Website
Botswana Technology Centre	BOTEC	NGO	Botswana	www.botec.bw
Forestry Association of Botswana	FAB	NGO	Botswana	www.envngo.co.bw
Bethel Business and Community Development Centre	BBCDC	NGO	Lesotho	www.lesoff.co.za/bbdc
Mauritius Council for Development Environmental Studies and Conservation	MAUDESCO	NGO	Mauritius	
National Foundation for Research in Agroforestry	NaFRA	NGO	Mauritius	
Yonge Nawe Environmental Action Group	YNEAG	NGO	Swaziland	www.yongenawe.org.sz
Agenda for Environmental and Responsible Development	AGENDA	NGO	Tanzania	www.newafrica.com/agenda.htm
Community Based Environment Trust and STDs Prorgramme	COBETS	NGO	Tanzania	
Kilimanjaro Environment Facility	KEF	NGO	Tanzania	www.kef.or.tz
Lawyers' Environmental Action Team	LEAT	NGO	Tanzania	www.leat.or.tz
Tanzania Traditional Energy development and Environmental Organization	TATEDO	NGO	Tanzania	www.tatedo.org
Centre for Energy, Environment and Engineering Zambia Limited	CEEEZ	NGO	Zambia	
Energy & Environmental Concerns for Zambia	EECZ	NGO	Zambia	http://sparknet.info/goto.php?org&op=member&co=ZM
ZERO Regional Environmental Organization	ZERO	NGO	Zimbabwe	www.zero.org.zw
Dr Tobias Takavarasha	FANRPAN	NGO	Zimbabwe	www.fanrpan.org
Food, Agriculture and Natural Resources Policy Analysis Network	FANRPAN	NGO	Malawi	www.fanrpan.org
AGAMA Energy	AGAMA	NGO	South Africa	www.agama.co.za
Community Agency for Social Enquiry	CASE	NGO	South Africa	www.case.org.za
Earthlife Africa Johannesburg	EARTHLIFFE	NGO	South Africa	www.earthlife.org.za
groundWork	GROUNDWORK	NGO	South Africa	www.groundwork.org.za
International Institute for Energy Conservation	IIEC	NGO	South Africa	www.cerf.org/iiec
Sustainable Energy Africa	SEA	NGO	South Africa	www.sustainable.org.za
Sustainable Energy Society of Southern Africa	SESSA	NGO	South Africa	www.sessa.org.za
The Foundation for contemporary Research	FCR	NGO	South Africa	www.fcr.org.za
The Wildlife and Environment Society of South Africa	WESSA	NGO	South Africa	www.wcape.school.za/wessa
African Centre for Biosafety	ACB	NGO	South Africa	www.biosafetyafrica.net
Biowatch South Africa	BIOWATCH	NGO	South Africa	www.biowatch.org.za
Citizens United for Renewable Energy and Sustainability	CURES Southern Africa	NGO	South Africa	
Friends of the Earth	FofE	NGO	South Africa	www.groundwork.org.za