OPENING PANDORA'S BOX: GMOS, FUELISH PARADIGMS AND SOUTH AFRICA's BIOFUELS STRATEGY

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"the negative emissions approach shows a way ahead for sub-Saharan Africa. Addressing the problem of abrupt climate change and solving the problems of Africa can go hand in hand".

"Corn ethanol is helping to establish the alternative fuel infrastructure. It is paving the way for research in alternative sources of ethanol, including sugar beets, sugarcane, swithgrass and plant cellulose." Monsanto Company

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INTRODUCTION

Towards the end of 2006, the South African Cabinet approved a "Draft Biofuels Industry Strategy" ("Biofuels Strategy"), where after, the document was released for public comment.

The Biofuels Strategy is supported by a feasibility study, and read together, these documents propose the establishment of a biofuels industry with E8 and B2 blend targets based on bioethanol from maize and sugarcane, and biodiesel from soyabeans and sunflower seeds respectively. We are told that E8 and B2 level of biofuel production equates to 75% of the 2013 Renewable Energy target, and represents 4.5% of total liquid fuel use.

Whilst we welcome the need to address our dependence on fossil fuels, our modes of consumption and production and its concomitant environmental and socio-economic problems, we state at the outset that we are opposed to the notion that large- scale liquid biofuels should be considered as part of the renewable energy package of solutions for South Africa. We are particularly opposed to biofuels produced from agricultural plantations, food and genetically modified crop plants and trees.

We question the underlying rationale of the Biofuels Strategy, namely, that biofuels based on the production of low cost, high yielding maize, sugarcane and oil seeds will be

environmentally, socially and economically sustainable and efficient as a renewable source of energy.

We are also extremely concerned about the failure of the Biofuels Strategy to address important issues concerning control and domination of the biofuels market by business and industry, particularly, multinational companies.
Late last year, Archer Daniels Midlands (ADM), the company who first sold the idea of maize-derived ethanol as an auto fuel to the US Congress in the late 1970s, announced they would dominate the global biodiesel and ethanol industries while continuing to be a leader in agricultural processing and grains and oil seeds. ADM is the largest biodiesel producer in Europe and the largest ethanol producer in the US. They plan to expand to Brazil's sugar market and Indonesia's palm oil market.

We give this example merely to point out that the South African Biofuel Strategy can so easily be traced to the strong industry lobby coalesced under SABA, (Southern African Biofuels Association). SABA is comprised of biofuels producers such as Di Oils Africa, De Beers Fuel and Ethanol Africa, equipment and technology suppliers (Shaval Biodiesel, Praj Industries, and Thyssen Krupp Engineering), Academia (Wits), Agricultural Producer Associations (GRAIN SA, South African Cane Growers Association), Financial Institutions (ABSA), government Departments, DME, and State-owned organisations, CEF), and multinational grain exporters such as Louise Dreyfuss.

Thus, despite the many noble statements littered throughout the feasibility study and the Strategy itself, very little will change for the millions of poor black people in South Africa, in whose name the Biofuel Strategy is being touted as an economic empowerment tool.

In this paper we discuss several issues grouped under two main headings, namely -

(a)GMOs and Biofuels; and

(b)The energy balance of the crops proposed by the Biofuels Strategy.

In addition, we would like the South African government to provide answers to the following:

(a)What mechanisms will be put in place to ensure that food crops are not diverted away from local food security needs, to feed a burgeoning biofuels market?;

(b)What mechanisms will be put in place to ensure that the increased diversion of maize for ethanol production will not drive food prices up, as has already occurred in Mexico, where the price of staple tortillas rose by 400% as a result of maize being diverted to ethanol production in the US. The same can be asked about land prices.

(c)What are the likely environmental and socio-economic implications of setting a mandatory target? Who will pay for these costs? (p.8 of the Biofuels Strategy);

(d)What exactly, does the package of so-called "second generation technologies" entail and where do new transgenic technologies feature in this tool- box? (p.8);

(e)What will "streamlining of environmental impact assessment requirements entail"? (p.9);

(f)What does the import of raw materials entail? ("until such time as the local agricultural market can respond to new varieties of crops" p.12); and

(g)Why it has failed to address alternative biofuel technologies such as biogas from algae, human, animal and agricultural waste etc.

BIOFUELS AND GENETICALLY MODIFIED ORGANISMS

(a) Exponential Increase in GM Plantings in South Africa

The Biofuels Strategy has a direct bearing on the bitterly contested terrain of genetically modified crops, yet it has myopically ignored this Pandora's box. What makes this particularly unforgivable is its failure to account for the environmental and socio-economic consequences of the expansion of South Africa's GM acreage of maize and soyabeans, if the target of E8 and B2 is to be realised. The drafters of the Biofuel Strategy naively believe that stockpiles of maize will suffice. We disagree.

We are of the opinion that stockpiles of maize will fluctuate, depending on maize prices (for food and fuel), weather conditions such as droughts, surpluses of available grain production and so forth. Indeed, it is highly likely that a parallel market for maize will be created; one for food and the other for fuel, with the market for fuel fetching higher prices and thereby diverting maize intended for food, away to feed new fuel demands.

SA's acerage of GM crops is reported to have grown to approximately 29% of maize and 59% of Soyabeans. Indeed, according to the International Service for the Acquisition of Agri-Biotech Application (ISAAA), South Africa's GM plantings for the 2006/7 period is estimated to have increased by 180%-from around 500 000 ha to 1.4 million ha.
The Biofuels Strategy will provide impetus for more varieties of GM maize and soybean to be pushed through South Africa's lax regulatory regime and in so doing, present unacceptable risks to human health and the environment.

Already Monsanto is positioning itself to push new GMOs through the US approval system, which will be followed by approval in South Africa. According to Monsanto, its new products in development will help increase both the crop yield and the oil yield per acre such as its Roundup Ready2Yield Soybeans. (Roundup Ready2Yield soybean is currently under review by the US Department of Agriculture). According to Monsanto's petition, its new soyabean -MON 89788- can improve crop yields by 4 to 7 & compared to the current Roundup Ready soyabeans being grown in the US, Argentina and South Africa.

All Monsanto Roundup Ready products are designed to tolerate Monsanto's herbicide, Roundup.
Furthermore, the South African authorities have also already received an application by Swiss Agrochemical company, Syngenta for permission to import into South Africa, GM maize variety (Event 3272), containing an enzyme produced from a deep sea micro-organism, which humans and animals have never previously been exposed to. Event 3272 GM maize represents the very first genetically modified industrial crop for industrial application as fuel ethanol production.

Although GM canola (rapeseed oil) is not grown commercially in South Africa, it is only a matter of time before Monsanto's patented varieties are pushed through the regulatory system to be grown on 500 000 ha of prime, non-irrigated arable land in the former Transkei as part of the grand design of the Eastern Cape Biofuels Strategic Task Team, and the Biofuels Strategy.

(b) Biotech/ Seed Industry becoming more dominant/powerful

The seed industry is at the beginning of the biofuels supply chain and will continue to exact a dominant role in South Africa's biofuels industry. It is no secret that the seed industry stands the most to gain from the global biofuels revolution, particularly biotechnology giants such Monsanto who already have a stranglehold on SA's seed industry. Monsanto bought out 2 of South Africa's largest seed companies, Sensako and Carnia already, as far back as 1999/2000, and gained 45% of South Africa's maize seed market and almost the entire market in wheat seed.

Monsanto SA holds ownership of at least 9 GM varieties of soya beans, 13 yellow maize varieties and 4 white GM maize varieties. Monsanto also holds an additional 36 non-GM yellow maize hybrid varieties, 18 white maize hybrid varieties and 2 soya bean varieties. Eleven sunflower varieties and a small number of other winter grains, lupins, lucerne and grain sorghum constitute the remainder of Monsanto's registered varieties in South Africa. Monsanto's recent acquisition of cottonseed company Delta & Pinelands, substantially increases its seed holding.

There is no doubt that the Biofuels Strategy will thus greatly increase Monsanto's profit margin.

(c) Biosafety Concerns

i. Environmental Impacts of GMOs GM crops are associated with environmental risks. We reiterate that current scientific knowledge and understanding of the ecological impacts of GM crops is inadequate. More scientifically rigorous ecological research on their environmental risks is critical. Indeed, the Department of Environmental Affairs and Tourism (DEAT) in collaboration with the South African National Biodiversity Institute (SANBI) are currently in the process of designing methodologies for assessing the ecological impact of the potpourri of GMOs released into the South African environment

since 1989. This is being done in terms of mandatory obligations established by the National Environmental Management Biodiversity Act (NEMBA).

Our battle against the import and marketing and release of GMOs into our environment is well documented and we will not repeat it here. Nevertheless, we wish to highlight that the increase in plantings of GM Roundup Ready maize, Soya and canola if it is commercialized, means an increase in the use of Monsanto's herbicide, glyphosate.

Glyphosate is a broad-spectrum herbicide and large-scale cultivation of glyphosate resistant GM crops will result in an increase in the use of glyphosate with concomitant negative environmental impacts. Glyphosate is acutely toxic to humans and animals. California reports the third most commonly reported pesticide related illness amongst agricultural workers . A study on mice fed GM soybean suggests that Roundup Ready soybean intake was impacting on the morphology, particularly the nuclear features of liver cells, in both adult and young mice . Glyphosate has also been indicated in several unwanted effects on aquatic systems, terrestrial organisms and ecosystems . Negative impacts on human , , rodent and fish health have also been observed.

We have been consistently calling for a moratorium on all environmental releases of GMOs, and reiterate that demand here.

ii. Socio economic impacts There are very few studies that comprehensively investigate medium to long-term socio-economic impacts, particularly concerning resource-poor farmers. In addition to paying the technology fee, users of GM crops in SA sign an agreement stipulating that they may not: use the licensed seed for more than one season; use the seed for any other purpose including breeding, research, seed production and analysis; resell or transfer the seed to any other person or grower; and save any crop produced from the GM seeds for future planting, or supply saved seed to anyone else. These restrictions have huge ramifications for livelihood strategies of small- holder farmers.

Already, Monsanto has conceived of an ingenious smallholders' programme known as the 'Seeds of Hope Campaign', which targets the 'bottom of the pyramid' - very low-income consumers who have substantial purchasing power as a group. During the 1990s, Monsanto introduced 'Combi-Packs' - boxes of materials designed specifically for smallholder farmers, having access to anything from _-5 hectares of land. The boxes contain a package of hybrid maize seed, some fertilizer, some herbicide, and pictogram instructions for illiterate users. Through the Seed of Hope Campaign in the Eastern Cape-the poorest of South Africa's nine provinces, where Monsanto's project was subsidised with huge chunks of public funds, which enabled it to penetrate extremely impoverished communities- first by introducing a Green Revolution type package as an important precursor to the introduction of its GM maize seeds, ably assisted by Bayer Cropscience, amongst other players.

The Biofuels Strategy appears to be heading in the direction of benefiting the seed, fertiliser and chemical industries, while having negligible impacts on total food

production, food security and further marginalizing African rural areas.

There is no reason why Monsanto and other companies like it, will not profit from the Biofuels Strategy and extend their campaign into a "Seeds of Biofuels Campaign for the Poor", making it a neat fit with the Biofuels Strategy.

iii. DANGEROUS TECHNOLOGY

The health risks posed by GMOs need further research. SA has approved GMOs that use old technologies with antibiotic resistant gene markers. These have been banned in many countries in the world and are under review also by Parties to the Biosafety Protocol. Scientists have warned that the continued use of viral promoters pose unacceptable health and environmental risks. We are also on record, for opposing a huge number of applications of GM maize or food approvals, on food safety grounds.

Contamination of the South African food supply by GM maize destined for use in ethanol production cannot be excluded, as the chances of contamination taking place are very high, along the entire chain of production, as has happened in 2000 involving the Aventis CropScience's StarLink maize contamination scandal in the US. In any event by-products of biofuel crops will certainly be used in animal feed production and thereby inevitably enter the food chain.

(d) EXPLOSION OF FIELD TRIALS OF SECOND- GENERATION GM CROPS

South Africa's Biofuel strategy is based on what is commonly referred to as "first generation biofuels" –the use of grain, roots and tubers and vegetable oils as feedstock. In particular, it mimics global biofuel consumption trends based on ethanol, which is derived mainly from sugar, maize and other starchy crops. Biodiesel using vegetable oils as feedstock comes only second.

Although the Biofuels Strategy makes reference to the so- called second generation of biofuels it gives no clear indication what these entail. However, developing energy crops mean new applications of genetic engineering, which are now aimed at altering the fundamental structure of plants.

The Biofuel Strategy will provide additional incentives/excuses for a substantial increase in the spate of field trials already being conducted of a mish mash of GM crops earmarked for the biofuels industry.

Monsanto's has several drought tolerant varieties in its pipeline as does other Biotech giants such Bayer, Syngenta, Dow, BASF and Dupont . Staying ahead of the pack, Monsanto SA has already bagged approval on the 30 January 2007, from South Africa's GMO regulatory authority to conduct field trial experiments with a drought tolerant GM maize variety.

South Africa's Agriculture Research Council (ARC) is also currently deeply involved in

field trials of GM soybean to withstand drought conditions.
ARC has also been granted permission to conduct field trials of GM drought resistant groundnuts. If the groundnut reaches the stage of commercialisation, it will be called "High Proline peanut." South Africa is a net exporter of groundnuts and typically exports 70-75% of its crop either as edible or oil nuts or as processing groundnut oil and cake. There is already a demand from the mobile industry for the production of oil seeds to power mobile phone base stations in remote rural areas. Recently, key players in the mobile industry-GSM Association, Ericsson and South Africa's MTN teamed up to announce biofuels as an alternative source of power for wireless networks in the developing world. The three companies have set up a pioneering project in Nigeria to demonstrate the potential of biofuels to replace diesel as a source of power for mobile base stations located beyond the reach of the electricity grid. Groundnuts, pumpkin seeds, jatropha and palm oil will be used in the initial pilot tests. This is a significant development, which may see an increase in GM groundnut trials in South Africa.

GM bacteria has also been implicated in frontier biofuel production based on the production of ethanol from cellulose, the fibrous material in all plants. Ways are being developed to convert abundant plant cellulose fibres to biofuels so that even larger volumes of these valuable materials can be produced.

Diversa's recently merger with Celunol Corp makes it the first company with fully integrated technologies for cellulosic ethanol production. This combined company will enhance existing Diversa enzyme business with aggressive push into cellulosic ethanol plant development and production.

Diversa and Syngenta also announced a new 10- year research and development deal to find enzymes that could covert biomass into biofuels.

ENERGY BALANCE: UNSUSTAINABLE LIQUID BIOFUELS

We are aware that the question of efficiency of biofuels is contentious. Prominent scientists such as Professor David Pimentel from the College of Agriculture and Life Sciences, Cornell University and Tad W. Patzek, Professor of Civil and Environmental Engineering at the University of California-Berkeley, have conducted research to prove that biofuels are not sustainable at all. Nevertheless, the drafters of the SA's Biofuel Strategy appear to have been successfully persuaded by industry not to trust these studies.

Nevertheless, we wish to place on record here, their findings so that these may be factored into the public debate, in an open and democratic manner.

David Pimentel of Cornell University produced the following results: (we use the terminology such as corn, gallons and pounds, to keep it consistent with the findings of the research).

*An acre of U.S. corn yields about 7,110 pounds of corn for processing into 328 gallons of ethanol. But planting, growing and harvesting that much corn requires about 140

gallons of fossil fuels and costs US$347 per acre. Thus, even before corn is converted to ethanol, the feedstock costs US$1.05 per gallon of ethanol.

*As many as three distillation steps are needed to separate the 8 percent ethanol from the 92 percent water. Additional treatment and energy are required to produce the 99.8 percent pure ethanol for mixing with gasoline.

*Adding up the energy costs of corn production and its conversion to ethanol, 131,000 BTUs are needed to make 1 gallon of ethanol. One gallon of ethanol has an energy value of only 77,000 BTU. This means that about 70 percent more energy is required to produce ethanol than the energy that actually is in ethanol. Every time you make 1 gallon of ethanol, there is a net energy loss of 54,000 BTU.

*Ethanol from corn costs about US$1.74 per gallon to produce, compared with about US$0.95 to produce a gallon of gasoline. This is one of the chief reasons why fossil fuels, and not ethanol, are used to produce ethanol. The growers and processors can't afford to burn ethanol to make ethanol.

*Most economic analyses of corn-to-ethanol production overlook the costs of environmental damages, which should add another US$0.23 per gallon. Corn production in the U.S. erodes soil about 12 times faster than the soil can be reformed, and irrigating corn mines groundwater 25 percent faster than the natural recharge rate of ground water.

*The average U.S. car, travelling 10,000 miles a year on pure ethanol (not a gasoline-ethanol mix) would need about 852 gallons of the corn-based fuel. This would take 11 acres to grow, based on net ethanol production. This is the same amount of cropland required to feed seven Americans.

*If all the cars in the U.S were fuelled with 100 percent ethanol, a total of about 97 percent of U.S. land area would be needed to grow the corn feedstock. Corn would then cover nearly the total land area of the U.S.

Professor Ted Patzek from the University of Berkeley-California also announced his findings on ethanol efficiency, published in the journal Critical Reviews in Plant Science. In this study, he factored in the myriad energy inputs required by industrial agriculture, from the amount of fuel used to produce fertilisers and corn seeds to the transport and wastewater disposal costs. The following were conclusions from the study:

*The cumulative energy consumed in corn farming and ethanol production is six times greater than what the end product provides the car engine in terms of power.

In June 2005, another study on the carbon dioxide emissions, cropland area requirements, and other environmental consequences of growing corn and sugarcane to produce fuel ethanol also indicated that direct and indirect environmental impacts of growing, harvesting, and converting biomass to ethanol far exceed any value in developing this energy resource on a large scale.

The researchers, Marcelo E. Dias de Oliveira, Burton E. Vaughan, and Edward J. Rykiel, Jr., who were also from Cornell University published their findings in the July 2005 issue of BioScience, the journal of the American Institute of Biological Sciences (AIBS), which discovered the following:

*In the U.S., ethanol yielded only about 10 percent more energy than was required to produce it.

*In Brazil, where ethanol is sourced out from sugarcane, the process yielded 3.7 times more energy than was used to produce it.
At the same time, the study also looked into some consequences of moving to greater fuel ethanol use. The results were unfavourable to in both countries. In Brazil, reducing the rate of deforestation seemed likely to be more effective for taking carbon dioxide out of the atmosphere. In the U.S., reliance on ethanol to fuel the motor vehicle fleet would require enormous, unachievable areas of corn agriculture, and the environmental impacts would outweigh its benefits, due to its heavy dependence on private vehicle use.

Pimentel and Patzek both announced the results of their collaboration on the detailed analysis of the energy input-output ratio of ethanol production from corn, switch grass and wood biomass as well as for biodiesel production from soybean and sunflower plants. This time around their research yielded the following findings, which were published in Natural Resources Research (Vol. 14:1):

**For ethanol, it was found that:

*Corn requires 29 percent more fossil energy than the fuel produced.

*Switch grass requires 45 percent more fossil energy than the fuel produced.

*Wood biomass requires 57 percent more fossil energy than the fuel produced.

**For biodiesel, it was found that:

*Soybean plants require 27 percent more fossil energy than the fuel produced.

*Sunflower plants require 118 percent more fossil energy than the fuel produced.

It must be noted that the use of GM crops adds to the overall cost because of the economics associated with the growth of transgenic plants. Patent protection of GE crops ensures that there is a fixed cost associated with their planting which would have to be taken into consideration in the energy calculation.

CONCLUSION

Although we are vehemently opposed to the use of GM crops in the production of

biofuels, we are not only seeking here, only a ban on the growing of GM crops for biofuels (commercially and in field trials).
The bigger picture for all of us must that that biofuels based on industrial scale monoculture plantations are not a green nor sustainable option. To ignore these realities places the nation in peril.
It is estimated that the replacement of all our fossil fuels consumption with biofuels would require at a minimum, 22% of the net primary productivity (NPP) of the Earth's current biota. A figure that would be substantially higher if biofuel production remains less energy efficient than the generation of energy from fossil fuels.

All of the prime productive land has already been given up to agriculture. How much more would be required or have to be appropriated to serve the needs of producing crops for energy?