WHAT IS THE IMPACT OF GMOs ON SUSTAINABLE AGRICULTURE IN ZAMBIA?

A RESEARCH STUDY SPONSORED BY

KASISI AGRICULTURAL TRAINING CENTRE
and
JESUIT CENTRE FOR THEOLOGICAL REFLECTION

15 AUGUST 2002

JESUIT CENTRE FOR THEOLOGICAL REFLECTION
P.O. Box 37774 10101 Lusaka, Zambia
Tel: 260-1-290410 Fax: 260-1-290759
E-mail: jctr@zamnet.zm Web: www.jctr.org.zm

WHAT IS THE IMPACT OF GMOs ON SUSTAINABLE AGRICULTURE IN ZAMBIA?

A. PREFACE

The challenge of balancing short term food problems with long term agricultural problems is an urgent concern for Zambia today. Following an unanticipated drought situation, a situation proceeded the year earlier by too much rain and damaging flood conditions, there is a drastic shortfall in our basic food commodity, maize. As a consequence, an estimated two million Zambians are at risk of famine.

In the midst of this situation, the possible implications of introducing into the country genetically modified organisms (GMOs) are being raised among the farming community, government officials and the general public. Of immediate concern is the offer by the United States of America to provide funds to purchase relief maize that is a GMO.

Considerable public attention has been focused on questions of health, that is, the safety to our health if we eat genetically modified maize coming from the USA. There are conflicting points of view presented in the public media about health considerations. Some reports say: "No problem!" and others say "Warning: extreme dangers!" In the midst of all this is the looming spectre of hunger and starvation facing an increasing number of Zambians.

Certainly the issue of *consumption* is important. But in much of the current discussion, insufficient attention is being paid to the very important issues of *production*, *trade and marketing.*

Simply stated, the critical point of debate must be that the very serious problem of food consumption *(the presence of hunger) must not be dealt with in ways that create even more serious problems of* food production *(the destruction of agricultural infrastructure).*

It is in the belief that more attention should be focused on the impact of GMOs on Zambia's agricultural infrastructure that a special short-term research study was commissioned jointly by the Kasisi Agricultural Training Centre (KATC) and the Jesuit Centre for Theological Reflection (JCTR). This joint effort was undertaken as part of KATC's mission to serve small-scale farmers and promote sustainable agriculture, and JCTR's mission to promote social justice and encourage poverty eradication.

"The Zambian government must not give in to the pressures exerted by offers of GMO maize before adequate study is done and effective precautions taken," states Paul Desmarais, Director of KATC.

According to Peter Henriot, JCTR Director, "Prudent evaluation of the offer of GMO maize relief is required, especially in the light of government's consideration of a National Biotechnology and Biosafety Policy."

The current study was undertaken by Mrs. Bernadette Lubozhya, an agro-scientist with long experience of dealing in aspects of biotechnology in Zambia. Widespread consultation has accompanied her research.

The study and its recommendations are offered to government officials, Members of Parliament, the farming community, civil society organisations and the general public. KATC and JCTR look forward to reactions to the study and to its recommendations.

Food security within the context of sustainable agriculture in Zambia is a matter of extreme importance at this moment and in the foreseeable future.

15 August 2002

JESUIT CENTRE FOR THEOLOGICAL REFLECTION
P.O. Box 37774 10101 Lusaka, Zambia
Tel: 260-1-290410 Fax: 260-1-290759
E-mail: jctr@zamnet.zm Web: www.jctr.org.zm

B. RESEARCH

1. Introduction

The push for the adoption of genetically modified (GM) crops in Zambia is posing a serious challenge to the present and future agricultural infrastructure of Zambia, with consequent danger to the viability of food production to meet the needs of our ten million-plus population. Indeed, it poses a particular threat to the survival of the powerless majority (small-scale farmers) of the farming population. In their quest to increase their profit margins in the agricultural business, a powerful minority group of the farming population is attempting to use the small-scale farmer to persuade the government to allow them to bring in GM crops into the country.

The proponents of genetically GM crops are presenting these crops as part of the key solutions to boosting and stabilising rural incomes. They are also being offered as part of the answer to the national problem of food insecurity. However, the current commercial GM crops have in fact little if anything to offer to the small-scale farmers on one hand, while on the other hand, these crops are likely to exacerbate the rural household food insecurity and further erode the little cash income which might be there.

Proponents of GM crops in the Zambia National Farmer's Union (ZNFU) membership consist of a very small group of corporate members such as the Cotton Ginners Association. This group's basic concern is the anticipated improvement of profitability GM cotton would bring to their industry[1].

Those opposed to the introduction of GM crops into the country can be divided into three groups:

i. Specialised associations such as the Tobacco Association of Zambia, the Zambia Export Growers Association, and the Zambia Coffee Growers' Association Ltd. This group is concerned with the effect GM crops would have on competitiveness and their potential loss of access to European export market. Because of European rejection of GM crops, members of this group see that they will lose this market.

ii. In addition to the loss of the export market, the Organic Producers and Processors Association of Zambia is concerned with effects of genetically modified crops on sustainable agriculture within this county.

iii. Moreover, there is widespread growing concern among small-scale farmers (who comprise more than three-quarters of the farming population in the country) about the effects of genetically modified crops on the informal seed sub-sector, which supplies 80 per cent of their planting seed in the country. This group is also concerned with the higher seed price for GM crops in comparison to the seed currently grown in the country.

The unfortunate thing is that while the members in favour of GM crops are a small minority, they are in the position of power in the farmer's body (ZNFU) to effectively influence what the government and the public in general hears and reads. When reading

[1] Proceeding of the Special Agricultural Consultative Forum meeting on GMOs (11th October, 2001). Chrismar Hotel, Lusaka.

The Zambian Farmer (a ZNFU publication), for example, one is given the impression that most members of ZNFU are in favour of genetically modified crops and animals. Several issues of The *Zambian Farmer* magazines have carried articles in favour of genetically modified organisms (GMOs), while articles containing divergent views have never been published.

This current research paper has been written to show that GM crops do not offer the benefits that the proponents claim. In fact, the GM crops are likely to bring many problems including serious negative effects on the development of small-scale farming in Zambia – the basis for the country's food security system. We argue that GM crops will drastically and dangerously alter the infrastructure of Zambian agriculture.

2. What are we talking about?

To provide a background to our study, we begin with a few definitions of important words and phrases that we will use.

Sustainable agriculture[2] is a food system that (a) provides a reasonable rate of return to farmers, to sustain farm families, agricultural infrastructure, and rural communities; (b) assures a reasonable rate of return to public and private providers of farm inputs (seeds, fertilizers, etc.), information, services, and technologies; (c) preserves and generates soil, water, and biological resources upon which farming depends, and avoids adverse impacts on the natural environment; (d) increases productivity and per-hectare yields at least in step with the growth in demand; and (e) adheres to social norms and expectations in terms of fairness, equity, compliance with regulations, food safety, and ethical treatment of workers, animals, and other creatures sharing agricultural landscapes.

Food Security is access to all people at all time to enough food for an active and healthy life[3]. Households will be food secure when the following conditions are met. First, enough food must be available in both *quantity* for adequate energy intake and *diversity* of food types (quality) for adequate intake of nutrients. These foods must also be *culturally* acceptable. Second, households must have access to these food supplies. Access is determined by household's endowments (land, labour, capital and other resources) and how these are transformed into food entitlements which include the various means for procuring food. Third, food supplies must be *sustainable* through seasons and over years. Fourth, household food security (HFS) must be equitably distributed to ensure that the poor and vulnerable have secure access to the food they need. Fifth, HFS is intricately tied to livelihood security, and is more likely to be achieved when livelihoods are sustainable.

[2] Benbrook's definition of sustainable agriculture. Dr. Charles M. Benbrook operates (since 1990) Benbrook Consulting Services in the USA. During the early 1980s, Dr. Benbrook served as an agriculture policy analyst for the President's Council on Environmental Quality and then as staff director of the Subcommittee on Department Operations, Research and Foreign Agriculture of the Agricultural Committee of the U.S. House of Representatives. From 1984 to 1990, he was executive director of the Board of Agriculture, National Academy of Sciences.

[3] Nutrition and Household Food Security in Farming Systems Research (1992). Southern and Eastern African Regional workshop Commentary and Papers.

Biotechnology is any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use[4].

Genetic engineering is a set of laboratory techniques for isolating genetic material from organisms, cutting and joining it to make new combinations, multiplying copies of the recombined genetic material (also called recombinant DNA) and transferring it into organisms, bypassing the process of reproduction. Genes may be exchanged between species that would never interbreed in nature. The whole process is called genetic modification or genetic manipulation.

Genetic modification allows the transfer of genetic material (in the form of DNA sequences) between unrelated organisms that would under normal conditions, never be able to breed. This involves the cutting of segments of DNA from one species of an organism, modifying that DNA and then inserting the modified DNA segments into the genomes of cells or embryos. The cell or embryo is then allowed to develop to a new organism, out of which a genetically modified line (commonly called *genetically modified organism* or GMO in short) or transgenic line is derived. Genetic modification is currently used only to introduce a single new trait, which might be based on the activity of a single gene, or a small number of genes.

Genetically modified organisms (GMOs) are organisms whose genetic material has been artificially changed to enable them to perform functions that they would not normally do naturally. A genetically modified (GM) tomato, for example, is one whose genetic makeup has been altered through the insertion of a gene of a fish that lives in very cold water to enable it (the GM tomato) to survive cooler temperatures.

Genetic material means hereditary substances, which actually defines what an organism is and what the characteristic of that organism is.

Genome is the totality of the genetic material of a cell or organism.

3. A One-Sided Debate

Until recently (July 2002), the debate in Zambia appears to have been one-sided in favour of GM crops. Being aware that part of the international community (such as members in the European Union, Japan, etc.) regards GM products as having *potential risks* to human health and the environment, the proponents of GMOs have been aggressive in trying to introduce GM crops in Zambia. In their quest to achieve their goal (i.e. to get the GM crops into the country), the advocates of GM crops have been using four strategies.

i. ***Information***. The first strategy the advocates of GM crops have used is influencing the source and flow of information in order to provide biased information to both the government and the general public concerning GM crops. Since 2001, the pro-GM group has been controlling what is printed in *The Zambian Farmer* magazine (ZNFU's monthly publication) concerning GM crops.

[4] According to the Convention on Biological Diversity (1992)

Consequently, almost every publication of *The Zambian Farmer* has been carrying an article in favour of GMOs[5].

Furthermore, the pro-GM group has been instrumental in the calling of three notable meetings. The first two meetings were aimed at bringing in GM cotton and tobacco. The objective of the third meeting was to get the government produce a policy framework that would facilitate the introduction of GM crops in Zambia[6].

ii. ***Study***. The second strategy the pro-GM group has used is to commission a study that would give national leaders an impression that Zambia badly needs GM crops to enhance the development of its agriculture sector[7].

It is unfortunate that in their study report the consultants seem to be deliberately misinforming the government and the public at large on a number of issues. Examples of this misleading can be cited as follows.

First, the report states that the "majority of ZNFU members believe that GM crops would boost Zambia's agricultural productivity and sustainability." However, the actual fact is that the pro-GM group is the one in *minority* (as noted in the introduction). The other truth of the matter is that the participants at the Agricultural Consultative Forum meeting recommended that a moratorium be put in place to prevent any research on GM crops or commercial production of GM crops until a biotechnology and biosafety legislation is put in place by the government[8]. Indeed, the call for a moratorium has been reiterated by almost all the members of the ZNFU who export agricultural commodities to Europe. This group has asked the government to stop all attempts to introduce GM crops in Zambia since the presence of such crops (GM) in the country would cost them their EU markets. It is simply not truthful for the report to state that the *majority* of ZNFU members endorse GM crops.

In addition, the report does not even take into account that GM crops are likely to negatively impact on the *informal seed sector* that supplies 80 per cent of seed to the 75 per cent of the farming population in the country. Low productivity among small-scale farmers is caused by other factors other than lack of improved technology (i.e. improved crop varieties) in the country.

Moreover, the statement in the report which reads *"*Seed in Zambia is of inferior quality and imported seed costs are high for most of the country's farmers*,"* is certainly misleading. Zambia is a country that hosts four seed companies (two of them indigenous – ZAMSEED and Mazabuka Research Institute) with superior varieties of various crops that are commonly grown. In fact these companies actually supply some certified seeds to some neigbouring countries such as Malawi, Congo D.R., Angola and Namibia.

---

[5] Please see appendix I for detail. See also *The Zambian Farmer* volume 5, number 1; volume 5, number 7; and volume 5, number 8, as examples

[6] Please see appendix II for detail.

[7] Peter Gregory and Lovemore Simwanda (2002), Agricultural Biotechnology and Biosafety in Zambia: A Zambia National Farmers' Union Position Paper for Input into Government Policy and Legislation.

[8] Proceedings of the Special Agricultural Consultative Forum meeting on Genetically Modified Organisms (GMOs). 11th October, 2001.

It is distressing that in the current debate, a debate with extremely important consequences to all Zambian citizens, the consultants could make misleading statements in building a case for GM crops,. (It is perhaps important to note that the international consultant who conducted the study, Dr. Peter Gregory, is not neutral on GM crops[9].

iii. ***Propaganda***. The third strategy the pro-GM group has employed is the promotion of the GM crops as a **"***modern***"** technology. This is indeed a form of propaganda, utilised in order to win some supporters who tend to think that "modern" can simply be equated with "good." These supporters have assisted the group in trying to persuade the government to allow in GM crops, seeds and products into Zambia. By using lines such as "Unless you move toward GM crops, you are not going to move forward in agricultural development," the argument diverts from actual hard data on implications of introducing GM cops.

iv. ***Distortion***. The fourth strategy the pro-GM group has been using is taking advantage of the fact that in the past the Zambian government did not consistently develop a good agricultural policy. Consequently, the GM advocates have been trying to sell GM technology to government leaders on the over-stated claim that lack of improved crop technologies is central to the poverty and food security problems among the rural people.

v. ***Pro-environment***. The fifth strategy of the pro-GM group has been to paint a picture that GM crops are more environmental friendly. We examine this misleading claim later in the paper (see 4.7).

4. Implications for Zambia of adopting GM crops

The ZNFU consultants in the major study referred to earlier make the claim that the potential benefits adopting GM crops would include:

i. Positive impact on national food security with genetically modified crops becoming a valuable tool to complement conventional and organic approaches;

ii. Reduction of input costs (such as insecticides and herbicides) through the use of GM crops with resistance to various pests and reduction of the level of required crop management because of lesser need for chemical controls.

Let us look at each of these arguments, by raising pertinent questions that need to be answered before we can fully understand the implications of adopting GM crops.

4.1 Does Genetic Modification *Complement* Conventional and Organic Approaches?

The proponents of the use of GM in agriculture argue that humankind has been selecting and manipulating plant and animal food stocks for millennia. Therefore, they contend, this new technology is simply the next stage in this process. However, technically speaking, GM and sexual reproduction bear no resemblance to each other. This point requires some technical explanation.

[9] Please refer to study he conducted on Bt Cotton in Makhatini, South Africa.

In conventional traditional forms of breeding, variety has been achieved through selection from the multitude of genetic traits that already exist within a species' gene pool. In nature, genetic diversity is created within certain limits. A maize variety can be crossed with a different kind of maize variety, but maize will never be crossed with sorghum, although they are both of grass family. Even when species that may seem to be closely related do succeed in breeding, the offspring are usually infertile – a horse, for example, can mate with a donkey (ass), but the offspring (a mule) is infertile.

In contrast, genetic engineering crosses the coded DNA barrier and utilises very powerful (and unnatural) laboratory techniques for transferring genetic material directly between plants and animals. Using these techniques, genes from one species are usually taken and then inserted into another in an attempt to transfer a desired trait or character. It is now possible for plants to be engineered with genes taken from bacteria (for example Bt Cotton), viruses, insects, animals or even human beings.

Genetic engineering bypasses conventional breeding by using artificially constructed parasitic genetic elements, including viruses, as vectors to carry and smuggle genes into cells. Once inside cells, these vectors slot themselves into the host genome. For example, using this technique, a gene that leads to the production of a chemical with *antifreeze* properties from an arctic fish (such as the flounder) can be selected and spliced into tomato to make it frost-resistant! This type of tomato is essentially a new organism, which will be self-perpetuating and hence permanent. Such kind of a plant could never be produced using conventional breeding.

Genes in conventional breeding are passed from parent to offspring in *vertical* manner. But genes in genetic engineering are conveyed through use of viruses and other parasites in a *horizontal* manner. Therefore the two *cannot* be said to be complementing each other.

Take the instance of Bt, indisputably the most important biopesticide registered for use worldwide. It is a very important pesticide for organic farmers. Bt spray formulations are suitable for use in managing many difficult-to-control lepidopteran and coleopteran insects. Lepidopteran insects are the major problems for farmers producing field crops like cotton. But of even greater concern from the perspective of human health, lepidopteran species in fruit and vegetable crops require the most frequent applications of the generally most toxic insecticides.

Most fruit and vegetable growers in the world design Integrated Pest Management (IPS) systems around tactics and techniques needed to control lepidopteran species. Bt and/or pheromones form the back-born of many such systems. Use of these soft biopesticides makes it possible for farmers to avoid the need for damaging, broad-spectrum sprays that often trigger secondary pest population explosions, along with a host of other problems – farm worker poisonings, wildlife killings, dietary health risks etc.

Contrary to the consultants' claim that GM crops could become a valuable tool to complement organic farming, prolonged cultivation of Bt crops in fact could lead to resistance developed in response to transgenic Bt transferring to fermented Bt products and render the GM crop useless against resistant pests[10].

[10] *Science*, Volume 253, September, p 1075

4.2 Would Genetically Modified Crops Contribute towards Food Security in the World?

Food security is much more than simply the production of food for a country, as we clearly noted in our opening set of definitions. In this sense, argument as to whether genetic modification technology can feed Zambia is somewhat simplistic. Other significant intermediary factors influence access to, and distribution of, food on country scale and within individual communities. This important point is well illustrated in the case of the recent food crisis in Argentina in late 2001. During 2001, Argentina harvested enough wheat to meet the needs of both China and India; yet Argentina's people went hungry. Argentina's status as the world's second largest producer of GM crops - largely for export - could do nothing to solve its very real hunger problems at home[11].

A similar picture can also be drawn in Zambia concerning an increased production of an improved biotechnology, hybrid maize. When maize and fertilizer subsidies reached their peak in the late 1980s, the area under maize cultivation in this country was about 1 million hectares. This accounted for about 70 per cent of the total cropped area in the country. During that same period, however, the Nutrition Surveillance Programme data showed that under-nutrition had generally persisted and indeed had worsened in some cases[12]. Clearly, it takes more than the introduction of a biotechnology to achieve food security here.

A study conducted by the Soils and Crops Research Branch (under the Ministry of Agriculture and Co-operatives), showed that some improved technologies, while they were beneficial to the poorer farmers and their households in the short run, proved too costly in the long run. An extensive institutional support that was given to the production of hybrid maize (which is usually mono-cropped) led to a decline in the hectarage of traditional staple food crops such as sorghum and cassava. Since many relish crops (those that are part a typical Zambian diet such as groundnuts, beans, pumpkin leaves, etc., eaten with maize, sorghum, millets or sorghum as staples) are inter-cropped with traditional staples, there was also a decline in relish food availability.

This clearly showed that while there were increased cash incomes among some small-scale farming households due to cash crop production, it was at the expense of household food security[13].

Therefore, the presence of an improved biotechnology such as a hybrid seed of maize does not necessarily contribute towards food security of a country. Moreover, the fact that genetically modified crops are patented, they actually are likely to further threaten food security in Zambia[14]. All GM crops are patented by their owners under the provisions of the Intellectual Property Rights (IPRs) legislation. This deprives others, including the small-scale farmers, the right to plant, replant or propagate the seeds without express authority of the owner of the patent. To this, they would be required to pay royalties. It is therefore, apparent that one of the effects of genetic modification is to

[11] Nicholas Parrot and Terry Marsden (2002). The Real Green Revolution. Published by Green Peace Environmental Trust.
[12] Comprehensive Agricultural Development and Food Security Programme (1999). Food and Agriculture Organisation of the United Nations.
[13] Adaptive Research and Planning Teams Annual Reports of 1986, 1987 and 1988.
[14] See appendix I

make small-scale farmers dependent on external corporations for seed and food production. Thus in a real sense they become dependent on their foreign groups for their very livelihoods. Such a turn of events clearly does not contribute to food security in Zambia.

4.3 Does Genetic Modification Increase Productivity on Existing Fields?

There is evidence that GM crops do not consistently yield higher than conventional crops. Below are a few examples of this evidence.

- In May 2001, Nebraska University's Institute of Agriculture and Natural Resources (in the United States of America) released the results of a two-year study showing that Roundup Ready soyabean yielded 6 per cent less than their closest non-GM relatives and 11 per cent less than high-yielding non-GM varieties.

- The University of Wisconsin found GM soyabean yields from the 1998 harvest were lower than non-modified varieties in over 80 per cent of cases in trials across nine states in the USA.[15]

- Research published in 1998 by the University of Arkansas and Cyanamid reveals reduced profit levels and lower yields for GM soyabean and cotton compared with unmodified varieties.

- In the United Kingdom, reports of crop trials from the National Institute of Agricultural Botany show yields from GM winter oilseed rape and sugar beet 5 to 8 per cent less than high yielding conventional varieties.

What this evidence presents to us is a refutation of the claim that GM crops will produce so much more food than ordinary crops here in Zambia. We simply cannot accept this claim on face-value. This is especially true given the lack of the sophisticated support system that prevails in countries such as the United States of America or the United Kingdom.

4.4 Will the Use of GM Crops Reduce the Costs of Inputs (such as insecticides and herbicides)?

Genetically modified crops require more herbicides than what farmers were initially led to believe, leading to increased weed management costs[16]. Benbrook points out that a full Roundup Ready system is costing farmers about 50 per cent more than the cost of [conventional] seed plus weed management systems in the Midwest of the U.S.A. Roundup ready maize was treated on average with about 30 per cent more herbicides than non-GM maize in the year 2000[17].

Furthermore, Mike Owen[18] reports that when considering the use of herbicide-tolerant maize or soyabeans and the appropriate herbicide, weed management is not conceptually different than where traditional crop varieties and herbicide programmes are used. He

[15] http://www.uwex.edu/as/soybean/slides/1998%20ASTA%20Expo/sld022htm
[16] http://www.weeds.iastate.edu/weednews/roundupcottonad.htm.
[17] http://www.weeds.iastate.edu/mgmnt/qtr98-4/roundupfuture.htm.
[18] "North American Developments in Herbicide Tolerant Crops" (November 1998) Weed Science http://www.weeds.iastate.edu/weenews/Brighton.htm

further states that the cost of weed control in herbicide-tolerant crop management systems is not different from the conventional systems.

Reports that claim that Bt modified crops such as Bt cotton make it possible for farmers to reduce the pounds of insecticide active ingredients by 50 per cent on average are being challenged by several independent scientists. Mae-wan Ho, (a prominent geneticist) and colleagues[19] argue that such gain does not always hold true. For example, Bollgard cotton under high infestation conditions may need supplemental traditional chemical control.

Lim Li Ching and Jonathan Matthews report that the latest official guidance in Australia makes it clear that Bt cotton is in some circumstances failing to control its principal target pest. Consequently, farmers in that country are being advised to spray additional insecticides on Monsanto's GM Bt cotton, Ingard, "under conditions of reduced Ingard plant efficacy".

4.5 Would the Use of Genetic Modification Boost the Conservation of Biodiversity?

Genetic modification does not boost biodiversity in the real sense buts adds to the environment new organisms that could impact negatively on it. Genetic modification could negatively impact on the informal seed sub-sector that supplies 80 per cent of planting seed to the 75 per cent of the farming community in the Zambia. In fact, there would be less biodiversity because there are fewer seed companies controlling the genetic material that is being marketed. The genetic material in the environment would be contaminated by the GM genes.

4.6 Would the Use of Genetic Modification Accelerate Plant Breeding?

While genetic modification could accelerate plant breeding, this technology is very costly and dependent on very expensive facilities and highly skilled experts. The cost of the development and commercialisation of a GM crop variety was recently estimated at 30 million United States Dollars. This kind of money has never been and is not likely to be ever available for use in the research industry in Zambia. Moreover, legislation and regulations to contain GMOs and their products during the development and testing phases before release are strict and costly. This is a factor demanding additional costs. Therefore, if Zambia wants this technology, it will have to be content with importing already developed variety rather than go into the extensive process of developing the technology in this country.

4.7 Are There Harmful Effects from GM crops on Humans, on Animals or on the Environment?

Apart from the studies conducted on GM food crops to check whether the genetic modification done on these crops have introduced new allergies or toxicity to humans, we know of no studies on other possible negative impacts on humans, animals and/or micro-organisms' health. However, findings of some farmers on the negative effects that GM maize have had on their animal herds give us some clues on what could happen

[19] Jan. 2001 www.i-sis.org

to human beings as well.[20] Bt maize stockfeed, for example, has been found to reduce the sow (breeding female pigs) farrowing (off-spring/piglet production) rates by nearly 80%

In Iowa, USA, 14 pig producers have linked their sow herd's reduced farrowing experiences to the Bt maize stockfeed. For instance, Terry Rosmer, a farmer in Iowa, traced his sow herd furrowing problem to Bt maize. Another farmer in the same state, Norm Smith, stated that he started experiencing breeding problems within 30 days of feeding his sow herd with his crop of Bt maize. When one of the 14 pig producers switched back to non-Bt maize, the furrowing rate problems disappeared within that herd.

The case of Bt maize's negative impact on the reproduction system of pigs illustrates the fact that Bt crops have been rushed to market without proper testing. There have been no mandatory tests on the long-term effects of the GM crops on livestock or human health. For example, the US Environmental Protection Agency (EPA) that regulates Bt corn requires no tests to determine how the crop impacts the reproductive system of the animals that eat it.

Therefore one cannot help but ask the obvious question as to whether the Bt maize would not also have a negative effect on humans' reproductive system, bearing in mind that an average Zambian essentially depends on maize for all their meals, every day of the year!

Most of the research by the biotech industry has focused on making crops resistant to their own "broadspectrum" herbicides. This means that a field can be sprayed with chemicals and nearly all plants will die except the resistant crop. For example, when fields planted with genetically modified maize, cotton and soyabean for resistance to roundup (these crops are commonly called Roundup Ready maize, cotton, or soyabeans), are sprayed with this "broadspectrum" herbicide, then all plants will die except the GM ones.

The problem is that while Roundup is promoted as an environmental friendly herbicide, its principal ingredient, glyphosate, has been found capable of killing fish[21], reducing the growth of earthworms (beneficial organisms that are essential in breaking down plant material into soil) and increasing their mortality[22]. Glyphosate is also reported to be toxic to many of the beneficial mycorrhizal fungi which help plants to take up nutrients from soils[23].

In the tight competition of ensuring that once a farmer has bought seed of a particular crop which is genetically modified to resist a particular herbicide, that farmer is also tied to purchasing that particular brand of herbicide (i.e. the one the GM crop has been

[20] See Jim Riddle (May 2002). Bt Corn (Maize) Linked to Hog (Pig) Breeding Problems. ‚gfa@rjvint.globalnet.co.uk>

[21] World health Organisation, United Nations Environment Programme (1994). 'Glyphosate: Environment Health Criteria 159. Geneva, Switzerland.

[22] J.A. Springett and R.A.J. Gray. Effect of repeated low doses of biocides on the earthworm *Aparrectodea caliginosa* in laboratory culture', Soil Biol. Biochem., vol. 24 (12), pp 1739-1744.

[23] D. Astok, B. Freedman and D. Boyle (1989). Effects of the herbicides 2, 4-D, glyphosate, hexazinone, and triclopyr on the growth of three species of ectomycorrhizal fungi. Bull. Environ. Contam. Toxicol., vol42, pp 835-839

modified to resists) from the same company or sister company that sold him/her the GM seed. In Canada, for example, there are at least three types of GM oil bearing rape (commonly called canola crop) each of which has been modified to resist a particular herbicide from different biotech companies. One kind of problem this development has created for the farmer is to develop a dependency syndrome by the farmer one company to provide both the seed and the herbicide. The other problem is the creation of potential "super weeds" which could result from gene flow. In fact there is already some evidence that this problem has already developed.

One study shows that after only three growing seasons of growing pure GM canola crops, certain fields had some off-type plants (plants that look different from the main crop) having resistance to not only the herbicide the main variety had been modified against, but to two other herbicides of different brands[24]. These multiple herbicide resistant plants were a result of cross-pollination between three GM canola varieties caused by pollen drift from neighbouring fields each of which had been modified to resist a particular type of herbicide.

The problem with these multiple herbicide resistant plants is that they have become difficult to eradicate with existing herbicides - hence the term that they are "super-weeds". Hence, the farmer would have to spray three chemicals to get rid of that type of plants. This means that instead of using less chemicals to protect the environment the opposite will happen.

Perhaps a worse problem is that these "super weeds" could cross with wild relatives. This will have a negative impact on the existing biodiversity.

Results from a study by the Nanjing Institute of Environmental Sciences[25] suggest the following:

- Bt cotton harmed the natural parasitic enemies of the cotton bollworm, the pest that it is designed to control.
- The populations of pests other than cotton bollworm had increased in Bt cotton fields and some had replaced the cotton bollworm as primary pests.
- The resistance of Bt cotton to bollworm decreased significantly over time, probably losing all its resistance to bollworm after being planted continuously for 8 to 10 years.

The CaMV promoter is a gene-switch from the cauliflower mosaic virus (CaMV) which is incorporated into practically all GM crops already commercialized or undergoing field trials. The artificial gene-constructs containing the CaMV promoter may be especially prone to breaking and joining up with other genetic material, thereby increasing the chance that it can transfer horizontally to unrelated species. The potential hazards are harmful mutations, cancers, reactivation of dormant viruses and generation of new viruses[26].

[24] "Seeds of Uncertainty," (March 2002)
[25] Nanjing Institute of Environmental Sciences is part of the Chinese Government's Environmental Protection Administration.
[26] Mae-Wan Ho, Angela Ryan and Professor Joe Cummins (2000). The CaMV promoter – a recipe for disaster? Third World Resurgence Issue No. 114/115

Proponents for GMOs argue that the CaMV 35S promoter (in its natural form) is not harmful, arguing that people have been eating the virus in infected cabbage and cauliflower for many years without ill effects. The 35S promoter in the *natural* CaMV is a stable, integral part of the virus, and does not transfer into the host genomes (be they human, plant, etc.) to reproduce itself. The 35S promoter in *artificial* gene-constructs (produced by genetic modification), however, are incorporated into host genomes. And when these integrated viral promoters (in artificial gene-constructs) come into contact with non-active genomes of viruses (which are present in all genomes) they can reactivate the dormant viruses or generate new viruses by recombination. This possibility has been demonstrated in the laboratory where infectious viruses have been produced[27]

The CaMV promoter is very aggressive. In its isolated form, it is active in all plants, **a**lgae and the *E.coli bacteria* that live in the gut of all animals including a human. The available evidence clearly indicates that there are serious potential hazards associated with the use of the CaMV promoter. It is for this reason that GM crops and products containing the CaMV should not be introduced into the Zambian soil until they can be shown to be safe.

4.8 Have GM Crops Been Adequately Tested?

Given the potential dangers cited above, it is understandable that the demand for accurate and adequate testing of biotechnology is of paramount importance for all Zambians and must be heeded.

The ZNFU report cited above (see 3.ii), co-authored by Gregory and Simwanda, states that "Crop biotechnology is one of the most extensively reviewed agricultural advancements to date. There have been no substantiated harmful effects of GM crops on human health or the environment." But what the pro-GMOs advocates are avoiding to acknowledge is that these verification trials have also been done by the owners of the technology themselves.

As a case in point, scientists and manufacturers considered pesticides totally risk-free when first marketed in the late 1940 and the data that documented their very ill effects took nearly 20 years to surface. Similarly, major problems may result from GM crops over time.

Moreover, the companies that manufacture and market GM crops in the USA are responsible for assessing their safety, which results in a potential *conflict of interest* that could compromise the rigour of safety assessments. This raises a legitimate suspicion that these tests could be biased in favour of the biotech companies. Professor Chuck Hagedorn, for example, had this to say:

"Traditionally, companies in the US would introduce a new variety, and our extension crop specialists (in each state where the crop is grown) then field test the new variety for at least 3 to 5 years. During this field-testing process the extension crop specialists introduce the new variety to farmers in their region and give them unbiased information

[27] Meyer, M. and Dessens, J. (1997) ***J. Gen.Virol. 78, 147-51***

(the good points and bad points) about growing the new variety. The agricultural companies would also get good information about the performance of their new varieties from this 'traditional' crop evaluation process. With the GM crops however, this traditional process has been largely bypassed, mainly due to the rush to try and establish market share with the GM crops. Now, the agricultural companies are going directly to the farmers with contracts for growing their GM crops, and the extension crop specialist is 'out of the loop'. This is a classic case of what has been described in the literature as a situation where commercial development and marketing is way ahead of the science."

Hagedorn adds that the Unites States Department of Agriculture has deregulated GM crops with speed to an extent that it will take some type of major problems to make the Department take a slower approach. Finally, Hagedorn says that the stand the GM crop advocates (including the two consultants that were hired by ZNFU) have taken, that claim that no problems are likely to occur, is indeed highly questionable because nobody should presume to be in such complete control of biology[28].

It is also important to note that the few experiments that have been done to examine the safety of GM crops, especially the many ways that these modifications could affect the environment, have been partial.

Several scientists in the United States also seem to have the view that there is not enough data to ascertain that GM crops pose no danger to the environment. An independent advisory panel of scientists (comprising twelve biologists and entomologists), for example, observed that while some studies have shown that Bt (*Bacillus thuringiensis*) toxins can stay in the soil for as long as 234 days, there have been no field studies carried out to assess long-term environmental effects of Bt-crops. Therefore, the panel advised the Environmental Protection Agency to commission studies that would determine, under operational field conditions in different geographical regions and soil types, the extent to which Bt toxins from Bt crops, accumulate in soil[29].

An obvious conclusion point can be made here: when such tests are so questionable and take so long and so much expertise in a developed country like the United States, how can Zambia, a country with very inadequate testing facilities, be pushed to rush into adopting GM crops without legitimate caution being exercised?

5. Some Ethical Considerations

Food is about life. Agriculture therefore necessarily calls for ethical reflections. It is not simply a matter of business, of commerce, of profit-making. To deal with the controversial issue of the introduction of GM crops into Zambia in a complete fashion, we must therefore raise some serious ethical considerations. Briefly summarised, the value questions that should be raised would include the following:

i. Is it correct for one person or one company to claim ownership of and patent for a living organism? Until recently only non-living organisms were patented.

[28] www.btinternet.com/~nlpwessex/documents/gmlemmings.htm

[29] http://www.epa.gov/scipoly/sap/2000/october/octberfinal.pdf.

Living organisms were in the public domain, with the benefits for everyone and not only for those with the resources to capture exclusive patents. This, of course, has direct ethical bearing upon the development of poor people and poor countries like Zambia.

ii. As soon as a GM crop is released, it will contaminate other non-GM plants through pollination. For example, wild maize in Mexico, which is the origin of new maize genetic material, is now contaminated by GM maize. It is irresponsible to contaminate the wild species of crops with GM material. Once released a GM crop can never be recalled. Should such contamination be allowed, given its impact on future sustainable agriculture in Zambia?

iii. How do we balance off the property rights of farmers versus the "Intellectual Property Rights" of a company? Farmers will have to buy GM seed every year and it will become an offence to replant your own GM seed. The farmer may be prosecuted if she or he does so. But farmers have traditionally kept and traded their seed with neighbours for replanting for long centuries. Why should Zambian farmers now lose this fundamental right as a consequence of the actions of profit-seeking companies?

iv. The food system is being controlled more and more by a few Trans-National Corporations based in the rich countries of the North. These TNCs own the seed, the pesticides, and in some cases even the grain elevators. For Zambia, a fundamental set of ethical issues arise when we ask: Who benefits from this global food system? Who suffers?

v. The introduction of GM crops will make it impossible to grow an organic crop because of cross-pollination. But there is a fundamental moral responsibility that one's actions should not harm one's neighbour. Introduction of GM crops into Zambia will contaminate the organic crops and prevent the organic farmer from marketing her or his produce as organic. By what right can such damage be done to a large number of Zambians?

vi. GM crops will favour an industrialized agriculture. An industrialized agriculture will favour large farms and mechanization at the expense of smaller family farms. This will further increase unemployment in Zambia and deepen the serious problem of widespread poverty. The ethical question in fostering industrialized agriculture over small family farms is: does Zambia want to increase unemployment among its population?

vii. Another ethical question relates to the unknown consequences on other life forms of introducing GM crops. For example, Bt crops will kill some soil micro-organisms upon decaying. Is it correct to kill these life-giving organisms because of the introduction of this new technology? We simple do not know the long term effects on the health of people. There should be a cautious approach to the introduction of this technology into Zambia until we know more about its impact on humans and on the environment.

viii. Genetic resources by themselves are of no value until complemented by an ability to put them to economic use. The TNCs have the economic resources to add value to Zambia's raw genetic resources. Should they be allowed to do this

without an effective regulatory structure put in place, especially one that protects the rights of small-scale farmers and local communities?

These and other ethical considerations must enter into the discussion of GMOs in Zambia if we are to build a future that is respectful of human rights, community development, poverty eradication and protection of the environment. Government officials, political leaders, civil society, church leaders, private sector business people and ordinary citizens must be vigilant in putting these points of ethics at the top of any agenda relating to GM crops in this country.

6. Conclusions and the Way Forward

The argument developed in this paper shows that the introduction of GM crops into Zambia is being pushed by a small minority of the population, without adequate account being taken of the dangerous implications for an infrastructure of sustainable agriculture that will guarantee food security in the country. Moreover, there are negligible benefits to farmers and consumers on one hand, while on the other hand, there is the likelihood of many long-term problems, including:

- Increased herbicide use, erratic performance and poor economic returns to small-scale farmers.

- Negative impact on the informal seed sub-sector, which supplies 80 per cent of planting seed to the 75 per cent of the farming community in the country.

- Dominance of corporate monopoly (large-scale farmers with international connections) over food production, a situation that drives family farmers (especially small-scale farmers) to destitution.

- Diversion of the very essential emphasis on sustainable agriculture that guarantees future household food security.

- Potential environmental problems such as insect resistance, contamination of wild plant relatives to our domesticated crops, greater use of chemicals, less bio-diversity, and harmful mutations that can cause diseases.

- Loss of European markets for Zambian products such as fresh flowers, fruit and vegetables, tobacco, coffee and organic products, because the EU bans genetically modified organisms (GMOs).

GM crops have been and are being introduced too quickly around the world. Zambia should not blindly follow the lead of countries like the United States of America, on the grounds of becoming "modern" in our agricultural sector. Rather, we should be prudently cautious like countries in the European Union, since too little is yet known about the possible environmental or ecological and health effects of GM crops. This is particularly true in a developing country situation such as ours.

Our concern here is clear: far from addressing the underlying structural causes of hunger, genetically modified crops will actually exacerbate these causes. Ensuring food

security in Zambia requires an approach to agriculture that is, in almost every respect, the *reverse* of that being promoted by genetic engineering companies and their allies in this country.

The way forward for Zambia is thus marked by the need to wait for more clarity concerning potential risks to and long-term impacts on human health, the environment and the agricultural infrastructure before the country considers again a possible adoption of GM crops. During this waiting period**,** however, there is a need to build the capacity to test and control GM crops

To promote sustainable agriculture in the country, the problems mentioned above should be addressed. A government policy that would encourage farmers (especially small-scale farmers) to rely more on *internal* inputs (within the farm and from its immediate surrounding area) and less on external inputs must be put in place.

There is an OAU African Model Legislation that could be very helpful for Zambia to follow as it writes it Biosafety Policy. The African Model protects the rights of local communities, farmers and breeders, and provides for regulation of access to biological resources.

C. POLICY RECOMMENTDATIONS

We are aware that the discussion of the introduction of GMOs into Zambia is not simply a theoretical debate. At this immediate moment, it is a policy debate whose outcome will have tremendous consequences for the lives of countless Zambians, now and in the future. It is a debate that must be shaped by understandable and unbiased information and by clear and socially just principles.

Our conclusion in this study is based upon a very straightforward line of argument:

- Our basic thesis is that *food security in Zambia for all Zambians requires sustainable agriculture.*
- We are convinced by our study that *GMOs will have a negative impact on sustainable agriculture*.
- Therefore we reach the conclusion that *GMOs should not be introduced into Zambia*.

Based on the findings of this research report, the Kasisi Agricultural Training Centre and the Jesuit Centre for Theological Reflection make the following policy recommendations:

i. **There should be no introduction of GMO maize into Zambia. The position initially taken by the Government regarding the rejection of USA GMO maize as relief food should be maintained.**

ii. **Very serious and extensive research should be immediately undertaken by Government, relevant institutions and NGOs regarding the health, environment and agricultural impact of GMOs and their potential risks.**

iii. **The National Biotechnology and Biosafety Policy currently being considered by the Government should be subjected to wide public discussion with full involvement of all stakeholders and critical study by Members of Parliament.**

iv. **Government should undertake immediate steps to build the capacity necessary for testing agricultural products to detect the introduction of GMOs. This requires greater laboratory facilities.**

v. **Civil society should promote public education about GMOs in order to develop an educated citizenry that can reach conclusions that will safeguard Zambia's capability to build sustainable agriculture for the future.**

vi. **In all of the discussions, debate and decisions, the social justice concerns must be primary, especially the concern for the small-scale farmers that make up the backbone of our food security in Zambia.**

Both KATC and JCTR stand ready to cooperate with others in promoting a sustainable agriculture that brings present and future food security in the country.

APPENDICES

Appendix I

The Zambian Farmer, volume 5, number 1, carried an article entitled "Globe Warms to Biotechnology's Benefits." In this article, the author implied that genetically modified soyabeans, cotton, canola (oil bearing rapeseed) and maize are steadily replacing conventional soyabeans, cotton, canola and maize. The author of another article entitled "What are GMOs?" in *The Zambian Farmer*, volume 5 number 7, claims that genetic modification provides us with a way of meeting the growing demand on food without placing even greater pressure on our scarce resources. He has also written that it allows us to grow better quality crops with higher yields, which at the same time sustain and protect the environment. *The Zambian Farmer,* volume 5, number 8, has an article entitled "Tell Consumers They Are Wrong on GM." The author of the article says that GM foods pose no apparent risk to human health. In *The Zambian Farmer,* volume 5, number , the author of an article headed "Green Movements Blocking Agriculture Revolution" is alleging that western environmental groups are blocking ways to ease hunger in the poorest parts of the world by failing to consider how gene-spliced (genetically modified) crops could help people out of poverty.

The Zambian Farmer has, up to date, published only one article ("Seeds of Uncertainty," Volume 5, Number 8) that shows that GM crops are creating some serious problems. This is despite the fact that several critical articles have been submitted for publication. Such a bias in this widely-read magazine has been influencing people in Zambia to believe that adoption of GM crops is the right thing any business-minded farmer or wise government official should be thinking of.

Appendix II

On the 21st May 1999, a seminar on cotton–biotechnology was held in Lusaka. At that seminar, Monsanto Company (a USA-based GM company) presented genetic modification as the technology that would improve cotton producer's efficiency and profitability in the country and called Bt (*Bacillus thurigiensis*) technology a "magic solution" to pest control in cotton[30]. All the stakeholders in the cotton industry readily accepted this assertion. Consequently, during the 1999/2000 and 2000/2001 growing seasons, field trials of genetically modified cotton (with a gene from *Bacillus thurigiensis* bacterium) were carried out at Magoye Research Centre in Southern Province, in spite of the fact that the Zambia had in place no Biosafety Legislation. The field trials were only suspended because Monsanto was concerned that it could not continue operating illegally (i.e., in the absence of a Biosafety Legislation or regulations).

Another GM Company, Vector Company, after an earlier (between February and March 2001) failure to convince senior policy makers to allow GM tobacco into Zambia, managed to get some Ministry of Agriculture and Co-operatives personnel to convene a meeting on GM tobacco. The aim of the seminar was to persuade all tobacco stakeholders that the GM burley tobacco would boost the profitability of small-scale farmers – the primary producers of tobacco in Zambia. At that occasion however, the Tobacco Association of Zambia blocked the proposal because growing of GM tobacco

[30] Proceedings of the workshop on cotton-biotechnology, 1999.

in Zambia could easily contaminate conventionally produced tobacco because it is very difficult to execute 100 per cent topping (i.e. removal of flowering part of every tobacco plant before the flower opens up in order to avoid cross pollination between plants). The second reason for rejecting the proposal was that the tobacco producers in the country would lose both European and Australian export markets since these markets have made it clear that they will not buy from GM crop producing countries.

The push for GM crops in the country finally moved the Agricultural Consultative Forum (ACF) to convene a special meeting on GMOs on 11th October 2001. The Permanent Secretary (PS) to the Ministry of Agriculture and Co-operatives is on record to have challenged the workshop participants to come up with very concrete recommendations that would guide the utilisation of GMOs in Zambia's agriculture sector. The PS is also reported to have further stressed the need for participants to explore what opportunities GMOs bring in the face of widespread food insecurity, while avoiding compromising the safety and health of consumers.