

## **EFFECTS OF GENETICALLY MODIFIED AGRICULTURAL PRODUCT ON THE HEALTH OF CONSUMERS IN NIGERIA**

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### **Abstract**

*Genetically modified plants are plants whose natural state has been altered by introducing genes from other organisms into their DNA via genetic engineering. These changes make the plants have attributes that they don't possess naturally. They are a significant step forward in the production of agricultural crops. In pursuit of sustainable food security in Nigeria, the government has embraced the adoption of genetically modified plants (GMOs) as a product of biotechnology for improvement and increased productivity in the agricultural sector that would lead to improved socioeconomic status of Nigerian farmers and enhanced national economic prosperity to achieve foreign investments and earnings from safe modern biotechnology sector. This technology has its merits and demerits like other inventions. This paper assesses the effects of genetically modified agricultural products on human health in pre and post economic recession in Nigeria.*

**Keywords:** *Genetically modified plant, DNA.*

## INTRODUCTION

Humans have been manipulating the genetic composition of crop plants for thousands of years. Plants with favourable characteristics have been produced by conventional breeding methods. Desirable traits are selected, combined and propagated by repeated sexual crossings over numerous generations. This is a long process, taking up to 15 years to produce new varieties. Genetic engineering not only allows this process to be dramatically accelerated in a highly targeted manner by introducing a small number of genes, it can also overcome the barrier of sexual incompatibility between plant species and vastly increase the size of the available gene pool. Biotechnology has played a critical role in global agriculture since the start of the green revolution in the mid 1900 (Southgate *et al* 1995).

### Concept of Genetically Modified (GM) plants

Genetically Modified (GM) plants are those plants that have been genetically modified using recombinant DNA technology with the aim of introducing new trait to the plant which do not occur naturally in the specie as well as a greater control over traits than previous methods such as selective breeding and mutation breeding. Genetically Modified (GM) plants are made by inserting DNA from bacteria, viruses, plants or animals into a plant to get the plant to produce one or more proteins that it would not normally produce. The process is therefore very different from conventional plant breeding. This is done by modifying endogenous genes. The protein encoded by the gene will confer a particular trait or characteristic to that plant. The technology can be utilized in a number of ways, for example to engineer resistance to abiotic stresses, such as drought, extreme temperature or salinity, and biotic stresses, such as insects and pathogens, that would normally prove detrimental to plant growth or survival. The technology can also be used to improve the nutritional content of the plant, an application that could be of particular use in the developing world. New-generation GM crops are now also being developed for the production of recombinant medicines ,and industrial products, such as monoclonal antibodies, vaccines, plastics and bio fuels (Sticklen M 2005).

A number of techniques exist for the production of Genetically Modified plants (G.M). The two most commonly employed are the bacterium *Agrobacterium tumefaciens*, which is naturally able to transfer DNA to plants, and the 'gene gun', which shoots microscopic particles coated with Deoxy ribonucleic acid (DNA) into the plant cell (Southgate *et al* 1995).

Generally, individual plant cells are targeted and these are regenerated into whole GM plants using tissue culture techniques. Three aspects of this procedure have raised debate with regard to human health.

- The use of selectable markers to identify transformed cells
- Transfer of extraneous DNA into the plant genome (i.e. genes other than those being studied)
- The possibility of increased mutations in GM plants compared to non-GM counterparts due to tissue culture processes used in their production and the rearrangement of DNA around the insertion site of foreign genes (Suize et al 2008)

## **Genetically modified agricultural product in pre and post economic recessions in Nigeria**

Nigeria is Africa's most populous country (of more than 180 million people) and has the largest economy. The country depends on proceeds from oil and gas exports for more than 90 percent of her revenue. Despite the oil boom over the past three decades, Nigeria has struggled to diversify its economy and develop its agricultural sector. The agricultural sector accounts for about 40 percent of GDP—providing employment for about 70 percent of the population. Nigeria is a net importer of food and major agricultural products. Imported food and agricultural products average \$7 billion per annum—the decline in global oil prices over the last two years has negatively impacted the country's income as well as its ability to pay for all imported goods. Economic activities had shrunk more than 30 percent until the Government of Nigeria (GON) boosted its supply of foreign exchange during the first quarter of 2017 which helped the country out of recession in August 2017 (GAIN 2017).

In pursuit of sustainable food security in Nigeria, the government has embraced the adoption of genetically modified foods (GMOs) as a product of biotechnology for improvement and increased productivity in the agricultural sector that would lead to improved socioeconomic status of Nigerian farmers and enhanced national economic prosperity to achieve Foreign investments and earnings from safe modern biotechnology sector, Environmental sustainability, Jobs/wealth creation arising from various modern biotechnology activities, Availability of raw materials for industrial growth, particularly in the Nigerian textile sector, Development of plants/organisms that can reduce the impact of climate change and serve in pollution remediation, Improvement of the medical sector using various organisms that abound in the country. But Nigeria, like some other countries of the world, has started to battle with environmental conflicts arising from the introduction of genetically engineered foods has shifted focus to the role of agri-business. Discussions and opinions about GM foods which include crops, processing aids, and public policy issues that are related to them have been a product of debate in the last two decades (Scholderer, J. and Verbeke, W.2012).

The debate has generated a lot of heat in the West. Thereby, making the European consumers to be wary of GM products, fearing they may impair human health in the future, while the environmentalists also argue that its technology could have devastating consequences on the environment (Obadina, 2003). One of the attractions of introducing GM crops in Nigeria is that they may benefit the environment when crops could be modified to be resistant to the pest in order to remove the need to spray with a pesticide. The technology also holds the opportunity of developing varieties which may flourish in arid conditions (Keil, et al 1998)

The absence of effective policy formulation and poor implementation combines to threaten Nigeria's food security. In 2001, Nigeria established the National Biotechnology Development Agency (NABDA) to promote, commercialize and regulate biotechnology products. NABDA had operated without any legislation since its creation. The Bio-safety bill lingered in the country's parliament over the 6th and 7th sessions of the country's National Assembly, while stakeholders and lawmakers were unanimous on the importance of passing it into law. Fifteen years later, in April 2015, Nigeria's bio-safety bill was signed into law

which resulted in the establishment of the National Bio-safety Management Agency (NBMA) to regulate the law. This law leans heavily on the precautionary approach and requires certification and mandatory labelling for imports of all biotech products. NBMA is principally responsible for providing oversight for biotechnology's use and regulating the commercialization of biotechnology products in Nigeria. The Agency has become the focal point and authority on (bio-safety and approaches to) agricultural biotechnology as a tool to achieve food security. Nigerian government officials publicly announced their interests in commercializing Bt cotton, Bt maize, and Herbicide Tolerant (HT) soybeans, which are already approved commercially in South Africa. Although there has been no official approval for commercialization of biotech products in Nigeria, there is an expectation that commercialization will lead to increased yield and contribute to food security and industrial growth especially in the ailing textile industries. GON also expects adoption will promote the quantity and quality of cotton that Nigeria can export to other countries. While farmers' attitude about biotechnology is positive, certain Civil Society groups and Environmental Activists have intensified their anti-GE campaigns over the recent years. Nigeria's biotech law also requires mandatory labelling of products containing GE product/ingredients exceeding four percent. These continue to have some negative impact on the hitherto GE-favoring Nigerian consumers. As a result, strategic risk communication needs be heightened by stakeholders to address the misconceptions and make most Nigerians aware of the benefits of modern agricultural biotechnology. (GAIN 2017)

There are 5 GE crops under development that Nigeria is likely to commercialize within the next 5 years.

- **Bt Cowpea:-** The cowpea was developed in Australia with significant collaboration with Nigerian scientists. Purdue University in 1987 started the research in collaboration with the Network for Genetic Improvement of Cowpea for Africa and the Commonwealth Scientific and Industrial Research Organization (CSIRO) Australia, the African Agricultural Technology Foundation (AATF), and the Rockefeller Foundation. The Bt gene was donated royalty free by Monsanto and it is being inserted into cowpea to resist Maruca, an insect that reduces cowpea yield by over 60%. The research is carried out in the Institute of Agricultural Research (IAR) Zaria and it is undergoing farmer-managed field trials at Zaria, Kano and Zamfara.
- **Bt Cotton:-** The National Bio-safety Management Agency (NBMA) has granted approval to Monsanto for the commercial release of Bt Cotton. The Institute of Agricultural Research, Zaria has commenced the multi-locational trials on Bt Cotton. The first general release trial took place in 2016 in four locations: Abuja, Zaria-Kaduna State; Mokwa, Niger State and Ogun State. The second trial commenced in August 2017 and is on-going in two locations in Abuja FCT; Lafiya, Nassarawa State; Zaria-Kaduna State; Katsina; Gombe, Gombe State; Mokwa, Niger State; Ogun State under the supervision of Mahyco Company, and has shown tremendous progress.
- **Bt Maize :-** NBMA approved the confined field trial application of Monsanto's insect resistant maize, which is yet to commence.

- Africa Bio fortified sorghum :- The ABS project is being supported by Bill and Melinda Gates foundation (BMGF) and DuPont Pioneer and USAID. It is at its confined field trial stage at the Institute of Agricultural Research Zaria. The Product has been modified to have increased levels of vitamin A, iron and zinc.
- Nitrogen use efficient, water use efficient and salt tolerant (NEWEST) Rice :- The NEWEST rice project was commissioned in October 2015 at the National Cereal Research institute Badeggi. The project is facilitated by the African Agricultural Technology Foundation (AATF) with the aim of increasing rice productivity in flooded, poor Nitrogen and saline environments.(GAIN 2017)

### **Genetically Modified Food Controversies in Nigeria**

Civil society groups in Nigeria and around the world have engaged in a thorough global assessment of the performance, and the implications of GM crop releases around the world since 1996. These efforts have been aimed at providing an accurate picture of the global spread and implications of these crops and organisms, and also to help separate the hype from reality (Premium Times (2017)). Several non-governmental organisations have petitioned the National Assembly over attempts to introduce genetically modified (GM) maize and cotton into Nigeria's food and farming system. Several non-governmental organisations which include Environmental Rights Action/Friends of the Earth Nigeria (ERA/ FOEN), Health of Mother Foundation (HOMEF), All Nigerian Movement Union (ANCOMU), Women Environmental Programme (WEP, Rice Farmers Association of Nigeria (RIFAN), and Nigerian Women in Agriculture (NAWIA) have made serious objections to introducing genetically modified (GM) maize and cassava into Nigeria's food and farming system (CI, 2005). This did not go without response from the National Bio-safety Management Agency (NABMA) and Open forum on Agricultural Biotechnology (OFAM) that allayed the fears of Nigerians about alleged attempts to introduce genetically modified (GM) crops, saying every genetically modified organism (GMO) in the country is properly analysed and approved by the agency. Global anti-GM food campaigns have been influencing public attitudes to GM foods in Nigeria. Consumers International (CI), a worldwide federation of consumer organizations with 38 member organizations in about 22 African countries played an important role in shaping the debates around GM foods. It advocates a legal regime in which all GM foods are subject to rigorous, independent safety testing, labelling and traceability requirements, and in which producers are held liable for the environmental or health damage switch their products may cause. There is growing acceptance of this approach globally. In particular, there are challenges around reconciling the rights of product developers with those of consumers. Many public protests have centred on ethical or ecological grounds, the uncertainty about the impacts of the technology, and the public right-to-know and to have access to information, including through labelling. In several countries, concerns have been raised as to whether "the technology is tantamount to playing God, interfering with nature, contrary to local ethics and also whether gene insertion would play havoc with the totem system that lies at the heart of local cultural association" (Scoones, I. (2005).

## **Effect of genetically modified agricultural product on human health**

Critics of GM food warn that there is insufficient evidence that these foods are safe for humans and the environment. In particular, the methods used to insert genes into plants could disrupt the functioning of the plant, resulting in changed production of existing substances and the production of completely novel toxic or allergenic substances.

### **Health effects of GM crops with the Bt toxin**

The use of the Bt toxin in GM crops is very different from the use of the whole bacteria for pest control in various agro-productive systems, since in GMOs the Bt toxin is present during the plant's entire cycle and even remains in the soil up to 240 days after harvest (Saxena, Flores, and Stotzky, 2002). It forces exposure to the toxin in unparalleled doses and periods. There are studies and documented cases of allergies to the Bt toxin in humans, and proof that feeding Bt GM maize to rats and pigs results in swollen stomachs and intestines as well as to tissue, blood, liver, and kidney damage (Schubert, 2013).

### **Health impacts of agritoxin-resistant GM crops**

Eighty-five percent of GM crops are manipulated to make them resistant to one or more herbicides, either alone or in combination with pesticide genes. This has led to an unprecedented increase in the use and concentration of agritoxins, which has multiplied hundreds of times the level of residues in foods. Evidence of this is that, in order to authorize GM soy, several governments had to change their regulations to allow up to 200 times more glyphosate residues in foods (Bøhn and Cuhra, 2014).

Contamination of water sources with agritoxins and residues in foods were already a health problem in intensive rural production areas, but it has now become dramatic due to the increase in the use of herbicides to manage GM crops, and has expanded to urban areas.

### **Malformations and cancer from glyphosate in GM crops**

Scientific experiments with animals and studies published in peer-reviewed journals demonstrate that glyphosate, the most widely used herbicide with GM crops, has teratogenic effects, i.e. it can produce congenital deformities (Carrasco et al., 2010).

In 2009, a simple experiment with animal models (birds and amphibians) in Argentina demonstrated that dilutions of RoundUp (the most widely used commercial formula of glyphosate) or the introduction in the embryo of an equivalent to 1/200,000 of the glyphosate present in commercial formulas produced effects on gene expression during embryonic development, capable of inducing malformations during its early stages (Carrasco, et al., 2010).

Another chronic illness related to glyphosate is cancer. The close relationship between glyphosate and cancer results from the fact that glyphosate can block the DNA repair enzyme system in cells, which induces the accumulation of damages to the genetic material. This can be observed with high-sensitivity tests that detect the level of damage. Genotoxicity testing in

animals demonstrates that, in the populations of individuals exposed, the values are several times greater than those of individuals in the control group that is not exposed (López, et al., 2012). These evidences of damage to the genome through exposure to agritoxins, in particular to glyphosate, are a warning of possible chronic effects and the doorway to oncological illness.

More recently, Samsel and Teneff (2013) demonstrated the relationship between the increase in the use of glyphosate and many metabolic illnesses as a result of P450 inhibition and imbalances in the physiological detoxification processes carried out by these enzymes. This demonstrates that glyphosate's interference with CYP enzymes acts synergistically with the disruption of the biosynthesis of aromatic amino acids by the gut flora together with the hindrance of serum sulphate transport. As a result, these processes have an influence on a wide variety of illnesses: gastrointestinal diseases and obesity, diabetes, heart illnesses, depression, autism, and cancer, among others.

### **Conclusion**

GM crops have their merits and demerits like other inventions. However, it cannot be dismissed outrightly. If GM crops are capable of causing common diseases or if their effects appear only after long-term exposure, we may not be able to identify the source of the problem for decades, if at all. Heavily invested biotech corporations are gambling with the health of our nation for their profit. This should be a call for attention to re-examine the contentious areas of this technology with a view to enabling Nigerians to benefit from its application.

### **Recommendation**

In Nigeria, environmental impact assessment/studies should be required before approval is given to any GMO for commercial purposes, with a monitoring plan must which be presented to identify unanticipated gene flow effects. GM crops should be evaluated individually on a case-by-case basis, both prior to release and after commercialization. Nigeria should domesticate the existing international bio safety treaties and protocols to strengthen the national bio-safety acts which serve as the regulatory framework for GM foods by the National Bio-safety Management Agency (NBMA), Federal Ministry of Environment. A collaborative meeting should be held comprising the government, academia, research institutes and civil society organisation to make informed decisions on the adoption and cultivation of genetically modified food in Nigeria.

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