

BIOSAFETY AND BIOTECHNOLOGY SYNERGY FOR AGRICULTURAL SUSTAINABILITY AND FOOD SECURITY IN NIGERIA

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ABSTRACT

This study assessed the issues of biosafety and its law as it applies in Nigeria. It also assessed how Nigerians perceive the introduction of genetically modified organisms (GMO's) and its advantages to our crops and farming systems. In recent times where we are faced with an escalating population, food shortage and increased environmental problems, it becomes important that we must be concerned with concrete action to alleviate or mitigate the dilemma inherent in the need for increased food and safe guarding the environment. A lot of developed countries have been able to deal with food shortage because of the level of improvement in their agricultural sector. Agricultural biotechnology is one of the technologies which enable gene transfer across the natural barriers, thus creating a universal gene pool. Modern agricultural biotechnology application which emerged recently is a vital element that influences the relationship between science, technology and policy. Agricultural biotechnology is also being used to develop low-cost disease-free planting materials for crops such as cassava, banana, potato etc. The use of techniques of modern biotechnology in agriculture and food production has on the other hand given rise to fervent debates over the last two decades about the benefits versus the risks posed by GMOs and its products. It is in this perspective that we have a role to play in the safe and effective application of biotechnology for the benefit of agriculture and the environment at large. Additional developments in agricultural biotechnology will require further discussion which will open new areas for debate. It is through dialogue, particularly between the public, the scientific community, and policy makers that a better understanding, more objectivity and a closer understanding may be achieved as the process of biotechnological development continues. Policies in the long term must not only reflect technological and scientific realities, but also people's concerns and aspirations as well as international realities. Similarly, the governance of such products and ensuring their biosafety which includes safe uptake and use remains a quintessentially anticipatory challenge where the very existence and nature of risk and harm remains scientifically and normatively contested (Gupta 2001). Due to the risks that have resulted from biotechnology techniques, measures had to be put in place to reduce and where possible eliminate such potential risks. This brought about BIOSAFETY and in the process, Biosafety law which is an act to provide for the management of Biosafety. The relationship between biosafety and biotechnology can be divided into two segments. First, for appropriate biotechnology applications to be transferred in a safe and effective way, biosafety regulatory mechanisms have to be put in place. Second, the saving and protection of biodiversity is a complex venture or effort that requires, on one hand, protecting natural habitats (for example from the invasion of alien species), and on the other hand, easing pressure on land extension into natural habitats. It is this latter aspect that is directly related to the sustainability issue and agricultural production and productivity. The whole process of biotechnology, biosafety and biosafety law has raised a lot of concerns especially in developing countries in Africa, Nigeria inclusive with regards to GMOs associated with food and agriculture.

Keywords: Biosafety, Biosafety law, Genetically Modified Organism (GMO) and Biotechnology

Introduction

Genetically Modified Organism (GMO) is a plant, animal, microorganism or other organism whose genetic makeup has been modified in a laboratory using genetic engineering or transgenic technology. Biotechnology is broadly defined as the application of

scientific and engineering principles to produce valuable substances by deploying biological agents (Kumar, 2015). Here, the biological agents are not only limited to microorganisms, animals and plants are also being used for this purpose. Biotechnological advances in the field of life sciences have given rise

to questions regarding the potential adverse effects of the genetically engineered organisms on the native biological diversity. Dangers originating out of biotechnological interventions in life sciences include, unintended changes in the competitiveness of modified organisms, virulence, adverse change in characteristics of target species, adverse impacts on non-target species, adverse impacts on ecosystem, potential for weediness in genetically modified crops, potential for transferring invasive genes to wild relatives, instability of the inserted gene, short & long term toxicity, short & long term allergenicity, increase in antinutritional properties from GM foods, probable genetic changes/mutations in new born from Genetically Modified Organisms (GMOs).

Biotechnology is also being used to develop low-cost disease-free planting materials for crops such as cassava, banana, maize, potato etc. as well as creating new tools for diagnosis and treatment of plant and animal diseases. Plant genetic engineering promises to contribute significantly in agriculture, energy and health sectors, and environmental stewardship. However, like any other powerful technology, biotechnology also requires to be handled with utmost care and safety. With the increasing applications of biotechnology in almost all the areas of human endeavours, there is a crucial need to ensure that the technology is used judiciously. It is clear now that modern biotechnology promises to enhance the quality of human life, if used judiciously. On the other hand, if used haphazardly and carelessly, it may have negative impacts as well. Biosecurity is the need of the day, as bioterrorism is another associated concerns emerging rapidly. This is an important need to be taken care of in the interest of the sustainable research and development as well as for healthy and safe environment.

To make sure biotechnological advances are carried out without harming the native biodiversity, Biosafety measures have to be put in place. Biosafety is used to describe efforts to reduce and eliminate the potential risks resulting from biotechnology and its products (NBMA, 2018). It has similarly been defined as "*the avoidance of risk to human health and safety, and to the conservation of the environment, as a result of the use for research and commerce of infectious or genetically modified organisms*". It can also be referred to as containment principles, technologies and practices that are implemented to prevent unplanned exposure to pathogens and toxins or their accidental release into the environment. Biosafety describes the principles, procedures and policies to be adopted to ensure environmental and personal safety. Biosafety is the study for prevention of large-scale loss of biological integrity, focusing

both on ecology and human health. In agriculture, (including animal husbandry, fishery and forestry), the concept of biosafety involves assessing and monitoring the effects of possible gene flow, competitiveness and the effects on other organisms, as well as possible deleterious effects of the products on health of animals and humans. (Bellagio, 1998). A fundamental objective of any biosafety program is the containment of potentially harmful biological agents, toxins, chemicals and radiation.

The issue of biosafety became much stricter after 2001 when anthrax attacks in the United States raised the threat of bioterrorism using laboratory prepared pathogens. This shows that biosafety is not just a personal necessity but a crucial collective effort to ensure biological safety for a clean and safe environment. Relevant scientific disciplines that support biosafety studies include molecular biology, plant breeding, genetics, plant pathology, agronomy, weed science, entomology and ecology, among others. In the last few decades, biotechnology research has resulted into the development and release of several GMOs for commercial uses. Releasing GMOs into the environment may have direct or indirect effects including gene-flow or gene-transfer to wild relatives, trait effects on non-target species, pest resistance and other unintended effects. One of the most significant environmental benefits of GM crops is the drastic reduction in pesticide use in agriculture. Despite their potential, there is a multitude of concerns about the impact of GM crops on the environment. With the increasing number of countries adopting molecular tools and techniques in their life science research and development activities, the biosafety issues are gaining attention to ensure biological safety for the public and the environment. Recognizing the need of biosafety in GE research and development activities, an international multilateral agreement on biosafety "the Cartagena Protocol on Biosafety (CPB)" has been adopted by many countries world over. Policy decisions taken in regard to biosafety may have long-term implications for the sustainability of agriculture and food security.

Biosafety Law in Nigeria

Recognizing the need of biosafety in GE research and development activities, an international multilateral agreement on biosafety "the Cartagena Protocol on Biosafety (CPB)" has been adopted by 167 parties, including 165 United Nations countries, Niue, and the European Union. The Protocol entered into force on 11 September 2003, and its main objectives are: (i) To set up the procedures for safe trans-boundary movement of living modified organisms, and (ii) harmonize principles and methodology for risk assessment and establish a mechanism for

information sharing through the Biosafety Clearing House (BCH). Research work in the area of GE and GMOs requires prior approval from the appropriate regulatory authorities of the country. Following guidelines provided for minimizing biosafety issues is mandatory. The primary regulatory body at research institute level is the Institutional Biosafety Committee (IBSC) or its equivalent body consisting of experts from different relevant disciplines. The IBSC ensures existence of the basic biosafety equipment required as for the safety level of the experiments to be conducted.

In Nigeria, we have the National Biosafety Management Agency (NBMA) that sees to the regulation of biosafety law. The mission of the National Biosafety Management Agency is to promote the basic tenets of biosafety as enunciated in the Cartagena Protocol on Biosafety, and enforce Nigeria National Biosafety Management Agency Act 2015 to ensure the safe application and use of products of modern biotechnology. The bill on Biosafety law was finally signed into law by President Goodluck Johnathan by the 7th National Assembly on Monday April 21st 2015. Biosafety law is an act that provides for the management of Biosafety. The National Biosafety law is crucial in the management of Modern Biotechnology in the country. According to Ms Rose Gidado, who is the Deputy Director for National Biotechnology Development Agency (NABDA), modern biotechnology has been identified as an important tool that can help countries to achieve food sufficiency/food security, industrial growth, health improvement and environmental sustainability. The NBMA regulates modern biotechnology activities and the release into the environment, handling and use of genetically modified organisms which are products of modern biotechnology to prevent adverse impact on the environment and human health. On the other hand, the National Biotechnology Development Agency promotes modern biotechnology activities and GMOs.

She added that the Biosafety law in Nigeria will give the legal framework to check the activities of modern biotechnology locally as well as GM crops imported into the country and it will also provide avenue to engage Nigerian scientists and experts from different fields to identify and pursue solutions to our local challenges. "The Biosafety Law also recognizes the complex issues to be addressed by Central Authorities in the judicious application of Modern Biotechnology; it bases the deliberate release of GMO on Advance Informed Agreement (AIA)". Speaking further on the purpose of the Law, Ms. Gidado explained that the Biosafety Law apart from

being an act to provide for the management of Biosafety and other related matters, it will also seek to: Harness the potentials of what modern biotechnology has to offer under a legal regulatory regime; Ensure environmental, human and socio-economic safety while harnessing the benefits associated with the practice of modern biotechnology and its outputs; and Exercise the sovereign right over all the nation's natural resources and authority to regulate access to such resources.

She added that the law will also allay the fear of the populace on the socio-economic consequences of modern biotechnology, especially among the small scale farming systems that are prevalent in Nigeria. She reaffirmed Nigeria's commitment to the principles of the World Trade Organization and to reaffirm Nigeria's commitment to the goals and objectives of the Convention on Biological Diversity (CBD), and the Cartagena Protocol on Biosafety, which Nigeria has signed and ratified as well as safe use of modern biotechnology and provide holistic approach to the regulation of modified organisms in Nigeria among other purposes.

Speaking further, Ms. Gidado who is also the country's Coordinator, Open Forum on Agricultural Biotechnology in Africa (OFAB), Nigeria Chapter, said the country stands to gain lots of benefits with the law put in place as Nigeria can without delay commercialize Bt-cotton, Bt-maize, Herbicide Tolerant (HT)-soya beans, which are already in South Africa, Burkina Faso and Egypt. This, she said, could lead to increased yield productivity to ensure food security and industrial growth especially in the ailing Textile Industries. "It will also promote the quantity and quality of cotton that Nigeria can export to other international countries." Gidado added that the passage of the law will also ensure the much desired in-flux of foreign direct investment from notable world leading companies in Biotechnology thereby improving gross domestic product growth rate and increase job creation. "The Law will promote national security through the application of DNA finger printing for crime detection, paternity testing, identification among others. "It will also promote active commercialization of the research and development projects in our various Universities and Research Institutes hence improving our economy as well as support the country to become one of the leaders in Biotechnology, particularly in Africa."

For Professor Ado Shehu Garko, the Vice Chancellor University of Katsina State, the law will allow and encourage research and business with biotech products including consumption. He added that the law would assist farmers reduce production cost and

get more profit growing biotech crops, “more nutritious crops can be developed and even medicinal crops can be developed.” In recent times when oil prices have been dwindling, the country needs to diversify from oil into agriculture for enhanced economic development. One of the stakeholders in the passage of the law in Nigeria, the International Service for the Acquisition of Agri- Biotech Applications (ISAAA) explained that the country “will benefit” from the potentials of GM plants. “In the developed world, there is clear evidence that the use of GM crops has resulted in significant benefits.”

Some of the benefits Nigeria stands to benefit from having the law in place include higher crop yields; reduced farm costs, increased farm profit and the improvement in health and the environment. ISAAA says while most of the debates over transgenic crops have taken place mainly in the developed nations in the North, the South stands to benefit from any technology that can increase food production, lower food prices, and improve food quality. Ms. Gidado noted that some institutes had been accredited and their containment facilities equally certified for modern biotechnology activities. “These institutions are; The National Root Crops Research Institute (NRCRI), Umudike, Institute for Agricultural Research, Zaria (IAR), the Federal University of Technology, Akure and the National Biotechnology Development Agency (NABDA).”

She added that with the law in place in the country, the fear of potential risks of GMOs had been addressed as the Biosafety law defines offences and Penalty for violation. The law, she said “contains powers” to authorize release of GMOs and practice of modern biotechnology activities; “confers the power” to carry out risk assessment/management before the release, handling and use of GMOs. It will cover all Genetically Modified Organisms/Living Modified Organisms (LMOs) and products thereof including food/feed and processing and covers socio-economic consideration in risk assessment.

The Issues of Biosafety and Biosafety Law in Nigeria

Biosafety is a matter of public health and with the increasing emphasis on adoption of GE technology; biosafety issues are gaining importance to ensure safety of the public and the environment. There has been increasing awareness among the researchers, producers and users of GMOs, administrators, policy makers, environmentalists and general public about biosafety. Therefore, many countries have put into place regulatory policies and regulatory bodies for research and development of GMOs. However strict compliance to biosafety guidelines is still required in

many developing countries. Though there are several technical issues of releasing GMOs in the country and its environs for commercial uses, safety of the laboratory workers, consumers and the environment as a whole is the biggest issue even in Nigeria. Unfortunately, stringent biosafety and biosecurity rules are still impractical in many countries where researchers often need to handle infectious agents such as anthrax and plague to protect public health as well as lacking the proper infrastructure.

In Nigeria, there are a lot of raised issues with concerns over release of GMO’s and its safety not just on human consumption but also its safety towards the environment and its economic benefit to farmers as well, especially the small scale farmers. There are also concerns that the National Biosafety Management Agency does not ensure the strict compliance with biosafety law with regard to release of GMO products into the Nigerian environment. This has resulted in a protracted debate over the application of genetically modified crops into the food system of the country. The debate has resulted into two groups: Pro-GMO and Anti-GMO. They groups against GMO include farmers, Faith based organisations, Civil Society groups, Friends of the Earth Nigeria, Environmental Rights Action, Nigerian Institute of Food, Science and Technology (NIFST) and Health of Mother Earth Foundation (HOMEF). The major concerns and issues raised by the Anti-GMO groups against GMOs, biotechnology and biosafety are about the safety of the Nigerian environment, its biodiversity and food systems.

For instance, the Director of HOMEF stressed that there are serious challenges GMOs pose in the areas of toxicology, allergy, immune dysfunction and genetic disorders which make it very important that Nigeria adopts the precautionary principle. There are also issues on liability and redress, concerns on conservation of indigenous crops and agricultural biodiversity. HOMEF also raised concerns on issues of proper labelling of GMOs. They insist that the promise to have GMOs labelled in Nigeria to ensure that the public has a choice on whether or not to eat such crops will not work mainly due to the country’s socio-cultural and economic realities and that’s if such foods will be labelled as GMOs in the first place. They also raised concerns that the general public has little or no knowledge about GMOs.

They also raised concerns about NBMA not following the due process and conditions that need to be met before giving approval of permits for confined field trials of GMOs to be carried out or released in Nigeria. They gave an example of when permit was granted to the International Institute of Tropical

Agriculture (IITA) and ETHZ Plant Biotechnology Lab in Zurich to carry out Confined Field Trials (CFT) of genetically modified (GM) cassava (AMY3 RNAi Transgenic lines) in Ibadan by the Nigerian Biosafety Management Agency (NBMA). HOMEF insists that NBMA didn't follow due safety process before granting this permit. HOMEF and Friends of the Earth Nigeria also insist that some GM foods like Monsanto's maize is accompanied with a cocktail of chemicals including glyphosphate formulations which the International Agency for Research on Cancer (IARC) a sub unit of the World Health Organisation (WHO) says is likely to cause cancer yet, this maize was imported into the country without due diligence. Similarly, organisations like Nigeria Institute of Food, Science and Technology (NIFST) have raised concerns over GM seedlings. They stated that GM seedlings would be inimical to the country's local seedlings and that the GM seeds would make it impossible for our local seedlings to be productive for farmers and the nation. They are not convinced that the country's biosafety and biosafety laws provide for the security and sustainability of our local seedlings.

Conclusion

GMOs are emerging as very important tools to solve several current problems; however biosafety is an equally important concern. It is very well understood now that modern life science research would enhance the quality of human life, if used wisely and safely. On the other hand, if used carelessly, it may have negative impacts on the environment and human life. Biosafety is important not only from the safe product development point of view but also for safe utilization of the technology. Therefore, to maximize the benefits of GE technology, adoption of biosafety measures must be ensured and doubts related with general risks and hazards, long term safety to health, nutrition, environment and sustainable agriculture must be properly dispelled. Nigeria as one of the most populous countries in Africa is growing with an escalating population and recently has always depended on oil revenue for its income. With much attention being paid to diversification of our economy, agriculture seems to be the best alternative and if we are to meet up with feeding our escalating population and at the same time protecting the environment, then the country has to embrace modern agricultural biotechnology to achieve this set goal. With modern agricultural biotechnology, the country will stand to achieve a lot especially with the biosafety law in place and strictly adhered to. All bodies involved need to work together starting from the Research Institutes to the farmers, the National Biotechnology Development Agency (NABDA), to National Biosafety Management Agency (NBMA) as well as

Civil Society Organisations both the Anti and Pro GMO group. The country will gain a lot from modern agricultural biotechnology if applied judiciously following the Biosafety law and principles. The issue of food shortage or scarcity will be mitigated as seen with countries that have adopted this modern technology. The views expressed here are those of the author only. These may not necessarily be the views of the institution/organization the author is associated with.

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