Africa on GMOs: Scientific response to anti-technology NGOs

Advances in molecular biology, genomics and biotechnology have greatly revolutionized agriculture and human and animal health. While the application of techniques from these fields offers great benefits for human population, it also raises questions, which often inspire widespread debates on ethical, scientific, and social issues.

In recent times, there has been increasing concern on the deployment of these techniques to generate genetically modified crops (GM crops or GMOs) in Nigeria and other African countries. While some of these concerns are valid, most are unfounded and have only given rise to conspiracy theories that leave the general public unnecessarily alarmed, confused and misinformed.

Currently, public debates on GM crops seem to be more spirited and acrimonious than those on GM vaccines, hormones and other drugs, even though both GM crops and human-related GMOs are developed using similar techniques and subjected to similar biosafety and risk assessment analyses before release. In an era of social media, the Internet is full of hype and scary pictures that play neatly on our cognitive habits. Perhaps this is because several crop varieties produced through genetic engineering with their huge market and products derived from them are widespread in the marketplace. Where there are competing economic interests, rumormongering and fear may also be commodities and the truth a casualty. This piece addresses key scientific facts about genetically modified crops so as to debunk the false claims often associated with GMOs, as Nigeria debates the issue.

Genetically modified organism (here from referred to as GMO and unless stated, applied to plants only) is an organism that harbors foreign DNA within its genome (genetic make-up). The exogenous DNA may come from bacteria, virus, plants or animals. When expressed by host species, exogenous DNA confers a GMO certain desirable characteristic(s) that is/are of agronomic or medicinal importance. For example, a DNA fragment responsible for the production of insulin isolated from humans can be introduced into bacteria to make it produce the hormone in large quantity.

Genetic modification of plants for human use is nothing new. Early humans of Africa, China, Middle East and Mexico have genetically modified plants over thousands of years. Beginning by growing plants collected for food or fiber in the wild and by choosing individuals with their preferred traits (such as bigger seeds), our ancestors successively selected and used seeds from one generation to the next until they obtained specific crops. This slow process over many generations, led to the accumulation of differences between domesticated crops and their wild relatives. Indeed in some cases (like corn), the process is so remarkable that the wild species that gave rise to the crop can only be traced through genomic studies.

An example of a plant with visibly missing ancestor is cauliflower, which does not resemble any other plant in nature. Plant species that were intercrossed and grown in a given geographical location led to new varieties and as these varieties were transported to other locations they intercrossed with other species to give rise to entirely new species. This was also true for animals. An example of this is wheat, which is a product of incorporating genes from different species. Thus the concept of using genes from different species as a basis for crop improvement is an ancient one. Interestingly, the very idea of

transferring gene from one species to another is one of the bones of contention about GMO crops. Today, crop breeders and molecular biologists actually employ the same principles as those early farmers.

The mechanism involved in generating GMO in laboratory is also nothing new in nature. For thousands of years, a soil bacteria known as *Agrobacterium tumifaciens* developed a strategy of inserting a portion of its DNA into plants, making them undergo uncontrolled cell division, thus providing the bacteria with nutrients in a host-bacterial relationship. When scientists discovered this, they cleverly “disarmed” the bacteria such that, in place of the tumor inducing DNA of the bacteria, which causes the uncontrolled cell division, they can insert one or more pieces of DNA from any source, which can, for example, make the plant grow taller, produce more grains, become more resistant to bacteria, virus or insect or simply produce desirable substances like hormones, drugs and enzymes.

Since its first successful application, there have been several improvements in the technology such that today, scientists can direct the entry of several copies of one or more piece of DNA into a plant genome with high degree of precision using different transformation methods. One of the more recent techniques used in developing genetically modified crops is RNA interference (another natural process which was first discovered in worms and for which a Nobel prize was won). This approach allows for targeting and silencing genes in viruses, bacteria or insects that attack plants, through a mechanism similar to vaccination in humans.

Besides helping us understand biology and physiology of plants, genetic engineering has led to the development of improved crops such as cotton, soybean, cowpea, cassava, tomato, coffee, banana and several products derived from them. The technique has also been used to generate crops with improved protein content, higher oil yield, plants that serve as biofactories for hormones, vitamins and growth factors among others.

The number one argument against genetic engineering focuses on the safety of consuming crops and products generated from the technique. However, millions of people and animals have been consuming GMOs for more than 30 years without a single documented case of adverse effect that can be attributed to the consumption.

From a biological point of view, all the foods we have been consuming throughout our lives are derived from genetically modified organisms. The crops we have domesticated and crossbred over the years are not any more transgenic than those generated in laboratory today. Man has been altering the genetic makeup of his environment for thousands upon thousands of years. Indeed the differences between the plants and animals we consume today and their ancestors, which were subjected to the process of genetic transformation, are in the extreme. With technological advancements, man simply learned to improve and speed up processes of breeding in order to improve quality of life, just as the development of antibiotics has greatly improved our health. Except for their superior traits (higher yield, more resistance, generation of a product), there is nothing distinguishable between a GMO and the so-called natural product.

Consider the following: In the last ten years, more than 1700 studies have been conducted to determine the safety or efficacy of genetically engineered crops. To date, not a single scientific study has reported

even of headache as a result of consuming GM crop or its product. It is very important to point out that independent public sector scientists conducted many of these studies, including many by scientists in the European Union, where the political establishment generally has been hostile to GMOs over the objection of mainstream scientists.

Among the studies that claim to record adverse effect as a result of consumption of GMO, a now-retracted study by a group of French scientists led by Gilles-Eric Séralini deserves special attention given the false alarm it has created. The group originally reported that rats fed with genetically engineered corn developed tumor. However, simple analysis of the report exposes it as "bad science" at the very least.

Although the original paper was eventually retracted (and then republished without peer review), the damage had already been done and given the conspiratorial nature of our thoughts, many would prefer to accept the discredited study even as it stands roundly condemned by scientific community the world over. Besides employing poor methodology (the rats used in the experiment are naturally highly susceptible to tumor), using poor sample size, weak statistical analysis and grammatical errors, the scientists refused to release key methods and data so that others can independently verify their claims; a sacred practice known as peer review among scientists.

Much anti-GMO sentiments appear to be directed against Monsanto, a multinational company that developed Bt-corn. Often in their haste to roundly condemn multinational companies based on ideological differences, many critics of GMOs ignore the that fact that GMOs also include genetically modified bacteria that produce medicines like insulin for diabetics, blood clotting agents, immune cell growth factors and chemotherapeutic formulations that have saved millions of lives. Lost within the debates on capitalism, critics seem to miss vital point by focusing on multinational companies (who are, no doubt involved in lobbying), while ignoring the scientific facts involved in developing these products and the benefit they bring to poor farmers and general public.

The biggest fallacy often comes in the form of blanket claims about the "danger" of GM crops as against assessment of the benefits and risks of each GMO on a case-by-case basis. Indeed the anti-GMO sentiment is hyped to such dangerous dimensions that alternative medicine and natural products entrepreneur Mike Adams, who runs the highly popular but lowly regarded NaturalNews.com website, and is thought of as one of the most irresponsible voices in science and a leader of the crusade to demonize GMOs and undermine the advances of medicine, has of recent, resorted to attacking supporters of genetic engineering as modern day Nazis and calling anti-GMO activists to kill scientists and journalists that support GMOs for "crime against humanity".

Reviewing scientific literature on GM crop safety during the last 10 years, experts recently built a classified and manageable database following analysis of scientific papers covering original research papers, reviews, relevant opinions and reports addressing all major issues that emerged in the debate on GM crops. Based on the data, the review concluded that it is safe to consume GMOs. (In standard scientific practice, consensus among majority of scientists is sufficient proof to accept conclusions even when counter claims such as the discredited Seralini reports exist.)

Discussions on politics and economy about the threats of lobbying, patenting seeds, corporate corruption

and the damage companies might cause to the planet are valid and remain relevant. However, we need to be clear about what it is we are debating. Ideological debates should not be used as excuse to dismiss scientific facts, which show that GMOs are safe for consumption, just because we don't like one of the companies that generates them. If the reader can imagine an activist sending anti-GMO tweets from a Dell computer while wearing Nike shoes and sipping Coca-Cola drink from a McDonalds restaurant, then he will see the contradiction in the anti-GMO stance.

Given the challenges facing global food production such as climate change, population growth, and competition for arable lands, foods have to be produced with reduced environmental impact and with less input from non-renewable resources if the increasing demands for food and medicine worldwide are to be met. Indeed, no region in this world is as highly susceptible to food shortage and health risk as the African continent. Currently, the world population stands at 7.2 billion and is projected to increase by 1 billion each decade, reaching 9.6 billion by 2050, with more than half of this increase expected take place in Africa. Already, thousands of refugees displaced by Boko Haram from northern Nigeria and those displaced by rebels from Mali and South Sudan are flooding into the Niger republic, a country known for its high birthrate and consistent food crises. There is urgent need to adopt new technologies to address the looming crisis.

Currently, transgenic technology ranks very high among the few approaches known by scientists that can effectively revolutionize food production in Africa within the shortest possible time. When applied in combination with traditional breeding methods and other agricultural practices, the impact will be remarkable—if political opposition does not scuttle innovation. While it is true that agricultural improvement doesn't necessarily have to be through GM, in certain cases, conventional breeding fails due to unavailability of desirable traits in the existing gene pool, which will allow for developing new desirable varieties. In such cases, the only alternative is transgenic technology. This has been successfully demonstrated by Brazil, a world leader in tropical agriculture.

Unfortunately, most African countries have fallen victims of anti GMO propaganda and conspiracy theories that have no scientific basis whatsoever. Even more unfortunate is the colonial mentality of roundly rejecting the technology simply because some European countries have not fully accepted it. One hopes that by the time we realize how naive this position is, millions more would not have died of hunger, poverty and terror attacks, not to talk of the economic losses. Anti-GMO activists in Africa need to understand one basic fact; Europe is not a model for agricultural activities in African countries and it's precisely for this reason that the fiercest anti-GMO groups are from Europe.

Ethical conflicts involving the adoption and development of transgenic technology can be resolved by ensuring that for each product generated, rigorous biosafety analyses are conducted. This can be addressed through partnership between scientists and risk analysts on one hand and activists on the other, most of whom actually need to be more familiar with the science behind the technology. Here also, we have the example of Brazil which has recently developed a transgenic common bean resistant to virus and released the crop for commercial use following rigorous biosafety evaluations, based on the guidelines of the Brazilian Biosafety Committee (CTNBio) following a process that lasted for over 10 years. It is worth highlighting that this technology and the studies based on possible environmental impacts as well as human and animal nutrition as required by CTNBio, were developed and executed

entirely by the Brazilian Research Cooperation (EMBRAPA), which is 100 percent public. Seeds from the crop are available to the public.

Although the recent announcement by Nigeria's National Agricultural Biotechnology Development Agency (NABDA) that the federal government has put in place necessary regulatory guidelines to fast track the adoption of GM crops and that a biosafety law will be passed to promote research and development in biotechnology is encouraging, Nigeria and indeed Africa are missing out in utilizing the technology as a BBC report recently put it. A report published by Chatham House titled On Trial: GM Crops in Africa, highlights the multiple barriers that inhibit the development and adoption of pro-poor GM varieties in Africa, which include regulatory constraints, consumer distrust and weak farmer demand, poor research funding. All of these are exacerbated by the anti-GMO campaigns even though the development of new GM technologies in Africa is dominated by the public sector. It is instructive to note that, by the time this piece was being concluded, two US missionary workers that contracted Ebola virus in Liberia are being cured with a cocktail of antibodies produced using GM tobacco.

It would appear that a large number of stakeholders in agriculture and the general public still do not understand transgenic technologies and ignorance inspires fear; a potent weapon of propaganda and economic wars sustained by "bad science". Ignorance is nothing new in public discourse but enlightened Nigerians should seek to understand GM crops and debates should be based on peer reviewed and verifiable scientific facts and understanding of biology, not conspiracy theories and scaremongering.

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