

## Mini Review

# Recognizing biotechnology as a tool for sustainable development

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The last century has been largely driven by wealth of natural resources; however, more than ever before, knowledge, skills and intellectualism are now the driving force of current global wealth creation. The demonstration of this fact can be found with nations that have advanced their science and technology system and have adopted new technologies. Knowledge of space science, information technology and biotechnology in particular are been explored to narrow the divide between 'have' and 'have not' in these communities. The application of biotechnology is not new, it has been employed for centuries in the production of fermented foods such as gari, bread, beer, yoghurt, cheese and beverages such as wine. Modern advances in biotechnology hold great promise for addressing key challenges in agriculture, human health and the environment. Biotechnology, as with any new technology has its advantages and limitations; the application of modern biotechnology has highlighted its positive impact on agriculture, human health and the environment through increased crop yields, the reduced use of pesticides and herbicides, production of nutritionally enhanced foods and affordable vaccines. It is indeed an essential panacea to the pervasive poverty and food security problem in Nigeria. The debate about biotechnology continues because of, politics, trade and ethical issues that have been raised in the public domain with little distinction being made between biotechnology as a tool and genetically modified (GM) crops and foods as products, leading to the intense controversy about the perceived risks to human health and environment. This highlights the importance of having biosafety regulations in place and ensuring that there is adequate in-country capacity so that all the necessary precautions are adhered to. The debate must shift to how this technology can be adopted and deployed to benefit the nation and its citizens in such a way that the ecosystem is not threatened.

**Key words:** Biotechnology, biosafety, wealth.

## INTRODUCTION

Africa is endowed with natural resources possessing market potentials. In the absence of market segmentation, the Sub-Saharan Africa region will be the third largest single market in the world, after China and India with a population approaching the billion mark, which offers tremendous opportunities for economies of scale. The latest statistics indicate that Sub-Saharan Africa is the only region of the world where poverty increased during the last decade and projections are not encouraging either. By 2015, the Sub-Saharan Africa region alone will account for over

50% of the world's extremely poor population, those living on less than a dollar a day. The recent International Fund for Agricultural Development report (IFAD) makes a strong case that the effective use of biotechnology will be essential to the alleviation of rural poverty in developing countries. Biotechnology is now being heralded as the technology for the future and promises are already being made that this new technology will solve the problem of world hunger as it revolutionizes agriculture.

The application of biotechnology (traditional biotech) is not new, it has been employed for centuries in the production of fermented foods such as gari, bread, beer, yoghurt, cheese and beverages such as wine. Modern advances in biotechnology hold great promise for addressing key challenges in agriculture, human health

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and the environment. The Convention on Biological Diversity (2000) defines biotechnology as “any technological application that uses biological systems, living organisms, or derivatives to make or modify products or processes for specific use”.

Biotechnology as with any new technology has its advantages and limitations. The application of modern biotechnology has highlighted its positive impact on agriculture, human health and the environment through increased crop yields, the reduced use of pesticides and herbicides, production of nutritionally enhanced foods and affordable vaccines. The debate about biotechnology continues as political, trade and ethical issues that have been raised in the public domain has made little distinction between biotechnology as a tool and genetically modified (GM) crops and foods as products, leading to the intense controversy about the perceived risks to human health and environment. Despite scientific evidence, associated risks are continuously debated. There is however a consensus on the need for effective and continuous monitoring, assessment and management of the potential risks. This highlights the importance of having biosafety regulations in place and ensuring that there is adequate in-country capacity so that all the necessary precautions are adhered to (Wambugu, 1999).

Taking cognizance of the different applications of biotechnology in the environment, food and agriculture, healthcare and the industrial sectors, it is indeed an essential panacea to the pervasive poverty and food security problem in Nigeria. Though biotechnology is not the only solution to these challenges, it is an essential tool that cannot be ignored. Thus, policy makers and scientists need to urgently identify specific areas of interest to address peculiar problems and the debate should be shifted to the nature of innovative policies and laws to regulate the adoption and deployment of this technology in such a way that both the end-user and the scientist are adequately protected from any exploitative tendencies.

## APPLICATION IN FOOD AND AGRICULTURE

By the early 1980s, it became apparent that the agricultural sector could no longer meet the domestic food requirements. Agricultural production has stagnated at less than 1% annual growth rate with the population growth rate between 2.5 - 3% per annum; thus, domestic food supply had to be augmented through large imports. The food import bill rose from a mere 14112.88 million naira annually during 1970-74 to N1, 964.8 million naira in 1991 (Talabi and onasanya, 2004).

The conventional breeding process being the basis for development of essentially all varieties of plants used in African agriculture today is slow, commonly requiring 10 years before a new variety can be released. One of the biggest problems with this process is that desirable characteristic being sought to improve a given species

may not be found among any of the plants of that species hence a dead end for the transfer of the desired trait is reached. Genetic engineering more than any other technology has the potential to address these challenges at the same time introducing cultivars traits from an unlimited gene pool. So far, most of the plants that have been genetically engineered have been for crops with single gene alteration that confers agronomic benefits like resistance to pest or herbicides. By 2005, the acreage for genetically engineered (GE) crops was estimated to be 222 million acres worldwide, and the number of countries growing such crops had reached 23 in the same year, however most of the acreages are mainly concentrated among four crops (soybeans, corn, cotton and canola) and five countries. The United States accounts for 55% of global acreage, Argentina had 19%, Brazil (10%), Canada (7%) and China (4%) (ISAAA, 2005). The African continent more than any other needs to adopt the application of biotechnology and transgenic crops to its Agricultural system for it to be able to feed its teeming population on the current cultivated area with reduced environmental impact. The yield gains from GM crops has made it possible for the world's farmers to double global food harvest in the last 50 years on roughly the same amount of land at a time when global population increased by more than 80% between 1996 -2006; China had an enhanced income of US\$5.8 billion from Bt cotton; in 2006 alone it earned US\$817 million (James, 1998). Some modest achievements are been made in Nigeria and should be commended, particularly the current effort between the Institute for Agricultural Research (IAR) Zaria and African Agricultural Technology Foundation (AATF) Kenya on maruca resistance cowpea/bean. Maruca (caterpillar of a butterfly) attack is the biggest problem of cowpea accounting for over 30% loss of this crop; National Biotechnology Development Agency (NABDA) is committed to this project by supporting the construction of a level -2 containment facility. Also NABDA is also establishing state of the art tissue culture facility across the country for the development of *in vitro* micro propagation of endangered, underutilized exotic and indigenous plant species. NABDA is an institutional organ of government responsible for the promotion, coordination and deployment of biotechnology in Nigeria.

## APPLICATION IN ENVIRONMENT

The environment embraces the three levels of life forms on the earth namely the genetic diversity within the species which is the functional unit of heredity in plant, the diversity of species both wild and domesticated within a geographic area and the diversity of habitats and ecosystem for diverse species around the world. These are today being threatened by the activities of man. It has become clear that the old method of dumping industrial, military and agricultural chemicals into waterways or burying them underground is causing both short and long

term effect and damage to the environment as well as to human health. Today biotechnology as a tool is providing newer, more efficient clean up techniques and at the same time wealth is generated from what ordinary would have been considered as waste. The US Environmental Protection Agency reported that several million tons of hazardous waste was generated in the 1970's and using conventional clean up techniques, geological survey estimated that up to a trillion dollars will be required to clear the backlog of the polluted sites.

## **APPLICATION IN HEALTH AND DRUG DEVELOPMENT**

Biotechnology has heralded in a new era in prevention, diagnostics and therapeutics of diseases and infections. Molecular mechanisms of disease are now better understood, diagnostic methods improved, therapeutic modalities increased; safer and more effective vaccines developed. Research is directed towards developing new kinds of improved vaccines (polysaccharide-protein conjugates, immunogenic proteins) for preventing bacterial diseases. Another high priority is the development of genetically engineered vaccines against human immunodeficiency virus (HIV), hepatitis A and C and other viruses. The use of biosensors to measure metabolites, enzymes and other cellular products in small biological samples is increasing. Novel natural therapeutics development is being promoted using proteins that originate from living systems, as this type of therapy will provide a more specific and effective treatment, with fewer side effects, than conventional drugs. Drug discovery is being improved by the use of molecular modeling and the development of cell receptor based agents. With the discovery that the genes associated with cancer are also present in non-humans, there has been considerable effort and real promise in using laboratory organisms such as yeast to screen various types of anticancer drugs.

## **CONCLUSION/RECOMMENDATION**

Despite the controversies surrounding biotechnology and the difficulty in arriving on a compromise position, it has gained acceptance because there is a consensus that the technology provides global opportunity. Biotechnology is a tool that provides people the opportunity to better their situation; it is something needed to facilitate not impede development. The debate has to shift to the nature of innovative policies and law to regulate our adoption of this technology.

As we adopt this technology, we need to have the right policies and regulatory framework agencies in place to interface and negotiate on our behalf with the big multinational companies that have these technologies. Check and balances are to be put in place to maintain and preserve our local diversity thereby preventing foreign companies from patenting our local germplasm; policies on intellectual property rights clearly define to avoid exploitation of our indigenous scientist, researchers and deserving stakeholders. A clearly defined, ambitious and well funded sustainable programme for developing our indigenous capacity must be in place that will develop our pool of manpower to drive our biotech system.

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