



## BIOTECHNOLOGY IN THE 21<sup>ST</sup> CENTURY, A WAY OUT OF POVERTY AND HUNGER FOR AFRICAN NATIONS



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Received: February 11, 2023 Accepted: April 15, 2023

### Abstract

Sub-Saharan Africa is one of the most food insecure regions in the world. Africa's overall food production capacity is said to be increasing at the rate of 1.4% while its population is expanding at about 2.4% per year. The continuing decline in food production has to be reversed if massive food insecurity, poverty, social and political instability are to be averted. Genetic modification, biofortification and other new and emerging technologies, including synthetic biology, artificial intelligence and tissue engineering may have potential implications for the future of crop and livestock agriculture. However, biotechnology requires investments in research and development, human capital, infrastructure and knowledge flows, regional and international collaboration, and technology foresight and assessment for agricultural innovations. The adoption and full utilization of biotechnology in general, and agricultural biotechnology in particular in Sub-Saharan Africa appear to be very slow. It was in view of the above that this review was designed and intended to determine if biotechnology investment can get Africa out of poverty and hunger, the current status of African biotechnology investment, and level of investment in biotechnology that would get African out of poverty and hunger. An integrative review was used as the project design, and the study had searched for more than 40 articles and reviewed more than 35 of the articles being the most recent. As at 2022, seven countries out of fifty-four had the functional biosafety systems. Number of commercial approval of GM crops, the types approved and approval for commercial release of the crops for local consumption is negligible. The study concluded that African nations are far behind in terms of acceptance, adoption, and utilization of modern biotechnology. The study recommended increase in funding for R & D so as to increase number of crops release for commercial cultivation and export, investment in other sectors of biotechnology like medical (bio-pharma, diagnostics, vaccines, etc.), environment, industry, etc., put workable policies & legislation for biosafety and patent right protection, encourage trans-border trade among regional members, increase awareness on GM crops through outreaches.

**Key Words:** Biotechnology, Hunger, Poverty.

### Introduction

#### *Background to the Study*

According to United Nations Conference on Trade and Development (United Nations, 2017), about 795 million people, are undernourished with majority living in developing countries and rural areas. New, existing, and emerging technologies can address the four dimensions of food security. Genetic modification, method for improving soil fertility, and irrigation technologies can increase food availability. Post-harvest and agro-processing technologies can address food accessibility, biofortification can make food more nutritious, and climate-smart solutions anchored in science, technology and innovations, including the use of precision agriculture and early warning systems can mitigate food instability. New and emerging technologies, including synthetic biology, artificial intelligence and tissue engineering may have potential implications for the future of crop and livestock agriculture. However, harnessing the potential of such technologies for food security requires investments in research and development, human capital, infrastructure and knowledge flows. Today, most countries are not self-sufficient in food grain production due to climate change, environmental limitations, etc. Biotechnology can make it possible to customize the genetic make-up of crops plants, so that they can grow in exceptionally dry/wet and hot/cold climates. Biotechnology can help to increase crop yield, greater flexibility in growing environment, reduce the use of chemical pesticides and improve nutritional content.

Biotechnology is the use of biological processes to make products that are useful to man. It is the application of scientific and engineering principles to the processing of material by biological agents to provide goods and services. It is the integrated use of Biochemistry, Microbiology, Engineering sciences in order to achieve technological application of the capabilities of microorganisms, culture tissue cells and their parts.

Biotechnology of the first generation had led to the production of wine, beer, cheese, vaccine, etc. The second generation biotechnology provided means of conventional breeding and tissue culture techniques. The third generation biotechnology or Modern Biotechnology also known as the Biotechnology in the 21<sup>st</sup> century uses modern technology such as recombinant DNA technology, GMO's, genetics, molecular biology, etc. to understand biological phenomenon in a new level of precision; that is at the cellular and molecular level, and solve problems or create products that are useful to man. The diversity went beyond the Human Genome Project with new discovery path ways, and diverse applications and DNA identification. Biotechnology had explored how DNA impacts health, understood what all genes do, learned what the rest of the human genome does, developed more accurate and rapid diagnostics, and designed customized treatments. Biotechnology had made it possible to clean up toxic wastes from environment, capture excess carbon to help reduce global climate change and generate clean energy sources. Three (3) major areas of biotechnology are:

- 1) **The Medical Biotechnology:** Also called the red biotechnology which involves the designing of organisms to produce antibiotics, and the engineering of genetic cures to diseases through genomic manipulation.
- 2) **The Industrial Biotechnology:** Also called white biotechnology that involves the designing of organism to produce useful chemical.
- 3) **The Agricultural Biotechnology:** Also call green biotechnology that involves the designing of organism to grow under specific environmental conditions or in the presence or absence of certain agricultural chemicals.

#### **Statement of the Problem**

Today, less than 60% of the people on the planet grow what they eat. By 2025, half will live in cities and need to be fed through market channels (UN estimate). The world food production would have to double on existing land over the next 20 years to meet the growing population. The world population is expected to reach 7 billion within 25 years, and over 10 billion in the year 2050, while agricultural production is growing at the slower rate of about 1.8 % annually. In some African countries like Nigeria, the researcher is a living witness that banditry is a common security challenge that is widespread in most rural settlement where farming activities occur frequently, and most villagers are now moving in large numbers to towns and cities for the safety of their lives and properties. Immediate implementation of agric biotechnology is the solution. However, this technology has not penetrated areas where it is most needed like Africa and Asia.

#### **Research Questions**

1. Would investment in biotechnology get Africa out of poverty and hunger?
2. What is the current status of Africa investment in biotechnology?
3. Which level of investment in biotechnology will get Africa out of poverty and hunger?

#### **Objectives of the Study**

- 1) To determine if investment in biotechnology would get Africa out of poverty and hunger.
- 2) To determine the current status of Africa investment in biotechnology.
- 3) To determine the level of investment in biotechnology that can get Africa out of poverty and hunger.

#### **Significance of the study**

This study intends to find if biotechnology investment can get Africa out of poverty and hunger. The study stands to benefit the various African governments, the entire African population including the young graduates that are leaving colleges and universities without jobs, the businessmen and women of African origin and the foreign investors who are willing to invest their wealth for profit making as well as experts.

African governments stand to benefit from biotechnology projects for investments, the employment of millions of youths roaming the streets of their countries in search of jobs and often negatively used by selfish politicians for thuggery during elections, the enormous taxes that may be realized from companies and payee, etc. The general population stand to benefit from availability of markets for local businesses, availability of food in excess and at affordable prices, job creation, and opportunities for abundant lands that lay untapped to be sold, rented or built

for housing accommodation. The vast number of both local and foreign investors stand to benefits through investing their wealth for profit making as well as shouldering social responsibilities to the development of mother Africa that is in dear needs of infrastructures.

Lastly, the experts stand to benefit from their expertise through consultation services, contracts and other forms of expert services.

#### **Scope of the Study**

This study intends to cover all African countries, and will review relevant literatures on biotechnology. The review would cover Status of Biosafety Policies and Legislation in African countries, Country's status and update on commercial approval of GM Crops, budgetary allocation to research especially on biotechnology, number of available biotechnology projects, number of available investors in biotechnology, both domestic and foreign.

#### **Methodology & Data Collection**

An integrative review was used as the project design and the studies had covered all the 54 countries in the African continent.

#### **Sources of Data Collection**

The following criteria were used as bases for selection of biotechnology literatures for the review: year of publication, language of the article, publication by national, regional and international organization (e.g. African Union, ECOWAS, United Nations, NEPAD), Reports on Outcomes of conferences and meetings of World and regional leaders on Africa, publications on biotechnology activities, progress, innovations by African countries, regional bodies in Africa, academia, etc., and global market reports on biotechnology and reports from companies and industries using biotechnology. The study also reviewed the various initiatives and agreements reached at regional and sub-regional as well as international levels by the African countries and international organizations towards accepting, adopting, and implementing biotechnology for economic growth and sustainable development, the current levels and its prospects.

#### **Results**

The study had searched for more than 40 articles on biotechnology, and had reviewed more than 38 of the articles (95%).

Below are summary of the review findings:

Based on the review conducted, Africa stand to benefit from accepting, adopting and utilizing biotechnology in a number of ways such as food availability, abundance and in varieties, healthcare services especially for diseases that are difficult to manage or had no therapy, job opportunities for youths, capacity building for experts in research fields and academia, increase revenue generation for governments and boosting of other economic activities.

The current state of Africa investment in biotechnology based on the review had indicated that seven countries have functional biosafety systems with commercial cultivation of Genetically Modified crops (Eswatini, Ethiopia, Kenya, Malawi, Nigeria, South Africa and Sudan, with S. Africa having the most mature system in place), eleven countries have enacted biosafety laws and legislation ( Burkina Faso, Cameroon, Ghana, Libya, Mali, Namibia, Senegal, Tanzania, Togo, Zambia and Zimbabwe), five countries have drafted biosafety Bills

(Algeria, Burundi, Cote d'voire, Guinea-Bissau, Madagascar, Morocco, Rwanda, Seychelles, Swaziland, Tunisia, Uganda), four countries have approved biosafety policy (Comoros, Democratic Republic of Congo, Eritrea, Rwanda), one country has drafted sectorial legislation with reference to biosafety (Egypt) and four countries have developed sectoral biosafety policies (Djibouti, Ethiopia, Mauritius, Seychelles).

The current status of African countries in the number of commercial approvals for Genetically Modified crops as well as the types of crops approved; Nigeria had granted the approval for commercial release of cowpea (AAT-709AA-4) and Bt Cotton (MON-15985-7-Bollgard II<sup>TM</sup> cotton) and TELA Maize (MON-87460-4 & MON-89034-3) in October, 2021, Eswatini had approved for commercial Bt cotton of JK seed from India (event 1, cry ac gene), Ethiopia had authorized the commercial cultivation of Bt cotton (JK seeds of India) and environmental release of maize (MON 810 & MON 87460) in April, 2022, Malawi had approved the commercial cultivation of insect resistant cotton (MON-15987-7-Bollgard II<sup>TM</sup> cotton) Kenya had approved the commercial cultivation of insect resistant cotton (MON-15985-7-BollgardII<sup>TM</sup> cotton) and viral disease resistant cassava for national performance trial, Sudan had authorized the cultivation of insect resistant cotton of Chinese technology.

The study had also found five most advanced countries of the world in biotechnology investment in 2022, possessing the followings:

Sweden has 285 biotechnology companies, the best education system in the world with one of the highest per capital research and development investment in biotechnology. One of its biotechnology company AlzeCure was able to raised \$11 million to finance clinical trial in 2022.

United States of America had 2,880 biotechnology companies, with industrial growing rate of 3.9% per annum. One of its biotechnology company Indigo has a start-up venture capital funding of \$1billion.

Switzerland has more than one thousand biotechnology companies, had provided employment to fifty thousand (50,000) Swiss citizens, had in 2022 contributed more than 40% of the country's exports and spent \$3 billion yearly on research and development.

Denmark, the fourth most advanced country of the world in biotechnology investment has 639 biotechnology companies, high quality academic institutions with research facilities and private cooperation, and among top world countries that host clinical trials.

Netherlands, the fifth in the list of most advanced countries of the world in biotechnology investment has 571 biotechnology companies, two of its biotech companies (Matricore and DeepTrial) have economic worth of \$15, 000 and \$10, 000 in funding as at 2022.

### Discussion

The findings of this study as deduced from the analysis are presented below and discussed fully. The study was designed to determine if investment in biotechnology would get Africa out of poverty and hunger, the current status of Africa investment in biotechnology, and the level of investment in biotechnology that can get Africa out of poverty and hunger.

Africa can benefit from biotechnology investment through improvement in agriculture which had traditionally

provided jobs to more than 85% of African population, increased crop yields via diseases and drought resistant seeds, avoidance of post-harvest loss through improved storage and processing of crops into varieties of package products, biofortification to increase the nutrient contents, jobs opportunities for skilled manpower graduates leaving African universities and not absorbed by the labour market. The healthcare is another area that Africa can benefit. The biotechnology pharmaceutical companies produce drugs, vaccines, diagnostics which can improve healthcare, provide jobs for trained health personnel, opportunities for training and re-training, and sponsorship to research field for experts in companies and academia and source of exports for products and services. As both local and foreign investors establish biotech related ventures, government benefit from taxes, would improve and stimulate various economic activities within the African sub-region. This will go a long way in tackling poverty and hunger ravaging the African continent.

The current status of Africa in biotechnology had indicated that the continent is far behind. Only seven countries out of fifty-four have functional biosafety systems in place. The number of commercial approval for genetically modified crops, the types approved, and the approval of commercial release of crops both for local consumption and exportation is still very small. However, the study had not found any investment in other sectors of biotechnology such as medical (biotech pharmaceuticals), industry and environment. Africa needs to invest in these areas of biotechnology too as the benefit is enormous, even more than agriculture.

The review had found wide range of local products developed through harnessing of available local Bioresources within the African region. This is an indication of large breakthrough in the area of local biotechnology with varieties of products processed from local available Bioresources, packaged and beautifully branded and arranged in shops for sales. This was found in Nigerian National Biotechnology Development Agency offices in bio-production units.

Developed countries of the world that had invested adequately in biotechnology like Sweden, USA and Switzerland had benefitted well from biotechnology investment in many ways. Sweden had the best education system in the world, the highest per capital investment in Research & Development, had 285 biotech companies with one of the company that sponsored clinical trial in 2022 with \$11 million.

The USA had 2,880 biotech companies, with industry growing rate of 3.9% annually, one of its biotech companies Indigo possessing a start-up venture capital funding worth \$11 billion. Switzerland had more than 1000 biotech companies that are contributing more than 40% of country's exports annually and spend \$3 billion yearly on Research and Development, and had employed fifty thousand Swiss citizens.

This is the real investment that can get countries out of poverty and hunger, and Africa deserve this level of investment.

### Conclusion:

The study concluded that African nations are far behind their counterparts in the developed nations in terms of adoption, and utilization of modern biotechnology. Its current status was that only seven countries out of fifty-four had functional biosafety laws in place. With

exception of S. Africa, none have more than approval and commercial release of 2 GM crops as at end of 2022. No investment in other sectors of biotechnology.

### Recommendations

1. African countries need to invest in other sectors of biotechnology such as medicine (Biopharmaceuticals, diagnostics, vaccines, etc.), environment and industry so as make the maximum use of those sectors.
2. African countries need to increase funding for research and development in the area of biotechnology, scale up the current number of GM crops on trial, so as to increase the approval and commercial release of the crops for consumption and exportation.
3. African nations need to build infrastructure that can attracts investors.
4. There is also needs for Africa to provide workable policy and legislations for biosafety and intellectual patent rights protection,
5. Africa countries should harmonize and share research findings among public research institutes, industries and universities for maximum results.
6. The African Union should encourage trans-border trade and remove cross-border barriers amongst its member states.
7. African countries should promote awareness and sensitization on GM crops through outreaches and increase community participation.

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