The Debate on Genetically Engineered Crops and the Politics of Food Security in Sub-Saharan Africa

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ABSTRACT

Human-centered (and nature-centered) challenges are not in short supply in the twenty-first century world. Africa's well documented share of these challenges is large, ranging from food insecurity, malnutrition, poverty, corruption and local conflicts exemplified by insurgency, terrorism and war. Can Africa, which is unable to provide basic necessities like food, electricity, clean water, health care services etc, tackle these problems through science and technology which are noted for serving 21st century modern society? Why have most African States rejected the much celebrated innovative research findings in biotechnological engineering which produced a variety of genetically engineered crops (e.g. Corn, Cotton, Soybeans for improved agricultural productivity) and a variety of genetically modified food (e.g. Potatoes, Maize, Tomatoes etc. for human nutritious consumption)? What are the factors prompting the unending certainly irreconcilable debate on the desirability or non-desirability of genetically modified (GM) food in Africa? These are questions constituting the main problematic of this contribution which seeks to examine the theoretical and empirical issues raised in the debate about the use of genetically engineered products in Africa's agriculture and the implication of this for food security on the continent. As an "opinion paper" we examine critically the contents and contexts of competing evaluations of the GM products in Africa by researchers, scientists, biotechnological companies, farmers, governmental regulators, consumers and environmental activists from the perspective of policy choices open to African governments. Following the introduction which sets the stage for subsequent analysis, section two of the paper is centered on a critical review of existing literature on the subject. The third section provides an overview of the debate to argue that the contrasting analyses of GM products in Africa are irreconcilable because of differing political/economic ideologies, and also because of competing commercial interests. The concluding section four provides some recommendations.

Keywords: Biotechnological Engineering, Genetically Modified Crops/Food, Agriculture, Food Security/Insecurity

INTRODUCTION AND THE BACKGROUND TO THE STUDY

Human and nature-centred challenges are not in short supply in the 21st century world: Food insecurity, malnutrition, poverty, corruption, climate-induced drought, low agricultural output, local conflicts arising out of the scramble for limited arable land, insurgency, terrorism and war, the rise of pandemic diseases – Lassa fever, Ebola, Zika etc are routinely confronting humanity. Africa's share of these challenges is high, ranging from high level of poverty, malnutrition, high infant mortality rate, lack of basic necessities such as clean water, nutritious food, healthcare service and, more importantly, low crop yields due to frail soils as compared to the rest of the world, Although there are no quick solutions to these complex challenges, advocates of Genetically Modified (GM) technology have argued the case for its adoption in Africa in order to boost crop productivity, food security and increased income for resource-poor farmers in rural Africa. At the recently concluded World Economic Forum in Davos, Switzerland, Bill Gates argued that GM crops are necessary tools to fight hunger and poverty in Africa. Similarly, Adenle [2012: n. p], has contended that the high level of poverty, malnutrition, hunger, low agricultural productivity in Africa provide great opportunity for GM technology to offer solutions.

Innovative research findings in science and technology are considered to be the foundations of modern society to which most African countries aspire. A compendium on *GM crops in Africa* published by the Washington-based International Food Policy Research Institute (IFPRI) and edited by Jose B. Falck – Zepack *et al* (2013: 1) has concluded that 'Biotechnology can contribute to economic development in Africa south of the Sahara'.[1] The term 'biotechnology' or 'biotech' for short, is a very wide concept which encompasses a wide range of procedures for modifying living organisms according to human purposes, going back to domestication of animals, cultivation of plants, and 'improvements' to these through breeding programmes that employ artificial selection and hybridization [see http://en.m.wikipedia.org./wiki/Biotec: Accessed 19/01/2016]. The American Chemical Society sees biotechnology 'as the application of biological organisms,

[1] Jose Falck – Zepeda, Guillaume Gruere, and Idah Sithole – Niang (eds), *Genetically Modified Crops in Africa: Economic and Policy Lessons from Countries South of the Sahara.* Washington: International Food Policy Research Institute [IFPRI], 2013.

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systems, or processes by various industries to learning about the science of life and the improvement of the value of materials and organisms such as pharmaceuticals, crops, and livestock'. The European Federation of Biotechnology defines the concept in terms of the 'integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services' [cited in Wikipedia: "Biotech": 2]. The United Nations Convention on Biological Diversity in its Art 2 defines biotechnology as 'the use of living systems and organisms to develop or make products, or any technological application that uses biological systems, living organisms or derivative thereof, to make or modify products or processes for specific use' [cited in Wikipedia, "Biotech; https//en.m.wikipedia.org/wiki/Biotechnology.19/1/2016: 1].

A term believed to have been coined in 1919 by a Hungarian engineer – Karoly Ereky – biotechnology has been used by human kind for thousand years in agriculture, food production and medicine. By the late 20th and early 21st century the use of biotechnology has expanded to include new and diverse sciences such as genomics, recombinant gene techniques, applied immunology, and development of pharmaceutical therapies and diagnostic test [see Wikipedia, "Biotech": 1 for more details].

Genetically modified crops [GM crops or biotech crops] are plants used in agriculture, the DNA of which has been modified using genetic engineering techniques with the aim of introducing a new trait to the plant which does not occur naturally in the species. New traits are introduced into the food crops to facilitate resistance to certain pests, diseases, and harsh environment (e.g. resistance to a herbicide) or improving the nutrient profile of the crop.[2] Genetically modified foods or GM foods, (also known as genetically engineered foods) are foods produced from organisms that have had changes introduced into their DNA using the methods of genetic engineering. The novel idea of using genetic engineering techniques in agriculture is to enable scientists introduce new traits into crops as well as to enable them have greater control over traits than the previous or old methods such as selective breeding and mutation breeding. The World Health Organization (WHO) defines Genetically Modified Food as food derived from organisms whose genetic material [DNA] has been modified in a way that does not occur naturally.[3]

Food biotechnology, the use of which dates back to the time of Sumerians and Babylonians is a branch of food science that seeks to improve food nutrients and food production. The Sumerians and Babylonians used yeast to make fermented beverages such as beer. Plant enzymes such as malts were also used at that time. Indeed, the invention of microscope paved the way for humans to discover micro-orgnanisms that can be used in food production. Historical record shows that by 1871, Louis Pasteur was the first scientist to discover that heating juices to a certain temperature kills dangerous bacteria affecting wine and fermentation. The eponymous pasteurization was applied to milk to improve food safety. In 1994, the research finding of Avery, McCarty and Macleod showed us that *nucleic acids* carried the genetic material of cells and could be passed between organisms. The first genetically modified plant was produced in 1983, using antibiotics resistant tobacco. In 1994, the *transgenic Flavr Savr* tomato was approved by the US Food and Drug Administration [FDA] for marketing in the US. The modification allowed the tomato to delay ripening after picking [see Wikipedia, "Genetically Modified Food": 2].

Genetically modified microbial enzymes were the first application of genetically modified organisms in food production and were approved in 1988 by the US FDA. These include the protease chymosin for cheese production. Cheese had typically been made using enzyme complex *rennet* that had been extracted from cows' stomach linings. Scientists modified bacteria to produce chymosin which was also able to clot milk resulting in the production of cheese curds. By 1995 in the US the following transgenic crops had received marketing approval viz: Canola with modified oil composition [Calgene]; Bacillus Thuringiensis (Bt) corn/maize [Ciba-Geigy]; cotton resistant to the herbicide bromoxynil [Calgene]; Bt cotton [Monsanto]; Bt potatoes [Monsanto]; glyphosate-tolerant soybeans [Monsanto]; virus – resistant squash [Monsanto –Asgrow]; and additional delayed ripening tomatoes [DNAP, Zeneca/Peto and Monsanto] {see Wikipedia, ibid: 2}.

With the introduction of the golden rice in 2000, Scientists have been able to genetically modify food to increase its nutrient value. By 2011 the USA has become the leading country in the production of GM foods. To be sure, twenty-five GM crops had received regulatory approval in the US. By 2015, 92% of corn, 94% of soybeans, and 94% of cotton produced in the US were genetically modified {see Wikipedia ibid: 2}.

Genetically modified organisms are generated and tested in the laboratory for desired qualities. The most common form of modification is to add one or more *genes* to an organism's *genome.* Once satisfactory strains are produced, the producer applies for regulatory approval to field-test them. Field testing involves cultivating the plants on farm fields or growing animals in a controlled environment. If these field tests are successful, the producer applies for regulatory approval to grow and market the crop. Once approved, specimens (seeds, cuttings, breeding pairs etc) are cultivated and sold to farmers. The farmers cultivate and market the new strain. Sometime, the approval covers only marketing but not cultivation.

A report by the US Department of Agriculture (USDA) has shown that the number of field releases for genetically engineered organisms has grown from four in 1985 to an average of about 800 per year. And cumulatively, more than17,000 field releases has been approved by September 2013. Some of the genetically modified crops approved by the US for marketing/cultivation are: (i) papaya genetically modified to resist the ring spot virus; (ii) New leaf potato marketed by Monsanto in the late 1990s was developed for the fast food market. However, the new leaf potato was withdrawn

[2] Wikipedia, "Genetically modified food", (https://en.m.wikipedia.org/wiki/genetically-Modified_food. Retrieved September 30, 2015, and Accessed January 4, 2016.

[3] "Food Genetically Modified", World Health Organisation [WHO]. Cited in Wikipedia: "Geneticallly Modified Food", *https://en.m.wikipedia.org/wiki/Genetically Modified Food*: 1. Retrieved 26 September, 2015 and Accessed 4 January, 2016.

in 2001 because retailers rejected it, and also because food processors ran into export problem; (iii) GM pineapple; (iv) Corn which is used for food and ethanol was modified to tolerate herbicides and to express a protein from Bacillus thuringiensis (Bt) that kills certain insects. By 2010, about 90% of the corn grown in the US was genetically modified; (v) Soybean was genetically modified to tolerate herbicides and by 2015, 94% of soybeans acreage in the US was genetically modified to be glyphosate – tolerant [see Wikipedia, ibid: 3].

There is no doubt that the outcomes of innovative research in biotechnological engineering have produced a variety of genetically engineered crops (e.g. corn, cotton, soybeans etc for improved productivity in agriculture), and a variety of genetically modified foods (e.g. potatoes. maize, pawpaw etc for human consumption). Bulk of these research works have taken place in the US and in the European Union. With the exception of a few African countries – South Africa, Burkina Faso and Egypt – many African countries have been reluctant to use GM crops in their agriculture, raising doubts about the safety of such crops. Why, we may ask, have most African States, burdened with food deficits, rejected the application of GM crops to boost their agricultural productivity? What are the factors responsible for the unending debate on the desirability or non-desirability of GM food in Africa?

These are questions constituting the main problematic of this contribution which seeks to examine the theoretical and empirical issues raised in the debate about the use of genetically engineered products in Africa's agriculture and the implication of this for food security on the continent. As an "opinion paper" we examine critically the contents and contexts of competing evaluations of GM products in Africa by researchers, scientists, biotechnological companies, farmers, governmental regulators, consumers, and environmental activists from the perspective of policy choices open to African governments. Following this introduction the next section two of the paper is centred on a critical review of existing literature on the subject. The third section provides an overview of the debate to argue that the contrasting analyses of GM products in Africa are irreconcilable because of differing political – economic ideologies and also because of competing commercial interests. The concluding section four provides some recommendations.

THE DEBATE ON GENETICALLY ENGINEERED PRODUCTS IN AFRICA: A CRITICAL REVIEW OF EXISTING LITERATURE.

The literature on the merits and demerits of the application of genetically engineered crops in Africa's agriculture is large and growing. We classify the contents of this literature into two broad categories reflecting the arguments of the sponsors of GM products on the one hand, and the counter arguments of analysts opposed to the adoption of the GM products not only in Africa but also in Europe and Asia on the other hand.

The controversies over genetically modified crops and foods are essentially disputes over the use of food and other products derived from genetically modified crops and other uses of genetic engineering in food production. The disputes involve consumers, farmers, biotechnological companies, governmental regulators, non-governmental organizations, environmental activists and scientists. At the heart of these controversies are issues relating to whether GM food should be labeled, the role of government regulators, objectivity of scientific research and publication and the effects on health, the environment, pesticide resistance, farmers and on global food supplies. Other areas of dispute are contamination of the conventional food supply, the rigour of the regulatory process and control over food by GM companies. Let us briefly examine some of the competing reactions to these issues on GM products.

(a) The Positive View of GM Products.

First, most of the advocates of GM products have argued that there is no scientific evidence to suggest that food from genetically modified crops are inherently riskier to human health than conventional food. Second, supporters of GM crops (also known as biotech crops) have shown that the applications of these crops have aided resistances to pests, diseases, stressful environmental conditions, and resistance to herbicides, reduction of spoilage and the improvement of the nutrient profile of the crops.

Third, it has also has been shown that farmers have widely accepted GM technology as evidenced by increasing land area cultivated with GM Crops. Between1996 and 2011, it has been shown that the total surface area of land cultivated with GM crops had increased by a factor of 94, from 4,200,000 acres to 395 million acres. By 2010, 10% of the World's crop lands were planted with GM crops. Record also shows that as at 2011, 11 different transgenic crops were grown commercially on 395 million acres (about 160 million hectares) in 29 countries including the USA, Brazil, Argentina, India, Canada, China, Paraguay, Pakistan, South Africa, Uruguay, Bolivia, Australia, Philippines, Myanmar, Burkina Faso, Mexico and Spain [see https://en.m.wikipedia.org/wiki/Biotechnology: 10. Accessed 19/01/2016].

Finally, advocates of GM products conclude by arguing that genetically modified crops are not inherently riskier to human health than conventional food, pointing out that the adverse health effects from genetic engineering have not been documented in the human population. They insist that the criticism of GM crops and foods produced by genetic engineering is "scientifically unjustified" [Wikipedia: Genetically modified food: https://en.m.wikipedia.org/wiki/Biotechnology: 9. Retrieved September 30, 2015.Accessed January 4, 2016].

(b) The Negative View of GM Products.

Criticisms of GM products have come from Africans and non-Africans alike. At the centre of their objections to GM products are the issues of regulation, labeling, health risks, effects on the environment and on the income of rural farmers. First on regulation, we must point out that there are two different approaches to this namely, the approach used by the European Union, and the approach used in the United States. As pointed out by Paarlberg (2013: 207), there are four main differences between these two approaches, viz: (i) the European regulatory approach requires new and separate laws that are specific to GM foods and crops. On the contrary, the US regulates genetically modified organisms [GMO] for food and environmental safety using existing laws governing non-

GM foods and crops; (ii) the European approach also requires the creation of new institutions (e.g. national biosafety committees) and a separate screening and approval process for GMOs.

But in the US, the institutions screening and approving GMOs (i.e the Food and Drug Administration, the Animal and Plant Health Inspection Service, and the Environmental Protection Agency) are the same institutions that screen ad approve non-GM foods and crops; (iii) in the European approach the approval of new technology can be declined on the ground of "uncertainty" alone without any evidence of risk. This is the famous "precautionary approach". But in the US, if Standard tests for risks (e.g. toxicity, allergenicity, and digestibility) have been passed successfully, there would be no regulatory barrier to commercial release; and (iv) in Europe products being marketed with GMO content must carry identifying labels unlike in the US where the food and Drug Administration does not require labels on any approved GM foods.

We will analyse the effect of these differing regulatory approaches shortly but suffice to mention here that most African countries have adopted the stringent European regulatory approach and, thus, delaying the adoption of the GM technology on the continent. Second, on health risks of GM foods, critics have argued the case for strict assessment before they can be considered safe for human consumption. In Australia for example, Ashley Ng (2014: 1) has reported that 'food produced using gene technology are prohibited from sale in Australia and New Zealand unless they have undergone strenuous pre-market assessment and (has) been approved by Food Standards Australia and New Zealand [FSANZ]'. Elsewhere in Nigeria, Aniebo [2014: 58], a molecular geneticist, has argued that 'the few scientific researches done on the effects of these (GM) foods on humans have showed stunted growth, impaired immune systems, bleeding stomachs, abnormal and potentially precancerous cell growth in the intestines, impaired blood cell development, misshaped cell structures in the liver, pancreas and testicles, altered gene expression and cell metabolism, liver and kidney lesions, partially atrophied livers, inflamed kidney, less developed organs, reduced digestive enzymes, higher blood sugar, inflamed lung tissue, increased death rates and higher offspring mortality as well'.

Third, on the environmental effect, critics have pointed out that GM crops will damage soil fertility in the long run. Rhodes-Vivour (2014: 14) has instructively pointed out that 'with huge acreage of land being planted all over the country (Nigeria) by these (GM) Corporations, the wind blows these seeds all over the country, leading to contamination of farms, competing for resources with natural variety and eventually the natural variety dies out. Farming on such an industrial scale will exhaust the soil, leading to the use of more fertilizer, which in turn, damages our water table. These harmful effects are irreversible'.

Finally, on the effect on the income of rural, small scale farmers, it has been shown that some of the early adopters of GM crops are beginning to abandon them. The droping of GM cotton in Burkina Faso provides an interesting lesson. According to Dowd – Uribe and Schnurr [2016: 2] the adoption of Bacillus thuringiensis [Bt] cotton in Burkina Faso in 2003 was applauded because it was hoped it would increase cotton yield. However, in recent years it was discovered that Bt cotton has not been beneficial to poor Burkinabe farmers because of the low quality lint being produced. The production of poor quality lint led to a lower price of Burkinabe cotton on the international market and this resulted in 'severe economic losses for Burkinabe cotton companies' which prompted a 'complete phase out of all Bt cotton production for the next two years' [Dowd-Uribe and Schnurr, ibid: 2].

AN OVERVIEW OF THE DEBATE ON GM CROPS/FOODS IN AFRICA

The competing evaluations of GM products in Africa are irreconcilable because of differing political and economic ideologies. At the political level, advocates of GM products are mainly based in "democratic" countries of Europe, North America, and Australia where the general belief in free flow of ideas across borders are encouraged. Accordingly, cross-border innovative scientific research aimed at finding solution to the common problem of world's food deficit and malnutrition are well funded by institutions in those countries. The International Food Policy Research Institute [IFPRI], based in Washington for example has dedicated a special portal known as 'Africa South of the Sahara Food Security Portal' to provide a set of indicators on food and nutrition security and early warning mechanisms as well as opportunities for dialogue among policy makers, researchers, the private sector and others seeking to increase the resilience of the world's poor to possible food-related crises, including price and climate shocks.

IFPRI is an international research centre which seeks to improve the understanding of national agricultural and food policies to promote the adoption of innovations in agricultural technology [see www.ifpri.org.Accessed 8/3/2016]. Interestingly, IFPRI and its agencies, have been criticized for their close connections to Western liberal democratic governments and multinational agribusiness promoting Genetically Modified Organism [GMO] in agriculture. At the economic level we find that the profit motives of multinational agribusiness have opened them to criticism in sub-Saharan Africa [SSA] where states in that region have argued the case for "food sovereignty". The New Alliance for Food Security and Nutrition – a G. 8 initiative – which seeks to catalyse private – sector investment in Africa's agriculture with a $300 G.8 aid money for the project has been roundly condemned in many parts of Africa. In Nigeria for example, the initiate required changes in Nigerian law such that large track of land will be seized from local farmers and given to corporations such as Monsanto and Unilever while seed laws will be revised to force small farmers to buy seeds and fertilizers from the corporate rather than seed – sharing which has been the practice for generations and ensure biodiversity [Rhodes – Vivour, 2014: 14].

Patented genetically enhanced seeds which are more resistant to diseases, drought and a promise of high yields are expected to be bought by every farmer from biotech firms that also claim intellectual property rights on their seeds which cannot be replanted because such crops will not be able to produce viable seeds due to the fact that the seeds have been

genetically modified. The implication of this is simply that Nigerian farmers will be completely dependent on the biotech companies for seeds each time they want to plant and the seed can be sold at any price the biotech firms dictated [Rhodes-Vivour,ibid: 14]. Importantly and of significant relevance is that with huge acreage of land being planted all over Nigeria and when the wind blows, these seeds will contaminate farms that are not using modified seeds. The implication of this is that those seeds will start growing on people's farms, competing for resources with natural variety and eventually the natural variety will die out. Besides, it has been shown that large – scale industrial farming using genetically modified crops will exhaust the soil, leading to the use of more and more fertilizer, which in turn, damages the water table as argued by critics of GM crops [Rhodes – Vivour, ibid].

Another area of concern to African policy makers and farmers is that genetically engineered seeds are very expensive compared to traditional seeds and have to be repurchased every planting season. This is one reason why the New Alliance for food and Nutrition Initiative has received little attention by African policy makers who are of the opinion that original crops are more labour – intensive but yet suitable for Africa which is not short of labour. Many governments in Africa have chosen to follow the highly precautionary European approach to GM foods and crops regulation despite the many advantages of these crops such as their resistance to insect damages, drought and their ability to produce water – efficient maize (a staple food) in Africa. The question that comes to mind centres on why so many African governments have followed the precautionary European Approach to the regulation of GM crops and food?
As instructively revealed by Paarlberg [2013: 214 – 216], five separate channels of external influences have led African governments to adopt the European regulatory approach. The external influences are: (i) Bilateral Foreign Assistance on which African governments are significantly dependent; (ii) Multilateral Technical Assistance through the United Nations Environmental Programme (UNEP)/Global Environmental Facility (GEF) Global Project for Development of National Biosafety Frameworks; (iii) Advocacy campaign against GMO by international Non-Governmental Organisations mostly based in Europe; (iv) Commercial agricultural exports to Europe which is six times larger than that of exports to the US; (v) Cultural ties of African elites to Europe than to the US which has led them to naturally endorse the European regulatory practices viewed as the best.

Whether Africa's adoption of this European stringent regulatory practice is beneficial in terms of facilitating the development of biotech engineering in agriculture is debatable but it is certain that Europe which African governments emulate has little need for GM technology. To be sure, European consumers are already well fed while African consumers are not yet well fed. Besides, African farmers are still battling to increase productivity. One way of resolving dilemma it has been argued, is for Africa to look for ways of making independent judgements regarding regulation of GM crops and foods just like the People 's Republic of China did [Paarlberg, 2013: 216].

Making an independent judgement on the evaluation of biotech crop requires seriously well funded scientific research which Africa simply lack. We examine this issue in the concluding section below.

CONCLUSION: SOME RECOMMENDATIONS ON HOW TO DEVELOP GM TECHNOLOGY IN AFRICA

Africa is the second – largest and second-most populous continent in the world, occupying a land area of about 30.2 million km^2 (or 11.7). As at 2013, it has a population of about 1.1 billion people which accounts for about 15% of the world's human population. Although Africa has abundant natural resources, it remains the world's poorest and most underdeveloped continent. Poverty, illiteracy, malnutrition, inadequate clean water supply, poor sanitation as well as poor health are feature common to the 54 sovereign states that make up the continent. The average poor person in sub-Saharan Africa is estimated to live on only 70cents per day indicating increasing poverty. Economic growth averaging some 5% in 2005 has been driven mainly by services and not by manufacturing or agriculture. The food security crisis of 2008 which followed the global financial crisis has pushed over 100 million Africans into food insecurity. [see Wikipedia, the Free Encyclopedia 'Africa', https//en.m.wikipedia.org/wiki/Africa#Economy. Accessed 9/3/2016].

The causes of this undevelopment syndrome are many but some analyst have traced them to corrupt governments committing serious human rights violations, high level of illiteracy, lack of access to foreign capital, frequent tribal and military conflicts and low agricultural output. The high dependence on export of raw materials and importation of food has pushed Africa towards agricultural innovations that will boost output in agriculture [Wikipedia, "Africa"].
While it has been suggested that opportunities do exist for African farmers to use GM products which will in turn have positive economic outcome including rapid increase in poor farmers' output and income, there are notable challenges which are inhibiting Africa's adoption of GM technology. Accordingly, the key issues to be addressed in the development of GM technologies for Africa's agriculture centre on (i) the need to promote Research and Development [R&D] in biotechnology which will incorporate the private sector; (ii) the need to promote the culture of innovation in entrepreneurship; (iii) the need for synergy between researchers and policy makers; (iv) the need to change the colonialist-imposed education curriculum to that which must incorporate professional training; (v) the need to adopt independent biosafety regulation instead of the reliance on high – cost European precautionary approach; and (vi) the need to increase the level of awareness about GM crops/food among consumers. The low acceptance of GM products creates barrier to the commercialization of these products, thus discouraging public sector research on GM technology. This has to be reversed not only by interdisciplinary scientific research but more robustly through cross-border Regional Corporation in innovative research. The legal frameworks for this have been laid in chapters IV and V of the *Revised Treaty of the Economic Community of West African States* [ECOWAS].

Finally, food insecurity goes beyond the inability of the poor Africans to grow or buy food. It also involves the inability of both the rich and the poor to access nutritious food. As Battersby [2016: 1] has reported, about 220 million people in Africa lack adequate nutrition. This is one compelling reason why policymakers in sub-Saharan Africa must also focus on "nutrition education" that will help people make better food choices.

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