

Research Article

Highlighting Exposures to Harmful Substances as Indicators of Africa's Vulnerability to Biological Weapons Related Attack: Strategies to Improve Regional Safety

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Abstract

Concerns have been expressed about Africa's rising population projected to hit 2.4 billion by 2050; the desperate poaching of Africa's strategic resources by foreign interests; and the rising escapades of foreign-sponsored terrorist- and militant-groups in Africa that may acquire access to biological weapons. This paper therefore seeks to highlight Africa's exposures to harmful substances as indicators of vulnerability to biological weapons related attacks; and to determine appropriate strategies to effectively protect Africa from the rising threat of harmful substances and bio-weapons related attacks in order to improve regional safety. An exploratory mixed method approach was adopted comprising data/information extraction; content analysis; simulation of the input-processing-output device; management by objective; and rational decision approach. Relying on a 17-point exposure to risks of harmful substances and events including harmful Genetically Modified Organism products, counterfeit medicines, adulterated foods and vaccines, and instigated epidemics and pandemics, it was found that Africa is highly vulnerable to bio-weapons attack. This high vulnerability is stoked by pliant biosafety regulatory agencies, frictionous regulatory landscape, surrender of sovereignty and national interest by African countries to external control, and other internal shortcomings such as entrenched trafficking rings, limited access of the populace to essential medicines and supplies, technology limitations, high cost of domestic production and docile cultural practices. The paper concludes that though Africa's vulnerability to bio-weapons attack is escalating to an impending emergency, a nine-point strategic action-plan will deescalate this vulnerability including: the establishment of the office of National Biosafety Adviser; funding biosafety agencies on consolidated revenue charge; adopting a proactive double-tier pre-shipment and destination inspections for importing affected products into Africa; upgrading biosafety laws to incorporate the three requirements of mandatory open market labelling, the precautionary principle and strict liability clause; sharpening of national and regional mechanisms for threat-detection, early warning and rapid response with intelligence sharing; among others.

Keywords

Africa, Biological Weapons, Biosafety, Counterfeit Products, Emergency Preparedness, Food Security, GMO

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1. Introduction

For many centuries on end, Africa has suffered siege, attack, subjugation and exploitation by external actors, from one phase and dimension to another. There had been the trans-Saharan slave trade that extracted African slaves and sold in Arabia and Asian Minor; followed by the trans-Atlantic slave trade by Europeans that extracted African slaves and sold in the Americas and the Caribbean. Then followed the wars of colonial conquest by European nations that exterminated many African communities; and subsequent colonial rule by Europe that subjugated, exploited and underdeveloped Africa. After independence, neo-colonial conspiracy and manipulation by the West through instruments as the World Bank, the International Monetary Fund (IMF), the World Trade Organization (WTO) and other similar contraptions sedated modern African political-economy to debt-burdened, foreign-dependent transit republics.

Africa's population is projected to rise to 2.4 billion by 2050 [1]. In the view of some global capitalists, Africa's perceived large population, if not tactically controlled, will consume and deplete 'strategic natural resources' within the African territory. These strategic natural resources, in their thinking, would be more efficiently utilized by global capitalists for the 'benefit of the global community'. Their logic of justification, to use the words of Friedman citing Foster, is that the earth and its strategic resources are a "free gift to capital [2, 3]".

In recent times, overt desperation has been employed by some foreign countries and their proxies in illegally exploiting premium natural resources of some African countries. For instance, in Nigeria, the so-called 'illegal bunkering' or 'crude oil theft' has become rampant and booming black market business for foreign cartels [and some local proxies] whereof oil tankers infiltrate Nigeria's territorial waters and lift crude oil surreptitiously without paying royalties and duties to the Nigerian state. Similar poaching tactics have been employed in the Sahel region to appropriate their uranium, and in Central Africa to appropriate their gold and diamond.

As capitalist competition and rivalries intensify between the West and Asia, especially China, desperation for illegal acquisition of Africa's resources has shifted and escalated to a worrying dimension. Now, foreign interests are suspected of sponsoring so-called terrorists, insurgents and bandits who massacre and burn down rural communities in Nigeria and in the Sahel region, driving surviving residents into far-away Internally Displaced Persons (IDPs) camps [4, 5]. In many instances, after the desertion of the affected villages, foreign mining companies establish their presence and operations with the terrorist and bandit groups providing cordons to ward off any intervention from formal state agencies.

Recently, concerns for attack with biological and chemical weapons, toxins, poisons and pharmaceutical products have surfaced. Reports of allegations of vaccines and medications laced with harmful substances and imported into Africa have

been made. Synthetic foods with uncertain composition and possible harmful dispositions are reportedly manufactured in Asia and imported into Africa. Genetically Modified Organisms (GMO) based foods, seeds and crops have been similarly reported to have been foisted on some African countries. Even COVID-19 pandemic conveyed fears of possible bio-weapons attack (whether accidental or planned) that have not been adequately allayed (see Table 1 and the authorities cited). In the context of this paper, vulnerability to biological weapons is deemed to run in the same trajectory with exposures to other harmful products such as adulterated foods, counterfeit medicines, fake vaccines, etc. Biological weapons attack is viewed in its broadest sense of deliberate use of organisms and other biotechnological products with the intension to cause harm to other persons. For brevity, we refer to all these related forms of attack simply as 'bio-weapons attack'.

Going through the historical trend of conquest, suppression and control that Africa has passed through as enumerated above, it gives cause for apprehension that oppressive and exploitative systems that viciously suppressed Africa in order to appropriate her resources can, as well, deploy apparently more stealth and convenient strategy of bio-weapons attack to sustain a strangle-hold on Africa while surreptitiously appropriating Africa's newly discovered but highly premium natural resources in an attempt to quench an un-abating capitalist thirst. As we can glimpse from Gisselsson [6] and Schneider [7], biological weapons appear to offer some strategic advantages: the capacity is easy to acquire and disguise as vaccine plants and pharmaceutical production centers; and its enabling technology has proliferated to the extent of possible accession by terrorist organizations.

Considering the perceived threat constituted by Africa's growing population, the current level of foreign incursion in the poaching of Africa's strategic resources, and the rising level of insecurity posed by insurgent-, terrorist-, bandit- and militant-groups in Africa who may acquire access to bio-weapons, it can be said that Africa is currently threatened, in fact, endangered by bio-weapons attack. This paper therefore aims to explore and highlight Africa's vulnerability to foreign bio-weapons attack by demonstrating exposures to related harmful substances and events. It seeks also to determine appropriate counter-measures to improve Africa's domestic resilience to prevent and control external bio-weapons attacks. The exploration borrowed experiences and lessons learnt from the COVID-19 pandemic and the pandemic response.

2. Method

An exploratory mixed method approach was adopted involving data/information extraction; data/information cleaning and inputting; content analysis; simulation of the Input-Processing-Output Device, management by objective (MBO); and rational decision approach (RDA).

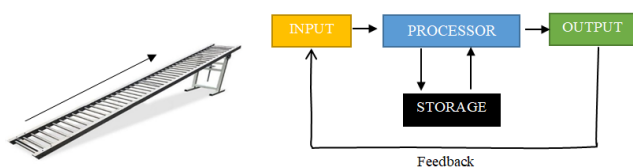


Figure 1. Conveyor Belt Feeding an Input-Output Device.

The input-output device, as a system, may be depicted as a computer system, a machine production system or a social transformation system. Data/raw material is fed into the outer input chamber, moved to and processed in the inner and central processing chamber; and the product exits at the outer output chamber. The difference or relation between the input and output defines the effectiveness and efficiency of the processing chamber. Through a feedback mechanism, the input can be adjusted or reviewed following the result of evaluation of the output-product. The processor constantly records / stores its operational experience in the storage chamber; and from the storage chamber also it draws up memory/experience/energy to moderate processing activities at the central processing chamber. As a general rule, if appropriate data/information/values/variables are fitted into any two of the three main chambers of the device, the missing data/information/values/variables in the third chamber can be correctly determined either through forward or backward integration.

Data and information relevant to exposures to harmful substances attack are extracted from existing records; arranged as if laid on a conveyor belt shown in Figure 1, and fed as inputs into the input chamber of the input-processing-output device. Africa, African countries, African governments, African institutions and agencies, and other regional key players are fitted in as processors in the processing chamber of the device. Effective prevention of bio-weapons attacks, as a desired objective, is fitted as expected output in the output chamber of the device. All experiences of Africa, from the trans-Saharan slave trade to the current neo-colonial control are fitted in the storage chamber of the device. Fitted in the storage chamber also, are Africa's experiences gained and capacities developed from managing previous epidemics and pandemics (including COVID-19). The storage chamber serves as store-house and oil-pump that lubricate processing activities at the processing chamber of the device. It is expected that in the course of time, as a matter of routine, processing action will utilize the feedback mechanism (from observed outputs and incoming inputs) to constantly review its operation.

Africa's vulnerability to bio-weapons attack are evaluated by relating the actions and inactions at the processing chamber to the incoming inputs represented by documented exposures to harmful substances and events. By applying MBO and RDA, necessary policies and actions, adjustments and adaptation needed at the processing chamber to manage the incoming inputs in order to achieve the set/expected objective/output are determined. This determination will draw heavily from the storage chamber, especially from lessons learnt from the

COVID-19 pandemic response, as applicable to Africa. These necessary policies and actions determined to be taken at the processing chamber will translate to recommended measures to improve regional resilience and safeguard Africa from exposures to harmful substances and reduce vulnerability to bio-weapons attack.

3. Result

Data and information pertaining to exposures to harmful substances attack, as applicable to Africa, and extracted from existing records are presented in the table below.

Table 1: Events and Issues Indicating Africa's Exposures to Harmful Substances Attack.

(See table attached as supplementary file)

4. Analysis and Discussion

4.1. The Current Concern for the Safety of GMO Products is Not Misplaced

The current and dominant position of the scholarly community and regulatory agencies is that consistent causal link between GMO foods and harmful health outcomes (toxicity, carcinogenicity, allergenicity, etc.) has not been sufficiently established, though research on the theme is ongoing [26, 27]. Since the safety or otherwise of GMO foods is only tangential to the central theme of this paper, it will not be needful to argue extensively on this issue. But a few observations need to be noted.

More and more research and informed commentaries have continued to advance new evidence against the safety of GMO foods, as concerns continue to rise. A fundamental scientific fact must be remembered: that any alteration of the natural process or composition that has advantages must have disadvantages also. Even a more ordinary process of refining sugar will differentiate it significantly from natural sugar with far reaching implications for human health including weight gain, heart disease, type-2 diabetes [28], etc. Hence, genetic modification of foods must necessarily have its disadvantages as it has its advantages.

Another important point worth noting is that the haste of modern society has conditioned us to ignore early warnings when it mattered, only to go for damage control when great harm has been done and suffered. When Adam Smith warned of the trend of burdensome population increase, his thesis was shot down on the premise that the pace of innovation and technology (including mechanized agriculture) will dispel any concretization of excessive population burden. When ecologists initially warned of a troubling trend in biodiversity shrinking, deaf ears were paid. Instead, some authors even advocated that 'paved surfaces' should be an indicator of development. Similarly, when heavy industries commenced and

continued unprecedented pollution that were doing great 'climate damage', we chose to concentrate more on the big profit and competitive advantages they brought. But today, population burden, biodiversity loss and climate change are, inarguably, part of our development challenges as we desperately struggle with population control, biodiversity conservation and restoration, and 'climate repair'. It is not unlikely that the same scenario will play out with GMO foods.

At present, three levels of concern are expressed about the safety of GMO foods: threat to human health, threat to the health of the environment, and threat to food security. In respect of impact on human health, Barrell and French [29] identified concerns for allergic reaction, cancer, antibacterial resistance, changes in human DNA and toxicity for body organs. Center for Food Safety [30] identified concerns for toxicity, allergic reactions, antibiotic resistance, immuno-suppression, cancer and loss of nutrition. Citing the view of a molecular biologist, Olugbode and Ibunge [31] writing for ARISE NEWS reports that several studies link the consumption of GMO foods to diverse health disorders including immune system dysregulation, chronic inflammation, increased allergic responses, tumor development and organ toxicity.

In respect of the threat of GMO foods to the environment, Barrell and French [29] identified concerns for the risk of outcrossing, a negative effect on insects and other species, and suppression of other plants leading to biodiversity loss. The risk of outcrossing (spontaneous transfer of genes from GMO foods to other plants in the wild) as well as the mixing of crops derived from normal seeds with those grown through GMO crops is particularly worrisome. The Washington File reports that the World Health Organization (WHO) acknowledges this as a "real risk" [32], citing the discovery of traces of GMO maize approved for animal feed in maize grown for human consumption in the United States. Quoting Professor Mira-beau, Olugbode and Ibunge decried a related phenomenon he described as "critical risk of genetic contamination of indigenous seed varieties" [31] arising from spontaneous gene transfer by GMO crops. According to HOMEf, some GMO crops are essentially pesticides while others are made to withstand the use of herbicides, leading to the emergence of what they called "super pests" and "super weeds" [33].

Much more important is the implication of GMO foods for long term food security of nations. Olugbode and Ibunge [31] submit that developers/manufacturers of GMO products hold patents which are enforceable. These patents, they argue, prohibit farmers from saving, sharing or replanting the seeds. They further observed that the GMO products without exclusive patents yield poorly when replanted. These, they argue, will consolidate control of indigenous food and farming systems in the hands of a few big foreign corporations. In the long term, this control will not only lead to capital flight but will also entrust African nations' food security in the hands of foreign seed industries and corporations. They alluded to this as 'colonizing our food system'. Up till now, no proponent of GMO foods has controverted the point that GMO products

constitute a risk for the food security of receiving nations, especially developing countries.

Hence, current concern for the safety of GMO foods and products especially for Africa, is justified, not misplaced. Many African countries, such as Nigeria, are actually 'food baskets', with potentials for exports of surplus produce. What is needed is the incentive of creating a favourable agroecology to actualize their full potentials and create surplus. This surplus can be exported to other sister African countries whose agricultural system and food production are constrained by aridity and climate-change challenges.

A compelling evidence substantiating the harmful nature of GMO as provided by HOMEf [33] is the series of lawsuits filed in the United States against Bayer/Monsanto due to cancer cases linked to the use of the company's GMO-associated glyphosate chemical and for the company's failure to warn users of the associated risk. In one of the cases, a US jury awarded US \$78 Million damages in favour of Dewayne Johnson against Bayer/Monsanto in 2018 [34]. HOMEf submits further that the said glyphosate implicated in the case is characterized as a carcinogen by the Cancer Research Arm of the World Health Organization (WHO) [35]. The same glyphosate, HOMEf contends, is replete in many products in the Nigerian market, even some products carrying NAFDAC numbers. The established instance of GMO outcrossing in maize in the United States as adduced by the WHO under question five (Q5) of the Washington File [32] is yet another compelling evidence.

In all ramifications, it is unacceptable, even inequitable, to foist food insecurity on Africa by any means. If Africa, the home of nature and lush, loses her food security, on what else can she pride her comparative advantage?

4.2. Why the Events [in Table 1] That Are Indicative of Harmful Substances Attack Happened: A Diagnostic Approach

If the events and issues listed in Table 1 are fitted as undesirable outputs/outcome in the output chamber of the input-output device and default or normal situation are assumed fitted in the input chamber, we can, from the output chamber, do a backward integration to diagnose and ascertain what may have gone wrong in the processing chamber to warrant the undesirable outcomes fitted in the output chamber.

4.2.1. Powerful Capitalist Interest Pressure Versus Pliant Regulatory System

The pharmaceutical, food, beverage, cosmetics, and vaccine related industries are multi-billion dollar businesses, and very lucrative areas for entrenched capitalists. Their financial chest confers enormous and irresistible powers and influence in national, regional and global political-economy. Same, even to a larger extent, applies to GMO products that are currently driven by the highest echelon of global capitalist interests including multi-national corporations and renowned

global philanthropic/donor organizations.

In his succinctly titled article "GMOs: Capitalism's Distortion of Biological Processes" [2], Friedman aptly captures the vice-like grips, the trampling runs and the obsession of corporate capitalists to extract maximum profits from the large "treadmill" that GMO businesses provide for them. Nweke *et al* [36] in their analysis likened the approach of capitalists promoting GMOs to 'state capture'.

Against the obvious power and influence of capitalist interests propelling pharmaceutical and GMO products, regulatory institutions and agencies become weak and pliant, offering sufferance to operators they are supposed to watch-dog. In the case of the United States, Center for Food Safety [30] described the attitude of the US Food and Drug Administration (FDA) to Genetically Engineered (GE) food companies and their operations as "carte blanche", in which case the FDA does not require labelling of GE foods and does not also require pre-market safety testing. Similarly, in the case of Nigeria, Olugbode and Ibunge describe it as "fundamental flaws" [31] of regulation whereof the Nigerian Biosafety Act does not require open market labelling of GMOs; does not prescribe the strict liability principle for harm caused by GMO companies; and does not either prescribe for harm caused by GMO companies; and does not either prescribe the "precautionary principle" that enables even a preliminary halt in GMO processes that may be found to pose threat to health or the environment. HOMEF called Nigeria's biosafety regulator "essentially a permitting agency" [33].

4.2.2. Frictional Regulatory Architecture and Landscape

In their petition against GMO foods in Nigeria, as indicated in Table 1 (item no. 3), the coalition expressed grave concern about Nigeria's biosafety regulatory architecture, pointing at conferment of enormous discretionary powers without adequate oversight on the part of the National Biosafety Management Agency (NBMA); and conflict of interest on the part of the National Biotechnology Development Agency (NABDA). The later was accused of sitting on the board of the NBMA to approve licences for a private biotech company in 2016 for events that were to be implemented jointly by the said private company and NABDA.

As indicated in Table 1 (item no. 2), the NBMA imposed sanctions and suspended all actions pertaining to alleged unlawful registration, field trials and release of four new transgenic cotton hybrid varieties already approved by the National Committee on Naming, Registration and Release of Crop Varieties, Livestock Breeds and Fisheries, citing non-compliance with the NBMA Act of 2019. But the committee was acting in accordance with the powers vested in it by the National Crop Varieties and Livestock Breeds Act of 1987. Interestingly, the NBMA is under the Federal Ministry of Science, Technology and Innovations; while the National Committee on Naming, Registration and Release of Crop Varieties, Livestock Breeds and Fisheries is under the Federal Ministry of Agriculture.

As indicated in Table 1 (item no. 14), the Director-General of the National Agency for Food and Drug Administration and Control (NAFDAC), an agency under the Federal Ministry of Health, while explaining the challenges the agency faces in checking the influx of fake and counterfeit products pointed at some constraints including:

- Online procurement systems that enable individuals at any location to order counterfeit products directly from foreign manufacturers while the order is delivered at their doorsteps by logistic companies.

- Cargo consolidation systems referred to as 'groupage' which allows multiple importers to share a single shipping container. This makes it difficult for regulators to identify suspicious consignments.

In respect of the first and second shortcomings listed above, the question asked by Bassey-Oravwuje as reported by Ezeamalu becomes very apt: "what happened to Nigeria's pre-shipment procedures?" [11] Of course, pre-shipment inspection has been an established shipment procedure. So why? What happened?

4.2.3. Surrender of Sovereignty and National Interest to External Multilateral Control

As long as World Health Assembly Resolution 73.1 pertaining to the mandate to determine the source of the outbreak of COVID-19 in Wuhan, China, has not been actualized [37], it will not be ruled out that SARS-CoV-2 was a bio-weapon and COVID-19 a possible bioterrorism, whether deliberate or accidental. Mrs. Melinda Gates and UNECA were right in their predictions of COVID-19 apocalypse in Africa as listed in Table 1, items numbers 15 and 17. The reasons for their fear are obvious. Africa's weak health systems, financially distressed governments and largely ignorant populations were not expected to be able to mobilize adequate response capacity to promptly roll-back a full-scale pandemic in the region. What saved Africa were: (i) that SARS-CoV-2 unexpectedly turned out to be vulnerable to African's harsh environment; (ii) the racial resistance among Africans; (iii) the residual effects of chloroquine products in the body fluids of Africans; (iv) and robust control efforts mustered by some African Governments as acknowledged by Okereke and Nielsen [23] including Uganda, Rwanda, Senegal, Nigeria, Mauritius and Somalia.

At no other time in recent history were national Governments worldwide subjected to the paternalistic control of a multilateral organization than during the COVID-19 pandemic response. This accounts for the frequent altercations that happened between the United States [under President Donald Trump] and the WHO, which eventually led to the formal withdrawal of membership of the WHO by the United States.

Obiano [24] contends that most national government acted as if hypnotized to surrender their sovereignty and national interest to multilateral control that masked as coordination. He argues, for instance, that it resembles hypnotism for countries

to allow patients die in their thousands from COVID-19 after August 18, 2020 when it was already empirically established that most deaths from COVID-19 occurred from pulmonary thrombosis and other forms of Diffuse Alveolar Damage (DAD) that gave rise to difficulty in breathing. Whereas pulmonary thrombosis has always been sufficiently treated with blood thinners to prevent blood clotting or thrombolytic drugs to dissolve already formed blood clots. Obiano argues further that countries should not have left patients untreated while waiting for official approval of new drugs whereas drug repurposing, as an established medical practice, allows the use in COVID-19 treatment of drugs approved for other uses.

Obviously, the COVID-19 pandemic response compelled countries to surrender their national interest to external multi-lateral control, as has never been done before.

4.2.4. Miscellaneous Shortcomings

The United Nations (UN) [14] identified two factors that contribute to the escalation of fake and counterfeit medical products in the African region. The first is the apparent broadness and chain of the trafficking ring including street vendors, law enforcement officers, pharmaceutical company employees, health agency staff, and public officials. The second factor is the yawning gap created by lack of access to healthcare and essential medicines which fraudsters exploit.

Among some other factors, Chukwugozie *et al* [38] identified limitations in technology, high cost of production, and cultural practices among the propellers of food fraud in sub-Saharan Africa. By technological limitations, they imply challenges of inadequate food fraud databases; and limited capacity for vulnerability assessment, food authenticity testing and food traceability analysis. High cost of production interplay with poverty and low purchasing power of the citizenry to create a large demand for apparently cheaper fake products. Poverty and ignorance interplay to create an uninformed and docile clientele that fail to heed to warnings for precaution; and who lack the capacity to challenge or seek redress from harm suffered from use of fake products. These anomalies provide safe haven and booming business environment for fake product traffickers.

There is also the generally known problem of extensive and porous borders that provide safe haven of operating channels for smugglers. The foregoing shortcomings fall under the immediate task responsibility of the Nigerian Customs Service (NCS), an agency currently under the Federal Ministry of Internal Affairs (the Interior).

We know, of course, that owing to Africa's erroneously perceived sense of need for external help, foreign aid has become a popular platform for foreign interests to infiltrate and weaken African Governments and their agencies. As it happens in the financial and trade sectors, so does it happen in the health and food sectors. Under the guise of partnership programs, some foreign partners have imported into parts of Africa vaccines, medications, commodities and supplements that are of questionable safety. A renowned global philanthropist

is known to have used 'development partners' he was sponsoring to organize summits that took policy decisions that are binding on host country governments and their agencies including matters pertaining to GMO products.

4.3. Strategies to Cushion Africa's Exposures to Harmful Substances and Vulnerability to Bio-weapons Attack

The foregoing events presented in Table 1 of the result section as well as the points of weakness highlighted in the preceding analysis and discussion demonstrate various facets of Africa's vulnerability to bio-weapons attack, whether or not the attack is deliberate or unintended. If we fit these facets of vulnerability as 'inputs' and fit effective protection from bio-weapons attack as desired 'output' in the input-output device, we can determine what needs to happen at the central processing/transformation chamber to achieve the desired output/set objective, tapping from our resilience/previous experiences stored in the storage chamber of the device (see Figure 1).

Considering the many commendable efforts already achieved by many African countries, collectively and separately, towards improving national and regional safety including the establishment of national and regional biosafety agencies, the following special actions are recommended:

i). Appointments to key positions in regional and national biosafety organizations should exclude persons with dual citizenship involving any nationality outside Africa. This will promote patriotism and nationalistic spirit and reduce the risk of divided allegiance and infiltration by 'mercenaries' operating as experts and consultants, as was the case in the COVID-19 pandemic response.

ii). National governments should create the office of National Biosafety Adviser (NBA) that will correspond to the office of the National Security Adviser that oversees military, defence, and security-related matters. The office of the NBA will serve as a point of coordination and harmonization for all issues and areas of conflict and overlap existing between and among various biosafety agencies within the country. The NBA, working next and directly with the Head of State, will provide an exclusive platform to deal with the intelligence and classified information needed to pursue or safeguard vital national interest relating to biosafety matters.

iii). Funding for national and regional biosafety agencies should be placed under consolidated revenue charge. This will prevent starving the agencies of funds while exposing them to dependence on foreign partners for bailout sponsorship programs that insidiously foist foreign control over African national and sub-national agencies.

iv). A more responsive, proactive and rapid pre-shipment inspection protocol must be put in place for all imports to Africa relating to food and pharmaceutical products. In respect of the 'groupage' cargo consolidation system said to be problematic for regulatory agencies, the freight company shall

be required to forward advance electronic copies of the consignments intended to be grouped in each container to the appropriate regulatory agency in the receiving country. With such advance copy, the regulatory agency will, through its outsourced agents, conduct pre-shipment inspection before containers are closed. Similarly, strict destination inspection must be carried out to reconcile with pre-shipment inspection reports. For small-sized packages passing through courier companies, regulatory agencies must execute the arduous responsibilities of: sensitizing appropriate personnel of courier companies; establishing strict requirements for declaration of suspicious packages and whistleblowing; and stiff penalties for serious breaches, including revocation of operating licences.

v). Appropriate national biosafety laws must be enacted where none exist, or amended where they prove inadequate, to ensure provision of the following three principles:

- 1) Accurate open market labelling for all ingredients and components;
- 2) Precautionary principle that will enable halt in testing, roll-out, or recall when reasonable suspicion is established; and
- 3) Strict liability clause that will place total responsibility for harm caused or suffered on manufacturers and promoters of regulated products, including GMO products.

vi). At least, once every five years, all-open biosafety summits shall be held at various levels to encourage all interested stakeholders, especially individuals and civil society organizations who act as the conscience of society, to make effective contributions to biosafety management including checks and balances.

vii). At both national and joint regional levels, African countries must sharpen their threat-detection and early warning mechanisms including the sharing of intelligence. They must overhaul and upgrade existing levels of emergency preparedness with tested and certified state-of-the-art rapid response operational units. As Gross [39] submits that preparedness prevents pandemics, preparedness will also prevent biological weapon-induced outbreaks or curtail their spread and magnitude of their impact if they occur.

viii). An African proverb says that if you fail to realize where and when the rain started beating you, you will also fail to realize where and when it will stop beating you. As some other countries have done [40], African countries, individually or collectively, need to convene statutory, comprehensive and independent post-pandemic inquests to interrogate more critically the COVID-19 pandemic response and unravel more knowledge and understanding of the successes and failures of the national, regional and global level responses in order to inform future actions for better outcomes. New knowledge and understanding gained from the post-pandemic inquest will be added to the storage chamber of the input-output device to lubricate future activities. If this is not done, African countries, individually and collectively, will approach and engage the

emerging global pandemic treaties and the one-health-approach from the position of weakness and disadvantage, with outcomes worse than in the COVID-19 era.

ix). Proactive pursuit of 'national interest' should be revived and re-prioritized by African countries as an overriding fundamental objective of state. Foreign partnerships and multilateral cooperation must be adjusted to align with national interest. Un-apologetic assertion of sovereignty will aid proactive pursuit of national interest. For instance, an African country that has expansive un-cultivated arable land should seek to expand agricultural production, reduce post-harvest losses, and encourage agro-allied industries to shore up her food security, instead of being enticed towards foreign controlled GMO plan that will, in future, jeopardize the country's food security.

5. Conclusion

From the period of the trans-Saharan trade till date, Africa has been under unrelenting attack from external forces. What has been changing is the form or nature of 'attack'; trans-Atlantic slave trade, colonial rule, neo-colonialism, and now destabilization with resource poaching. The concern is real that if the present destabilization applying sponsorship of insurgencies, banditry, and militancy becomes expensive (in terms of cost-benefit analysis) for the global capitalists, they may shift preference for and full focus on bioweapons attack which appears to hold potentials for more convenience, reduced cost but with maximum effect.

Already, bio-weapons attack has made rudimentary inroads into Africa through various commissions and omissions [8-25], mostly in the forms of adulterated foods, fake cosmetics and medicines, tainted vaccines, and suspicious GMO products as shown in Table 1. As we exit the COVID-19 pandemic, calls for preparation for the 'next pandemic' are high. Considering that bio-weapons laboratories across the world (such as in Wuhan, China) are carrying on new research and developing 'new products', these 'new products' must be 'tested' somewhere and perhaps subsequently deployed. Africa, incidentally, appears to be the best choice destination at present.

Evidence, as adduced in this work, indicates that Africa and African countries are very vulnerable to bio-weapons attack owing to weak biosafety regulatory ecosystems, receptive large markets, and a predominantly ignorant and docile client-population. Nevertheless, the ugly situation can still be remedied.

Interestingly, rudimentary achievements and great potential exist for African countries to shore up resilience and reduce vulnerability to bio-weapons attack. What is needed is the resolve to implement changes that will yield desired results. The nine-point action recommended in this work will assist African countries, individually and collectively, to protect themselves against harmful substances and bio-weapons attack.

Table 1. Events Evoking Concern for Vulnerability to BWA / Bioterrorism.

S/No	Events Evoking Concern for Vulnerability to BWA / Bioterrorism	Authority
Events / Issues Related to GMOs		
1	In July 2026, Nigeria's National Biosafety Agency (NBMA) raided and confiscated 57 cartons of transgenic hybrid cotton seeds weighing about 950kg imported into the country without regulatory approval. The illegal consignment was disposed with the assistance of the Environmental Health Council of Nigeria (EHCON) and the Nasarawa State Waste Management and Sanitation Authority (NASWAMSA)	NBMA [8]
2	On March 31, 2026, Nigeria's NBMA imposed sanctions and suspended all actions pertaining to unlawful registration, field trials and release of four new transgenic cotton hybrid varieties in Nigeria (MIC 561 BG 11; MIC 563 BG11; BIOSEED-FIYAH CH1001; BIOSEED-FIYAH CH1002). Surprisingly, the infraction was committed by another Federal Government Agency – the National Committee on Naming, Registration and Release of Crop Varieties, Livestock Breeds and Fisheries on the 26 th of March, 2026.	NBMA (b). [9]
3	On March 17, 2020, a civil society organization known as Health of Mother Earth Foundation (HOMEF) comprising farmers, scientists, medical practitioners, lawyers, etc. marched and submitted a petition to the Federal Government through the Lagos State Governor, requesting urgent need to ban Genetically-Engineered crops in Nigeria and to repeal the National Biosafety Management Agency Act.	HOMEF [10]
4	In 2017, through intelligence report, two illegal shipments of genetically modified maize into Nigeria were discovered by the Nigerian Government. The first illegal shipment comprised of 25,750 metric tons worth an estimated \$3.7 million, while the second shipment comprised of 42,900 metric tons valued at \$6.1 million. The two shipments berthed at Nigeria's Lagos port. The chance discoveries indicate that more GMO foods and products may be slipping through the country's ports and borders undetected.	Ezeamalu B. [11]
Events / Issues Related to Fake / Counterfeit Medicines		
5	Africa is likely the region most affected by trade in counterfeit pharmaceuticals. According to WHO estimates, 42% of all reports of fake medicines it received between 2013 and 2017 were reported in Africa. This figure doubles the 21% reported for the European Region and the 21% reported for North and South America within the same period.	Mwai P. [12]
6	Counterfeiting medicines is a huge problem in Africa given that the most popular medicines (anti-malarial, antibiotics, pain killers, sexual stimulants, and anti-retroviral) are the most commonly faked. According to research, up to 88.4% of anti-malarial drugs in some African countries are reported to be fake. Using such fake and ineffective medications cause between 64,000 and 158,000 deaths (from malaria alone) annually in sub-Saharan Africa.	Katerere D R. [13]
7	Every year, about 500,000 persons die in sub-Saharan Africa as a result of use of fake medicines. About 169,271 deaths per annum in the region are linked to substandard antibiotics used in treating severe pneumonia in children. Caring for persons who suffer from using fake and substandard medicines for malaria cost the region between \$12m to \$44.7 million every year.	UN. [14]
8	In the past few years, Nigerian hospitals admitted more than 1000 victims of adverse drug reactions. A study conducted by Bihar Dar University in Ethiopia reports that on sampling 7,508 medicines, 1,639 (21.83%) were confirmed to be falsified or substandard.	Omeje N. [15]
Events / Issues Related to Fake or Inappropriate Vaccines		
9	In November 2019, the WHO and partners identified new cases of Polio in four African countries: Nigeria, the Democratic Republic of Congo, Central African Republic and Angola. The outbreaks were caused by the mutation of the polio virus in the vaccine vials to active infectious status.	Mohamed E. [16]
10	In March 2019, the Ministry of Health in Niger Republic discovered the circulation of falsified Mencevax ACWH vaccines applied in the prevention of Meningitis types A, C, W and Y. In this regard, the WHO issued Medical Product Alert No 5/2019.	WHO. [17]
11	In November 2020, following intelligence gathering and warning released by INTERPOL, South African authorities raided and seized 400 ampoules (2,400 doses) of fake COVID-19 vaccines in Germiston, Gauteng. Three Chinese and one Zambian nationals were apprehended in connection with the crime. Similarly, in China, police discovered a criminal network selling counterfeit COVID-19 vaccines. A raid of their premises led to the confiscation of more than 3,000 fake COVID-19 vaccines and arrest of 80 suspects.	INTERPOL [18]; Aborede et al [19]

S/No	Events Evoking Concern for Vulnerability to BWA / Bioterrorism	Authority
Events / Issues Related to Food Fraud / Adulterated Foods		
12	Food Fraud Vulnerability Index is high in Africa. Of the ten (10) countries with the highest food fraud risk index globally (ranked from 0- 80), seven (7) are in Africa: Yemen (82.73); Ivory Coast (72.83); Sierra Leone (72.55); Chad (71.81); Benin (71.86); Syria (65.30); Guinea (63.37); Jordan (58.75); Madagascar (58.65); Egypt (58.36). Of the ten countries with the least food fraud vulnerability index globally, none is in Africa: Finland (11.26); Australia (11.53); South Korea (11.77); USA (12.39); Norway (13.68); Japan (14.22); Canada (14.92); Denmark (15.42) Israel (16.74); Austria (17.60).	Kristopaityte E. [20]
13	In late February 2022, two teenagers died from eating tainted biscuits in their school in Abuja, Nigeria. Several other schoolmates were hospitalized. Resulting panic from parents and guardians led to a temporary closure of the school. But till date, it is reported that the root cause of the episode has not been investigated nor the responsible company tracked and punished.	Nwuneli N. [21]
14	At the occasion of the commemoration of the 2026 International Anti-Counterfeiting Month observed globally in June, the Director-General of Nigeria's National Agency for Food and Drug Administration and Control (NAFDAC) stated that based on confiscations made by the Agency, cosmetics, foods and beverages account for over 50% of counterfeit products in the country. The D-G made an important disclosure that foreign companies involved in the counterfeiting business have agents or suppliers [in Nigeria] that monitor products with high market demand, and then arrange for counterfeit versions of the identified products to be manufactured abroad, especially in Asia.	The Guardian. [22]
Events / Issues Relating to COVID-19 Pandemic		
15	On April 10, 2020, in a Cable News Network (CNN) interview, Mrs. Melinda Gates was reported to have expressed a view that COVID-19 will have the worst impact on Developing countries, with a calamitous scene of dead bodies lying in the streets of African countries. Some commentators have come to term this view as 'coronavirus apocalypse in Africa'.	Okereke C and Nielsen K. [23]
16	In April 2020, the United Nations Economic Commission for Africa (UNECA) was reported to have released a report which estimated that between 300,000 and 3.3 million Africans could die of COVID-19.	Okereke C and Nielsen K [23]
17	Between January 7, 2020, and December 2, 2020, African countries, likewise other countries outside Africa, failed to take proactive steps towards utilizing emerging knowledge and opportunities to reduce their vulnerability to COVID-19, terminate the pandemic promptly and minimize national and regional level impacts of the pandemic.	Obiano EC. [24] Obiano EC. [25]

Abbreviations

DAD	Diffuse Alveolar Damage
DNA	Deoxyribonucleic Acid
FDA	US Food and Drug Administration
GE	Genetically Engineered
GMO	Genetically Modified Organism
HOMEF	Health of Mother Earth Foundation
IDPs	Internally Displaced Persons
IMF	International Monetary Fund
MBO	Management by Objective
NABDA	National Biotechnology Development Agency
NAFDAC	National Agency for Food and Drug Administration and Control
NBA	National Biosafety Adviser
NBMA	National Biosafety Management Agency
NCS	Nigerian Customs Service
RDA	Rational Decision Approach

UN	United Nations
UNECA	United Nations Economic Commission for Africa
WHO	World Health Organization
WTO	World Trade Organization

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Data Availability Statement

Data leading to the conclusion of this research are contained in the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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