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Assessing Chemical contamination of Nigeria's agro-food systems and human security

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Abstract

While agrochemicals are used to enhance agricultural productivity, their misuse, coupled with weak regulatory frameworks, has resulted in widespread contamination of soil, water, and food crops. Food security remains a critical challenge in developing nations like Nigeria, where agricultural systems face increasing pressure from environmental degradation, climate change, and chemical contamination. This study investigates the levels, impacts, and consequences of chemical contaminants in Nigeria's agro-food systems, with linkages to human security. The study further disaggregated human security into food security and human health outcomes. This research determined the extent of chemical contaminant usage and its impacts on food security dimensions (availability, accessibility, utilization, and stability) and related health outcomes in Nigeria. The research synthesizes existing literature and statistical data to assess the levels of pesticides, heavy metals, and hydrocarbons in the agro-food chain, analyzing their effects on crop yields, human health risks, and overall food security. Findings revealed alarming levels of food contamination, often exceeding WHO and FAO permissible limits, this contamination undermines food availability by reducing crop yields, and accessibility through compromised safety, utilization via diminished nutritional quality, and stability due to disrupted agricultural practices. Result emanating from the study also revealed that The study reveals that widespread contamination of Nigeria's food and water sources with pesticides, heavy metals, and hydrocarbons—mainly from agricultural, industrial, and mining activities—poses serious public health risks. These contaminants are linked to both acute effects, such as respiratory and neurological issues, and chronic conditions, including organ damage, reproductive disorders, and long-term risks like cancer. The study therefore recommends that the federal government should prioritize the development and implementation of a National Food Safety and Contamination Control Framework. This framework should establish clear, enforceable standards aligned with WHO and FAO guidelines, while also outlining robust monitoring, enforcement, and remediation strategies. The study further recommends that both Federal and State Ministry of Health, in collaboration with NAFDAC, NESREA, and the Federal Ministry of Agriculture, should mitigate the adverse health effects associated with chemical contamination, by establishing a comprehensive public health surveillance system focused on detecting and responding to chemical-related illnesses. This system should include routine health screenings in high-risk communities, particularly those near industrial, agricultural, and mining zone.

Keywords: Agro Food Systems, Chemical Contamination, Food Security, Human Health Outcomes

Introduction

Food security, defined as the availability, accessibility, and utilization of safe and nutritious food, remains a pressing global challenge, particularly in developing regions where agricultural systems are under increasing stress from environmental degradation, climate change, and chemical contamination. Globally, over 828 million people faced hunger in 2021, with sub-Saharan Africa accounting for nearly 60% of the food-insecure population (FAO, 2022). The use of agricultural chemicals such as pesticides and fertilizers has led to

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significant environmental and health concerns. According to Zhang et al. (2018), in the United States, pesticides are ubiquitously detected in nearly all stream water samples from agricultural areas, underscoring the pervasive contamination of food systems, while in China, the massive annual application of over 59 million tons of fertilizers and 1.8 million tons of pesticides has led to the contamination of about 150 million acres of arable land, highlighting the profound environmental impact of intensive agricultural practices. This illustrates the global scale of agrochemical misuse and its consequences, including soil degradation, water pollution, and adverse health outcomes such as cancer and endocrine disruption.

In Africa, agrochemical contamination is exacerbated by rapid population growth, urbanization, and the over-reliance on agrochemicals to boost agricultural productivity. The continent accounts for only 3% of global pesticide usage but faces disproportionately severe impacts due to improper handling and application practices (Demi & Sicchia, 2021). This improper handling of these chemicals often results in long-term health effects on the farmers unknowingly thus leading to severe health complications and even death. This is aggravated by the high level of unawareness resulting from low literacy levels as well as the low-income levels of farmers where most of the farmers engage in subsistence farming and sell surpluses for peanuts. In Kenya, a 30% rise in pesticide use over the past decade has led to pervasive contamination of water bodies and food crops, while in South Africa, mining activities have resulted in significant heavy metal contamination, rendering substantial agricultural land unusable and exacerbating food system challenges (Kariuki et al., 2021; Mathee et al., 2020). These rising cases have led to heightened risks of endocrine disruption, neurological damage, and other metabolic disorders among African populations.

The challenge of chemical contamination is particularly acute due to weak regulatory frameworks, limited enforcement capacity, and the widespread use of counterfeit agrochemicals. A study in Ghana revealed that 45% of pesticides sold in local markets were either unregistered or contained banned substances, posing significant risks to food safety and human health (Ntow et al., 2019). In Tanzania, high levels of aflatoxin contamination in maize and groundnuts have been linked to liver cancer, which accounts for 10% of all cancer cases in the country (Kamala et al., 2018). Studies show that aflatoxin levels often exceed European Union safety standards (4 ppb) in many African countries, leading to significant health risks such as liver cancer (PACA, 2012). The importation of unregulated pesticides from countries like China has contributed to a 200% increase in pesticide use across Africa over the past decade (Fabuhun et a., 2023).

Nigeria, as Africa’s most populous nation and largest economy, faces unique challenges in addressing chemical contamination in its agro-food systems. With over 70% of the population engaged in agriculture, the reliance on chemical inputs to enhance productivity has led to widespread contamination of soil, water, and food crops (Adekunle et al., 2020). The country as argued by Fabuhun et al. (2023) is one of Africa's

largest importers of pesticides, yet many products lack proper labeling or dosage instructions. This has led to widespread misuse among farmers, resulting in contaminated crops and long-term environmental damage. Okoffo et al. (2021) established that 60% of vegetables sampled contained pesticide residues exceeding the maximum residue limits set by the World Health Organization in Nigeria. Heavy metal contamination from artisanal mining and industrial activities in Nigeria's northern regions has led to severe health crises, notably the devastating lead poisoning incident in Zamfara State, which resulted in over 400 child fatalities, while aflatoxin contamination in maize and groundnut production poses a significant risk of liver cancer among vulnerable populations (Wenndt et al., 2023; Anka, 2024).

The emergence of new pests and diseases resulting from climate change has continued to disrupt crop and animal yield in Nigeria alongside farmers' desire to increase farm cultivation has led to the increasing demand for agrochemicals (Demi, & Sicchia, 2021). This implies that farmers have increased the levels of these contaminants as this serves as a motivation for pest prevention and disease control hence leading to higher productivity. It is established that the application of agrochemicals such as pesticides and fertilizer improves yield whereas pests and diseases cut down crop and animal production (Mandal et al., 2020; Babafemi et al., 2022). The increasing application of these chemical contaminants poses a significant threat to food security as it affects availability, accessibility, utilization and stability. According to Dalyop and Akims (2024), food security remains an unattainable luxury for many Nigerian households. This reflects the multidimensional effects of chemical contaminants on food security as it erodes the nutritional contents of food thereby leading to low acceptable daily intake with severe health outcomes in Nigeria. Although several studies have investigated the link between agrochemicals and health outcomes others have delved into the nexus between food security and health outcomes with no empirical evidence on how agrochemical contaminants affect food security with attendant consequences on health outcomes in Nigeria. Therefore, this study seeks to determine the level of chemical contaminant usage, and its impact on food security, and health outcomes in Nigeria with a focus on pesticides, heavy metals, and hydrocarbons.

Assessment of the Levels of Chemical Contaminants in Nigeria’s Agro-Food Systems

The quantification and evaluation of chemical contaminants in Nigeria’s agro-food systems reveal alarming levels of pesticides, heavy metals, and other agrochemicals, often exceeding the permissible limits set by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). Pesticides, particularly organochlorines and organophosphates, are widely used in Nigerian agriculture, but their misuse and overuse have led to widespread contamination. Studies in Nigeria have shown that pesticide residues in vegetables often exceed WHO maximum residue limits (MRLs), with findings in Lagos State indicating contamination in vegetables like Telfairia occidentalis and Celosia argentea (Njoku et al., 2017), and research

in Port Harcourt revealing that 70% of vegetable samples contained residues above MRLs (Omokpariola et al., 2024). For instance, the detected levels of chlorpyrifos, an organophosphate pesticide, in tomatoes were 0.5 mg/kg, significantly higher than the WHO MRL of 0.01 mg/kg. Similarly, research in the Niger Delta region detected organophosphate pesticides in 45% of water samples from agricultural areas, with concentrations exceeding the FAO's acceptable limits for irrigation water (Ogah et al., 2024). The excessive presence of chlorpyrifos and other organophosphate pesticides in Nigerian tomatoes and irrigation water, far exceeding international safety limits, undermines food security by contaminating essential food supplies, while posing severe health risks such as chronic toxicity and environmental degradation, thereby exacerbating public health crises and threatening sustainable agricultural practices.

Heavy metals, such as lead, cadmium, and mercury, are another major contaminant in Nigeria's agro-food systems, with elevated levels detected in crops, soil, and water. In Zamfara State, artisanal gold mining has led to severe lead contamination, with soil lead concentrations exceeding 100,000 parts per million (ppm), far above the WHO permissible limit of 400 ppm (Bartrem, 2017). This contamination has entered the food chain, with lead levels in crops such as maize and millet reaching up to 1.2 mg/kg, compared to the WHO limit of 0.1 mg/kg. In urban areas like Lagos and Kano, industrial effluents and improper waste disposal have resulted in high levels of cadmium and lead in vegetables. In Nigeria, the presence of heavy metals in vegetables poses a significant health risk, as arsenic levels surpassed WHO's maximum residual limits in Jigawa, Kano, and Taraba, reaching a peak of 0.862 mg/kg in peppers from Jigawa, while lead was ubiquitously detected, with concentrations as high as 1.000 mg/kg in onions and tomatoes from Adamawa (Barau et al., 2025). The pervasive contamination of Nigerian food crops with heavy metals, such as lead and arsenic, due to artisanal mining and industrial activities, poses a profound threat to both food security and public health, as it not only compromises the safety of staple foods like maize, millet, onions, and tomatoes but also exacerbates chronic health issues like cancer, thereby undermining the nation's overall well-being and sustainable agricultural practices.

Hydrocarbon contamination, primarily from oil spills and gas flaring in the Niger Delta, further exacerbates the problem. Between 1976 and 2014, over 7,000 oil spills were recorded in the region, contaminating soil, water, and crops (Udjoh, 2019). Oil spills introduce heavy metals and pollutants into the environment, which accumulate in crops and water sources, posing significant risks to food security and public health. The widespread pollution leads to chronic health issues, reduced agricultural productivity, and long-term ecological damage, exacerbating socio-economic challenges in affected communities. In the Niger Delta region of Nigeria, 90% of water samples from oil-impacted areas contained hydrocarbon levels exceeding the WHO guideline of 0.2 mg/L, with concentrations reaching up to 889.1 mg/L (Anyanwu et al., 2023).

Crops such as cassava and yam grown in these areas have been found to contain elevated levels of polycyclic aromatic hydrocarbons (PAHs), with concentrations exceeding the FAO's permissible limit of 0.2 mg/m^3. Seafood from the Niger Delta, a major protein source for local communities, has been found to contain high levels of hydrocarbons, with PAH concentrations reaching up to 4.55 to 7.75 mg/kg, compared to the FAO limit of 0.2 mg/kg (Udofia et al., 2021). The hydrocarbon contamination severely compromises Nigeria's food security and health outcomes by introducing heavy metals and pollutants into crops and water, leading to chronic health issues, reduced agricultural productivity, and long-term ecological damage, while also contaminating essential food sources like seafood and staple crops with harmful levels of polycyclic aromatic hydrocarbons. This portrays the health dangers chemical contaminants have on human health in Nigeria.

The assessment of chemical contaminants in Nigeria's agro-food systems reveals significant regional variations, with certain crops and areas being more affected than others. For example, vegetables such as tomatoes, spinach, and lettuce are particularly vulnerable to pesticide and heavy metal contamination due to their high water content and surface area. Also, staple crops such as maize, cassava, and yam are often contaminated with heavy metals and hydrocarbons, particularly in regions with mining and oil exploration activities. The significant variation in the level of agrochemical contaminants in Nigeria signifies the different levels of nutritional diets consumed by locals in these areas and the attendant health consequences in Nigeria. This implies that in all regions of Nigeria with crop and animal-specific levels of contaminants contents, there exist significant agrochemical contaminants that affect the acceptable diet intake of people which is far below the specified limit of WHO and FOA. This significantly low content has severe consequences on Nigeria's health outcomes and is reflected in its life expectancy with men in the South-west living an average of 7.4 years (50.2) longer than those in the North-east (50.8), and women in the South-west enjoying a lifespan 7 years (62.5) longer than their counterparts in the North-east (55.5) (Adewale, 2024).

Impacts on Food Security in Nigeria: A Four-Dimensional Analysis

Chemical contamination of Nigeria's agro-food systems has significantly undermined food security, posing serious health risks and reducing the availability of safe and nutritious food. Pesticide residues, including organochlorine pesticides (OCPs), have been found in Nigerian maize and beans at levels surpassing the maximum residual limits (MRLs) established by the EU and FAO/WHO, while trace metal concentrations in leafy vegetables pose a significant health risk, particularly for children, as evidenced by a hazard risk index (HRI) exceeding the safety threshold of 1.0 (Olutona et al., 2022; Oshatunberu, 2023). These levels far exceed international standards set by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), which recommend maximum residue limits (MRLs) for pesticides and heavy metals to ensure food safety (WHO/FAO, 2018). For instance, the permissible limit for lead in cereals is 0.2 mg/kg

according to Codex Alimentarius, yet Nigerian studies have reported levels as high as 1.5 mg/kg in some regions (Getu et al., 2022). This contamination not only reduces the nutritional quality of food but also discourages international trade, as Nigerian exports often fail to meet global safety standards.

Igharo (2018) corroborates these findings, revealing similar contamination trends in other African countries, though Nigeria's levels are notably higher due to lax regulatory enforcement and industrial activities. Conversely, Abegaz (2022) argued that contamination levels are exaggerated and that localized interventions have improved food safety in certain areas. The implications for food security are dire, as contaminated food reduces consumer confidence, limits access to safe nutrition, and exacerbates poverty among smallholder farmers who rely on agriculture for livelihoods. Chemical contamination in Nigeria's agro-food systems has profound implications for the four dimensions of food security: availability, accessibility, utilization, and stability. Each dimension is critically affected, undermining the nation's ability to ensure a safe and sustainable food supply for its growing population.

Availability

Food availability refers to the physical presence of sufficient quantities of food through production or imports. Chemical contamination in Nigeria reduces crop yields and livestock productivity due to soil degradation and bioaccumulation of toxins in plants and animals. For instance, heavy metals and pesticide residues have been detected in Nigerian agricultural products, which rendered them unfit for consumption or export (Alum, 2024). Compared to international standards of food safety set by agencies like the FAO and WHO, Nigeria lags significantly in meeting acceptable contaminant thresholds. Globally, safe pesticide residue levels are strictly enforced; however, weak enforcement in Nigeria exacerbates the problem. This discrepancy demonstrates the need for improved regulatory frameworks to ensure agricultural outputs meet both local and global standards.

The availability of food is severely compromised by chemical contamination, as contaminated crops and livestock products are often rendered unfit for consumption. In the Niger Delta region, oil spills have devastated agricultural lands, reducing the productivity of staple crops such as cassava and yam. Between 1976 and 2014, over 7,000 oil spills were recorded, affecting an estimated 1,000 square kilometers of farmland and significantly reducing food production (Onyeka & Onyeka, 2023). The high concentration of pesticide contamination has led to the rejection of crops in local markets. These instances highlight how chemical contamination directly reduces the quantity of food available for consumption hence with dire aggravated hunger in Nigeria.

Accessibility

Food accessibility is determined by individuals' ability to obtain food through economic or physical means. Chemical contamination increases production costs as farmers must invest in remediation efforts or lose income due to rejected exports. This economic burden disproportionately affects smallholder farmers, who constitute 90% of Nigeria's agricultural producers (Wudil et al., 2023). Consumers avoided purchasing vegetables grown in peri-urban areas due to concerns about heavy metal contamination, leading to reduced demand and lower incomes for farmers (Chand, 2018). Consequently, contaminated produce is often sold locally at reduced prices, limiting access to safe food for vulnerable populations. Internationally, countries with robust food safety systems ensure contaminated products are removed from supply chains; however, in Nigeria, such systems are underdeveloped. The 2024 Cadre Harmonisé analysis projected that 33.1 million Nigerians would face acute food insecurity by 2025, partly due to economic constraints exacerbated by contaminated food supplies (World Food Pragramme, 2024). This reluctance to consume locally produced food exacerbates food insecurity, particularly among low-income households that rely on affordable, locally sourced produce. Furthermore, the economic losses incurred by farmers due to crop rejection or reduced yields limit their ability to purchase food, creating a vicious cycle of inaccessibility thus leading to high chances of health risk in Nigeria.

Utilization

Food utilization involves the biological use of food for health and nutrition. Chemical contaminants such as pesticides and heavy metals compromise this dimension by causing acute and chronic health issues like cancer, neurological disorders, and reproductive impairments (Alum, 2024). Vulnerable groups such as children and pregnant women are particularly at risk. For instance, in Zamfara State, lead contamination from artisanal gold mining resulted in the poisoning of over 400 children, with many suffering from neurological damage and developmental disorders (Bartrem, 2017; Anka, 2024). In comparison, countries with stringent food safety protocols see lower incidences of such health issues because contaminated food rarely reaches consumers. For example, while global malnutrition rates stood at 19.1% in Africa in 2019 as argued by Wudil et al (2023), Nigeria's rates are likely higher due to the compounded effects of chemical contamination on nutritional quality. The consumption of pesticide-laden vegetables has been linked to chronic health conditions such as cancer, reproductive disorders, and endocrine disruption (Shahidullah, Islam, & Rahman, 2023; Zhou, Li & Achal, 2024). These health impacts reduce the ability of individuals to absorb and benefit from the nutrients in their food, undermining the utilization dimension of food security that enhances better health outcomes.

Stability

Food stability refers to consistent access to adequate food over time. The contamination of agricultural systems destabilizes food supply chains by reducing long-term productivity and increasing dependence on imports. Contaminants such as heavy metals and hydrocarbons can persist in the environment for decades, rendering agricultural lands unproductive and reducing long-term food production capacity. For example, hydrocarbon pollution in the Niger Delta has led to the degradation of soil and water resources, making it difficult for farmers to recover their livelihoods even years after oil spills occur (Ukhurebor et al, 2021). Furthermore, climate change exacerbates this instability by intensifying environmental contamination through flooding or droughts that mobilize toxins into farmlands (World Food Programme, 2024). Internationally, nations with advanced agricultural practices mitigate these risks through sustainable farming techniques; however, Nigeria's reliance on rain-fed agriculture and limited adoption of integrated pest management (IPM) strategies leaves its food systems vulnerable (Alum, 2024). The recurring use of unregulated pesticides and the lack of effective remediation efforts perpetuate contamination, creating an unstable food system. This instability is particularly concerning in a country like Nigeria, where over 40% of the population already faces food insecurity (FAO, 2022).

Adverse Human Health Outcomes in Nigeria

Chemical contamination in Nigeria’s agro-food systems has profound implications for human health, manifesting as both acute and chronic health effects, as well as long-term risks such as cancer. These contaminants, often found in agricultural products and water sources, can lead to a range of health issues, from minor gastric problems to severe conditions such as cancer, neurological disorders, and reproductive impairments (Rather et al., 2017; Sonone et al., 2020; Sarkar et al., 2022). These outcomes are driven by the consumption of food and water contaminated with pesticides, heavy metals, and hydrocarbons, which are pervasive in Nigeria’s environment due to agricultural, industrial, and mining activities. For instance, heavy metals like cadmium and chromium are known carcinogens that can cause acute and chronic health effects, including renal failure and neurological damage (Rehman et al, 2018; Engwa et al, 2019; Balali-Mood et al., 2021). In comparison to international standards, Nigeria's lack of stringent regulations exacerbates these health risks, as seen in the high levels of pesticide residues and heavy metals exceeding safety thresholds set by the EU and FAO/WHO (Muhammad, 2019; Rilwanu, 2021). The persistence of the high presence of these contaminants has resulted in both acute and chronic health effects on Nigerians thus leading to subsequent deaths.

Acute and Chronic Health Effects

Exposure to chemical contaminants through food and water can result in acute health effects, particularly in cases of high-dose or short-term exposure. For instance, pesticide poisoning is a significant public health

concern in Nigeria, particularly among farmers who handle these chemicals without adequate protective measures. Agrochemical residues, including banned substances like dichlorodiphenyltrichloroethane (DDT) and aldrin, persist in Nigerian agricultural products due to improper regulation and use. These residues cause acute poisoning (nausea, and vomiting) and chronic conditions such as cancer, reproductive disorders, and neurological impairments (Alum, 2023). Attributably, it is reported that the cancer incidence rate is approximately 113.6 cases per 100,000 persons per year, with a mortality rate of 74.6 per 100,000 persons per year in Nigeria. National Cancer Registry (2024) reported that approximately 127,000 new cases and 79,000 cancer-related deaths were reported in 2022. This demonstrates the rising cases of cancer which these chemicals are significant contributory factors. Research indicated that approximately 50% of abortions and 17% of congenital abnormalities occur among women who have been exposed to pesticides during pregnancy or while breastfeeding (Jain et al., 2023). This demonstrates the dangers associated with the utilization of these chemicals in agricultural production posing a significant threat to human existence due to misuse or lack of awareness of the effects of these chemicals. In Southeast Nigeria, 92% of surveyed farmers reported exposure to agrochemicals during application, with 73% experiencing sickness afterward. This is exacerbated by low literacy levels, as 65% of farmers could not read usage instructions, leading to improper handling and application (Apeh, 2019). Furthermore, the absence or ineffective implementation of regulations by agencies like the NAFDAC has also contributed to the widespread effect of these adverse health outcomes among farmers in Nigeria. Drawing from the estimated population of Nigeria,

Chronic health effects, resulting from long-term exposure to low levels of chemical contaminants, are equally concerning. Heavy metals such as lead, cadmium, and mercury accumulate in the body over time, leading to conditions such as kidney damage, cardiovascular diseases, and developmental disorders. According to Ugwu et al 2024), the factory effluent recorded the highest mean levels of the metals analyzed, which were higher than the permissible limits. This signifies that almost all the agricultural food consumed in Nigeria has some levels of leads which leads to chronic kidney disease. Buttressing the existence of heavy metals in agricultural products, Ibrahim et al (2024) established that 4.2% of households have increased lead levels as a result of the consumption of contaminated food. Nigeria has a relatively high burden of chronic kidney disease (CKD), with prevalence estimates varying between 1.6% and 12.4% of the population (Jacob & Sharma, 2023). This implies that many farmers engage in risky behaviors, such as eating while spraying pesticides or reusing pesticide containers for domestic purposes, further increasing exposure risks. These chronic effects underscore the long-term health burden imposed by chemical contamination, particularly in communities with limited access to healthcare and alternative food sources.

Cancer and Long-Term Risks

The accumulation of carcinogenic substances in the food chain poses a significant long-term risk to human health in Nigeria. Polycyclic aromatic hydrocarbons (PAHs), heavy metals, and pesticide residues are known carcinogens that lead to the development of various cancers. For example, in the Niger Delta region, where oil spills and gas flaring are prevalent, elevated levels of PAHs have been detected in seafood and crops. For instance, a study in Gombe State found that arsenic concentrations in vegetables exceeded permissible limits, although other metals were within acceptable ranges. While the non-carcinogenic risks were deemed low in this study, the presence of arsenic remains a public health concern (John et al., 2025). With this, in 2022, Nigeria recorded approximately 127,000 new cancer cases and 79,000 cancer-related deaths (Alliance for Action on Pesticides in Nigeria, 2024). This situation has become worrisome with the rising cost of labour and the quest for survival of low-income farmers in Nigeria. Similarly, the consumption of aflatoxin-contaminated maize and groundnuts, which is widespread in Nigeria, has been linked to liver cancer, a leading cause of cancer-related deaths in the country (Dhakal et al., 2023). These findings highlight the carcinogenic risks associated with chemical contamination and their disproportionate impact on vulnerable populations.

The long-term risks of chemical contamination extend beyond cancer to include generational health impacts. For instance, prenatal exposure to heavy metals such as lead and mercury results in developmental disorders, cognitive impairments, and reduced IQ in children. According to Olufemi, Mji and Mukhola (2022), when lead replaces essential ions, it can contribute to brain disorders, leading to decreased IQ, learning impairments, reduced attention span, behavioral issues, and potentially more severe neurological complications later in life, particularly with early exposure. This implies that even unborn can be affected by the exposure of their parent to these contaminants posing great dangers for the future generation. Therefore, the persistence of chemical contaminants in the environment ensures that these risks are ongoing, affecting future generations. The practical illustrations of the effect of these contaminants are reflected in different parts of Nigeria leading to uprisings from different groups as a result of the adverse effects of these agrochemical contaminants.

Conclusion

This study underlines the pervasive chemical contamination of Nigeria's agro-food systems, driven by weak regulation, improper practices, and counterfeit agrochemicals, which significantly undermines food security and poses severe public health risks. With the elevated levels of pesticides, heavy metals, and hydrocarbons, often exceeding international safety thresholds, this compromises food availability, accessibility, utilization, and stability, with regional variations exacerbating inequalities in dietary intake and health outcomes. Addressing this challenge requires comprehensive strategies, including strengthened regulatory enforcement,

sustainable agricultural practices, capacity building, and effective monitoring systems to ensure food security, improve public health, and foster sustainable development in Nigeria.

Recommendations

i. That the federal government should prioritize the development and implementation of a National Food Safety and Contamination Control Framework. This framework should establish clear, enforceable standards aligned with WHO and FAO guidelines, while also outlining robust monitoring, enforcement, and remediation strategies..

ii. That both Federal and State Ministry of Health, in collaboration with NAFDAC, NESREA, and the Federal Ministry of Agriculture, should mitigate the adverse health effects associated with chemical contamination, by establishing a comprehensive public health surveillance system focused on detecting and responding to chemical-related illnesses. This system should include routine health screenings in high-risk communities, particularly those near industrial, agricultural, and mining zone

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