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Crop Production and Pesticide Use: Has Ghana Overlooked the Obvious on Health?

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ABSTRACT
Vegetables and cereals, besides health benefits, are of significant socio-economic importance in Ghana, because, the whole production process provides employment for both rural and urban dwellers. Unfortunately, the high prevalence of pests (weeds inclusive) and disease complexes, associated with them, inflict significant economic damage on field and storage, if not properly managed. This review purposed to document challenges from pesticide use and suggest perspective recommendations for mitigation. Information was sourced from published journal articles, technical and annual reports (Research Extension Farmer Linkage Committee (RELC), Environmental Protection Agency (EPA, Ghana), and Institutions), the authors' observations and personal communication with farmers, agricultural extension agents and other experts. The review analysis indicated over 80% of farmers use pesticides, particularly on high-value cash vegetable and cereal crops; and also to alleviate human labour constraints. Challenges such as pesticide resistance, increasing incidence of existing pests and diseases, or the manifestation of new pests and diseases due to climate change or continuous cropping among others were evident, prompting shifts to increased pesticide use for management and also for desired profit. Highlights on concerns for the insatiable quest for pests and disease control by chemical means, consequently increased reports on dangers of continuous pesticide use on human and public health, the environment and the economy. This research revealed that a minimal understanding of the use and application of pesticides contributed to the non-intended effects on health and the environment. Hopefully, the identified gaps and recommendations if properly addressed by policy would significantly enhance quality production systems for global trade and protect local consumers. State the contribution of this study to scholarship.

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INTRODUCTION
Vegetables play a major role in the diets of both rural and urban Ghanaians for the maintenance of general health because they are the source of vitamins, minerals, other nutrients, soluble fibre, and antioxidants that boost the immune system. Maize and rice are the primary sources of energy for most Ghanaians and dependent on the strain/variety, can contain decent amounts of fibre, protein, vitamin B, iron, and manganese making them vital in the fight against malnutrition. The soluble fibre in Okra, for example, lowers serum cholesterol while the insoluble part absorbs water from the intestinal tract to minimize the

risk of particularly colorectal cancer and prevents constipation.[1] Cabbage is a known source of vitamins C, B6, and K, and contains some amount of folate (10-19% of the Daily Value (DV), dietary fibre (> 20%) and a small amount of thiocyanate that offers protection against goitre formation. Tomato is an excellent source of vitamins, folate, potassium, fibre, folic acid and carotenoids (Beecher, 1998) and protects against prostate or colorectal cancer and kidney stones besides the general heart, eye and skin health. Thus, in Ghana, the consumption of numerous vegetables in addition to cereals has been amplified as vital in the fight against the COVID-19 pandemic and other diseases.

Vegetables and cereals particularly maize and rice are strategic crops cultivated in all the agro-ecological zones in Ghana by both male and female farmers, irrespective of age for food and cash. Tomato, pepper/chillies, okra, garden egg, (*Solanum aethiopicum*), beans and onions are the major vegetables produced in both rural and urban areas. Cabbage, carrots, lettuce, shallots, green pepper, green beans, and aubergines are important cash crops for mostly migrants and some small-scale farmers in or near the peri-urban areas. The dominant exports are chilli peppers, okra, eggplant, guar beans, tinda, gourds, marrows and yard-long beans. Maize production accounts for 55% of grain output followed by paddy rice (23%), sorghum (13%), and millet (9%). Maize is also important for poultry feed as well as a substitute for the brewing industry. Rice with an annual per capita consumption of 45kg/person and rising due to population growth, urbanization and changes in consumer habits, is considered a fast food very popular among the youth, single adults and working parents.

Economically, Ghana also earns considerable foreign exchange through the export of vegetables, maize and rice, therefore their importance in the Ghanaian agricultural sector cannot be over-emphasized. Vegetable exports increased from $1,911,312 in 2014 to $2,058,339 in 2019,[2] while the export of maize was $1,591.47k and rice $423.6k in 2021.[3] Currently, there is an increasing consumption of lesser-known leafy vegetables such as *Corchorus olitorius* (Ayoyo) and edible amaranth, which can be exposed to indiscriminate pesticide application and drift when not intentionally grown and requires policy intervention.[4]

Besides their importance in the Ghanaian diet for general maintenance of health, the whole production-to-table (consumer) process is a major conduit of employment for both the rural and urban dwellers, contributing a lot to household incomes in all spheres of the Ghanaian settings. Unfortunately, the high prevalence of pests (weeds inclusive) and disease complexes, associated with them, inflict significant economic damage on fields and storage, if not properly managed. Various pesticides have been introduced over the years to curb this negative trend. However, there have been challenges to the application of these pesticides. This continues to affect the yield of the farmers leading to losses for both the farmer and the consumer.

This paper, therefore, aims to review the challenges emanating from pesticide application and then make key recommendations, linkages and approaches from a research perspective to ensure sustainable healthy production systems for the crops to compete on the global market while protecting local consumers.

METHODOLOGY

This review was based on comprehensive data and information from the Google Scholar search engine for published journal articles related to pesticide use and abuse practices in crop production in Ghana, socio-economic and gender factors in relation to crop production and pesticide use, as well as pesticide exposure and attendant health implications. Additional information on crop production and pesticide use constraints was gathered from Research Extension Farmer Linkage Committee (RELC) meeting reports, technical and annual reports of various institutions, the authors' observations and personal communication with farmers, extension agents, Environmental Protection Agency (EPA, Ghana), as well as other experts in crop production. This information was synthesised and analysed for the following themes under review.

[1] S.W. Zook, "All about Okra ," 2004, www.Physiology.Wise.Edu/ravi/okra; R. Wolford and F. Banks, " Okra," 2006, http://www.urbanext.uivc/veggies/okra1.html.
[2] Dode Seidu, "Assessment of Losses and Causes of Border Rejections of High-Value Exports from Ghana ," 2022, https://pdf.usaid.gov/pdf_docs/PA00ZSRH.pdf.
[3] Tanko Bagbara and Urowole Philips, "Rice Production: A Priority to Ghana: Ministry of Food and Agriculture," 2021.
[4] A. Gerken, J.-V. Suglo, and M. Braun, *Crop Protection Policy in Ghana* (Pokuase - Accra: Integrated Crop Protection Project, PPRSD/GTZ, 2001).

PRESENTATION OF FINDINGS AND DISCUSSION

Crop Production Constraints

The increasing demand for vegetables and cereals for local consumption to feed particularly the growing urban population in Ghana, as well as production for cash income has led to expansion and intensification in production. However, the production of these crops is associated with a high prevalence of pests (insects, weeds, nematodes, rodents, birds, etc.) and disease complex (viral, bacterial, and fungal) that cause significant economic damage and as the Ghanaian population soars, demand outstrips production. The production also suffers from limitations in human labour, access to improved quality seed, declining soil fertility, and availability of adequate quality water. The crops are also susceptible to environmental stress such as drought, high rainfall, or moisture, which are precursors to pest invasion and disease infestation.

The annual RELC meetings from all regions since 2014 consistently report pesticide misuse/abuse due to the incidence of the yellow-leaf-curl-virus (TYLCV) disease in tomato, shoot, and fruit borers (SFB) in garden egg and pepper, which confirms other similar reports.[5] Ghana is still grappling with the management of the diamondback moth (DBM, *Plutella xylostella*), a severe pest of cabbage resistant to almost every known or approved insecticide, which caused fields in the Upper East and Western North (Sefwi Bekwai) Regions to be abandoned years ago. Weeds which generally tie up 22-38% of total field labour time, also serve as alternative hosts to other pests and diseases. For example, the weeds *Ischaemum rugosum* and *Brachiaria* spp. are notorious in rice and maize fields respectively, with the latter as an alternate host to the fall armyworm menace. These constraints coupled with the cropping systems make managing the pests and disease complex a herculean task for farmers including home gardeners. In 2015, the export of vegetables from Ghana was suspended due to concerns about the management of quarantine pests. Thus, addressing the pests' infestations and disease incidence would significantly contribute to reducing, for example, the shortfall in rice production estimated to be 50% by Saito *et al*.[6] The basic production systems are sole cropping, intercropping/mixed cropping, or multiple cropping where the different crops are cultivated on separate plots on the same field. Hence, in the peak season, there is an attendant shift to increased use of pesticides (organic and synthetic) to mitigate the pest and disease challenges and also to mitigate the human labour constraints. It is estimated that across regions more than 80% of farmers in the production of these high-value cash vegetable and cereal crops apply pesticides. This they do without recourse to the effect on humans, the environment, crops, and targeted and non-target organisms (beneficial organisms) often leading to pollution, food contamination, health challenges, killing of natural enemies of pests, and the building up of pesticide resistance.

Why Agricultural Pesticides?

A pesticide is a chemical or biological substance that kills, retard the growth, or deters pests that damage or interfere with the growth of plants and animals so desired by humans. Pesticides generally and with the best intentions are designed to function with reasonable certainty and minimal risk to human health and the environment for the control of pests and diseases in agricultural fields. Over 80% of rice farmers in almost all 16 regions of Ghana identify weeds, insect infestation, and disease as major constraints in rice production (personal communication with RELC Coordinators; Annual RELC Planning Session Reports 2016, 2017, 2018, 2019). Farmers are very much aware that pests and diseases if and when not appropriately managed cause serious yield reduction of over 50% and that weeds can also serve as an alternate host to other pests and diseases. Weed seeds directly contaminate harvest produce and reduce quality leading to fairly low market price. Weeds such as *Ischaemum rugosum (Saromolla grass)*,

[5] F J Manneh, C K Kwoseh, and J L Starr, "Production Practices and Pest and Disease Problems of Tomato Farmers in Ashanti Region of Ghana," *Journal of Agriculture and Ecology Research International* 6, no. 3 (2016): 1–9; David Owusu-Ansah and Emmanuel Akyeampong, "Religious Pluralism and Interfaith Coexistence: Ecumenicalism in the Context of Traditional Modes of Tolerance," *Legon Journal of the Humanities* 30, no. 2 (December 31, 2019): 1–18, https://doi.org/10.4314/ljh.v30i2.1; D Obeng-Ofori and J Sackey, "Field Evaluation of Non-Synthetic Insecticides for the Management of Insect Pests of Okra Abelmoschus Esculentus (L.) Moench in Ghana," *SINET: Ethiopian Journal of Science* 26, no. 2 (2003): 145–50; Anthony Youdeowei, "Principles of Integrated Pest Management: Growing Healthy Crops.," *Principles of Integrated Pest Management: Growing Healthy Crops.*, 2004.

[6] K. Saito et al., "Towards a Better Understanding of Biophysical Determinants of Yield Gaps and the Potential for Expansion of the Rice Area in Africa.," in *Realizing Africa's Rice Promise* (UK: CABI, 2013), 188–203, https://doi.org/10.1079/9781845938123.0188.

Rottboellia cochinchinensis (Itch grass) and *Oryza barthii* (wild rice) are among the FAO noxious weeds, whose seeds contaminate rice and considerably reduce the market value.

Several years of research activities, personal observations, farmer demonstrations and discussions have revealed that to be more sustainable and enhance productivity, farmers have expanded their fields, and diversified and intensified production through various cropping systems. However, crop intensification comes with changes and increases in pests and disease diversity making control and management costly. Responding to the increasing demand for these crops and products has led to an increased shift in the use of insecticides and fungicides (both referred to as Poison by farmers) and herbicides. Some of the reasons are:

- Difficulty in accessing high-yielding and/or pests and disease-tolerant varieties, particularly vegetables.
- Mitigate constraints on the availability of human labour.
- Ease the drudgery of manual labour for weeding.
- The dependence on efficiency of control as well as time use.
- To support economic crop production (herbicide can reduce weed control cost by 45% in rice).
- To target specific pests and diseases ordinarily difficult to control or manage and as an immediate stop-gap measure (armyworm).
- Protects crop against early weed competition (herbicides).
- To ease the deleterious effect of introduced alien and invasive pests and diseases through human activities from within Ghana and in the sub-region.
- Sell produce at particular markets or market days.
- Meet the quota and demands of lenders.

Urbanization has also led to the development of some lowland enclaves around or near towns for vegetable and cereal (rice, maize) production into residential or commercial sites. The choice then for most farmers besides crop intensification is relocating further inland with limited access to resources and markets. Pesticide use in crop production has over the years, considerably reduced crop losses in Ghana;[7] and therefore, the continuous increase in importation. Data from EPA indicated that Ghana imported 108,535.65 metric tonnes (Mt) of pesticides in 2021-2022 of which herbicides, insecticides, and fungicides constituted 80.7 %, 13.5% and 5.8% respectively. MoFA (2003) confirms the prevalent increased volumes of these pesticides to the expansion of food-cash crops to meet increasing demand.

The Problem of Pesticide Abuse

Farmers perceive chemical control as a panacea for all pest problems in Ghana, unconscious that their desperate interventions in the quest to achieve sustainable production for maximum profit have greatly influenced the evolution, the dynamics and the resistance to control or manage pests and diseases related to their crops. Unfortunately, the supply chain for chemical control is often limited in terms of the availability of acceptable and appropriate pesticides and well-labelled information suitable for cropping systems. The consequence is indiscriminate handling, use, application, and storage of pesticides without recourse to human and animal health as well as environmental safety. Afari-Sefa *et al.* report on the use of pesticides approved for cocoa on vegetables.[8] In a participatory rural appraisal in the Dormaa Municipal of Bono Region, farmers intimated to us that, their non-compliance to harvest interval is catalysed by traders who want to preserve the shelf life of tomato produce in transit. Hence, farmers must ensure the visible presence of pesticides on the produce at the time of purchase, not conforming to this practice implies less price for the produce or loss of market (Personal communication, 2019). Various studies have revealed the indiscriminate disposal of empty pesticide containers, and storage of used and unused pesticides inside living areas in homes or together with food and other products in inappropriate places.[9]

[7] E E K Clarke et al., "The Problems Associated with Pesticide Use by Irrigation Workers in Ghana," *Occupational Medicine* 47, no. 5 (1997): 301–8.

[8] Elvis Asare and Victor Afari Sefa, "Pesticide Use Practices and Perceptions of Vegetable Farmers in the Cocoa Belts of the Ashanti and Western Regions of Ghana," *Advances in Crop Science and Technology* 03, no. 03 (2015), https://doi.org/10.4172/2329-8863.1000174.

[9] Atta Kwesi Aidoo et al., "Pesticides Abuse and Health Implications in Ghana: A Review," *International Journal of Environment, Agriculture and Biotechnology* 4, no. 3 (2019): 874–83, https://doi.org/10.22161/ijeab/4.3.38; Elvis Dartey Okoffo, Michael Mensah, and Benedicta Yayra Fosu-Mensah, "Pesticides Exposure and the Use of Personal Protective Equipment by Cocoa Farmers in Ghana,"

These actions have exposed the numerous actors in the production chain to various health and environmental risks. The Regulatory bodies in Ghana though, have increased awareness of these practices that lead to public health risks and are constrained with limited human resources for effective monitoring and enforcement of compliance. Nevertheless, the resolution depends on knowing the gaps for policy intervention.

Table: Identified Gaps in Pesticide Application

Issues	Problem	Remark
Input dealers (Retailers)	Unable to differentiate between trade and common names Inadequate knowledge of pesticide use and application Counterfeiting products (packaging, labelling) Improper or poor packaging or labelling Storage of pesticides Inappropriate sales outlet with poor ventilation	Unable to educate customers on safe use or proper choice labels in Foreign languages, No indication of re-entry or Pre-harvest interval Product quality affected Poor communication on health and environmental risks
Farmers/ Sprayers	Inability to read and understand Labels (some in Foreign language etc.) Inadequate details on the target pest or disease Lack of knowledge on how pesticides work Inadequate finances Inadequate information on appropriate spraying equipment Inadequate access to sprayer accessories such as personal protective equipment, nozzles, and repair kits. Farming near water bodies	Spray drifts and inhalation water contamination Inappropriate application rate Improper mixing of pesticides Applying at improper crop stage Wrong timing of application Not observing harvest waiting periods
Pesticide spraying equipment	Wrong nozzles, Improper calibration, Faulty sprayers, water source, Spraying without PPE, Inadequate PPE Improperly washed sprayers Access to sprayer accessories	Over or under application, spillage, Spray drifts, water contamination, dermal contact
Disposal of containers & pesticides	Indiscriminate (anywhere); pour into water bodies or onto the field, containers thrown on the field, etc.	contamination and pollution
Storage of pesticides	Storing with food crops or other products Pouring into other containers Keeping leftover chemical solutions	Sharing to be reused or for economic reasons without thinking of contamination
Extension and Technology transfer	Financial constraints affecting mobility Limitations on pesticide trend Poor feedback mechanism among stakeholders Very high extension-to-farmer ratio (1:1,500)	Misinformation on application poor information flow Unable to visit farmers regularly
Socio-economic factors	Gender dimension (migrants, indigenes, youth) Land tenure system	Desire to earn more money; dictates work ethics

Environmental Systems Research 5, no. 1 (December 27, 2016): 17, https://doi.org/10.1186/s40068-016-0068-z; Ziblim A. Imoro, Joshua Larbi, and Abudu B. Duwiejuah, "Pesticide Availability and Usage by Farmers in the Northern Region of Ghana," *Journal of Health and Pollution* 9, no. 23 (September 2019), https://doi.org/10.5696/2156-9614-9.23.190906; Memuna M. Mattah, Precious A. D. Mattah, and Godfred Futagbi, "Pesticide Application among Farmers in the Catchment of Ashaiman Irrigation Scheme of Ghana: Health Implications," *Journal of Environmental and Public Health* 2015 (2015): 1–7, https://doi.org/10.1155/2015/547272; Clarke et al., "The Problems Associated with Pesticide Use by Irrigation Workers in Ghana."

Media	Exaggeration of performance Not technically enabled on pesticides	Misinformation to Farmers believe what they hear from the media

Socio-economic Factors and Gender

Pesticides are sold by both males and females but the application is generally a gender role assigned to men, though both male and female indigenes and immigrants are into the production of these crops (vegetables and cereals).[10] Nevertheless, in certain situations, women become compelled to spray, due to limited financial resources and delays in the acquisition of male labour among others. Often, gender type and the land tenure system are major determinants in the use and application of technology as well as the desire to earn more money in the vegetable and cereal crop production systems (Personal observations and interactions). So, the decision to apply the pesticide is mostly initiated depending on the gender of the farm head based on the tenure of the land (family or rented), the location of the site, the source of water, access to labour, and the time available for the activity. Thus, the integrity of the pesticide and its application depending on the contractual terms between the farm head and the applicator could have a positive or negative effect on human health or the environment. Farmers and applicators most often ignore or have poor information on the cropping history of the land before use, the effects on farming near water bodies, use of personal protection equipment (PPE), agronomic practices, and other protective measures or just do not care. The effectiveness and efficiency of pesticide use are very much dependent on the time of application in the day, of which early morning or evening is ideal. Applications are sometimes done on windy days or without recourse to the direction of the wind or well into the day endangering themselves and others to spray drift and volatilization. Unfortunately, some pesticides accumulate slowly in the environment while others are degraded into forms more toxic than the original. These get into the air, soil, and water bodies and/or are absorbed by other plants and directly and indirectly ingested unknowingly by humans and animals. As a result, women who most frequently are involved in fetching water for application and on occasion as applicators including babies carried on their back, become more vulnerable to pesticide exposure through drift.[11] Young men who are more into vegetable production for higher turnovers and the applicators (may not be farmers) also suffer a similar fate.[12] Detectable levels of some insecticide residues were found in "waakye" (rice and beans) and some vegetables (lettuce, cabbage, tomato and onion) in samples of street-vended food.[13] Regrettably, Ghanaian policymakers are still yet to fully understand that the sound health of humans and the environment is dependent on strict enforcement of safety practices and protocols for all stakeholders in the pesticide industry.

Pesticide Exposure and Health

Reported effects on humans after pesticide application and handling in the field or storage, or reuse of containers include a burning sensation (most common), catarrh, headache, stomach pain, fever, chest pains, unconsciousness, itching/watering eyes and body pains.[14] Pesticide exposure has also been linked with various diseases including cancer. Okra farmers in Kumbungu district, Ghana are reported to drink

[10] Laura Zseleczky, Maria Elisa Christie, and Joyce Haleegoah, "Embodied Livelihoods and Tomato Farmers' Gendered Experience of Pesticides in Tuobodom, Ghana," *Gender, Technology and Development* 18, no. 2 (2014): 249–74.

[11] Birtukan Atinkut Asmare, Bernhard Freyer, and Jim Bingen, "Women in Agriculture: Pathways of Pesticide Exposure, Potential Health Risks and Vulnerability in Sub-Saharan Africa," *Environmental Sciences Europe* 34, no. 1 (December 13, 2022): 89, https://doi.org/10.1186/s12302-022-00638-8; Maria Elisa Christie, Emily Van Houweling, and Laura Zseleczky, "Mapping Gendered Pest Management Knowledge, Practices, and Pesticide Exposure Pathways in Ghana and Mali," *Agriculture and Human Values* 32 (2015): 761–75; Zseleczky, Christie, and Haleegoah, "Embodied Livelihoods and Tomato Farmers' Gendered Experience of Pesticides in Tuobodom, Ghana"; William J Ntow et al., "Occupational Exposure to Pesticides: Blood Cholinesterase Activity in a Farming Community in Ghana," *Archives of Environmental Contamination and Toxicology* 56 (2009): 623–30.

[12] Ntow et al., "Occupational Exposure to Pesticides: Blood Cholinesterase Activity in a Farming Community in Ghana."

[13] W. J. Ntow, "Organochlorine Pesticides in Water, Sediment, Crops, and Human Fluids in a Farming Community in Ghana," *Archives of Environmental Contamination and Toxicology* 40, no. 4 (April 1, 2001): 557–63, https://doi.org/10.1007/s002440010210; A K Armah, G A Darpaah, and G Wiafe, "Water Quality Studies on Two Irrigation-Associated Rivers in Southern Ghana," *Journal of the Ghana Science Association* 1, no. 2 (1999): 100–109.

[14] Michael K. Miyittah et al., "Health Risk Factors Associated with Pesticide Use by Watermelon Farmers in Central Region, Ghana," *Environmental Systems Research* 9, no. 1 (December 25, 2020): 10, https://doi.org/10.1186/s40068-020-00170-9; Aidoo et al., "Pesticides Abuse and Health Implications in Ghana: A Review."

milk to neutralize the toxic effect of accidental ingestion of pesticides.[15] Report on deaths in the Volta Region from eating okra stew and banku confirmed the presence of chlorpyrifos (an active ingredient of an insecticide) in the meal,[16] while elsewhere in the world, high levels of pesticide residues have been recorded on families residing closer to agricultural fields.[17] Women because of their biological makeup and high adipose tissues are easily affected at different stages in their lives:[18] adolescence, pregnancy, lactation, and menopause. Depending on the type of pesticide and the frequency of exposure, even low doses can create irreversible effects.[19] These health-related impacts on women include breast cancer, pesticides in breast milk, decreased ovarian reserves, impaired menstrual cycles, higher risk of endometriosis, infertility, spontaneous abortions, reduced immune system, skin disorders, neurological or psychological effects, and respiratory diseases. Exposure during pregnancy is associated with premature births, perinatal deaths, neuro-behavioural consequences, foetal growth retardation, congenital malformations, and early childhood cancers.[20] Afari-Sefa *et al*. reported of negative impact on the health of some farmers in the Ashanti and Western Regions after pesticide application, while a female rice farmer from Chiraa in the Bono Region reported the same in 2021 (Personal communication).[21] Due to inadequate knowledge of PPE, small-scale commercial vegetable growers in the Eastern Region exposed to pesticide application experienced skin/eye irritation.[22] Biological monitoring studies on certain farmers and field workers on pesticide use for some years revealed higher risks for acute and chronic health effects due to occupational exposure.[23] A comprehensive analysis of some farmers revealed the presence of organochlorine pesticide residues in the breast milk and human blood of vegetable farmers, with adverse health effects on the children from those that had accumulated above the 'tolerable daily intake'.[24] These according to Atta Aidoo *et al*., could be attributed to poor handling, storage, misuse/abuse of pesticides and not using PPE.[25] In the same report by Atta Aidoo *et al*., they point to the limitation in recognizing pesticide poisoning cases by healthcare practitioners, because they are not fully integrated into the pesticide use chain.[26] It is common knowledge that some health officials opine that certain deaths seemingly natural among farmers could be pesticide-related since poisonings are hard to diagnose.

Mitigating Occupational Pesticide Exposure

Chemicals are poisonous but the right dose makes it a remedy and therefore all actors in the chain must have the special skills to understand. Currently, there exists quite an information on pesticide abuse and its related inherent toxic effects on health and the environment. However, there is a need for a one-stop database for information on the actual extent of pesticide poisonings for general consumption and policy formation.

[15] H Yahaya et al., "Pesticide Use and Health Risk Awareness of Okra (Abelmoschus Esculentus L.) Farmers in Dalun in Kumbungu District, Ghana," 2021.
[16] E. D. Frimpong, " FDA Finds Pesticide in Killer Banku and Okro Meal at Akakpokope. ," 2018, https://www.graphic.com.gh/news/general-news/fda-finds-pesticide-in-killer-banku-okro-meal-at-akakpoko...
[17] Clémentine Dereumeaux et al., "Pesticide Exposures for Residents Living Close to Agricultural Lands: A Review," *Environment International* 134 (2020): 105210.
[18] Miriam Jacobs and Barbara Dinham, *Silent Invaders: Pesticides, Livelihoods and Women's Health* (Zed Books, 2003); Ana M Garcia, "Pesticide Exposure and Women's Health," *American Journal of Industrial Medicine* 44, no. 6 (2003): 584–94; Michele La Merrill et al., "Toxicological Function of Adipose Tissue: Focus on Persistent Organic Pollutants," *Environmental Health Perspectives* 121, no. 2 (2013): 162–69..
[19] Leslie London et al., "Pesticide Usage and Health Consequences for Women in Developing Countries: Out of Sight out of Mind?," *International Journal of Occupational and Environmental Health* 8, no. 1 (2002): 46–59; International Labour Organization (ILO), *Exposure to Hazardous Chemicals at Work and Resulting Health Impacts: A Global Review* (Geneva, Switzerland: ILO, 2021).
[20] International Labour Organization (ILO), *Exposure to Hazardous Chemicals at Work and Resulting Health Impacts: A Global Review* .
[21] Asare and Sefa, "Pesticide Use Practices and Perceptions of Vegetable Farmers in the Cocoa Belts of the Ashanti and Western Regions of Ghana."
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[24] International Labour Organization (ILO), *Exposure to Hazardous Chemicals at Work and Resulting Health Impacts: A Global Review* .
[25] Aidoo et al., "Pesticides Abuse and Health Implications in Ghana: A Review."
[26] Aidoo et al., "Pesticides Abuse and Health Implications in Ghana: A Review."

RECOMMENDATIONS

For economic incentives to Ghana and sound health and environment to the populace in general, this study recommends the under-listed:

- Communication and training on pesticide issues be well articulated and made accessible to all relevant stakeholders towards sensitization.
- Consciously develop local content integrated Crop and Pest Management practices for sustainable production.
- Proper analysis and documentation of various stakeholders and their activities along the vegetable and cereal (rice and maize) production chains.
- Effective partnering and strengthening of institutions in agriculture with the Ministry of Health (MOH) for documentation of reported ailments by all actors in the agriculture sector to reconcile medical issues and occupations for policy interpretation and formulation.
- Improve the knowledge base of health workers on symptoms of pesticide exposures and poisoning for better diagnosis and data.
- Set up a dedicated unit within the Plant Protection and Regulatory Services (PPRSD) for all reports on pesticide issues – resistance, contamination, recommended pesticides, list of vendors, etc.
- Development of a central one-stop database for information sharing and documentation to help policymakers understand the actual impact of pesticide exposure on human and animal health and the economy.

CONCLUSION

The issue under discussion here is about the judicious use of pesticides for sustainable crop production to protect the domestic and export markets as well as for healthy living. Achieving this feat needs a concerted holistic effort from all stakeholders for food safety and a healthy environment. The intent of this review is to provide the conduit for drawing support to strengthen relationships and partnerships among the key ministries, offices and service providers. These include the Ministry of Environment, Science, Technology and Innovation (MESTI), Universities, the Ministry of Food and Agriculture (MoFA), the Ministry of Fisheries and Aquaculture Development, the Ministry of Information, the Ministry of Health (MoH), the Ministry of Communication and relevant Non-Governmental Organizations (NGO). As Ghana pushes to anchor itself as a lower-middle income country with agriculture as the hub, the researchers therefore hope that MoFA and MESTI will be at the forefront to provoke a national dialogue to the following questions:

1. What can the government, farmers, and media do differently to promote and improve the safe use of pesticides to save the vegetable export market?
2. What is expected from the National Agricultural Research and Extension Systems (NARES)?
3. How can the concept of Integrated Crop and Pest Management (ICPM) or the use of botanicals be enhanced and promoted?
4. Why are the current communication channels of phytosanitary issues to and from relevant stakeholders not adequate?
5. How can the activities of NGOs/NARES/MoFA/ be well integrated as partners and not be seen as competing?
6. How well can the Extension Services be integrated into the District Assembly for effective and efficient technology delivery?
7. How to resource the Policy, Planning, Monitoring and Evaluation Division (PPMED), EPA and the Plant Protection Regulatory Services Division to properly be effective in their assigned respective roles?

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