

A Review on Global Pesticide use and Food Contamination: Africa Perspective

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Review Article

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ABSTARCT

Pesticide application has increased globally with increasing demand for food, and modernized Agriculture as a result of an explosion in the world's population growth recently, most especially, in developing nations in Africa, Asia, and South America. However, pesticides have helped to improve productivity, protect the nutritive integrity of food crops, and ensure year-round food supplies worldwide. Its production and applications continued from one decade to the other until its environmental and health implications becomes hazardous to the ecosystem. Tracing the source shows that pesticides have found entry into the human food chain. In response to these problems, researchers all over the world have conducted several kinds of research on pesticide applications, and their residual contamination in food. This review crosses from the past to present research on the usage of pesticides, their accumulation in food, and possible methods of their reduction as highlighted by researchers over many years. There is a need for continuous monitoring of pesticide residue profile in soil, crop produce, and animal products in developing countries so that it will not exceed Maximum Residue Limits (MRLs).

Keywords: Agriculture; Contamination; Pesticide residue; Food safety

INTRODUCTION

Regardless of a person's economic, social, or traditional background, having access to healthy food is a fundamental human right. To ensure food supply for the rapidly growing human population, which is projected to reach 9.7 billion in 2050 and 10.4 billion in 2100. It is strongly anticipated that the agricultural industry would experience tremendous growth in the next decades. More than half of the projected increase in global population up to 2050 will be concentrated in just eight countries of the world: the Democratic Republic of the Congo, Egypt, Ethiopia, India, Nigeria, Pakistan, the Philippines, and the United Republic of Tanzania. Disparate growth rates among the world's largest countries will re-order their ranking by size. The 46 LDCs are among the fastest-growing economies in the world. The population of many is expected to quadruple between 2022 and 2050, placing additional strain on resources and making it more difficult to fulfill the Sustainable Development Goals (SDGs) [1].

LITERATURE REVIEW

Specifically, throughout the following ten years, to fulfill the nutritional needs of the world's expanding population, the agricultural sector needs to boost production by 15% and by 2050, it is projected that a 50% increase will be necessary and for this to happen, the application of various agrochemicals such as pesticides and fertilizer is going to play a major role. In this context, it is clear that the agri-food industry is at a turning point, with sustainability through an efficient and effective agrochemicals application to boost production with the ultimate objective to provide healthy food crops to the fast-growing world's population. Present-day agricultural practices should aim at supplying the world's expanding population with healthy and quality food while minimizing the adverse effects of agrochemicals such as pesticides on the environment, people, and producers' bottom lines. Integrated Pest Management (IPM) system in Agriculture addresses environmental, economic, and social challenges related to pest management in food crop farming and storage. It entails carefully weighing all available pest management methods before incorporating the necessary controls to prevent the spread of pest populations. To grow healthy crops with the least amount of pesticide use and to reduce the risks that pesticides pose to human health and the environment, it combines biological, chemical, physical, and crop-specific (cultural) management strategies and practices. This results in sustainable pest management (SDGs). IPM is a dynamic process that employs an ecological systems perspective that encourages the user or producer to take into account and use the complete range of optimal pest control solutions available taking into account economic, environmental, and social factors. The foundation of IPM is ecology, the idea of ecosystems, and the desire to maintain ecological services. It promotes natural pest management mechanisms and the growth of a healthy crop with the least amount of interruption to agro ecosystems. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) signed a memorandum of understanding with the United Nations (UN) and other relevant international organizations in 1985 to establish the "International Code of Conduct on Pesticide Management," an international code of ethics for the management of agrochemicals, in response to concerns about the trade and safe use of pesticides. However, its adaption in the home country ranges from the stringent regulatory framework in the European Union (EU) to the considerably looser framework in developing countries. Many countries have been reported to adhere to this ethical Code scrupulously. Additionally, 65% of the countries do not forbid or restrict the use of highly dangerous pesticides, according to a recent study performed jointly by the WHO and FAO [2]. The same source revealed that there are significant issues with pesticide registration procedures, uses, and management throughout Africa. Additionally, there is the issue of accumulating outdated and expired pesticides that are brought

back from developed countries for safe disposal, like in the East Africa Rift zone, for example, the issue of the buildup of outdated and expired pesticides that are sent back to industrialized nations for proper disposal. The regulation on Maximum Residue Levels (MRLs) and import tolerances, as Implemented by the European Union, for example, can ensure that the agricultural products fulfill the appropriate safety criteria when concerns about the impact of pesticide use center on whether the food is safe for consumers. Insecticides, fungicides, herbicides, rodenticides, molluscicides, nematocides, plant growth hormones, regulators, and other agricultural compounds are classified as pesticides and are used to protect crops against illnesses and pests that could harm them. Although many pesticides are hazardous, toxicity and classification are dependent on the chemical constituent. According to previous studies herbicides (42.48%) are used and applied the most globally, followed by insecticides (25.57%), fungicides (24.19%), and other (7.76%) [3,4]. The benefits of using pesticides have been widely documented in the literature, and include a considerable decrease in yield loss in a variety of patterns and ways, and a decrease in insect pests on crops. Pesticide plays a fundamental role in reducing crop yield losses and stabilizing the supply of agricultural products. And the use of pesticides has been identified in the literature as one of the major agricultural breakthroughs in various emerging continents, including Africa. Due to factors like ignorance, illiteracy, and insufficient training, many farmers apply pesticides blindly, with only about one-third of users taking into account the written instructions. This has led to issues with the environment and public health. More than 95% of the time, pesticides are administered to unintended locations, like food plants. The main source of pesticide residue contamination in food plants is the direct application of pesticides to growing plants, with a little input from pesticide residue in the soil where they are applied. It is well known that contaminated food items can harm the immune system in humans who consume them, which is brought on by an increase in the daily diet intakes of chemicals from the contaminated food crop. Consequently upon these negative developments arising from various pesticide malpractices and its adverse effect on our ecosystem, the researchers' goal of this review is to explain the distribution of Pesticide use, its market distribution in the world with Africa as a focus, residue occurrence in some food crops and finally the best ways to ameliorate the problem, particularly in African countries [5].

Dichloro-diphenyl-Trichloroethane (DDT), and whose insecticidal properties were accidentally discovered was the first and most significant synthetic organic pesticide. DDT's broad-spectrum activity, persistence, insolubility, low cost, and ease of usage were once lauded as magical qualities. Particularly, P,p'-DDT was such an efficient pesticide that it increased agricultural yields and was so reasonably priced that its use swiftly expanded around the world. DDT was additionally applied in numerous non-agricultural settings. In World War II, for example, it was used to delouse soldiers, and it is employed in public health to eliminate mosquitoes, which are the carriers of malaria. Following the effectiveness of DDT applications, new chemicals were created, resulting in the era as the "shower of chemicals" in her book "The Silent Spring." The "green revolution" and the extensive usage of pesticides in agriculture are both well known. The Green Revolution was an agricultural movement that spread throughout the globe and started in Mexico in 1944. Its main objective was to increase grain yields in a world that already struggled to provide enough food to feed its fast-growing population. The use of pesticides and other agrochemicals was one of three key parts of agricultural techniques that were involved in the "green revolution." Between 1990 and 2007, the use of pesticides increased on its own, but after that, there was a tendency to decline. Pesticide use worldwide has been estimated to increase up to 3.5 million tonnes and the numbers are rising steadily. Roughly 45% of the overall consumption is readily used by European countries while approximately 25% of the remaining is used in the USA and the rest by the rest of the globe. One of the biggest issues in the agricultural sector is insect

pests. According to the Food and Agricultural Organization (FAO), these pests reduce crop yield globally by 20 to 40 percent yearly. Each year, insects and pest infestations together cost the world economy some \$220 billion and invasive insects around US\$70 billion annually. The following analysis breaks down the global pesticide market by pesticide type: herbicides (50%), insecticides (30%), fungicides (18%), and other types such as rodenticides and nematicides (2%). In addition, between 1990 and 2019, the average amount of pesticides used per acre in Africa increased from 0.32 kg to 0.39 kg. According to estimates, pesticides are used in the production of close to one-third of agricultural products. The volume at which pesticides are being utilized is quickly growing due to the perception that pesticides can reduce harvest uncertainty. Besides, purchases of insecticide are made by both large and small manufacturers, and, subsidies for pesticides have become less common in most developing countries since the 1990s, due to a combination of structural adjustment policies and emerging sustainability thinking. Currently, around two million tonnes are used per year on a global scale, most of which are herbicides followed by insecticides, fungicides, and other types such as rodenticides and nematicides. Globally, a total of approximately 9000 species of insects and mites, 50000 species of plant pathogens, and 8000 species of weeds injure crops, of which insect pests caused an estimated 14% of loss, plant pathogens caused the 13% loss, and weeds the 13% loss. According to estimates, pesticides are used in the production of close to one-third of agricultural products. Without the use of pesticides, losses from insect damage to fruits, and vegetables, and cereals might reach 78%, 54%, and 32%, respectively. Using insecticides reduced crop loss due to pests by 35% to 42%. In the USA, fungicides were used on 80% of the fruit and vegetable crops. The use of fungicides was predicted to improve the commercial worth of apples by 1223 million US dollars. Without pesticides, cotton, wheat, and soybean exports from the United States would decrease by 27%. Overuse of pesticides and pollution, however, has also increased. According to government data from 2016, Chinese farmers used pesticides at a rate that was three times higher than the global average and according to a 2013 Greenpeace investigation, 70% of pesticides applied in China did not reach plants as intended and instead leaked into the groundwater and soil. Insecticide, rodenticide, and herbicide poisoning accounted for 7.16%, 6.4%, and 3.4% of the overall cases of pesticide poisoning, respectively. Highly toxic organophosphorus pesticides were the main cause of human poisonings, and they account for 86.02% of all cases. In eastern China's Zhejiang province, between 2006 and 2015, approximately 3000 children were poisoned by pesticides, with the majority of instances occurring during the growing season, according to research published in June 2017. The aforementioned pesticides have aided in increasing crop productivity, safeguarding the nutritional value and maintaining the structural integrity of food, facilitating storage to ensure year-round supplies, and providing delicious food products as well as other agricultural and industrial raw materials.

DISCUSSION

More than 90% of the 107 major crops in the world are pollinated by more than 20,000 species of bees. They have experienced a dramatic decline in population over the past few decades due to anthropogenic activity, particularly the use of pesticides and other agrochemicals in farming systems and the environment. According to recent studies, hazardous insecticides, particularly neonicotinoids like acetamiprid, clothianidin, imidacloprid, thiacloprid, and thiamethoxam, have contaminated 75% of the world's honey. Possible loss of biodiversity as a result of widespread pesticide use. Unfortunately, many additionally, it was found that neonicotinoids have been recognized as a significant factor in the global drop in bee population ^[6]. Some reports claim that the usage of pesticides may be to blame for the global extinction of some insect species or the collapse of insect populations. The insect

population in the Orbroicher Bruch nature reserve has decreased by 78%, according to a recent report by scientists at Radboud University Nijmegen and the Entomological Society Krefeld who looked into other insect species and abundance in more than 100 nature reserves throughout Western Europe since the 1980s. According to a study, hoverflies had 143 species in 1989 and 104 species in 2014. Chemical pesticides, especially those that contain chlorinated chemicals, can be hazardous to humans and are frequently persistent in the environment. These pesticides are harmful to a wide variety of life forms, and their effects can have an even wider reach than the area where they are produced and applied. If agricultural workers do not wear the appropriate protective equipment, direct inhalation, and skin contact with chemical pesticides can be harmful to them, dangerous for adjacent people, and even fatal. Most farmers in developing nations lack formal education and lack knowledge about safe chemical handling practices. Farmers' health may suffer as a result of the improper handling, application, and interaction of these agrochemicals. Ingestion of contaminated foods, ingestion of contaminated soil, especially in children who may not wash their hands before eating after playing with contaminated soil, contamination may also occur by use of pesticides containers as domestic water and food storage cans as observed among local farmers in developing countries, and contamination are all common pathways for human exposure to pesticides. However, the problem of food safety and health danger has persisted due to the ongoing and careless use of pesticides. Persistent Organic Pollutants (POPs) are a family of chemicals that include many of the most commonly used pesticides. POPs have lengthy half-lives, poor biodegradation rates, and the capacity to bio-accumulate in living tissue. Large concentrations of pesticides can contaminate the entire food chain when they accumulate in food sources. Humans are extremely concerned about food safety. To lessen the risk to human health from pesticide residue and its metabolites, careful handling and use must be used to limit human exposure and contact, especially through the food chain. Pesticides are intentionally released into the environment through agricultural practices and environmental cleanliness, in contrast to other pollutants. Despite the use of Good Agricultural Practices (GAP), some crops produced on pesticide-treated soils may contain residual levels of the pesticides or their metabolite(s). Organochlorine and organophosphate pesticides, such as dichlorodiphenyltrichloroethane (DDT), glyphosate, and methoxychlor, in particular, adsorb heavily to soils and have a high potential to remain unavailable to microorganisms for biodegradation. In addition, regular pesticide use can result in chemical overload on agricultural soils and, as a result, the plant's uptake of the pesticides under favorable conditions. Additionally, pesticide leachate finds its way into groundwater or other bodies of water, posing a serious risk to aquatic life, animals, and people who consume it. According to the World Health Organization, three million farmers in developing countries are thought to be acutely poisoned by pesticides each year, resulting in 18,000 deaths. Numerous studies have been done that indicate pesticide exposure may raise the likelihood of developing diseases including Parkinson's disease, cancer, and male infertility, to name a few. Organochlorines, organophosphates, and carbamates, as well as other insecticides and herbicides, have been linked in a small number of research on pesticide exposure and the risk of Parkinson's disease. Organochlorine insecticides, such as beta-hexachlorohexane (-HCH), are neurotoxic, create oxidative stress, and harm the brain's dopaminergic system, according to animal toxicological tests. Human exposure to Pesticides can cause human fecundity and affect the intelligence quotient causing many human and animal disorders. Additional research has demonstrated a connection between Parkinson's and Alzheimer's disease and exposure to HCH. More specifically, multiple case-control studies have found an association between pesticide exposure and an elevated incidence of Parkinson's disease. Reports have described Parkinson's disease in people exposed to organophosphates, paraquat, diquat, maneb, and other ethylene bisdithiocarbamates in addition to

analytical investigations. Compared to individuals with other neurological disorders, Parkinson's disease patients' post-mortem brains have higher levels of organochlorine residues, particularly dieldrin. Because they might change how hormone systems work and have negative health consequences on people, some pesticides are considered to be endocrine disruptors. By imitating the actions of natural hormones, preventing their normal function, or interfering with the biosynthesis or removal of hormones, they lead to toxicity. The effects of oestrogen can be mimicked by several substances, including pesticides and organic plant products. Endocrine imbalance frequently causes cancer, infertility, reproductive problems, and sexual abnormalities. More specifically, genital abnormalities, testicular cancer, and some types of worse sperm quality can occur at an early age or even when the fetus is still developing. Although pesticides have played a significant role in the expansion of agriculture worldwide, they frequently affect species other than those they are intended to kill. Organophosphate and organochlorine pesticides, for instance, can affect neurological systems by damaging neurotransmitting enzymes and can be consumed by a variety of species [7,8].

CONCLUSION

Pesticide production has continually increased over the years because of higher agricultural activities taking new shapes and dimensions with the sole aim of feeding ever increasing world population. Although, some pesticides have been banned for their toxicity yet in circulation for their cost-effective implications. The use of pesticides ignorantly has resulted in their entry into the food chain and consequently into the consumers of such products. Having in mind that there are attendant health challenges resulting from their consumption, it is, therefore, necessary to take caution on the usage and consumption of contaminated products.

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