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Assessment of Pesticide Residues in some Selected Plants in Billliri and Kaltungo Local Government Area, Gombe State, Nigeria

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ABSTRACT

The study aimed to assess pesticide residues in selected plants in the Billiri and Kaltungo local government areas of Gombe State, Nigeria. Parts of the selected plants, namely *Acacia nilotica*, *Piliostigma reticulatum*, and *Calotropis procera* were randomly collected, including leaves, stem bark, and roots. These plant parts were washed with tap water and de-ionized water to remove air pollutants, then oven-dried at 105°C to eliminate moisture. The dried samples were pulverized using an agate pestle and mortar and sieved through a 0.5 mm mesh to obtain a uniform particle size. Pesticide residues were determined using gas chromatography (GC). Fourteen organochlorine pesticide residues were detected, including Delta-Lindane, Alpha-Lindane, Gamma-Lindane, Heptachlor, Aldrin, Heptachlor Epoxide, Endosulfan I, P,P-DDE, Endrin, Endosulfan II, P,P-DDD, P,P-DDT, and Methoxychlor. Based on the results from all locations, the lowest concentrations were below the maximum residue limit as per FAO/WHO guidelines, which range from 0.001 to 0.5 ppm. The highest concentrations of organochlorine pesticide residues reported in this study may be attributed to environmental pollution and pesticide use, consistent with the mean values reported in soils from Numan LGA in Adamawa State, Nigeria. In the intricate tapestry of modern agriculture, the assessment of organochlorine pesticide residues in the distinct agroecological locales of Billiri and Kaltungo Local Government Areas unravels a compelling narrative of historical legacies, environmental intricacies, and imperatives for change.

Keywords: Pesticide residues, Organochlorine pesticides, *Acacia nilotica*, *Piliostigma reticulatum*, *Calotropis procera*, Environmental pollution and Gas chromatography (GC)

INTRODUCTION

Usage of pesticide has increased significantly during the last three decades consequent with changes in farming practices and the increasing intensive agriculture. This extensive use of pesticides has resulted in the presence of their residues in various environmental matrices, especially foodstuff proving high risk of these chemicals to human health and the environment [1] and [2]. According to [3], [4] and [5], vegetable farmers in Nigeria uses a wide range of pesticides at different levels to reduce losses from pest and diseases. However, despite the contribution of pesticide to agricultural production, evidences in other studies showed presence of pesticide residues that could be harmful to human health and the ecosystems in general. Most of the crops and vegetables are consumed in the communities where they are also cultivated and sold in the open markets if not exported to other several part of the nation [6]. When pesticides are applied to destroy pests and pathogens, only 15% of the applied amount hits the target, with the remaining 85% being distributed in soils, air and water.

Moreover, the improper implementations of hazardous chemicals and pesticide regulations and lack of awareness on technical knowhow among the farming communities leaves most of the pesticides active ingredients in plants and soil [7], [8] and [9]. It is an established fact that pesticides and some of their metabolites can cause harm to human and the environment [10]. It is therefore necessary to study the levels of pesticides in environments where they are used in different activities. Such a study should raise awareness of the potential threats of pesticides [11]. To avoid health hazards as a result of the indirect consumption of insecticides and/or their metabolites, it is important to study the XCD levels of these chemicals in food chains as well. Moreover, it is actually an illegal practice to import harmful chemicals including pesticides without an approval by the government [12] and [13]. However, illegal importation of pesticides is a common practice in Nigeria, but the government does not regulate the influx of these chemicals to avoid jeopardizing with the food security [14], [15], [16]. Human exposure to pesticides through food, water and handling could have a negative impact on the health of people. This cannot be regulated effectively if the level at which this occurs is not known. [17] and [18]. A pesticide is any substance used to kill, repel or control certain forms of plant or animal life that are considered to be pests. Pesticides include herbicides for destroying weeds and other unwanted vegetation, insecticides for controlling a wide variety of insects, [19] fungicides used for prevent the growth of molds and mildew, disinfectants for preventing the spread of bacteria and compounds used to control mice and rats [20], [21], [22]. [23], Pests contribute significantly to food losses and the control of pests is very central to the attainment of food security at all levels. The growing demands to enhance good productivity to meet the challenge of the world populations have led to different methods or ways of agricultural technology in which pesticide play a crucial role [19]. Pesticides are extensively used to increase agricultural products by preventing, controlling or lessening the damage caused by pests. Because of the widespread use of agricultural chemicals in food production people are exposed to pesticide residues through their foods and water [24] and [25].

MATERIALS AND METHODS

Sample Area

Billiri is a Local Government Area of Gombe State, Nigeria. Its headquarters are in the town of Billiri in the northeast of the area on the A345 highway. It is situated at 9°51′53″N 11°13′31″E coordinates. It has an area of 737 km² and a population of 202,144 at the 2006 census. Kaltungo is one among the 11 Local Governments Area of Gombe State, Nigeria. Its headquarters is in the town of Kaltungo in the western part of the Local Government Area on the A345 highway at 9°48′51″N 11°18′32″E. It has a landmark area of 881 km² and a population of 149,805 according to 2006 census.

Plant Sampling /preparation

Approximately 1 kg of each part (leaves, stem Burk and root) of the selected plants namely ***Acacia Nilotica, Piliostigma reticulatum, and Calotropis procera*** were collected randomly in different areas of Biliri and Kaltungo LGAs. The plants' parts was washed with tap water and de-ionized water to remove air pollutants, followed by oven drying at 105 °C to remove moisture. The dried samples was pulverized, using pestle and mortar, followed by sieving through a 0.5 mm mesh size sieve to obtain a uniform particle size. Each selected plant's part sample were labelled and stored in a dry plastic container that had been pre-cleaned with concentrated nitric acid to prevent heavy metal contamination prior to analysis [23].

Extraction of Pesticides Residues/analysis

Pesticide residues was extracted following the method described by AOAC. Ten grams (10 g) of sample was mixed with 60 g of anhydrous sodium sulphate in an agate mortar to absorb moisture. The homogenate was transferred into a 500 mL beaker, and the extraction was carried out with 300 mL of n–hexane for 24 h. The crude extract obtained was concentrated using a rotary vacuum evaporator at 40 °C to dryness. The sample residue (1 mL) was measured into 50 mL of chloroform and transferred to a 100 mL volumetric flask and diluted. Most of the chloroform were evaporated at room temperature before adding 1 mL of the solvent mixture (20% benzene and 55% methanol). The mixture was sealed and heated at 40 °C using a water bath for 10 min. After heating, the organic sample were extracted with n–hexane and water in a proportion of 1:1. The mixture were shaken

vigorously for 2 min, and n-hexane phase were transferred onto a small test tube for injection into a Gas Chromatograph (GC) for analysis. Overall, the GC enabled the identification of pesticide residues, which were recorded in mg/kg. The initial injection temperature at the nozzle were maintained at 70°C for 5minutes, and increased and maintained for 10 minutes at 310°C and at 100°C/minute. The initial temperature at the oven were maintained at 70°C during 4 minutes, then increased to 150°C at 50°C/minute, then to 235°C with 3°C/minute at last maintained for 3 minutes at 300°C with 50°C/minute.

RESULTS AND DISCUSSION

Organochlorine pesticides in plant samples

The concentrations of organochlorine pesticides measured in the plant samples from Billiri and Kaltungo were presented in Figures 1- 6 below. Plants samples analysed showed the presence of the fourteen (14) organochlorine pesticides namely Delta Lindane, Alpha Lindane, Beta Lindane, Gamma Lindane, Heptachlor, Aldrin, Heptachlor epoxide, Endosulfan I., P,P' – DDE, Endrin, Endosulfan II, P,P' – DDD, P,P' – DDT and Methoxyclor.

Organochlorine pesticides in root and stem bark of Tamarindus Indica from Billiri

The concentrations of the organochlorine pesticide residues are presented in Figure 1 shows the observed pesticides as concentration occurrences in Farm A and Field B from Billiri.

Presence of Lindane compounds

The concentration of lindane (Delta, alpha and gamma lindanes) was detected in all the roots and stem of tamarind. The highest concentration of Delta Lindane was found in roots of tamarind from farm B (21.02 ppm), this is therefore the most polluted location in the study area, followed by the same root sample from farm A (17.07 ppm), followed by stem bark from farm B (13.04 ppm) and stem bark from A (7.74 ppm). Similarly, high concentration of Alpha Lindane was found in roots of *Tamarindus Indica* from farm B (1.03 ppm), this is therefore the most polluted location in the study area, followed by the stem bark from farm A (0.48 ppm), followed by stem bark from farm B (0.37 ppm) and root from A (0.04 ppm). The highest concentration of Gamma Lindane was found in roots of tamarind from farm A (0.29 ppm), followed by the same roots from farm B (0.23 ppm), followed by stem bark from farm A (0.08 ppm) and stem bark from B (0.06 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the soil samples analysed, with low concentrations. A concentration of 0.01 ppm was recorded for Heptachlor in all the root and stem bark samples from at farm A and B. For Heptachlor epoxide, a concentration 0.02 ppm was recorded in roots sample from farm A and B. However, a concentration of 0.06 ppm and 0.05 were recorded in stem barks from farm A and B respectively. The solubility of these pesticides is very low and their contribution is low.

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Root sample from farm B recorded the highest aldrin levels (31.77 ppm), followed by root sample from farm A (24.90 ppm), then stem bark from farm B (19.11 ppm) and stem bark from farm A (14.95 ppm). Endrin concentrations were highest in root from farm B (2.02 ppm), followed by stem bark from farm A (0.43), stem bark from farm B (0.33 ppm) and root from farm A (0.03 ppm).

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. A concentration of 0.01 p,p'-DDE was recorded in all the samples farm A and B. However, the highest concentration of p,p'-DDD was recorded in root farm A (0.07 ppm), followed by root from farm B (0.06 ppm), stem bark from farm A (0.02 ppm) and stem bark from farm B (0.01 ppm). The highest value of p,p'-DDT was recorded in root from farm A (0.02 ppm), whereas root from farm B and stem bark from farm A an equal trend of DDT distribution (0.01 ppm) Contrariwise, stem bark from farm B recorded zero concentration of p,p'-DDT. The the following order: *p,p′*-DDD > *p,p′*- DDT > *p,p′*-DDE. The concentrations of DDT reported in this study were higher than the mean values of reported in soils from Numan LGA in Adamawa State, Nigeria [26].

Endosulfan I and II.

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Root samples from farm A recorded the highest concentration of endosulfan I (12.10 ppm), followed by root from farm B (10.61 ppm), stem bark from farm A (6.75 ppm) and stem bark from farm B (5.19 ppm). Similarly, the endosulfan II concentrations followed the same trend. Root sample from farm A recorded the highest accumulation (1.19 ppm), followed by root from farm B (1.15 ppm), stem bark farm B (0.37 ppm) and stem from farm A (0.36 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Root from farm A recorded the highest methoxychlor concentration of 0.22 ppm. However, a concentration of 0.02 ppm was recorded in root from farm B, stem bark from farm A and B. The presence of methoxychlor residues raises concerns about potential ecological and health impacts. Methoxychlor, although considered a less persistent alternative to some other organochlorine pesticides, can still pose risks due to its toxic properties and potential for bioaccumulation [14].

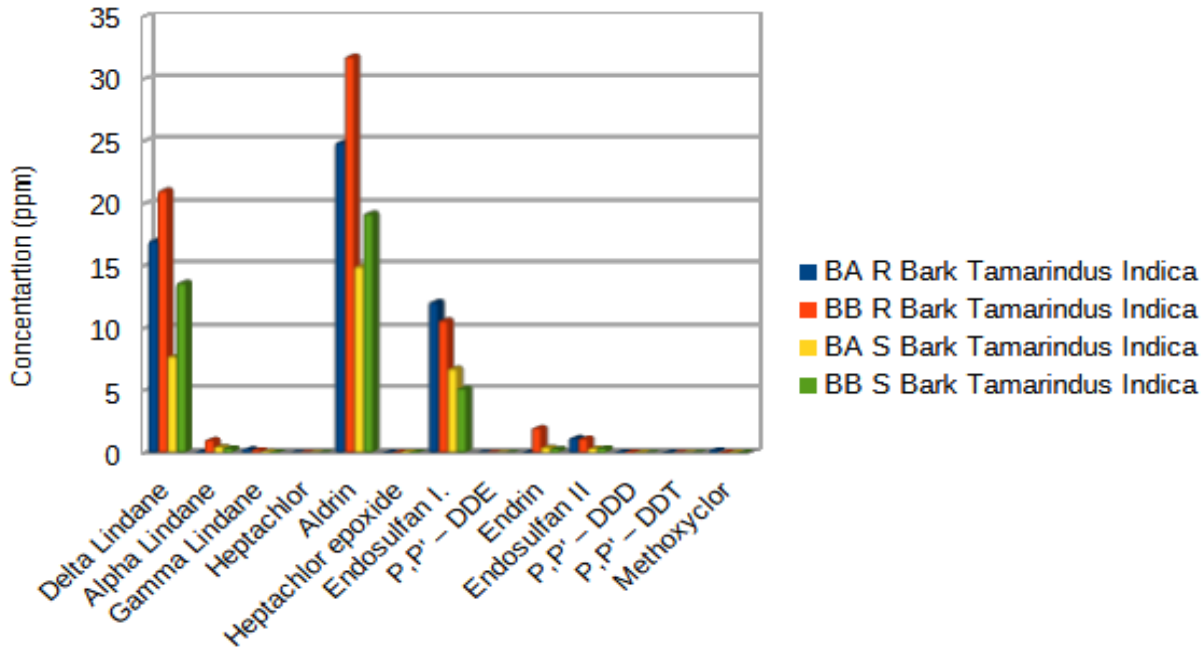

Figure 1: Concentration of organochlorine residues level in root and stem barks of *Tamarindus Indica* grown in farm A and B from Billiri LGA of Gombe State.

Organochlorine pesticides in root and stem bark of Tamarindus Indica from Kaltungo

The concentrations of the organochlorine pesticide residues are presented in Figure 2 shows the observed pesticides as concentration occurrences in Farm A and Field B from Kaltungo.

Lindane compounds

The concentration of lindane (Delta, alpha, beta and gamma lindanes) was detected in all the roots and stem of tamarind. The highest concentration of Delta Lindane was found in stem bark from farm A (0.18 ppm), followed by the root sample from farm A (0.12 ppm), followed by stem bark from farm B (0.07 ppm) and root from B (0.05 ppm). The highest concentration of Alpha Lindane was recorded in stem bark from farm B (0.35 ppm), followed by the stem bark from farm A (0.29 ppm), followed by root from farm A and B with 0.15 ppm each. The highest concentration of beta Lindane was found in root from farm B (1.24 ppm), followed by the stem bark from farm B (0.23 ppm), followed by stem bark from farm A (0.12 ppm) and root from A (0.11 ppm). However, the highest concentration of Gamma Lindane was found in roots from farm B (0.58 ppm),

followed by the same roots from farm A and B (0.13 ppm), followed by root from farm A (0.07 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the root and stem bark samples analysed, with low concentrations. Stem bark from farm A has the highest concentration of 0.08 ppm for Heptachlor, followed by stem and root bark from farm B with a concentration of 0.05 ppm each and root from farm A with a concentration of 0.04 ppm.in all the root and stem bark samples from at farm A and B. For Heptachlor epoxide, the highest concentration 0.11 ppm was recorded in stem bark from farm A, followed by root from farm B (0.08 ppm), stem bark from B (0.06 ppm) and root from farm A (0.01 ppm).

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Root sample from farm A recorded the highest aldrin levels (5.11 ppm), followed by root sample from farm B (2.57 ppm), then stem bark from farm B (3.09 ppm) and stem bark from farm A (0.56 ppm). Endrin concentrations were highest in stem bark from farm B (3.68 ppm), followed by stem bark from farm A (2.27), root from farm B (1.11 ppm) and root from farm A (0.42 ppm).

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. The highest concentration of p,p'-DDE was recorded in stem bark farm B (0.14 ppm), followed by stem bark from farm B (0.03 ppm), root from farm B (0.02 ppm) and root from farm A (0.01 ppm). However, the highest concentration of p,p'-DDD was recorded in stem bark from farm A (0.11 ppm), whereas root from farm B (0.08 ppm), root from farm A (0.09 ppm) and stem bark from farm B (0.05 ppm). The highest value of p,p'-DDT was recorded in stem bark from farm A (0.21 ppm), whereas root from farm A (0.09 ppm), stem bark from farm B (0.08 ppm) and root from farm B (0.02 ppm). The following order: *p,p'*-DDT > *p,p'*- DDE > *p,p'*-DDD. The concentrations of DDT reported in this study were in agreement with the mean values of reported in soils from Numan LGA in Adamawa State, Nigeria [26].

Endosulfan I and II.

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Stem bark from farm A recorded the highest concentration of endosulfan I (3.18 ppm), followed by stem bark from farm B (1.39 ppm), root bark from farm B (0.71 ppm) and root bark from farm A (0.05 ppm). Root sample from farm B recorded the highest concentration of endosulfan II (6.04 ppm), followed by root from farm A (5.03 ppm), stem bark farm B (3.66 ppm) and stem from farm A (0.19 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Root from farm A recorded the highest methoxychlor concentration of 0.13 ppm, followed by stem bark from farm A (0.09 ppm). However, a concentration of 0.06 ppm was recorded in root from farm B and stem bark from farm B.

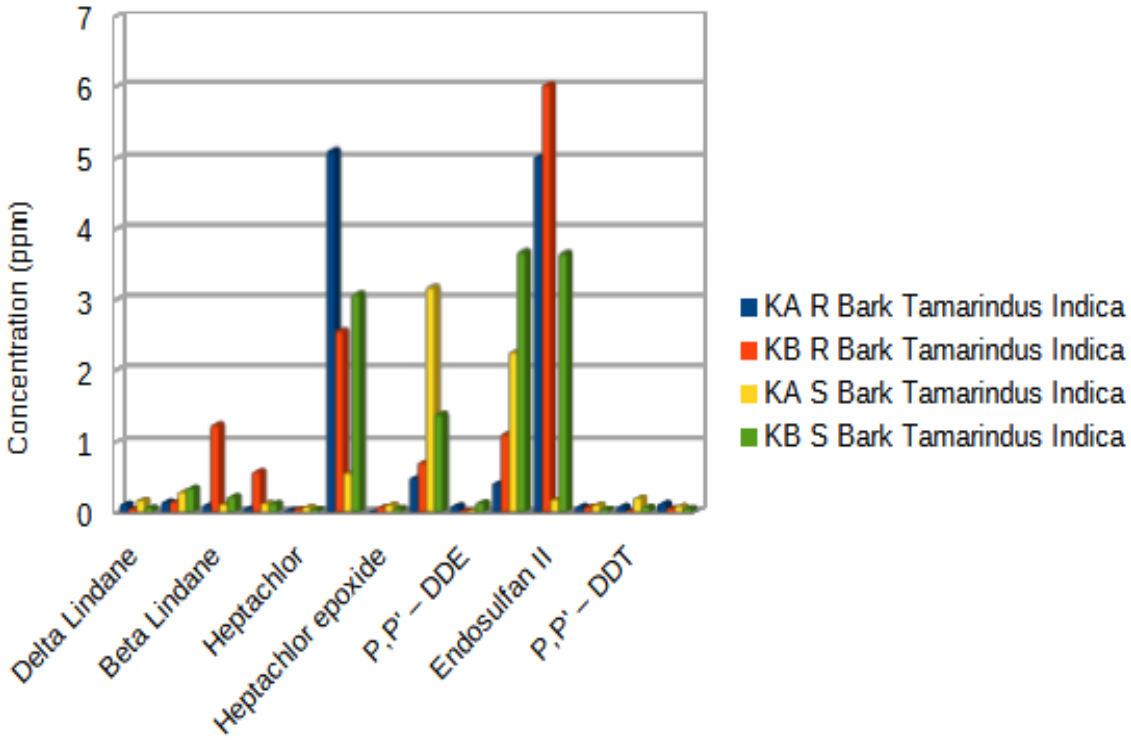

Figure 2: Concentration of organochlorine residues level in root and stem barks of *Tamarind*us *Indica* grown in farm A and B from Kaltungo LGA of Gombe State.

Organochlorine pesticides in root and stem bark of Parkia Biglobosa from Billiri

The concentrations of the organochlorine pesticide residues are presented in Figure 3 shows the observed pesticides as concentration occurrences in Farm A and Field B from Billiri.

Presence of Lindane compounds

The concentration of lindane (Delta, alpha and gamma lindanes) was detected in all the roots and stem of tamarind. The highest concentration of Delta Lindane was found in root bark from farm A (0.68 ppm), followed by the stem bark from farm A and B (0.29 ppm each), and root bark from farm B (0.01 ppm). The highest concentration of Alpha Lindane was recorded in stem bark from farm A and B (12.58 ppm each), followed by the root bark from farm A (7.54 ppm), followed by root from farm A (1.24 ppm). Similarly, the highest concentration of Gamma Lindane was found in stem bark from farm A and B (0.9 ppm each), followed by the same roots from farm A (0.07 ppm) and root from farm B (0.04 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the root and stem bark samples analysed, with low concentrations. Root bark from farm B has the highest concentration of 0.08 ppm for Heptachlor, while stem bark from A, B and root bark from farm A has the same concentration with a value of 0.01 ppm each. For Heptachlor epoxide, the highest concentration 18.13 ppm was recorded in stem bark from farm A and B each, followed by root from farm A (11.89 ppm), and root from farm B (0.04 ppm).

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Root bark from farm A recorded the highest aldrin levels (17.59 ppm), followed by root bark from farm B (0.79 ppm), then stem bark from farm A and B with the same value of 0.24 ppm. Endrin concentrations were highest in root bark from farm A (214.75 ppm), followed by stem bark from farm A (202.85), stem bark from farm B (0.08 ppm) and root from farm B (0.06 ppm).

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. The highest concentration of p,p'-DDE was recorded in root bark farm B (0.02 ppm), while the following root bark from farm A. stem bark from farm A and B recorded the same concentration of 0.01 ppm. However, the highest concentration of p,p'-DDD was recorded in root bark from farm A (1.54 ppm), followed by stem bark from farm A and B (0.44 ppm each) and root from farm B (0.03 ppm). The highest value of p,p'-DDT was recorded in stem bark from farm A and B (0.08 ppm each), followed by root from farm A (0.03 ppm) and root from farm B (0.01 ppm). The following order: *p,p'*-DDD > *p,p'*- DDT > *p,p'*-DDE. The concentrations of DDT reported in this study were in agreement with the mean values of reported in soils from Numan LGA in Adamawa State, Nigeria [26].

Endosulfan I and II

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Root bark from farm A recorded the highest concentration of endosulfan I (6.26 ppm), followed by stem bark from farm A and B (4.94 ppm each), and root bark from farm B (0.69 ppm). Root sample from farm A recorded the highest concentration of endosulfan II (0.98 ppm), followed by stem bark from farm A and B (0.59 ppm) and root bark from farm B (0.04 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Root from farm A recorded the highest methoxychlor concentration of 0.15 ppm, followed by root bark from farm B (0.08 ppm). However, a concentration of 0.02 ppm was recorded in stem bark from farm A and B each.

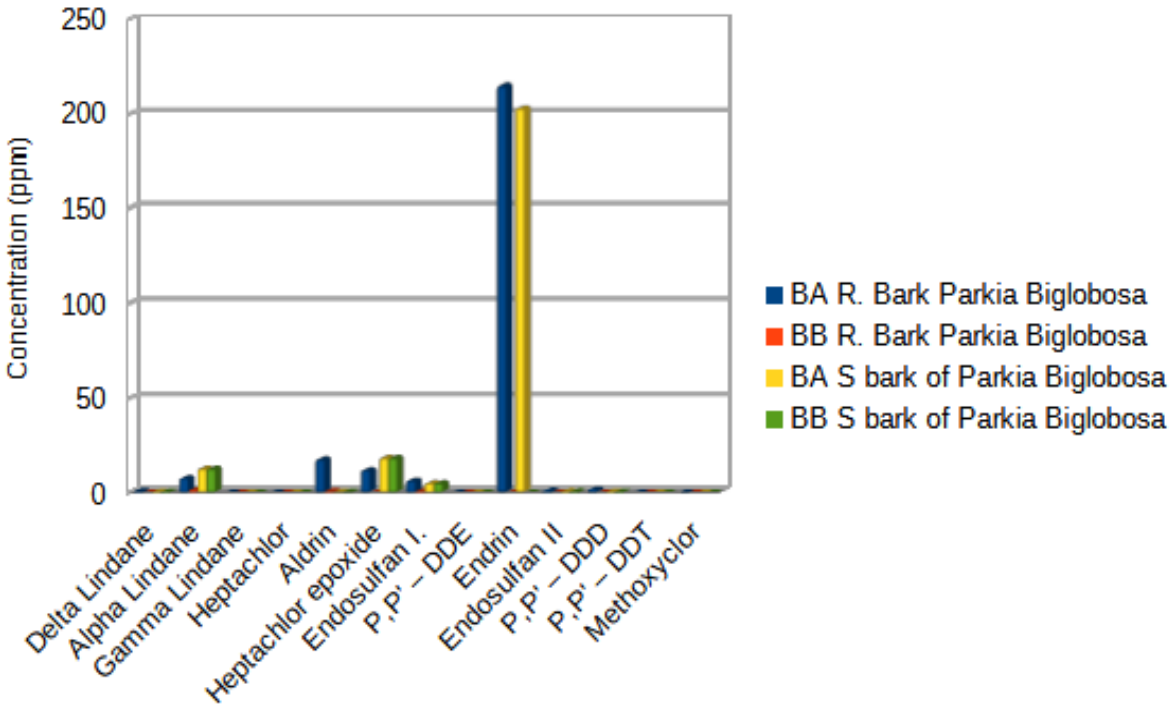

Figure 3: Concentration of organochlorine residues level in root and stem barks of *Parkia biglobosa* grown in farm A and B from Billiri LGA of Gombe State.

Organochlorine pesticides in root and stem bark of *Parkia biglobosa* from Kaltungo

The concentrations of the organochlorine pesticide residues are presented in Figure 4 shows the observed pesticides as concentration occurrences in Farm A and Field B from Kaltungo.

Presence of Lindane compounds

The concentration of lindane (Delta, alpha and gamma lindanes) was detected in all the roots and stem of tamarind. The highest concentration of Delta Lindane was found in root bark from farm A (8.2 ppm), followed by the root bark from farm B (0.5 ppm), root bark from farm A and B (0.01 ppm). The highest concentration of Alpha Lindane was recorded in root bark from farm B (5.8 ppm), followed by the root bark from farm A (4.74 ppm), followed by stem bark from farm A (1.97 ppm) and stem bark from farm B (1.52 ppm). The highest concentration of Gamma Lindane was recorded in root bark from farm A (0.96 ppm), followed by the stem bark from farm A (0.21 ppm), stembark from farm B (0.16 ppm) and root from farm B (0.06 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the root and stem bark samples analysed. Root bark from farm A has the highest concentration of Heptachlor (32.85 ppm), followed by stem bark from A (0.03 ppm) and stem bark from farm B (0.02 ppm). However, no concentration has been recorded in root bark from farm B. For Heptachlor epoxide, the highest concentration 78.09 ppm was recorded in root bark from farm A, followed by root from farm B (9.41 ppm), stem bark from farm A (3.68 ppm) and stem bark from farm B (2.83 ppm).

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Root bark from farm B recorded the highest aldrin levels (172.76 ppm), followed by stem bark from farm A (60.06 ppm), stem bark from farm B (46.2 ppm) and root bark from farm A (10.33 ppm). Endrin concentrations were highest in root bark from farm B (156.02 ppm), followed by root bark from farm A (120.41 ppm), stem bark from farm B (92.63 ppm) and stem bark from farm A (90.41 ppm).

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. The highest concentration of p,p'-DDE was recorded in root bark farm A (152.96 ppm), followed by the stem bark from farm A (0.02 ppm). Root bark from farm A and B recorded the same concentration of 0.01 ppm. However, the highest concentration of p,p'-DDD was recorded in stem bark from farm A (2.41 ppm), followed by stem bark from farm B (1.85 ppm), and root from farm B (0.76 ppm) and root bark from farm A (0.02 ppm). The highest value of p,p'-DDT was recorded in root bark from farm A (0.05 ppm), followed by stem bark from farm A (0.04 ppm), stem bark from farm B (0.03 00m) and root from farm B (0.02 ppm). The following order: *p,p′*-DDE > *p,p′*-DDD > *p,p′*-DDT.

Endosulfan I and II.

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Stem bark from farm A recorded the highest concentration of endosulfan I (22.99 ppm), followed by root bark from farm B (17.81 ppm), stem bark from farm B (4.68 ppm) and root bark from farm A (3.16 ppm). For endosulfan II, the root bark from farm B recorded the highest concentration (14.18 ppm), followed by stem bark from farm A (9.74 ppm), stem bark from farm B (7.49 ppm) and root bark from farm A (1.73 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Stem from farm A recorded the highest methoxychlor concentration of 0.13 ppm, followed by root bark from farm B (0.12 ppm), root bark from farm A (0.09 ppm) and stem bark from farm B (0.01 ppm).

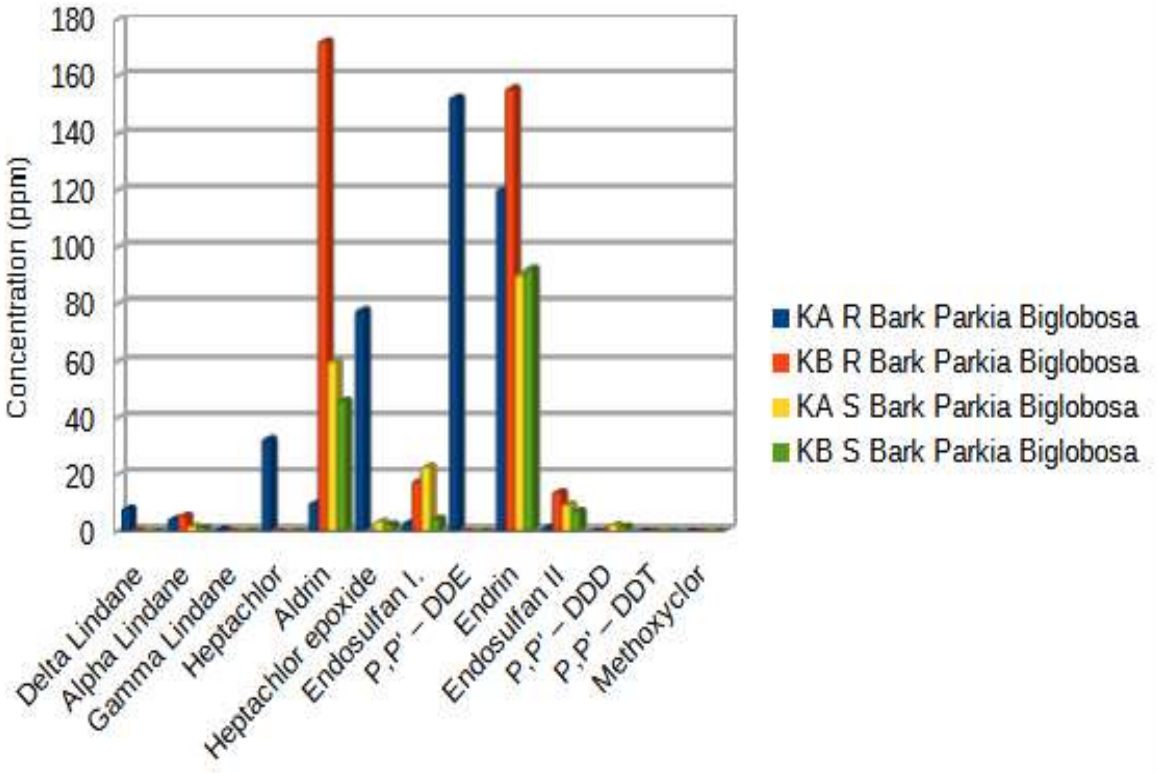

Figure 4: Concentration of organochlorine residues level in root and stem barks of *Parkia Biglobosa* grown in farm A and B from Kaltingo LGA of Gombe State.

Organochlorine pesticides in root and stem bark of *Balanites aegyptiaca* from Billiri

The concentrations of the organochlorine pesticide residues are presented in Figure 5 shows the observed pesticides as concentration occurrences in Farm A and Field B from Billiri.

Presence of Lindane compounds

The concentration of lindane (Delta, alpha, and gamma lindanes) was detected in all the roots and stem of tamarind. For delta lindane, a concentration of 0.01 ppm was found in all the samples. The highest concentration of alpha lindane was recorded in root bark from farm B (3.04 ppm), followed by the stem bark from farm A (1.65 ppm), followed by stem bark from farm B (1.27 ppm) and root bark from farm A (0.05 ppm). However, the highest concentration of gamma lindane was found in stem bark from farm A (0.09 ppm), followed by stem bark from farm B (0.07 ppm), followed by root bark from farm A (0.03 ppm) and root bark from farm B (0.02 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the root and stem bark samples analysed, with low concentrations. Stem bark from farm A and B recorded the same concentration of 0.01 ppm for Heptachlor whereas root bark from farm A and B with no concentration recorded. Similarly, for Heptachlor epoxide, stem bark from farm A and B recorded the same concentration of 0.02 ppm while root bark from farm A and B recorded the same concentration of 0.01 ppm.

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Root sample from farm B recorded the highest aldrin levels (22.85 ppm), followed by stem bark sample from farm A (17.5 ppm), stem bark from farm B (13.46 ppm) and root bark from farm A (3.71 ppm). Endrin concentrations were highest in stem bark from farm A (0.45 ppm), followed by stem bark from farm B (0.35 ppm). The root bark from farm A and B recorded the same concentration of 0.02 ppm.

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. The concentration of p,p'-DDE recorded has shown that the root bark from farm A and B and stem bark farm A and B have the same value of 0.01 ppm. However, the highest concentration of p,p'-DDD was recorded in root bark from farm B (2.02 ppm), followed by stem bark from farm A (0.22 ppm), stem bark from farm B (0.17 ppm) and root bark from farm A (0.02 ppm). Similarly, the highest value of p,p'-DDT was recorded in root bark from farm B (0.51 ppm), followed by Stem bark from farm A (0.04 ppm), stem bark from farm B (0.03 ppm) and root from farm A (0.02 ppm). The following order: *p,p'*-DDD > *p,p'*-DDT > *p,p'*-DDE.

Endosulfan I and II

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Root bark from farm B recorded the highest concentration of endosulfan I (4.16 ppm), followed by stem bark from farm A (2.58 ppm), stem bark from farm B (1.99 ppm) and root bark from farm A (1.51 ppm). Similar trend was observed for endosulfan II where the root sample from farm B recorded the highest concentration of (3.04 ppm), followed by stem bark from farm A (2.52 ppm), stem bark farm B (1.94 ppm) and root bark from farm A (0.05 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Root from farm B recorded the highest methoxychlor concentration of 1.02 ppm, followed by stem bark from farm A (0.77 ppm), stem bark from farm B (0.59 ppm) and root from farm A (0.02 ppm).

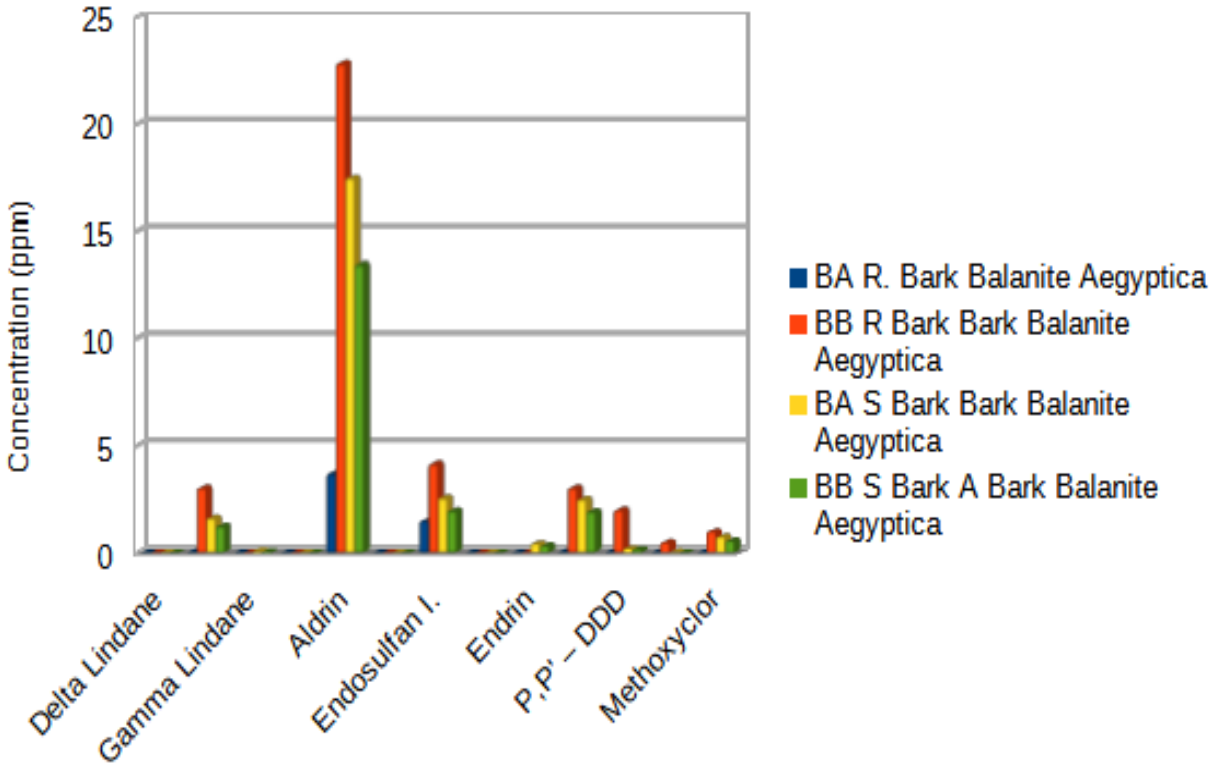

Figure 5: Concentration of organochlorine residues level in root bark and stem bark of *Balanites aegyptiaca* grown in farm A and B from Billiri LGA of Gombe State.

Organochlorine pesticides in root and stem bark of Balanites aegyptiaca from Kaltungo

The concentrations of the organochlorine pesticide residues are presented in Figure 6 shows the observed pesticides as concentration occurrences in Farm A and Field B from Kaltungo.

Presence of Lindane compounds

The concentration of lindane (Delta, alpha and gamma lindanes) was detected in all the roots and stem of tamarind. The highest concentration of Delta Lindane was found in root bark from farm B (0.22 ppm), followed by the stem bark from farm A (0.13 ppm), stem bark from farm B (0.09 ppm) and root bark from farm A (0.01 ppm). The highest concentration of Alpha Lindane was recorded in root bark from farm B (9.68 ppm), followed by the root bark from farm A (1.24 ppm), followed by stem bark from farm B (0.69 ppm) and stem bark from farm A (0.15 ppm). However, the highest concentration of beta lindane was recorded in stem bark from farm B (0.96 ppm), followed by stem bark from farm A (0.56 ppm) while no concentration was recorded for root bark from both farm A and B. The highest concentration of Gamma Lindane was recorded in stem bark from farm A (0.72 ppm), followed by the stem bark from farm B (0.36 ppm), root bark from farm B (0.07 ppm) and root from farm A (0.04 ppm).

Heptachlor and Heptachlor epoxide

Heptachlor and Heptachlor epoxide were found in all the root and stem bark samples analysed, with low concentrations. Stem bark from farm A recorded the highest concentration (0.06) ppm for Heptachlor, followed root bark from farm A (0.03 ppm), stem bark from farm B (0.02 ppm) and root bark from farm B (0.01 ppm). Contrariwise, for Heptachlor epoxide, root bark from farm B recorded the highest concentration of 13.95 ppm, followed by stem bark from farm B (0.11 ppm) while root bark from farm A and stem bark from farm A recorded the same concentration of 0.04 ppm.

Aldrin and Endrin

Aldrin and dieldrin residues were found in root and stem bark samples in the study area. Stem bark from farm B recorded the highest aldrin levels (5.36 ppm), followed by stem bark sample from farm A (1.78 ppm), root bark from farm A (0.79 ppm) and root bark from farm B (0.19 ppm). Endrin concentrations were highest in root bark from farm B (165.19 ppm), followed by stem bark from farm A (2.75 ppm), stem bark from farm B (1.23 ppm) and root bark from farm A (0.06 ppm).

DDT

p,p'-DDE and p,p'-DDD were detected in all the root and stem bark samples. The highest concentration of p,p'-DDE was recorded in the stem bark from farm B (0.09 ppm), followed by stem bark farm A (0.06 ppm), root bark from farm A (0.02 ppm) and root bark from farm B (0.01 ppm). Similarly, the highest concentration of p,p'-DDD was recorded in root bark from farm B (0.34 ppm), followed by stem bark from farm A (0.06 ppm), stem bark from farm B (0.05 ppm) and root bark from farm A (0.03 ppm). However, the highest value of p,p'-DDT was recorded in stem bark from farm B (0.16 ppm), followed by stem bark from farm A (0.13 ppm), root bark from farm B (0.06 ppm) and root from farm A (0.01 ppm). The following order: *p,p'*-DDD > *p,p'*-DDT > *p,p'*-DDE.

Endosulfan I and II

Endosulfan I residues were identified in all root and stem bark samples, with varying concentrations. Root bark from farm B recorded the highest concentration of endosulfan I (3.80 ppm), followed by stem bark from farm A (1.10 ppm), root bark from farm A (0.69 ppm) and stem bark from farm B (0.6 ppm). However, different trend was observed for endosulfan II where the stem bark from farm A recorded the highest concentration of (4.68 ppm), followed by stem bark from farm B (1.41 ppm), root bark farm B (0.45 ppm) and root bark from farm A (0.04 ppm).

Methoxychlor

Methoxychlor residues were identified in all the root and stem bark samples in the study area. Stem from farm A recorded the highest methoxychlor concentration of 0.17 ppm, followed by root bark from farm A (0.08 ppm), stem bark from farm B (0.07 ppm) and root from farm B (0.02 ppm).

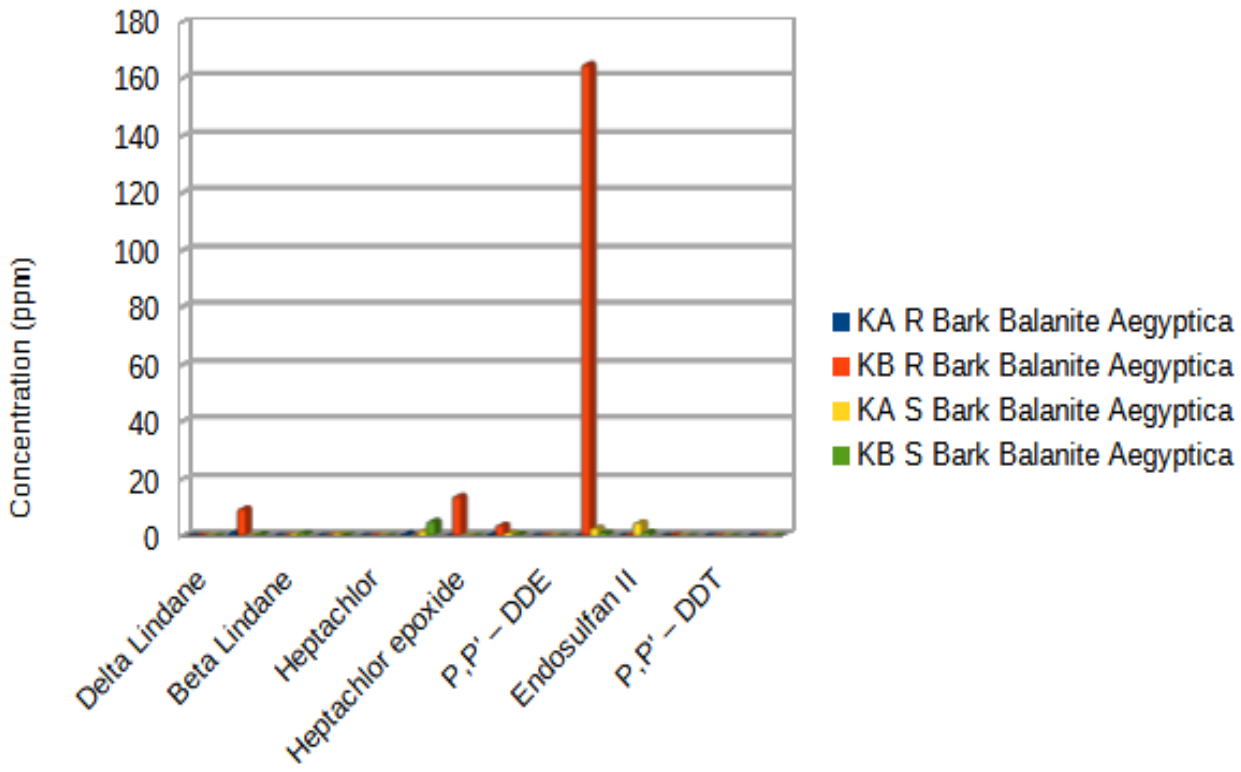

Figure 6: Concentration of organochlorine residues level in root bark and stem bark of *Balanites aegyptiaca* grown in farm A and B from Kaltungo LGA of Gombe State

CONCLUSION

In the intricate tapestry of modern agriculture, the assessment of organochlorine pesticide residues in the distinct agro ecological locales of Biliri, and Kaltungo Local Government Area unravels a compelling narrative of historical legacies, environmental intricacies, and imperatives for change. As the resonance of pesticide applications from yesteryears continues to reverberate through the soil and plants, the multi-dimensional lens employed in this study provides invaluable insights into the relentless interplay between past practices and present dynamics. Aldrin, dieldrin, endosulfan, heptachlor, heptachlor epoxide, dichlorodiphenyltrichloroethane (DDT), and methoxychlor residues persistently weave their presence within the agricultural landscape, serving as a testament to the enduring repercussions of earlier pest management strategies. The intricate contours of residue distribution across soil depths and plant species unveil a narrative of historical use patterns and diverse ecologies, contributing to the intricate mosaic of residue accumulation. The bioaccumulation potential magnifies these concerns, urging us to confront the intricate interplay between pesticide residues, food systems, and human health with unswerving resolve.

REFERENCES

1. Bentum J.K., Essumang DK, Dodoo DK (2016) Lindane and propuxur residues in the top soils of some cocoa growing areas in five districts of the Central Region of Ghana. Bull Chem Soc Ethiop 20(2):193–199. doi:10.4314/bcse.v20i2.21161
2. Kaur K, Kaur R. Occupational pesticide exposure, impaired DNA repair, and diseases. Indian J Occup Environ Med 2018;22:74-81.
3. Dimitri, M. (2017). Assessment of contamination of soil by pesticides . *International Journal of Advanced Engineering Research and Science* , 4,2.
4. Lamberrt, D, Luksch, T, Plant A (2013). Current challenges and trends in the

Discovery of Agrochemical science 341 (6147); 742

5. Markovic, M. (2010). Assessment of Heavy Metal and Pesticide Levels in Soil and Plant. *Journal of Arch Environ Contam Toxicol* , 1,23.
6. Bernardes, M.F.F.; Pazin, M.; Pereira, L.C.; Dorta, D.J. (2015). Impact of Pesticides on Environmental and Human Health. In Toxicology Studies—Cells, Drugs and Environment; Intech Open: London, Pp. 195–233.
7. Aravinna, P.; Priyantha, N.; Pitawala, A.; Yatigammana, S.K.(2018). Use pattern of pesticides and their predicted mobility into shallow groundwater and surface water bodies of paddy lands in Mahaweli river basin in Sri Lanka . Journal on Environ. Sci. and Health ,20, 53, 95.
8. Olayinka A.I. (2013) Levels of organochlorine pesticides (OCP S) residue in selected Cocoa Farms in Ilawe—Ekiti, Ekiti State, Nigeria. Open J Anal Chem Res 1(3):52–58. doi:10.12966/ojacr.11.02.2013
9. Qian, J.; Li, J.; Fang, D.; Yu, Y.; Zhi, J. (2014). A disposable biofilm-modified amperometric biosensor for the sensitive determination of pesticide biotoxicity in water. *Journal on Environmental Pollution*, 4,73–82.
10. UNEP (2010) Green Economy: Developing Countries Success Stories. United Nations Environment Programme. http://www.unep.org/pdf/greeneconomy_successstories.pdf
11. Fosu-Mensah, B.Y. , Okoffo, E.D., Darko, G. and Gordon, C. (2016): Assessment of organochlorine pesticide residues in soils and drinking water sources from cocoa farms in Ghana. Springer Plus, 5:869 DOI 10.1186/s40064-016-2352-9.
12. Hussain, F., Rasool, A., Aziz, K., Raisham, S., Aziz, S., Badshah, L., et al. (2020). Allelopathic inhibition of germination, seedling growth and cell division of selected plant species by *Calotropis procera* (Ait.) Ait. *Plant Sci. Today* 7, 1–8. doi: 10.14719/pst.2020.7.1.606
13. Mazlan, N.; Ahmed, M.; Muharam, F.M.; Alam, M.A. (2017). Status of persistent organic pesticide residues in water and food and their effects on environment and farmers: A comprehensive review in Nigeria. *Journal of natural Science*, 38, 2221–2236.
14. Ozcan, C. (2016): Determination of Organochlorine Pesticides in Some Vegetable Samples Using GC-MS. Pol. J. Environ. Stud. Vol. 25, No. 3, 1141-1147. DOI: 10.15244/pjoes/61627.
15. Marquis S. (2013).Agrochemical use in South Africa: The toxicological and sociological impacts of agrochemicals on susceptible populations in South Africa's agricultural sector. Cape town: Cape Town University Press,Pp.23-25.
16. Adams, R.M.; McAdams, B.C.; Arnold, W.A.; Chin, Y.-P. (2016). Transformation of chlorpyrifos and chlorpyrifos-methyl in prairie pothole pore waters. *Journal on Environ. Sci.*, 18, 1406–1416.
17. Ahmed, A. (2019). Assessment of Pesticide Residues in Some Commonly Cultivated Vegetable in Doma Metropolis, Nasarawa State, Nigeria. *international Journal of Environment, Agriculture and Biotechnology* , 3,12.
18. LOUIS, L.M. (2017). A Prospective Study Of Cancer Risk Among The Agricultural Health Study Farm Spouses Associated With Personal Use Of Organochlorine Insecticides. A thesis Submitted to the School of Graduate Studies Rutgers, The State University of New Jersey.
19. Lamichhane, J.R. (2017) Pesticide Use and Risk Reduction in European Farming Systems with IPM: An Introduction to the Special Issue. Crop Protection, 97, 1-6. https://doi.org/10.1016/j.cropro.2017.01.017
20. Nair RS, Paulmurugan R, Wilsanand V. Genotoxic effects of commonly used pesticides of South India in human lymphocytes. Enivromedia 2005;24:7-12.
21. Marie, L.; Payraudeau, S.; Benoit, G.; Maurice, M.; Gwenaël, I.(2017). Degradation and Transport of the Chiral Herbicide S-Metolachlor at the Catchment Scale: Combining Observation Scales and Analytical Approaches. *Journal of Environmental Science Technology*, 51, 231–240.
22. Alavanja MC, Bonner MR. Occupational pesticide exposures and cancer risk: A review. J Toxicol Environ Health B Crit Rev 2012; 15:238-63.

23. Akan J.C., Mohammed Z.& Adbulrahaman F.I.(2013). Organophorous Pesticide Residues in Vegetable and Soil Samples fromAlau Dam and Gongulong Agricultural Areas, Borno State, Nigeria. *International Journal of Environmental Monitoring and Anlaysis*. 1(2) 58-64.
24. Luo, C.; Huang, Y.; Huang, D.; Liu, M.; Xiong, W.; Guo, Q.; Yang, T. (2018). Migration and Transformation Characteristics of Niclosamide in a Soil–Plant System. *Journal of Soil Science,3*, 2312–232.
25. Yadav AS, Sehrawat G. Evaluation of genetic damage in farmers exposed to pesticide mixtures. Int J Hum Genet 2011; 11:105-9.
26. Mustapha, A.M (2023). Pollution assessment and health risk estimate of communities in the vicinity of savannah sugar company Numan, Numan LGA, Adamawa State. An unpublished thesis submitted to the chemistry department, Modibbo Adama University, Yola.

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