Screening of Persistent Organic Pollutant from Various Surface Water in Yola-North Local Government Area of Adamawa State

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Abstract- The main purpose of this work is to screen for the presence of polychlorinated biphenyl (PCBs) at different areas around Yola-North metropolis. The method adopted was the standard method used by National Agency for Food and Drug Administration and Control (2013). The water samples were collected from Jimeta modern market area, Jambutu area, Shinko/Bye-pass area and Specialist hospital/Luggare areas. The water samples were analyzed by Gas Chromatography using Trichlorobiphenyl and Tetrachlorobiphenyl as the reference standard. The experimental result shows that, Polychlorinated biphenyls were detected at all the specified locations around Yola-North local government area.

Index Terms- PCBs, Persistent organic pollutants, biphenyls

I. INTRODUCTION

Persistent organic pollutants (POPs) are carbon-based chemical compounds. POPs are primarily products and by-products of human industry. As the name suggests, they are persistent in the environment, resisting degradation through natural processes (Tesar, 2000). They have the ability to accumulate through the food web and to be transported long distances. Toxins as pesticides are able to directly kill or alter an organism. All the common pesticides share the property of blocking a vital metabolic process of the organism to which they are toxic (UNEP/GPA, 2001). The most hazardous of these pollutants are known as the "Dirty Dozen." There are three types of persistent organic pollutants. These classifications are based on how the POP enters the environment. They are not the only classifications, but are the most widely used. Insecticides are the first POP classification. Insecticides are purposely spread over the land to kill insects. Most of these were banned in the 70's, but have still been used over the years in third world countries. Because these POPs are still in use, they continue to flow through organisms and the environment from places like Russian to Alaskan villages (World Resource Institute, 2002). Industrial chemicals never intended for dispersal can also leak into the environment. PCBs (polychlorinated biphenyls) are the best-known example; other compounds include polychlorinated naphthalene (PCNs), chloroparaffins and brominated flame-retardants. The PCBs have been gradually banned in many countries (World Resource Institute, 2002). The third category of persistent organic pollutants occurs mainly as by-products of various manufacturing or combustive processes. These include hexachlorobenzene (HCB), polycyclic aromatic hydrocarbons (PAHs) and dioxins. To a limited extent, many of these compounds can also be formed naturally, but their uses for this purpose have declined substantially (World Resource Institute, 2002). Exposure to POPs has also been known to affect vitamin A metabolism. This lack of activity may cause an inclination towards infection and cancer. Another result may be reproductive disorders, skin lesions and disturbance in growth and development (Brouwer et al, 1989). Specific POPs, mainly chlorinated hydrocarbons, can also negatively impact the adrenal gland. The adrenal gland secretes epinephrine, the "fight or flight" hormone necessary to many organisms' survival. If the creatures no longer had this capability, they would be at an extreme disadvantage in their ability to survive (Kuiken et al, 1993). POPs may affect reproductive development through several different avenues. Chemicals such as DDT, specific dioxins and PCBs have the capability to diminish the survival of offspring, decrease fertility and disrupt reproductive function and reproductive cycles (Han & Stone, 2001). If pregnant females are exposed to POPs, then the embryo or fetus mortality rates increase exponentially. Sex hormone levels are abnormal, sperm production is reduced, and total reproductive failure is often imminent (Swain et al, 1992). There has also been evidence that gene expression can be altered, which may indicate that POPs have the ability to detrimentally affect liver function, impede fetal ovarian development, and disrupt carbohydrate, protein and lipid metabolism (Kushtia, 2001). Dioxins and furans are known to reduce the level of testosterone in males. Fetuses exposed to dioxins through the placenta and babies through breast milk exhibit dysfunctional muscle reflexes and hypothalamic/pituitary/thyroid system failure. Infants similarly exposed to HCBs often will contract arthritis, plus will experience acute illnesses and rashes (WFPHA, 2000). The main objective this work is to screen the presence of Tri- and Tetra-chlorobiphenyls in the environment of some Yola North Local Government Area of Adamawa State, Nigeria.

II. EXPERIMENTAL

2.1 SAMPLE COLLECTION

Acquisition of suitably representative samples is fundamental to any environmental measurement studies and should not be overlooked. Contamination during field collection can occur, particularly from PCBs in electrical equipment and building products (e.g., marine paints, joint sealants) or due to

the ongoing use of OCPs. "Clean" techniques need to be adopted, such as the use of special clothing and disposable gloves for sampling, sealed shipping containers, and field blanks. The sample was water from different location of the metropolis of Adamawa State capital and the sampling method used was random method in strategic locations of the metropolis. Screw caps should be lined with solvent-rinsed aluminum foil or Teflon cap inserts. Clear polyethylene bags, and polypropylene jars, are also appropriate for temporary storage but may not be suitable for long-term storage because of the possibility of migration of plasticizers (such as phthalates) into the tissue, especially for samples with high lipid contents, so glass jars with screw were used for sample collection. Samples was wrapped in aluminum foil and then inserted into plastic bags were the glass jar were limited and to reduce sample handling, which in turn reduces the potential for contamination. Freezing and storage of multiple small samples was done for analysis, rather than larger masses, to avoid multiple freezing. For sampling of natural water where PCB concentrations are in the low pg/L range, much larger samples are required. For example, (Achman *et al.*, 2002.) Pumped lake water (~100 L) directly into large-diameter filters (0.7 μm nominal pore size) and then through XAD-2 resin columns. Surrogate standards were added to the resin column prior to extraction. Similar solid-phase extraction approaches are used for sampling and extracting wet precipitation. Care must be taken to prepare and transport the samples under clean conditions.

2.2 SAMPLING AREA

Yola is the capital city and administrative center of Adamawa State, Nigeria. Located on the Benue River, it has a population of 336,648 (2010). Yola is split into two parts, the old town of Yola where the Lamido resides is the traditional city but the new city of Jimeta (about 5 km NW) is the administrative and commercial Centre. The locations of the sampling area are as fellows

(i) The Jimeta modern market area
(ii) Jambutu area
(iii) Bye –pass/ shinko area
(iv) Specialist hospital/ luggare area

The Map of Adamawa State is shown in **Figure I** below

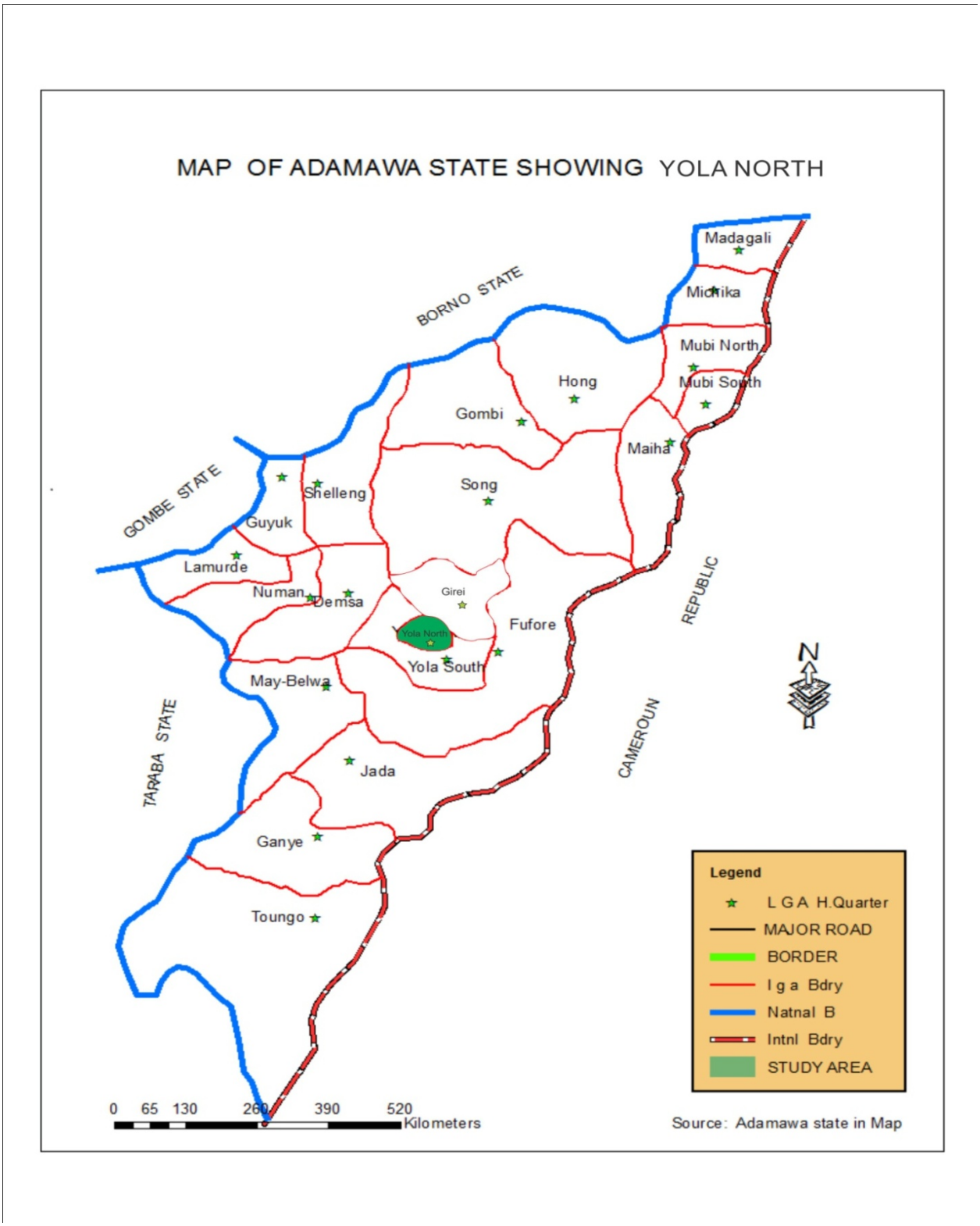

FIGURE I: Map of Adamawa State showing Yola Metropolis

2.3 EXTRACTION

The extraction method by NAFDAC, 2013 was adopted. The principle involves partitioning of pesticide residue into dichloromethane CH_2CL_2. Measured volume of the test portion was extracted with CH_2CL_2 by shaking in a separating funnel. The extract was then collected, dried with anhydrous Na_2SO_4 and solvent exchanged with methyl ter-buthyl ether (MTBE) was carried out on the extract. In this extraction procedure, 250ml of water sample was transferred into separating flask, and then 60ml dichloromethane was also added. The funnel was then covered

and shaken well to allow phase to separate (vent the funnel at intervals to prevent excess pressure build-up), then the funnel was packed with 10g of Na_2SO_4 and pre-wet with 10ml CH_2CL_2 after it has separated. The original phase (lower layer) was drawn through the packed funnel into the 250ml round bottom flask. The extraction was repeated twice with 30ml dichloromethane and passed through the Na_2SO_4 followed by addition of 2-3 drops of propylene glycol to act as a keeper and to evaporate the solvent to near dryness on rotary evaporator at 40^oc. 10ml of acetone was added into the flask and evaporated to near dryness. The procedure was repeated once more by adding 10ml of acetone to the above later step to ensure complete removal of dichloromethane which can interfere with subsequent determinative step. Finally, the final extract was mixed with few mills of hexane and transferred quantitatively to vial and then adjusted to 2mls by gentle evaporating with nitrogen gas. Thus the extract is ready for analysis using the Gas Chromatography (GC).

2.4 INSTRUMENTAL ANALYSIS

The Gas chromatography (GC) analyses were performed on a Varian CP-3800 GC equipped with a CP-8400 auto-sampler and an electron capture detector (ECD). A large volume injector was used (the injection volume was 5 µl) and the temperature program for the injector was: 280 °C, 1.0 min; 25°/min to 150°. Transfer line temp.280°C. A non-polar column, carrier gas hydrogen 5.7ml/min. (CP-SIL 8CB 25 m×0.15 mm×0.12 µm) from Varian, Middleburg, the Netherlands, was used. Helium was used as a carrier gas and nitrogen as the makeup gas. The column oven temperature was programmed from 50 °C, 0.5 min; 15°/min to 300°; hold for 6.5 min. total run time 22 min, column flow 1.0 µl/min (constant flow), injection mode spit less (purge time 0.75)

III. RESULT AND DISCUSSIONS

3.1 The Chromatograms of the samples

Figure II- VI shows the various results (chromatograms) for the samples collected in the five sampling area around Yola. While **Figure V- VIII** represents the chromatogram of the different concentrations of the reference standard used to detects the Persistent Organic Pollutants.

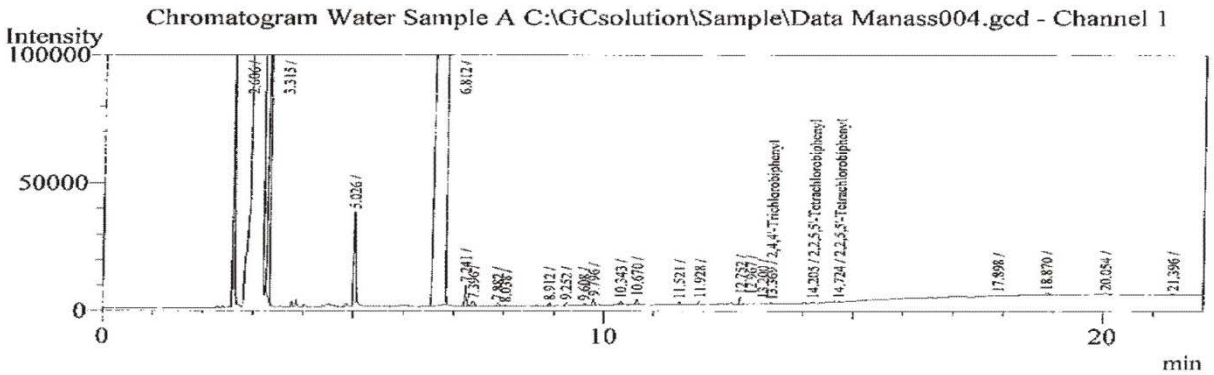

Figure II: Chromatogram of Water from modern market area

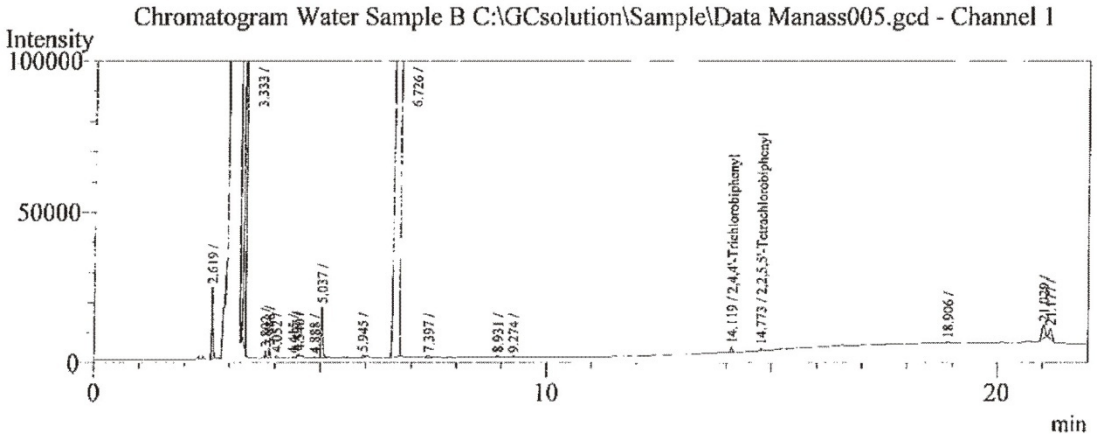

Figure III: Chromatogram of Water from Jamtubu area

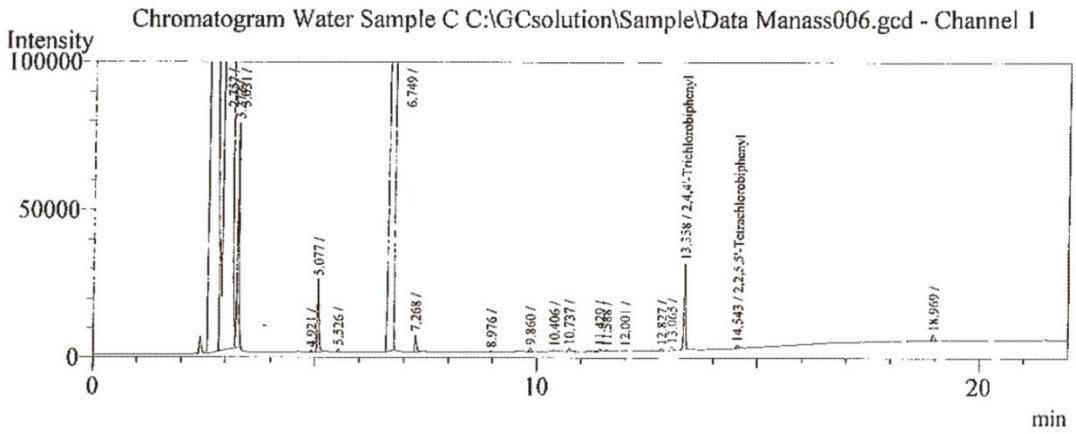

Figure IV: Chromatogram of Water from Bye-pass / Shinko area

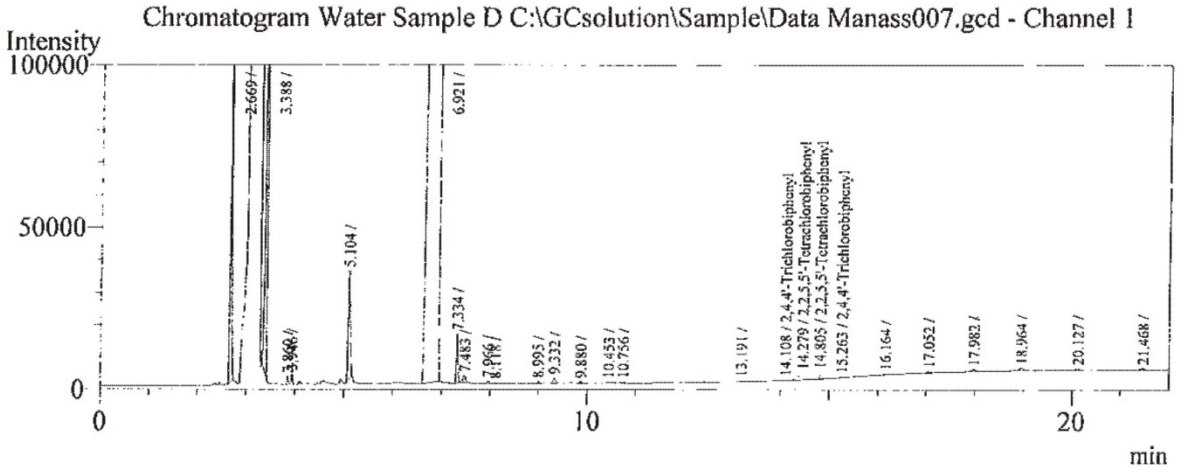

Figure V: Chromatogram of Water from Specialist Hospital / Luggare area

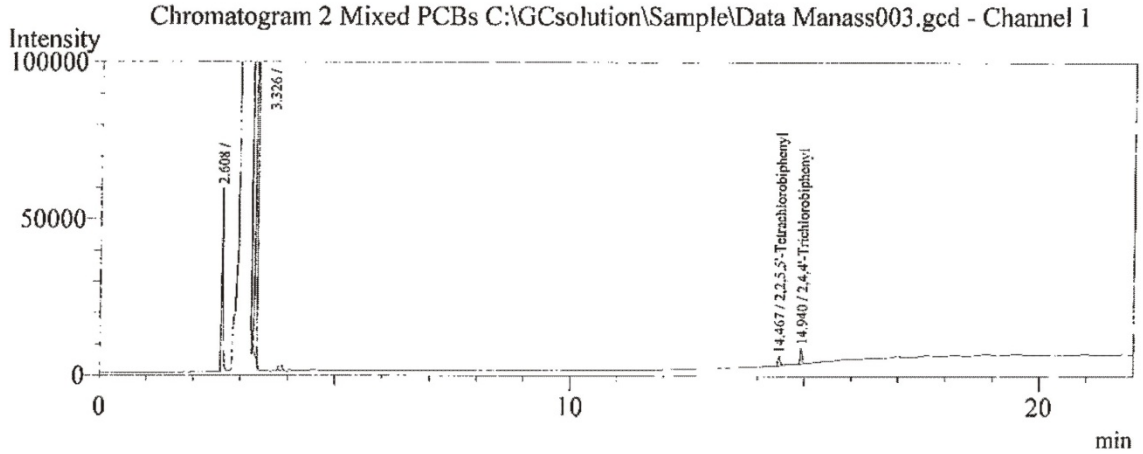

Figure VI: Chromatogram of Standard 40ppm

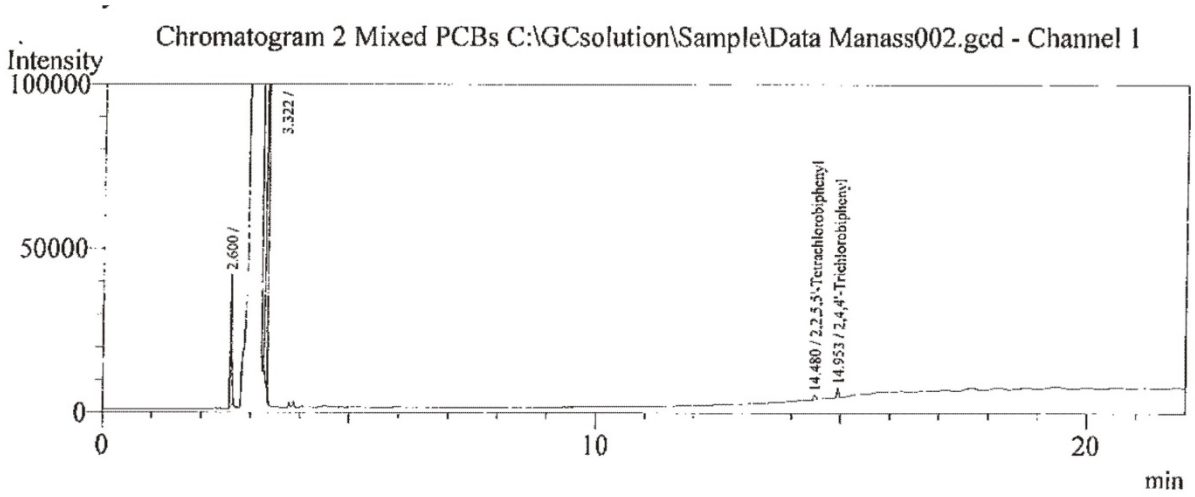

Figure VII: Chromatogram of Standard 60ppm

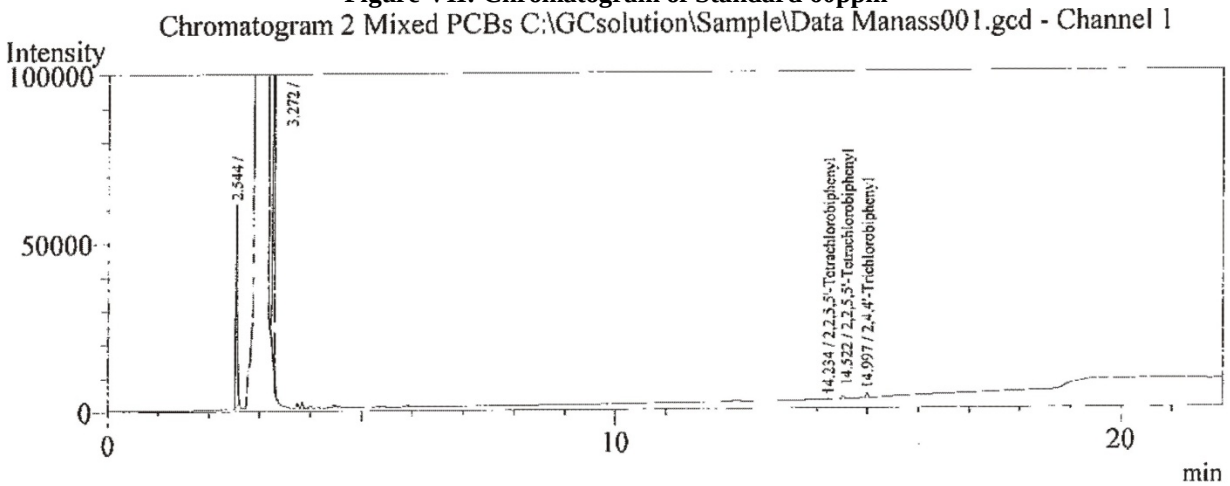

Figure VIII: Chromatogram of Standard 80ppm

Figures VI, VII and VIII represent the standards for the persistent organic pollutant precisely Trichlorobiphenyls and Tetrachlorobiphenyls at different concentration (40ppm, 60pmm, 80ppm.) and Figures II, III, and IV rae the results for the water sample from different locations of the state capital indicating the presence of PCBs. In all the locations specified, Tri- and Tetra-chloromethane (PCBs) were identified.

IV. CONCLUSION

The result of the experiments shows that, presence of persistent organic pollutant has been detected in the various water samples. This can be attributed to some of the agricultural activities and the presence of refuse dump-sites situated along the located sample area.

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