

ASSESSMENT OF POLYCHLORINATED BIPHENYLS (PCBs) IN  
WATER AND SEDIMENTS FROM NGONG AND MATHARE RIVERS

BY:

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of Master of Science in Environmental Chemistry of the University of Nairobi

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## DECLARATION

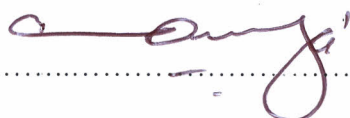
This thesis is my original work and has not been submitted for a degree award in any other university.



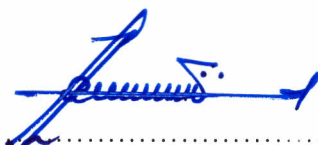
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This thesis has been submitted for examination with our approval as University Supervisors;



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## ABSTRACT

For decades, Polychlorinated Biphenyls (PCBs) have been recognized as important and potentially harmful environmental contaminants. The intrinsic properties of PCBs, such as high environmental persistence, resistance to metabolism in organisms, and tendency to accumulate in lipids have contributed to their ubiquity in the environmental media and have induced concern for their toxic health effects in humans and wildlife after prolonged exposure.

This research was carried out to establish the pollution status of Ngong and Mathare Rivers with respect to the seven UNEP indicator PCBs and two additional ones (PCB 105 and 156). This was accomplished by determining their spatial and temporal distribution in water and sediments from the two rivers and correlating the levels with physicochemical parameters of water.

Field samples were collected monthly between March and September 2009 from 7 sites along the Ngong and Mathare rivers representing upstream, middle stream and downstream terrains. Analysis of PCB congeners was achieved on Agilent Gas Chromatograph equipped with an electron capture detector after extraction with solvent following the USEPA methods 3510 and 3540. Mean percentage recoveries of PCB congeners were  $85.85 \pm 5.40$  and  $88.71 \pm 5.68$  in water and sediment, respectively, while the instrument detection limit varied between 0.00012 and 0.00691 ng/L for PCB 118 and 180, respectively.

PCB congeners' concentrations in water ranged from BDL to 838.23 ng/L in water samples from Ngong River and BDL to 307.12 ng/L in samples from Mathare River with

the highest mean PCB levels being observed in water samples from Donholm Bridge. PCB congeners 28 and 52 were the most prevalent in all sites and throughout the sampling period with occurrence frequency of 100%.

Residue levels of PCB congeners detected in sediments ranged from BDL-34.92  $\mu\text{g}/\text{kg}$  in samples from Mbagathi Bridge, 0.32-70.30  $\mu\text{g}/\text{kg}$  in samples from Mater Bridge and 0.91-88.01  $\mu\text{g}/\text{kg}$  in samples from Donholm Bridge. The frequency of occurrence of the PCB congeners in sediments was 100% for all the congeners except for PCB 138 which was not detected in 2 sampling sites ie Mbagathi and Mater Bridges in the month of April.

There was a general increasing trend in levels of individual PCB congeners as well as the sum of PCBs downstream of both rivers. The PCB levels were several fold higher in sediment than in water because PCBs are hydrophobic and tend to partition to the more organic components of the environment hence adsorb strongly to organic matter in sediments. The concentrations were higher during the dry months (March, August and September) than in the wet months (April, June, July). There was a direct relationship of PCB levels in water with physicochemical parameters (pH, TSS, TDS) as indicated by the positive Pearson's correlation coefficient values. Generally, the average PCB concentrations were below the USEPA allowable limit of 500 ng/L. However, with bioaccumulation and biomagnifications, the levels pose adverse potential health impacts to human and animal health.

This study provides baseline data on the levels of PCB residues in the selected matrices from the two rivers. This will inform policy makers on the quality of water of Nairobi River Basin as well as supplement the country's studies as an obligation for all parties to the Stockholm convention on POPs.