OBAFEMI AWOLOWO UNIVERSITY

ASSSESSMENT OF HEAVY METALS IN DOMESTIC WATERS IN FOUR LOCAL GOVERNMENT AREAS OF OSUN STATE, NIGERIA

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DEDICATION

This work is dedicated to

Almighty God

for giving me the grace to successfully complete this thesis

and to

my treasured husband.

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ABSTRACT

The study determined the concentrations of lead, arsenic, cadmium, zinc and copper in domestic water samples in four Local Government Areas of Osun State, Nigeria; compared the concentrations of selected heavy metals in the water samples from two sources and also compared the results with the permissible values from two regulatory bodies: World Health Organization (WHO) and Nigeria Environmental Standard and Regulatory Enforcement Agency (NESREA).This was with a view to providing information on the quality and safety of domestic waters from wells and boreholes in the study area.

Two hundred (200) water samples were collected from wells and boreholes in four Local Government Areas (LGAs) of Osun State (Ife Central, Irewole, IlaOrangun and Ejigbo). Fifty samples were collected from each Local Government Area (LGA). The grid locations of the sampling points were determined using a Global Positioning System. Ambient and water temperature and the pH were determined *in situ* while lead (Pb), arsenic (As), cadmium (Cd),zinc (Zn) and copper (Cu) contents were determined using Atomic Absorption Spectrophotometer (AAS). Data collected were analysed using One-way analysis of variance and the correlation matrix was also determined.

The results showed that the highest mean air temperature (30.7±0.3ºC), water temperature (29.9±0.3ºC) and pH (8.67±0.3) of the borehole and well samples were recorded in water samples collected from in Ife Central LGA. Samples collected from Ila-Orangun LGA was found to have the highest mean lead concentration (21 ± 0.004 µg/L and 60 ± 0.007µg/L) for borehole and well water samples respectively. The highest copper concentrations (633 ±

0.31 µg/L) and 596 ± 0.104 µg/L) in the well and borehole water samples were also recorded in IlaOrangun LGA .Water samples collected from Ife Central and Ejigbo LGA were found to have the highest arsenic (28 ± 0.004 µg/L and 28 ± 0.002µg/L),Cadmium (173 ± 0.015 µg/L and 147 ± 0.006 µg/L) and zinc (213 ± 0.022 µg/L and 255 ± 0.008 µg/L) concentrations for the borehole and well water samples respectively. Lead (Pb) and copper (Cu) concentrations in the water samples from the two sources fell within WHO and NESREA standard limits except for water samples collected from Ila-Orangun LGA. Arsenic (As) and cadmium (Cd) concentrations recorded were low in water samples collected from Ila-Orangun, but were high in samples from the other three LGAs. However, the concentration recorded were lower than the WHO and NESREA regulatory standards. The concentration of Zn recorded in the samples also fell within WHO and NESREA standard limits in the LGAs sampled.

The study concluded that although the heavy metals concentrations recorded in all the studied locations varied, however, they were within the permissible levels recommended by regulatory agencies.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Water is absolutely essential for life; it is undoubtedly the most precious natural resource that exists on our planet (Abowei and George, 2009). In the last decades, groundwater resource has become the potential source of domestic water supply in Ghana and the world at large (Hynds *et al*., 2014) including Nigeria. Interestingly, many public health surveys and water quality analysis has shown that groundwater is not immune to contaminants such as waterborne pathogens, toxic elements(Asamoah and Amorin, 2011).Over the last few years, surface water and groundwater resources are among the most important environmental issues due to heavy metals contamination and human industrial activities (Khodabakhshi *et al*., 2011; Ghasemi *et al*., 2011).The quality of water available and accessible to a community has tremendous impact on their living standard and well being; thus global and local efforts are widespread at ensuring adequate provision of clean and safe water to the world's growing population (DWAF, 2003). Although water plays an essential role in supporting human life and biodiversity, it also has a great potential for transmitting diseases when contaminated (Yakasai *et al*., 2004). Population growth coupled with other factors such as urbanization, agricultural activities, industrial and commercial processes have resulted in the accumulation of wastes and pollutants which ends up in water bodies, thereby altering the water quality, species composition and biodiversity in many aquatic systems (Dike *et al*., 2004). Water is a principal constituent of the planet earth.

Natural sources of fresh water are in the form of lakes, glaciers and ample ground water system of rivers (Bridget, 2007).

Water is also one of the essentials that supports all forms of plant and animal life (Vanloon and Duffy, 2005) and it is generally obtained from two principal natural sources; Surface water such as fresh water lakes, rivers, streams, etc. and ground water such as borehole water and well water (Mc-Murry and Fay, 2004; Mendie, 2005). Water has unique chemical properties due to its polarity and hydrogen bond which means it is able to dissolve, absorb, adsorb or suspend many different compounds (WHO, 2007). In nature, water is not pure as it acquires contaminants from its surrounding and those arising from humans and animals as well as other biological activities (Mendie, 2005). One of the most important environmental issues today is ground water contamination (Vanloon and Duffy, 2005).Also considering the wide diversity of contaminants affecting water resources, heavy metals receive particular concern considering their strong toxicity even at low concentrations (Marcovecchio *et al*., 2007). Water is a principal. Metals like cadmium, copper, lead, arsenic and zinc and so on and so forth. may occur in drinking water due to geogenic reasons or may be due to anthropogenic activities such as uncontrolled discharge of waste waters of different types of industries.

Groundwater is considered among the healthiest source of drinking water, but domestic, agricultural and industrial activities have led to the degradation of groundwater quality in different parts of the world. Groundwater contamination is responsible for water related and water borne diseases in developing countries like Nigeria. Therefore, the evaluation

of groundwater quality for human consumption is essential to human existence. The source of ground water contamination could be natural through ground water-rock interaction or through anthropogenic which involve human activities that can affect groundwater quality. Groundwater pollution which is man-made is worse than natural pollution as it eventually renders water unsuitable for use than its original state (WHO, 2007).The provision of good quality water is needed as an urgent step that will ensure groundwater quality, protection and conservation. Ground water is an important source of drinking water for human kind. It contains over 90% of the fresh water resources and it is an important reserve of good quality water. Groundwater, like any other water resource, is not just of public health but of economic value (WHO, 2007). The water pollution by heavy metals has become a question of considerable public and scientific concern in the light of the evidence of their toxicity to human health and biological systems (Adepoju and Alabi, 2005). They exist in water in colloidal, particulate and dissolved phases (Adepoju *et al.,* 2009) with their occurrence in water bodies being either of natural origin (fore example eroded minerals within sediments, leaching of ore deposits and volcanism extruded products) or of anthropogenic origin (that is solid waste disposal, industrial or domestic effluents) (Marcovecchio *et al.,* 2007). Some of the metals are essential to sustain life: calcium, magnesium, potassium and sodium must be present for normal body functions. Also, cobalt, copper, iron, manganese, molybdenum and zinc are needed at low levels as catalyst for enzyme activities (Adepoju *et al.,* 2009).

In Nigeria, drinking water comes from groundwater and surface water including rivers, lakes and reservoirs. Their water qualities may be impaired as a result of low water flow, municipal effluents and industrial discharges (Chitmanat and Traicaiyaporn, 2010). The free

style way of disposal of agricultural, industrial and domestic effluents into natural water bodies may also cause serious contamination of these water bodies. Rainfall is also an important factor in aquatic environmental pollution; dust, volcanic gases and natural gases (such as carbon dioxide, oxygen, sulphur dioxide and nitrogen) are all dissolved or trapped in rain (Tawari and abowei, 2012). Urban runoff as a result of rainfall worsens the water quality in rivers and lakes by increasing the concentrations of such substances as nutrients (phosphorus and nitrogen), sediments, animal's wastes (fecal, coliform and pathogens), petroleum products and road salts (Peter *et al*, 2010).

1.2: Health Hazards of Heavy Metals in Domestic Water.

Heavy metals can eventually dispersed and accumulated in the soil as well as surface and groundwater and may therefore impact adverse human health effect to living organisms (Rashed 2010; Chotpantarat ***et al.,*** 2011; Chotpantarat and Sutthirat, 2011). Heavy metals are known to be carcinogenic and fatal. They are generally dangerous to living organism especially man, because of their bioaccumulation nature, they accumulate in living tissues anytime they are taken up and stored faster than they are metabolized or excreted (Lentech, 2011).