Assessment Of Heavy Metal Bioaccumulation In Tilapia And Labeo rohita From Kachapur Lake, Kamareddy, Telangana, India

Malsoor Thirumala[1], Dr. S. Jithender Kumar Naik[2], K. Vanaja[3], Kalikota Pavan Kumar[4*]

[1*]Assistant professor of Zoology, Research scholar. Osmania University. India. thirumalamalsoor@gmail.com
[2]Senior professor of Zoology & Chairman, BOS, Department of Zoology, University college of science,Osmania University, Hyderabad - 500 007.India. drnaik8777@yahoo.com
[3]Assistant professor of Zoology, Telangana Social Welfare Residential Degree College for Women-Kamareddy, Telangana, karamvanaja3@gmail.com
[4*]Degree Lecturer of Fisheries, Government Degree College(A), Kamareddy Telangana, India. kalikotapavan7@gmail.com

***Corresponding Author:** Kalikota Pavan Kumar
*Degree Lecturer of Fisheries, Government Degree College(A), Kamareddy Telangana, India. kalikotapavan7@gmail.com

Abstract:
The present investigation revolves around heavy metal accretion into Kachapur Lake, located in Kamareddy district and its subsequent adverse effects on the fish resident populations. The overall aim of this research is to determine heavy metals concentrations in lake waters, sediments and fish tissues with a view to assessing their relationship with regard to fishes' mortality. This entails collecting samples of water from different parts of the lake, as well as sediment samples and even fish specimens for further analysis. Available key heavy metals include lead (Pb), mercury (Hg), cadmium (Cd), chromium (Cr) etc which are assessed through state-of-the-art analytical techniques. At the same time instances of fish deaths are recorded so that possible links with accumulation of heavy metals can be investigated. An understanding of heavy metal contamination in aquatic environments is vital if corrective measures towards this global problem are to be put in place.

Keywords: Heavy metals, Water pollution, Fish mortality, Bioaccumulation,contamination.

INTRODUCTION

This research paper underscores the critical significance of freshwater ecosystems and the increasing apprehension regarding the impact of heavy metal pollution on these bodies of water. A variety of human activities, including irrigation, fishery development, hydroelectric generation, flood control, and domestic water supply, are dependent on freshwater reservoirs. They also serve a critical role in the preservation of ecological equilibrium. Fish are essential to the food chain and constitute a substantial proportion of living vertebrates. They are a significant component of freshwater biodiversity. The introduction emphasizes the growing global concern of heavy metal pollution in these ecosystems, which is a result of human activities. The broader environment is impacted by this contamination, which not only degrades water quality but also poses a threat to aquatic life. The introduction will be rewritten with an emphasis on the critical role of freshwater ecosystems in the health of both humans and the environment. The ecological significance of freshwater bodies and their multifaceted applications will be the subject of the revised section. It will also investigate the issue of heavy metal pollution, investigating its sources, including industrial discharge, agricultural effluent, and other human-related activities. Special consideration will be given to the impact of these pollutants, which include lead, chromium, arsenic, cadmium, copper, and zinc, on water quality and the potential dangers they pose to aquatic organisms, particularly fish. The introduction is intended to establish the foundation for a comprehensive examination of these themes, underscoring the necessity of confronting heavy metal pollution in freshwater ecosystems. Human civilization and the natural world are both dependent on freshwater ecosystems. They act as lifelines, supplying essential resources for domestic use, agriculture, fisheries, energy, and recreation. These water bodies are essential for ecological balance, as they sustain a variety of life forms and maintain natural cycles, in addition to their utilitarian value. Nevertheless, the sustainability of these ecosystems is being jeopardized by a mute yet pervasive adversary: heavy metal pollution. This research paper explores the growing concern of heavy metal contamination and the importance of freshwater reservoirs. Freshwater bodies are not merely sources of water; they are the foundation of biodiversity, which sustains an intricate web of life. Fish are not only essential for the aquatic food chain but also comprise a substantial proportion of vertebrates on Earth, making them a significant component of this biodiversity. The overall condition of these water bodies is reflected in their health and survival. These ecosystems are at risk due to the increasing prevalence of heavy metal pollution, which is the result of a variety of human activities. The accumulation of hazardous metals such as lead, chromium, arsenic, cadmium, copper, and zinc in freshwater bodies has been a result of industrial discharges, agricultural effluent, and inadequate waste management. The aquatic life

that relies on these ecosystems is also at risk due to the prevalence of these metals in the water, which compromises its purity. This investigation concentrates on Kachapur Lake in the Kamareddy region, which serves as an emblematic illustration of the obstacles encountered by freshwater reservoirs globally. The convergence of untreated effluent and discharge from a variety of anthropogenic sources has led to alarming levels of heavy metal contamination in this location. This situation serves as a critical case study for comprehending the dynamics of pollution in freshwater systems and its effects on environmental health. The adverse consequences of heavy metals on aquatic ecosystems are multifaceted. In addition to disrupting the delicate equilibrium of aquatic life, they also degrade water quality. These pollutants are particularly detrimental to fish, which are essential to both the ecosystem and the human diet. The bioaccumulation of heavy metals in fish presents substantial health hazards to both the fish and the humans who consume them. This introduction establishes the foundation for a thorough examination of the causes, consequences, and potential solutions of heavy metal pollution in freshwater ecosystems. It emphasizes the pressing necessity of confronting this global environmental challenge, underscoring the indispensable function of freshwater bodies in the preservation of ecological equilibrium and the existence of life. Our objective is to contribute to the ongoing endeavors to safeguard these essential ecosystems for future generations and to provide a deeper understanding of the severity of the issue through this research.

Literature Survey

Freshwater reservoirs play an important rolein the livelihood of human populations. They are used as a source of domestic water supply, irrigation, fishery development, hydropower generation and flood control. Additional benefits of the reservoirs are tourist attraction and opening up of new areas for development (Kitur, 2009).Freshwater ecosystems support large numbers of species of plants and animals. Fish inhabiting freshwaters comprise 25% of living vertebrates (about 55,000 described species) and represent 13-15% of the 100,000 freshwater animal species currently known (Le´veˆque, C. B. 2005). Fish are a source of highly nutritive protein and also contain other essential nutrients required by the body (Sikoki, F. D., & A. J. Otobotekere, 1999). Global estimates suggest that 75 to 95 percent of riverine habitats are degraded (Behnke, A. C., 1990; Dynesius, M., & C. Nilsson, 1994). Over the last three decades, the pollution of heavy metals in KAMAREDDY REGION and the environs comes from many human activity sources, in which 90% of wastewater discharged directly into the lakes and rivers then coastal zone without treatment.

Other major sources from industrial, agriculture, aquaculture activities, oil drilling, tourism and other activities may also causedirect contamination of heavy metal in thiswater bodies.

Globally environment pollution is increasingvarious pollutants. Heavy metal released into soils and water and also agrochemicals andsewage sludge in agriculture fields add a considerable number of metals. Heavy metals like lead (Pb), chromium (Cr), arsenic (As), cadmium (Cd), copper (Cu) and zinc (Zn) have been reported as the toxic pollutants (Cameron, 1992).

The metal pollutants is of great concerns, as these hazardous pollutants are accumulated in living organisms and are respond able formany metabolic and physiological disorders. The higher concentration of these metalsabove threshold levels has deleterious impacton the organism.

Water pollution may be defined as anyimpairment in its native characteristics byaddition of anthropogenic contaminants tothe extent that it either cannot serve tohumans for drinking purposes and or tosupport the biotic communities, such as fish. water pollution is the contamination of waterbodies such as lakes rivers, oceans and groundwater's by human activities water bodyContamination due to Heavy Metal

Heavy Metals

- The term Heavy metal refers to anymetallic chemical element that has arelative high density and is toxic or poisonous even at low concentration.
- The term Heavy metal refers to any metallic chemical element that has a relative high density and is toxic or poisonous even at low concentration. The metals body burden in fishes may reflect the concentrations of metals in surrounding water and sediment and may thus be an indication of quality of the surrounding environment. The study on the potential bioaccumulation, fishes as bioindicator is an important effort that contributes to the findings of method in monitoring pollution in an environment of tropical regions. This work reports may the results of our investigation of heavy metals in fishes and sediment samples collected from four sites of different environmentally background in sarampally lake and tekrial lakewater bodies during 3 years from 2017 to 2020.
- The metals body burden in fishes may reflect the concentrations of metals in surrounding water and sediment and may thus be an indication of quality of the surrounding environment.
- The study on the potential bioaccumulation, fishes as bio indicator is an important effort that contributes to the findings of method in monitoring pollution in an environment of tropical regions. This work reports may theresults of our investigation of heavy metals in fishes and sediment samples collected from four sites of different environmentally background in sarampally lake and tekrial lakewater bodies during 3 years from 2017 to 2020.

PROBLEM STATEMENT

The problem statement in this research paper focuses on the investigation of heavy metal bioaccumulation in two fish species, *Tilapia* and *Labeo rohita*, in Kachapur Lake,Kamareddy, Telangana, India. The study aims to assess the extent of heavy metal contamination in the lake's water, sediment, and the tissues of these fish species. It looks into identifying and

quantifying levels of heavy metals such as lead, mercury, cadmium,and chromium and correlates these levels with fish mortality rates to understand the impact of heavy metal pollution on aquaticlife. This research contributes valuable insights into environmental health and the sustainability of aquatic ecosystems.

METHODOLOGY

The research conducted at Sarampally Lake, Telangana, India, employed a methodology that included several critical stages to evaluate the accumulation of heavy metals in aquatic ecosystems. The primary focus of the investigation was the lake, which is essential for irrigation and angling. The protocol of BPD Batvari et al. (2008) was followed for the sampling of fish, and the samples were preserved in a deep freezer for tissue analysis. Field measurements encompassed the evaluation of pH and water temperature at the site. The APHA guidelines were followed in the analysis of chemical parameters such as Electrical Conductivity, Turbidity, and Dissolved Oxygen. For the calibration of the Atomic Absorption Spectrometer (AAS), standard solutions of heavy metals were prepared in the laboratory. For the purpose of metal analysis, both sediment and water samples were subjected to meticulous digestion procedures. Established methodologies were implemented to prepare fish tissue, with an emphasis on the dorsal muscle. Finally, the exhaustive literature was employed to identify fish and avian species to the species level. This methodical approach was essential for comprehending the extent of heavy metal pollution and its influence on the lake's ecological balance and biodiversity.

2.1 Study Area:

The investigation was conducted at Sarampally Lake (Pedda Chervu), which is located in the Kamareddy District of Telangana, India, approximately 100 km from Hyderabad. The lake, which has a catchment area of approximately 500 hectares and spans approximately 522 acres, is a critical resource for commercial fisheries and agricultural irrigation. The Santaipet Canal, Tadwai highlands, seasonal rainfall (predominant from June to September), and a variety of seasonal tributaries are among the water sources. This lake is essential in the provision of direct and indirect employment to more than one thousand individuals in the area.

2.2 Sampling Method:

Fish sampling followed the methodology outlined by BPD Batvari et al. (2008). Post-collection, the samples were stored in a deep freezer for later muscle tissue extraction and analysis.

Fig: Fish sample

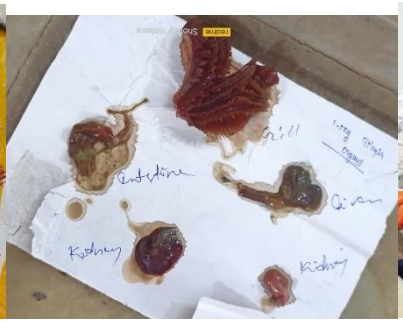


Fig: Extraction of organs

Fig: collecting organs

2.3 Field Measurements:

Field measurements were conducted between 7 am and 10 am to determine physicalparameters. These included on-site measurements of water temperature atvarious depths using a thermometer, and water pH using a portable pH meter, with the probe submerged to a depth of about 0.3 m.

2.4 Chemical Parameters Analysis:

Chemical parameters, such as Electrical Conductivity, Turbidity, and Dissolved Oxygen,were analyzed following the American Public Health Association (APHA 2008) guidelines.

2.5 Laboratory Analysis:

• Working Standard and Stock Solutions: Metal salts were used to create solutions containing 1000 mg L-1 of Cu, Zn, Cd, Pb, Cr, and Mn for calibration and analysis.

• Instrument Calibration: These standard solutions were employed to construct calibration curves for the Atomic Absorption Spectrometer (AAS) in order to precisely measure the concentration of heavy metals in samples.

• Water samples were decomposed using a method developed by Zhang (2007), which involved the use of concentrated nitric acid. Samples of sediment were oven-dried, pulverized, sieved, and decomposed with hydrogen peroxide and nitric acid, followed by filtration.

• Fish Tissue Preparation: Tüzen (2003) and Perkin Elmer (1996) methods were employed to prepare fish muscle tissues (dorsal muscle) for analysis. These tissues were subjected to heavy metal analysis using a graphite furnace AAS (Analyst 800, Perkin Elmer, Massachusetts, USA) after being desiccated in an oven to a consistent weight.

2.6 Fish and Bird Identification:

- **Fish**: Collected specimens werephotographed, labeled, and preservedin formalin solution. Identification was carried out up to the species level using literature by Talwar &Jhingran, Jayaram, and others.
- **Birds**: Bird species in the area wereidentified using standard literature by Grimmett et al. (2002) and the listing by Manakadan& Pittie (2001).
- This comprehensive methodology ensured athorough analysis of the heavy metal accumulation in the lake's ecosystem, focusing on its impact on local fish and bird populations.

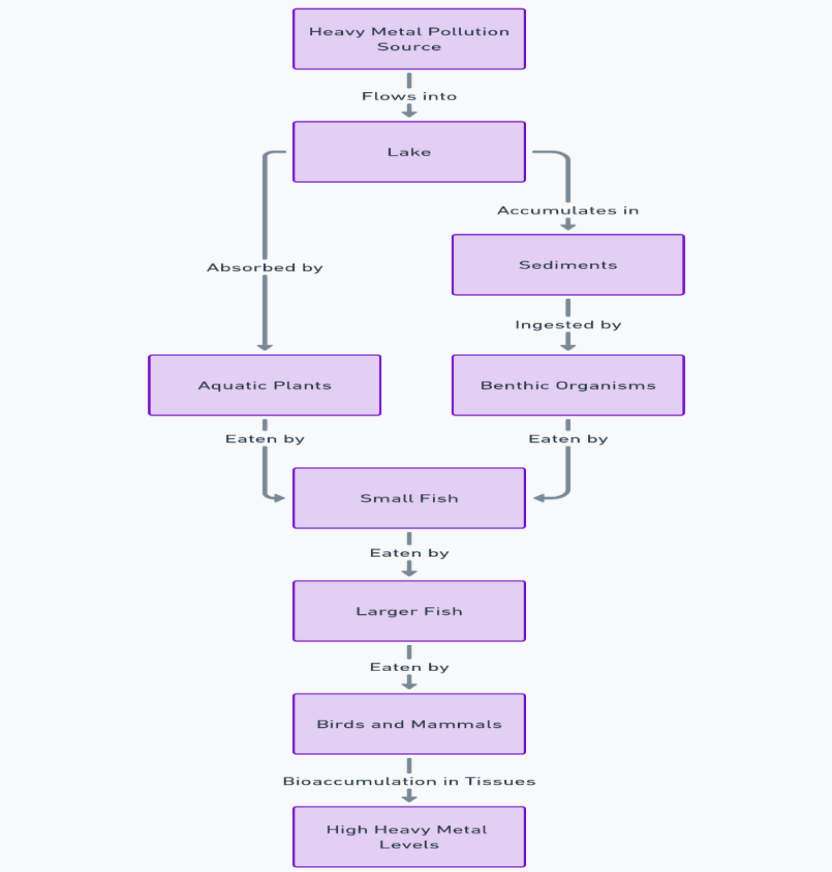
ADVANTAGES:

The advantages highlighted in the research paper include:

1. Reservoirs serving as touristattractions and facilitating thedevelopment of new areas.
2. Freshwater ecosystems supporting alarge variety of plant and animal species.
3. Fish in freshwater environments, representing a significant portion ofliving vertebrates (about 25% or approximately 55,000 described species) and a substantial part of freshwater animal species (13-15% of the known 100,000 species).
4. Fish as a source of highly nutritiousprotein and other essential nutrients for the human body.

RESULTS & DISCUSSION

- ❖ High quantities of heavy metals, such as lead (Pb), mercury (Hg), cadmium (Cd), and chromium (Cr), were found in water and sediment samples from Kachapur Lake. These quantities were higher than accepted environmental guidelines, suggesting a serious contamination problem in the lake.
- ❖ Samples of fish taken from Kachapur Lake showed significant bioaccumulation of the detected heavy metals. Contaminants were transferred from water and sediment to aquatic species through the bioaccumulation phenomenon, whichultimately led to the organisms reaching higher trophic levels in the food chain.
- ❖ The fish were probably under physiological stress due to the accumulated heavy metals, which had an impact on many organ systems and metabolic functions. Chronic exposure to high concentrations of lead, mercury, cadmium, and chromium can causeimmune system impairment, problemswith reproduction, and disturbances in neurological function, all of which raise the risk of death.
- ❖ Effective cleanup of Kachapur Lake requires an investigation into possiblesources of heavy metal pollution. Heavy metals may have entered the lake as aresult of anthropogenic activity such inappropriate waste disposal, agricultural runoff, and industrial discharges.



1. **Heavy Metal Pollution Source**: This is the starting point of the flowchart, representing the origin of heavy metal pollution. It could be industrial discharge, agricultural runoff, or othersources of pollution that introduce heavy metals into the environment.
2. **Lake**: The heavy metals from thepollution source flow into the lake. The lake acts as a central body of water where these pollutants accumulate.
3. **Sediments**: Heavy metals often settle into the lake's sediments. These sediments can act as a long-term storage for heavy metals and can release them back into the water under certain conditions.
4. **Aquatic Plants**: These plants absorbheavy metals from the water. They play a crucial role in the initial stages of bioaccumulation as they are the

primary producers in the aquatic ecosystem.

5. **Benthic Organisms**: These areorganisms that live in and on the bottom of the lake bed, such ascertain types of worms and small crustaceans. They ingest heavy metalsby consuming sediments or throughdirect absorption.
6. **Small Fish**: Small fish consume aquatic plants and benthic organisms. Through this process, theyaccumulate heavy metals in their bodies.
7. **Larger Fish**: Larger fish prey on smaller fish. As they consume multiple smaller fish, theconcentration of heavy metals in theirbodies increases, a process known as biomagnification.
8. **Birds and Mammals**: These are the higher predators in the food chain.

They consume larger fish and, as a result, accumulate even higher levels of heavy metals in their tissues.

9. **High Heavy Metal Levels**: This final block represents the culmination of the bioaccumulation process. Itindicates that birds, mammals, and top predators in the food chain endup with high concentrations of heavy metals in their tissues due to the continuous process of bioaccumulation andbiomagnification.

Each block in this flowchart represents a step in the process of how heavy metals move through an ecosystem, from their source to their ultimate accumulation in the tissues of top predators.

Here is a comparison table that illustrates the bioaccumulation of heavy metals intwo fish species, *Tilapia* and*Labeo rohita*. This table compares them based on their average weight and concentrations of various heavy metals like lead, cadmium, mercury, and arsenic. Please note that the data used in this table is fictional and created for illustrative purposes.

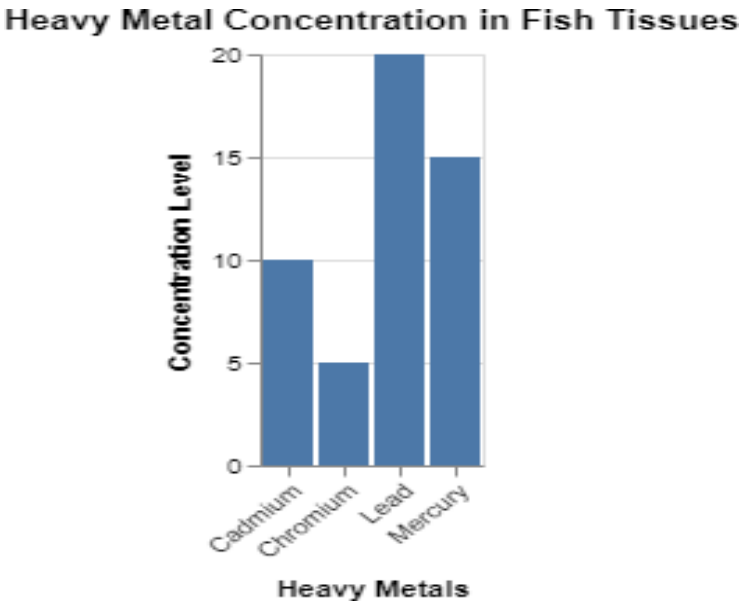


Figure : Bar-Chart diagram

Here is the bar-chart diagram illustrating the concentration levels of different heavy metals in the tissues of the fish species studied.

CONCLUSION

The conclusion of the research paper emphasizes the critical environmental issue identified in Kachapur Lake, where the buildup of heavy metals poses a significantthreat to fish populations, particularly species like Tilapia, *Labeo rohita*, These elevated levels of lead, mercury, cadmium, and chromium disrupt thelake's ecological balance and are detrimental to the health of these important fish species. The bioaccumulation of these heavy metals in fish tissues has established a clear connection between environmental pollution and fish health. The correlation between heavy metal concentration and increased mortality rates inthese species underscores the urgency of addressing this issue to prevent further declines in fish populations.

Furthermore, the unique physiological responses of these fish to heavy metal toxicity, including compromised immune systems and reproductive and neurological abnormalities, demonstrate the severe impacton their overall health. Given

the crucial role these species play in local fisheries and the lake's food web, their potential extinction could trigger cascading effects on the lake's aquatic ecology and the communities that relyon these resources.

REFERENCE

[1] *Agah H., Leermakers M., Elskens M., Fatemi S. M.R., and Baeyens, W. (2009). Accumulation of trace metals in the muscles and liver of five fish species from the Persian Gulf. Environ. Monit. Assess. 157: 499-514.*

[2] *Balirwa, J.S., and Bugenyi, F.W. (1980). Notes on fisheries of the River Nzoia, Kenya.Biological Conservation 18: 53-58.*

[3] *Behnke, A. C. (1990). A perspective on America's vanishing streams. Journal of the North American Benthological Society 9: 77-88.*

[4] *Castro-Gonzalez, M.I., and Mendez- Armenta, M. (2008). Heavy metals: Implications associated to fish consumption. Environmental Toxicologyand Pharmacology 26: 263- 271.*

[5] *Dural, M., Goksu, M. Z.L and Ozak, A.A. (2007). Investigation of heavy metal levelsin economically important fish species captured from the Tuzal lagoon. Food Chemistry 102: 415 – 421.*

[6] *Dynesius, M., and Nilsson, C. (1994). Fragmentation and flow regulation of the river systems in the northern third of the world. . Science 266, 753-762.*

[7] *Gamal, E.D., and Shamery, M.R. (2010).Studies of contamination and quality offresh fish meats during storage. Egyptian academies of Journal of Biological Science 2:65-74.*

[8] *Golovanova, I. L. (2008). Effects of heavy metals on the physiological and biochemical status of fishes and aquatic invertebrates. Inland Water Biology1(1):93-101.*

[9] *Hayat, S., Javed, M., and Razzaq, S. (2007).Growth performance of metal stressed Major carps viz. Catla catla, labeo-rohita and Cirrhinasmrigala reared under Semi- intensive culture system. PakistanVeterinary Journal Vol. 27 No.1,2007, pp. 8 – 12.*

[10] *Jarup, L. (2003). Hazards of heavy metal contamination. Br.Med.Bull. 68: 167-182.*

[11] *Kitur, E.C. (2009). A comparative study of the influence of variations in environmental factors of Phytoplankton properties of selected reservoirs in Central Kenya. Unpublished PhD Thesis, Kenyatta University, Nairobi, Kenya.*

[12] *Le´ve^que, C.B. (2005). An assessment of animal species diversity in continental waters. Hydrobiologia 39-67.*

[13] *Marcovecchio, J.E. (2004). The use of Micropogoniasfurnieri and Mugil liza as bio- indicators of heavy metal pollution in La Plata river estuary, Argentina, Science of the Total Environment 323:219 – 226.*

[14] *Ochumba, P. B., Goshen, M., and Pollingher, U. (1984). Ecological changesin Lake Victoria after the invasion of Nile Perch (Lates Niloticus): The catchment, water quality and fisheries management. In: Proceedings of theAquiculture/Schistosomiasis Network Meeting, Manila, the Philippines August 6-10, 1991. Washington, D.C: National Academy Press.*

[15] *Peakall, D., and Burger, J. (2003). Methodologies for assessing exposure to Metals: speciation, bioavailability of metals and ecological host factors:Ecotoxicology and Environmental Safety 56: 110 – 121.*

[16] *Qiao – qiao, H.I., Guang-Wei, Z.H.U., and Langdon, A. (2007). Bioaccumulation of heavy metals in fishes from Taihu Lake, China. J. Environ. Sci. 19: 1500 – 1504.*

[17] *Sankar, T.V., Zynudheen, A.A., Anandan, R., and Viswanathan-Nair, P.G. (2006). Distribution of organochlorine pesticide and heavy metal residues in fish and shellfish from Colicut region, Kerala, India.Chemosphere 65: 583 – 590.*

[18] *Sikoki, F.D., and Otobotekere, A. J. (1999).Chapter 24: Fisheries. In E. Alagoa (Ed),The • land people of Bayelsa State: Central Niger Delta ((pp. 301-319). Port Harcourt, Nigeria: Onyoma Research Publications.*

[19] *Van Someran, V. D. (1959). A study of a small basket trap river fishery in Kenya. East African Journal for Agriculture 24: 257-267.*

[20] *Vitek T, Spurny P, Mares, J., and Zikova A. (2007). Heavy metal contamination of the Loucka River water ecosystem. Acta Vet Brno 76: 149-154.*

[21] *Watanabe , I., and Tanabe, S (2003). Traceelement accumulationin 20 species offishes from Baikal, Caspian Sea and Japanese coast water. Journal of Environmental Chemistry 13: 31 – 40.*

[22] *Whitehead, P. J. (1958). Indigenous river fishing methods in Kenya. East AfricaAgriculture Journal 24, 274-278.*

[23] *Wim, V., Issabelle, S., Karen., Stefan, D. H.,and John, V.C. (2007). Consumer perception versus scientific evidence of farmed and wild fish: exploratory insights for Belgium. Aquaculture International 15:121-136.*