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International Journal on Biological Sciences

International Journal on Biological Sciences 15 (2), July-December 2024, Pp.126-131
ISSN No.: 0976-4518
https://doi.org/10.53390/IJBS.2024.15208

A LITERATURE REVIEW ON BIOACCUMULATION OF HEAVY METALS IN AQUATIC ECOSYSTEM WITH SPECIAL REFERENCE TO INDIA

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Review Paper

Received: 22.10.2024 Revised: 18.11.2024 Accepted: 07.12.2024

ABSTRACT

Fish is a popular choice for its nutritional benefits, but it is also important to be aware of potential risks associated with chemical contamination, Monitoring and regulating these contaminants are crucial for ensuring safe consumption of aquatic foods. The increasing risk of toxicity due to heavy metal accumulation in fish poses significant global dangers, particularly in aquatic ecosystem. Development projects have been a subject of study for their environmental impact, altering not just geometry but also natural hydrological and sedimentological processes. Our research aims to assess the impact of such projects on heavy metal accumulation in aquatic-origin fish, crucial for ensuring both fish and human health safety.

No. of Pages: 9 **References: 10**

Keywords: Fish, Human health, Heavy Metals, Bioaccumulation, Toxicity.

INTRODUCTION

Water is a very crucial component of life it is an abundantly found material in nature. It is a critical constituent of all living forms. Adequate water quality is vital for all living beings including humans who use it for drinking as well as for other purposes. Drinking water is supplied through groundwater sources like rivers, lakes, ponds, dams and so on (Dwivedi, 2020). These sources are always being contaminated with different types of pollutants (Kalal et al., 2020). So, these essentially need the quantitative analysis of pollutants in water (Momin Shaziya, 2018). Aquatic pollution is world's biggest problem and continues to threaten both public health and quality of life. India is a developing country near about 70% of industrial wastes is dumped untreated into local water bodies. These activities pollute usable water. Industrial wastes including electronic wastes, microplastics contain toxic chemicals, metallic waste, oil, and acids and along with these numbers of metals are released in an aquatic environment that harms the aquatic biodiversity (Verma and Prakash, 2020 & 2022). Some such substances are Arsenic (AS), cadmium (Cd), chromium (or), copper (Cu) lead (Pb), mercury (Hg), Zinc (Zn), Nickel (Ni) etc. (Khillare, 2018). Effects of arsenic on fishes are well studied by Prakash and Verma (2019 & 2020).

All the water resources are contaminated with sewage waste, industrial waste, toxic inorganic and organic

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pollutants. The anthropogenic activities are not only creating biodiversity threats but also various types of pollution Prakash and Verma (2022). Aquatic pollution results in a water quality that affects the aquatic organisms which in turn can affect human health through the food chain. And all these things can cause unpredictable changes in the ecosystem (Shinde et al., 2019). Aquatic life is totally dependent on the ecosystem for growth, reproduction and survival. Fishes are secondary consumers in the aquatic food web providing food for other trophic levels and human beings. The waters contaminated with heavy metals and sediments can bring many physiological, histological, haematological, behavioural, and other different changes in the fish community (Nandan, 2012).

A systematic literature review on the accumulation of heavy metals in fish and their impacts on human health would involve gathering and analysing relevant studies on this topic. The review would likely explore factors such as the sources of heavy metal contamination in aquatic environments, the uptake and accumulation of heavy metals in fish tissues, and the potential health effects on humans consuming contaminated fish. A systematic literature review with a specific emphasis on selecting and analysing relevant studies published in various databases like Scopus, Google scholar, and shodhganga. This type of review aims to provide a comprehensive summary of existing scientific knowledge on the topic.

Normal methodology

Preserving fish samples properly and then analysing them based on various criteria like sex, species, and size helps researchers understand their characteristics and potential health implications, such as heavy metal exposure. Dissecting the samples into muscle and liver tissues allows for specific analysis of heavy metal storage and exposure pathways. It is a thorough process to ensure accurate results. The process outlined involves thorough washing of fish samples with purified distilled water to remove any contaminants. After dissection, specific tissues like muscle, liver, and gonads are collected, dried, and stored for analysis. The samples are packaged, sealed, and frozen for future use. Determinations are made within a set timeframe to ensure the integrity of the samples. Further preparation involves homogenizing the dried samples, followed by lyophilisation, and finally, acid digestion for liquefaction. This detailed procedure ensures accurate analysis of the fish samples for various purposes.

For heavy metal analysis in fish organs, researchers often utilize either inductively coupled plasma optical emission spectrometry (ICP-OES) or atomic absorption spectrometry (AAS). Both methods are commonly employed for their sensitivity and accuracy in detecting and quantifying heavy metals in biological samples like fish tissues. Each method has its advantages and may be chosen based on factors such as the specific heavy metals being analysed or the laboratory's equipment and expertise

Historical Reviews:

The table below represents classification and comparative study between different articles on heavy metal accumulation in fish species, especially from India.

Author	Species	Study Area	Heavy Metal	State	Year
S. Biswas et al.	*Sarda Orientalis, Siganus Javus S. Commerson*	Kalpakkam	Cu, Mn, Mn, Fe, Cr, Pb	Tamil Nadu	2010
S. Jasuja	*M.Singhala, C. Mrigala, C.Carpio, L. Rohita*	Satlaj River	Cd, Cu, Zn, Pb, Cu	Panjab	2011
G. Ambedkar & M. Muniyan	*Mystrus vittatus, Tilapia, H. fossilis, Ctenopharyngodon idella,Saurida undosquamis*	Collidam River	Cu, Pb, Cd, Zn	Tamil Nadu	2011
K. Yadri et.al	*Etroplus suratensis, Tetradonv nigroviridis, Ambasis commersoni*	Savitri River	Pb, Cd, Hg	Maharashtra	2012
Bhupendra Kumar et. al.	*Bombe duck, Scolidon, Bhola, Pomfret, Hilsa, Markrel.*	Mandipur	Fe, Zn, Cu, As, Hg, Cd	West Bengal	2012
R.M. Patil		Ratnagiri	Cu, Zn, Cd, Hg	Maharashtra	2012
Kandasami D.	*Clibanarius infraspinatus, Maretrix casta, Mugil cephalus*	Arasalar Estuary	Cu, Zn, Cd	Tamil Nadu	2012
Ciji P.P.	*Puntius parrah*	Paraiyar river	Cu, Zn	Kerala	2012
M.J. Shaikh	*Labeo rohita*	Nathsagar Dam	Cd, Cr	Maharashtra	2013
N.S. Pimple & S.S. Kharat	*Osteoberma vigorsi*	Nira River, Bhor	Fe, Zn, Cu, Zn, Pb,Cu	Maharashtra	2013
M.D. Giripunge	*Tilapia mosambica*	Gandhi Sagar Lake, Nagpur	Pb, Cu, Cd, Mn, Fe	Maharashtra	2013

R.K. Negi & Arti Mourya	*Labeo rohita & Hypothalmix moltrix*	Haridwar	Cu, Cr, Pb, Ni, Zn, Cd	Uttarakhand	2013
Singh Jyotsna	*C. mrigala & Catla catla*	Yamuna River	Cd, Cr	Uttar Pradesh	2013
M.J. Shaikh	*Cirribinus mrigala*	Nathsagar Dam	Ni, Pb, Cd, Zn	Maharashtra	2014
Arya & Alpana	*Clarias batrachus & Channa panchutus*	Khan River, Indore	Hg & Cd	Madhya Pradesh	2014
K. Khillare et.al.	*Tilapia mosambica*	Sambhaji Nagar	Cu, Cr, Ni, Cu, Pb, Cd, Zn	Maharashtra	2014
Rajiv Kumar	*Labeo rohita & E. kavei*	Yamuna River, Allahabad	Pb, Cu, As	Uttar Pradesh	2015
Karunanidhi K. et.al.	*Takifugu oblongus, Arothron, Lagocephalus guentheri*	South East Coast of India	Cu, Pb, Cd, Zn.	Tamil Nadu	2015
Jayasooryan K. K.	*Hyporhamphus xanthopterus, Horabagrus brachysoma, Etroplous suratensis.*	Vambanand Lake	Zn, Cd, Pb, Cu	Kerala	2015
Divya Pal	*Labeo rohita & Labeo bata*	Dhanbad	Pb, Cu	Jharkhand	2016
Vidya Bhavani Malarapu	*Ariomma indicum, Pentaprion Longimanus, Nemipterus japanicus, Sphyreana obtusata*	Visakhapatnam	Cu, Mn, Fe Ag, As	Andhra Pradesh	2016
Chaitanya	*Pampus argentus, Rastreliger Kanagurta, Upeneus vittaus*	Visakhapatnam	Cr, Mn, Co, Cd, Pb	Andhra Pradesh	2017
Praveen Dattu Rajala	*Labeo rohita, Channa striata, Mastacembelus armatus*	Tammileru Reservoir	Cu, Zn, Fe, Pb, Cu	Andhra Pradesh	2018
K. Ramesh Babu	*Oreochromis mossambicus, Labeo rohita, C. mrigala*	Kolavai Lake, Kanchipuram	Cu, Cd, Cr, Pb, Fe, Zn	Tamil Nadu	2018
Alagamurgan C.	*Tilapia mosambica*	Sivakasi Town	Cd, Pb, Ag, Cu.	Tamil Nadu	2018
Bhatt B.N.	*Channapuncata, Oreochromis Niloticus*	Yamuna River	Pb, Cr, Cu, Cd, Zn	Uttar Pradesh	2019
Gorakhe D.C.	*Garra mullya, Mystrus cavasius, Oreochromis mosambica*	Mula Mutha River, Pune	Cd, Cu, Cr, Fe, Ni, Pb, Ni, Zn, Cd	Maharashtra	2020
Badusha M.	*Puntius filamentous*	Neyyar Besin	Cd, Cr, Cu, Fe, Mn, Ni, Pb, Ni, Zn, Cd	Kerala	2020
Jan Arefa	*Catla catla*	Bhopal	Cd, Cr, Cu, Fe, Hg, Ni, Pb, Zn	Madhya Pradesh,	2021
Shawkat Insha	*Channa punctutus*	Bhopal	Pb	Madhya Pradesh	2022
Singh Amrita	*Labeo rohita*	Western U.P.	Cu, Zn, Pb, Cd	Uttar Pradesh	2022
L.A. Samson	*Labeo rohita, Sperata seenghala*	Prayagraj Region	Cr, Ni, Zn, Cd	Uttar Pradesh	2023
Das Piyali	*Labeo rohita*	Karim Ganj	Cd, Cr, Cu, Ni, Pb, Zn	Assam	2023

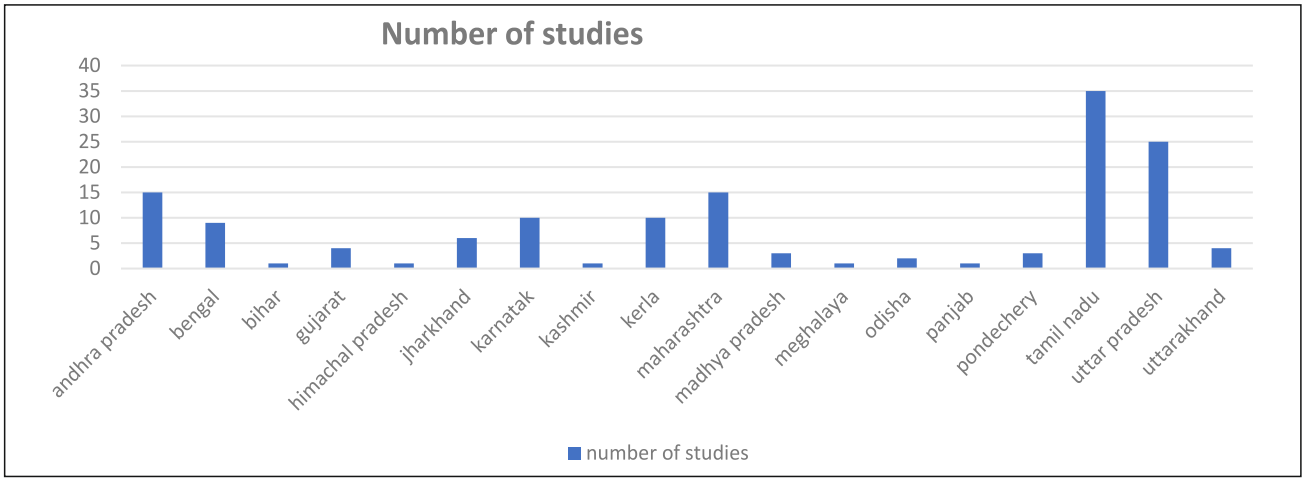

Fig. 1: Number of Studies in India by states.

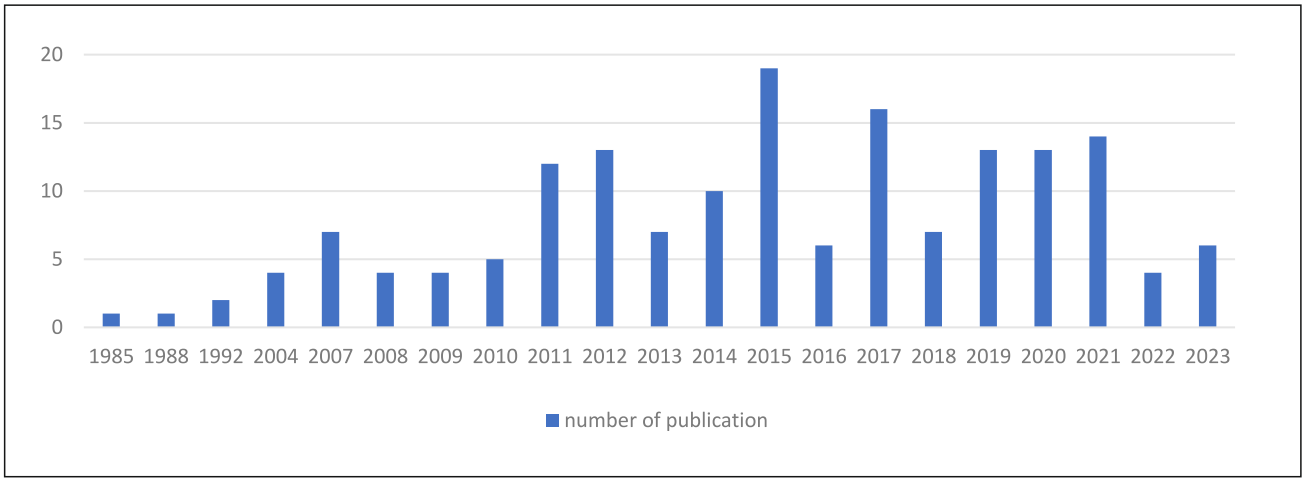

Fig. 2: Number of publication in India by years.

CONCLUSION

A. Distribution of article by states of India: Although researchers around the states of India have focused on the topic of heavy metal accumulation in fish and the impact of fish consumption on the human health, we can clearly distinguish that this topic is of interest to India as a developing country.

B. More studied species on this topic: According to the studies that have been done, the most studied species was *Labeo rohitha* followed by *Catla catla* and *Cirrihinus mrigala*. *Labeo rohita* is most commonly found and consumed fish all over the India hence the studies are also found more on this species.

C. Contribution of the authors: To visualize the relationship between the authors 180 articles in google scholar are observed. The most cited author is P. Sivaperumal followed by Mallick et al., A Grupta et al and I.H. Ravel et al.

D. Analysis of number of Publication: The analysis of metadata of each article allowed as to collect the year of publication of articles to produce flow chart below. which shows that number of to publication since 1984-2023. The number of articles begins to increase annually until it reaches 19 articles in 2015.

REFERENCES CUM BIBLIOGRAPHY

1. **Ambedkar G. And Muniyan M.** (2011). Advances in applied science research-2011-2(5) 221-225. "Bioaccumulation of some heavy metals in selected five freshwater fish prom Kollidam river, Tamilnadu, India.

2. **Arya Alpana** - To study the effect of heavy the metals on certain freshwater fishes of khan river with references (http://hdl.handle.net/10603/136/20)

3. **BhupendrakumarK.S.,Sajwan D.P. and Mukherjee S.** *Turkish journal of fisheries and aquatic science*-2012. Volume-12, issue-1 Distribution Hon of heavy metals in valuable costal Fishes from North east coast India.

4. **Celine Hilda Mary S.** Biomonitoring, macro & micro nutrient composition & heavy metal profiling of fishes available in south Coast Indian Waders assessment of heavy metal toxicity on oxidant defence system in fish shodhganga-(http://hdl.handle.net/10803 1304817)

5. **Dathu P. Rajala** (2018). Some studies on ichthyofaunal physicochemical parameter OF Tommilera reservoir with special reference to biochemical heavy metal concentration in tree fish species shodhganga - http://dl.handle.net/10603/370145

6. **Dwivedi S.** (2020). Evaluation of Drinking Water Quality Status by Water Quality Index: A Case Study of Shikhar Water Fall, Dehradun (UK), India. *International Journal of Biological Innovations*. 2 (2): 214-219.

7. **El. Sayed El. Deeb Mehana** (2014). Impact of water pollution with heavy metals on Fish health. Global Veterinaria.

8. **Ghodake D. and Chandshive N.** (2015). Study on determination and accumulation of heavy metals in Mula-Mutha River Pune district Maharashtra (E.M International).

9. **Gupta Krishna** (2011). Shodhganga (http://hd) handle.net/10603/78229 Studies on effect of heavy metal toxicity on histopathology of blood and hematopoietic tissue of some Fish species.

10. **Ingole S.B.** (2012). Physicochemical parameter and Ichthyofaunal Diversity of Majalgaon Dam Maharashtra. *International Journal of Applied Research*.

11. **Kalal V., Giri M.J., Baskar S. and Kuba R.** (2021). Detection of Pollutants present in the surface water of Ayad River, Udaipur, Rajasthan. *International Journal of Biological Innovations*. 3 (1): 212-220.

12. **Kar D., Sur P., Mandal S.K., Saha T., Kole R.K.** (2008). Assessment of heavy metal pollution in surface water. *International Journal of Environmental Science*.

13. **Mallarapa V.B.** (2016). Studies on heavy metal pollution and impact on selected fish species of Visakhapatnam tidal water. Shodhganga - http://hdl.handle.net/10603/379438.

14. **Mane P.C., Kadam D.D. and Chaudhari R.D.** (2010). Studies of some trace metals in water sample from Manjra Dam of Maharashtra India. *International Journal of Current Microbiology and Applied Science*.

15. **Mangalagiri P.** (2020). Bioaccumulation of selected fish heavy metals in selected species at different trophic levels in marine 2 "Fresh water ecosystem in Visakhapatnam Ap. India. http://hdl.handle.net/10603/365520.

16. **Momin Shaziya** (2015). Study of lake water pollution by heavy metals and its except on fish by using analytical technique. (http://hdl.handle.net/ 10603/72715- shodhganga).

17. **Momin Shaziya Mohamad Irfan** (2018). Study on lake water pollution and its effect on the fish by using analytical techniques. (http:/hd1handle.net/ 12345789/6343).

18. **Moriya Aarti**. Seasonal variation of selected heavy metals in water of a fish pond in and around Rurki Haridwar. (http//hdl.handle.net 10603/35996100)

19. **Nandan S. Bijoy** (2012). Toxicity due to Copper & zinc on certain freshwater fish. (shodhganga-http://hdl.handle.net /10603/25-999)

20. **Pawar R.T.** (2014). Ichthyofauna of Majalgaon Reservoir from Beed District Maharashtra. *Discovery International Daily journal*.

21. **Prakash, S. and Verma, A.K.** (2019). Impact of Arsenic on lipid metabolism of a fresh water cat fish, Mystus vittatus. *Journal of Fisheries and Life Sciences*. 4 (1): 33-35.

22. **Prakash, S. and Verma, A.K.** (2020). Effect of Arsenic on Serum Biochemical parameters of a fresh water cat fish, *Mystus vittatus*. International Journal of Biological Innovations. 2 (1): 11-19.

23. **Prakash, S. and Verma, A.K.** (2022). Anthropogenic activities and Biodiversity threats. *International Journal of Biological Innovations*. 4(1): 94-103.

24. **Pramita Garai, Priyajit Banerjee, Pradip Mondal and Nimai Chandra Saha** (2021). Effect of heavy metals on fish toxicity & bioaccumulation. *Journal of Clinical Toxicology.*

25. **Rajiv Kumar**. Accumulation of major heavy metals in water & sediments in Yamuna River at Allahabad and their toxicity in fishes. (shodhganga-http://hdl handle.net/10603/4/28)

26. **Robin R.S.** (2012). Heavy metal Contamination & risk assessment in the marine environment of Arabian Sea along south waste cost of India. *American Journal of Chemistry*. 2(4):191-208

27. **Sakshi Jasaja** (2002). Evaluation of heavy metal accumulation in some tissue of edible fish from river Satlaj, Panjab. Shodhganga - http://hdl.handle.net 10603/3635)

28. **Samson L.A.** Investigation of heavy metal contamination in river water and fish species Labeo rohita etc of Prayagraj region & its remediation through bio sorbent shodhganga http://hdl.handle.net/10603/506461

29. **Selvanathan Jero**. Impact of heavy metal pollutant Mercury and cadmium on biochemical & histopathological change in fresh water fish Clarias batrachus. Shodhganga. http://hdl.handle.net/10603/280186.

30. **Shaha Alekh.** Studies on the effect of copper chloride, zinc chloride, cadmium chloride, Nickel sulphate and cobalt Sulphate on fish *Labeo rohita*.(http:/hd1handle.net/ 123456789/13163).

31. **Shahjahan M.D., Taslima Mohammad Shadiqur Rahman** come Al-Emran, Iffat Alam a Caterina Faggiopub med, gov) Effect of heavy metals on fish physiology.

32. **Shaikh M.J.** (2020). (International *Journal of Researches in Biosciences, Agriculture and*

Technology) Analysis of heavy metals in water and fish Cirrhina Mrigala of river Godavari at Nath Sagar Dam, Maharashtra 2020

33. **Singh Jyotsna** (2012). Shodhganga http://hd1. handle net/10603/347915
34. **Singh, Eshwar**. B.U. Shodhganga (http://hdl.handle. net/10603/210455.) studies on some physiological aspects in freshwater fish, ophiocephaluschanna striatus in relation to heavy metal toxicity.
35. **Srikanth P.P., Somasekhar S.A. and Krishna Kanti** (2013). Analysis of heavy metals by using AAS, from Vishakhapatnam. *International Journal of Environment, Ecology, Family & Urban Studies*.
36. **Verma, A.K. and Prakash, S.** (2020). E-wastes and their impact on environment and public health. *International Journal of Applied Research.* 6(9): 164-168.
37. **Verma, A.K. and Prakash, S.** (2022). Microplastics as an emerging threat to the fresh water fishes: A review. *International Journal of Biological Innovations*. 4(2): 368-374.
38. **Wasim Sabbir, Rahman M.Z., Hasan M.M., Khan M.N. and Ray S.** (2016). Assessment of heavy metals in river water, sediment & fish muscle in Rupsha River, Khulna district, Bangladesh. *International Journal of Environment, Ecology.* 8(1):1-5.
39. **Yigit Tastan** et al. (2018). Effects of Heavy metals on fish. *Menba Journal of Fisheries Faculty*.4(1):36-47.