



**SRI VENKATESWARA INTERNSHIP PROGRAM
FOR RESEARCH IN ACADEMICS
(SRI-VIPRA)**



SRI-VIPRA

Project Report of 2024: SVP-2454

**“Microplastics in Our Environment: Their Impact on Fish
Population and Human Reproduction”**

**IQAC
Sri Venkateswara College
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SRIVIPRA PROJECT 2024

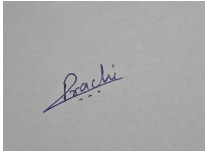
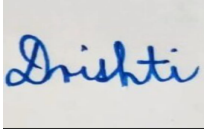
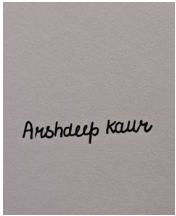
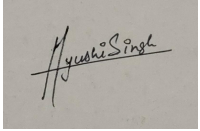
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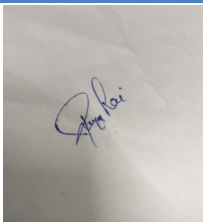
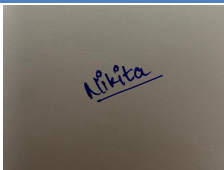
"MICROPLASTICS IN OUR ENVIRONMENT: THEIR IMPACT ON FISH POPULATION AND HUMAN REPRODUCTION."

Project Mentors

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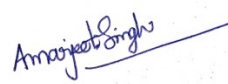
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Signature of Mentor



Signature of Mentor

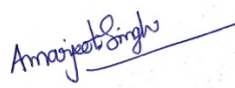
CERTIFICATE OF ORIGINALITY

This is to certify that the aforementioned students from Sri Venkateswara College have participated in the summer project SVP-XXXX titled “**Microplastics in our environment: their impact on fish population and Human reproduction**” The participants have carried out the research project work under our guidance and supervision from 1st July, 2024 to 30th September 2024. The work carried out is original and carried out in an offline mode.



Signature of Mentor

Dr. Anjali S. Nawani



Signature of Mentor

Dr. Amarjeet Singh

ACKNOWLEDGEMENTS

We would like to extend our heartfelt appreciation to everyone who contributed to the successful completion of this project. Our sincere thanks go to our project team members for their dedication throughout the project. Each member played a significant role in shaping the outcome. I would like to express my heartfelt gratitude to Sri Venkateswara College, University of Delhi for providing us the facility to conduct wet lab experiments. Special thanks to our Principal Professor V. Ravi for their guidance and valuable feedback, which enriched our work.

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INTRODUCTION

Microplastics (MPs), particles smaller than 5 mm, have gained significant attention in environmental research due to their persistence and wide distribution in aquatic and terrestrial ecosystems. In aquatic organisms, MPs are ingested through contaminated water and food sources, leading to bioaccumulation in tissues. In humans, MPs can enter the body via contaminated food (e.g., seafood), drinking water, and airborne particles. The concern arises when MPs cross biological barriers, such as the gastrointestinal tract and the blood-brain barrier, and accumulate in sensitive tissues, including reproductive organs.

The studies on microplastics in fish provide valuable insights into potential impacts on human health. Fish are often considered bioindicators for environmental contaminants, meaning that studying pollutants in fish can reveal information about pollution levels in our ecosystems. Here's how fish studies on microplastics can relate to humans:

1. Food Chain Implications

- Fish ingest microplastics in their environment, which can accumulate in their organs and tissues. When humans consume seafood, especially whole small fish or shellfish, they may be ingesting these microplastics, which could then enter the human body. This introduces concerns about how these plastics and their associated toxins might impact human health.

2. Toxin Transfer

- Microplastics can attract and bind with other harmful chemicals (like pesticides, heavy metals, and persistent organic pollutants) present in the water. When fish consume microplastics, they inadvertently ingest these toxins, which may accumulate in their bodies. If humans eat these fish, they could be exposed to these toxins, potentially impacting endocrine and reproductive health and even increasing cancer risks.

3. Physiological and Cellular Studies

- Studying how microplastics affect fish organs, cellular functions, and gene expression can reveal clues about their possible impact on human cells. For example, research has shown that microplastics may cause inflammation, oxidative stress, and cell damage in fish, and similar reactions could occur in human tissues upon exposure.

4. Environmental Persistence

- Fish are part of the broader ecosystem, and their contamination with microplastics reflects how these particles circulate and persist in the environment. Since humans are also part of this ecosystem, understanding the scope of contamination in aquatic life helps us gauge the overall extent of microplastic exposure for people through multiple pathways.

The findings in fish studies drive policies and research initiatives aimed at assessing and mitigating the effects of microplastics on humans and the environment.

OBJECTIVES

Pertaining to the available resources, we have done some preliminary studies in this project which will be useful for our future goals of understanding effects of microplastics on human health. There were four main objectives considered for this project work. They are, to learn:

- ❖ how to review the available literature on the problem,
- ❖ the fish culture in a laboratory set-up,
- ❖ the dissection of fish and identify the different organs in it such as gills,
- ❖ the assessment of water quality (physical parameters-such as pH, temp. *etc.*) the chemical preparation for assessment of water quality.

OBJECTIVE 1: TO LEARN HOW TO REVIEW THE AVAILABLE LITERATURE ON THE PROBLEM

Methodology: Many databases and websites were accessed to review literature including Google Scholar, PubMed, ScienceDirect, DOAJ, ProQuest, Cochrane Library, BASE, Scopus and Web of Science. Keywords like microplastics, water pollution, fish population, human reproductive health *etc* along with the Boolean operators (AND, OR, NOT) are used to narrow and broaden our search. While reviewing the literature we considered the publication of different time periods and included all types of publication (review, articles, research paper *etc.*). The publication of only English language were reviewed. In addition, the citation trails were followed to further refine results and conclusions.

Observation: Although direct evidence in humans is still emerging, parallels can be drawn from animal studies especially in fish. Epidemiological studies have suggested a possible link between high levels of plastic-associated chemicals (e.g., BPA) in the body and **decreased fertility rates** in both men and women potentially affecting menstrual cycles, ovulation, and sperm production. MPs may serve as vectors for these chemicals (which are actually **hormone disruptors**), exacerbating their effects. There is growing concern that MPs could contribute to **pregnancy complications**, such as preterm birth, low birth weight, and placental abnormalities, by crossing the placental barrier and inducing inflammatory or oxidative stress responses in maternal tissues. Chronic exposure may result in long-term reproductive health consequences, such as reduced fertility and increased risk of reproductive disorders.

Conclusion: Microplastics pose a significant and growing threat to reproductive health, with evidence from animal studies indicating harmful effects on fertility, hormonal balance, and pregnancy outcomes. While human studies are still in their infancy, the parallels between animal and human biology suggest that MPs could have similar consequences for human reproductive health. Addressing this issue will require a combination of regulatory action, public awareness, and further research to better understand the full extent of MPs' impact on reproduction and to develop strategies for mitigation.

Outcome: The literature review has been selected for poster presentation in International Conference on Reproductive Sciences and Molecular Medicines (ICRSMM-2024), to be held at Zoology Department, University of Delhi between 15th to 17th November, 2024.

OBJECTIVE 2: TO LEARN THE FISH CULTURE IN A LABORATORY SET-UP

Methodology: Setting up a fish culture laboratory in a college requires careful planning, appropriate equipment, and an understanding of fish biology and water management. Following points were considered while setting up the fish culture:

1. Fish Species Selection

- **Species Selection:** The fish species were selected on the basis of its availability, use and ease of work. As different species have different water quality, tank, and environmental needs-all these points were considered for the fish culture set-up. Common lab species include zebrafish (for genetics and developmental studies), guppies, rohu (*Labeo rohita*) and tilapia.

2. Location

- **Space Requirements:** The lab where culture set-up is to be established should have sufficient space for tanks, water supply systems, equipment, and room for researchers to work.
- **Utilities:** The culture room should have adequate electrical supply, water supply, and drainage, as well as ventilation to control humidity.

3. Purchase and Installation of Essential Equipment

- **Aquarium Tanks and Racks:** Tanks purchase were based on fish species and population density. For example, zebrafish require smaller tanks, while larger species need more spacious tanks.
- **Filtration System:** It is essential to install biofilters, mechanical filters, and UV filters to maintain clean water. Biofilters promote beneficial bacteria to break down waste.
- **Aeration Equipment:** Air pumps and air stones are essential for oxygenating the water.
- **Heating and Lighting Systems:** Many species require controlled temperatures, so heaters and thermostats are also installed. LED lights can provide stable lighting, and timers can simulate natural day-night cycles.
- **Water Quality Test Kits:** Regularly test for pH, ammonia, nitrites, nitrates, and dissolved oxygen.
- **Other Equipment:** Include fish nets, breeding tanks, water conditioners, buckets, and water hoses.

4. Setting Up Water Management Systems

- **Circulation and Filtration:** A system to ensure water circulation, filtration, and possibly recirculation to minimize water use is established. A semi-automatic water-changing system was also installed.
- **Temperature Control:** Stable temperatures were to be maintained by using heaters and chillers. Different fish species have different optimal temperature ranges.

5. Maintaining Water Quality

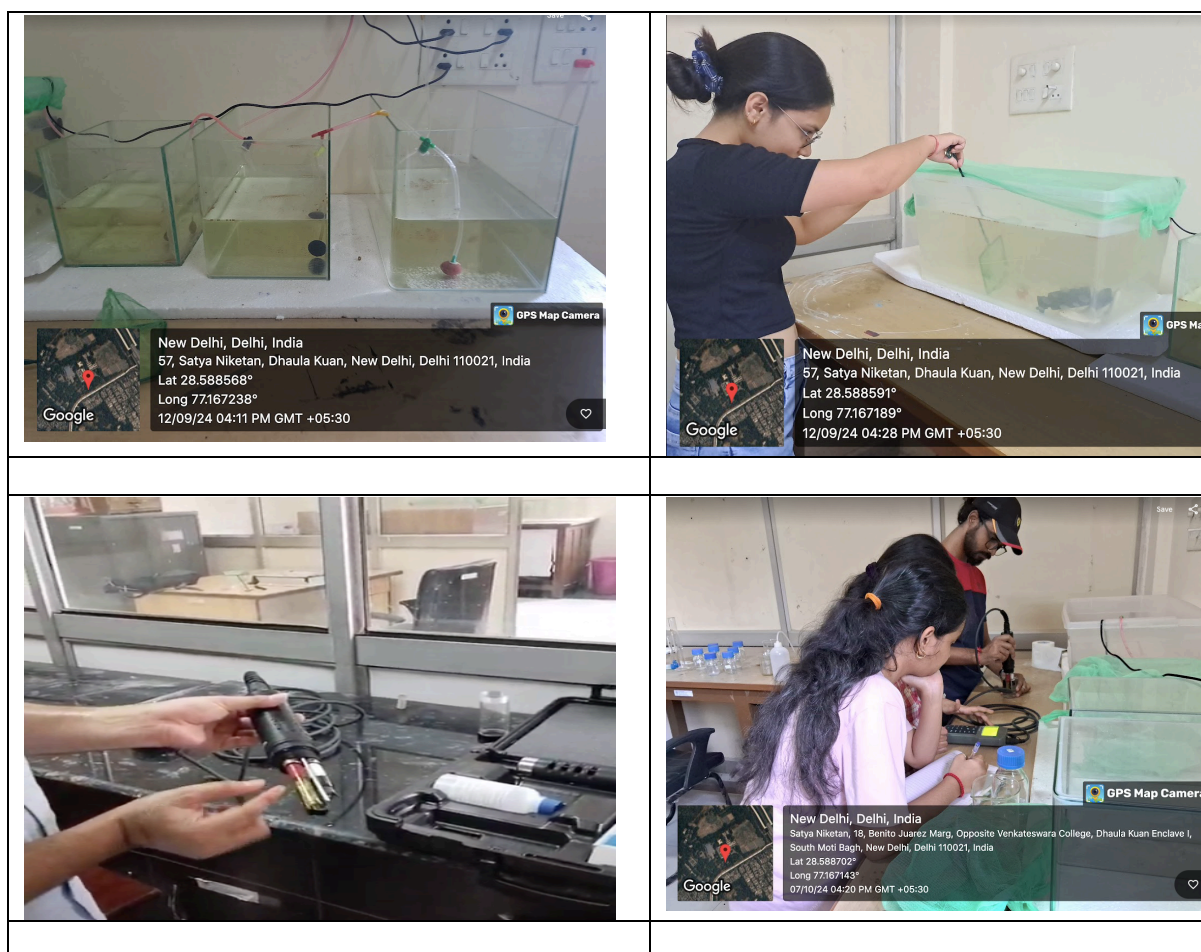
- **Regular Testing:** Daily monitoring of water parameters (temperature, pH, ammonia, nitrites, and nitrates) is essential to maintain fish health.

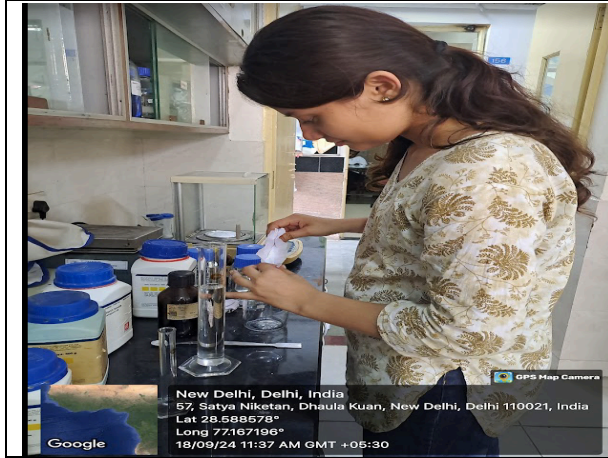
- **Water Conditioning:** Dechlorinators were used to treat tap water.
- **Cleaning Protocols:** Cleaning routines were established for tanks and filtration systems to prevent build-up of waste and algae.

6. Fish Feeding and Care Protocols

- **Feeding Routine:** A feeding schedule was developed based on the dietary needs of the species. Overfeeding can pollute the water.
- **Observation Protocol:** A daily routine was also established for checking fish health, noting any unusual behavior, signs of stress, or illness.

Outcomes: A fish culture laboratory was successfully established. We considered to work on Rohu fish which was easily available and commonly used food. Its scientific name is *Labeo rohita*.

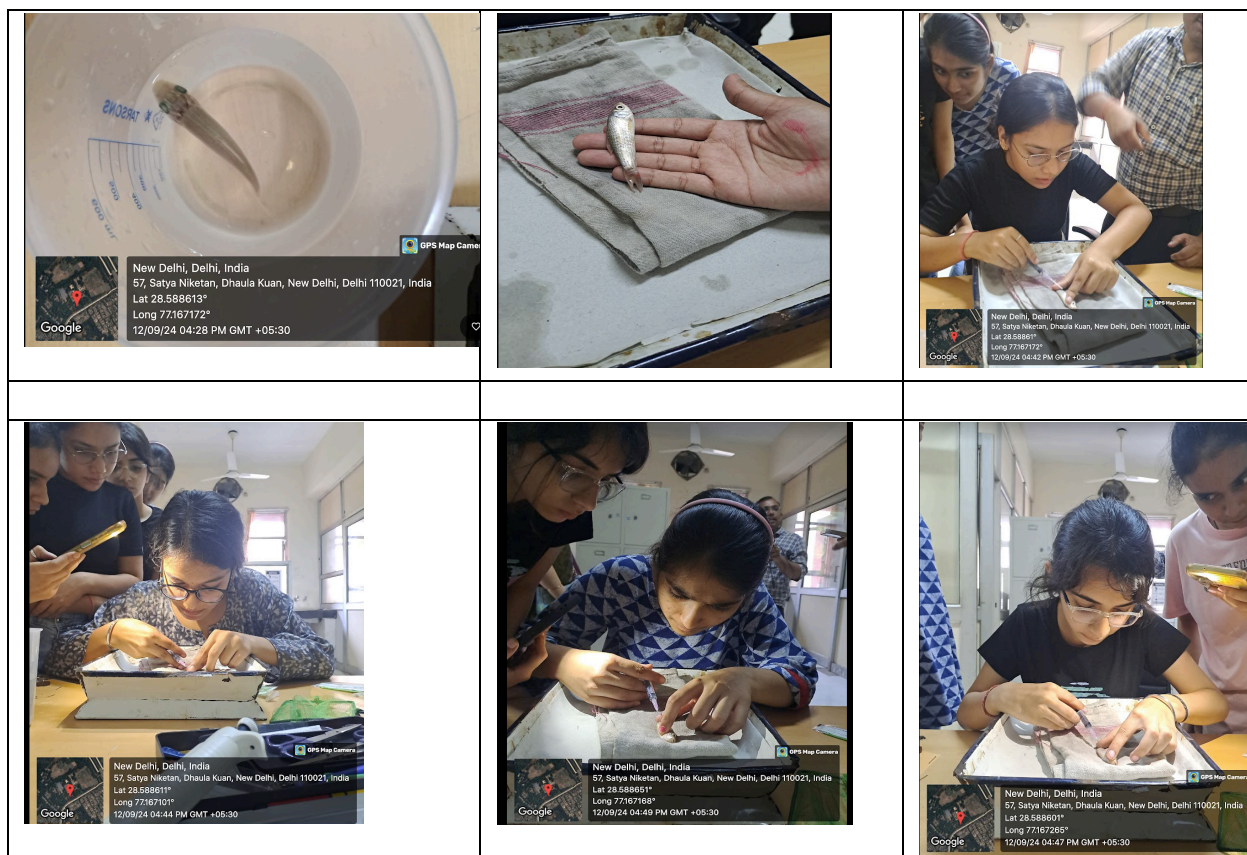


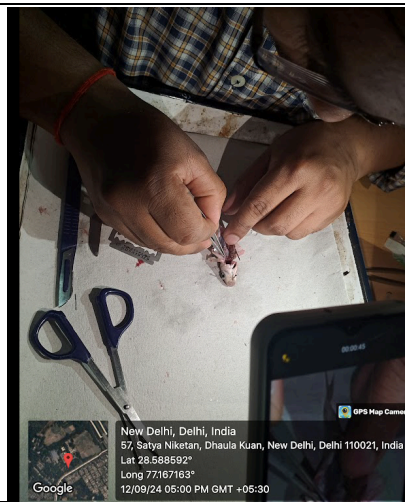
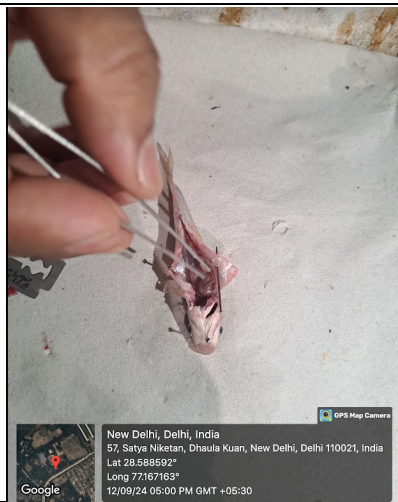
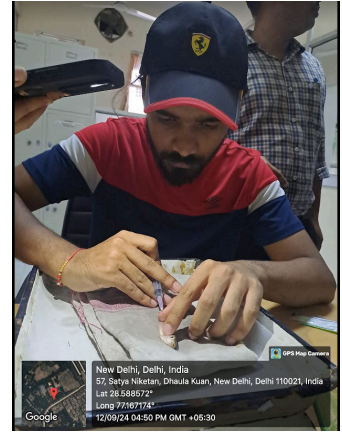
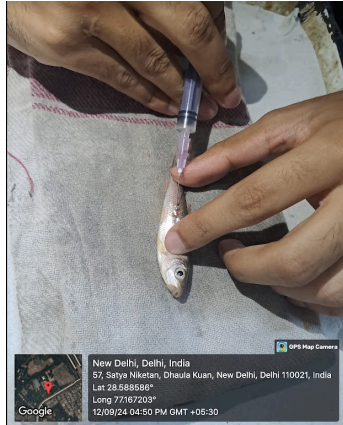


OBJECTIVE 3: TO LEARN THE DISSECTION OF FISH AND IDENTIFY THE DIFFERENT ORGANS IN IT SUCH AS GILLS

Methodology: The fish was first placed on a dissecting tray and neutralised a little bit if it is hyperactive and secured with pins. A mid-ventral incision was made from the anal opening to the gills using a scalpel. Followed by a cut through the muscle layer along the lateral line visible avoiding damaging internal organs. The body cavity was opened carefully and exposed the organs.

Outcomes: The external morphology of fish like types of fins present, type of scales, whether Osteichthyes or not were observed. The fish dissection was successfully performed, and various internal organs like the liver, heart, intestines, swim bladder, and other internal structures were localised. The blood was also collected and preserved for future use.





OBJECTIVE 4: TO LEARN THE ASSESSMENT OF WATER QUALITY BY ANALYSIS OF PHYSICAL PARAMETERS- pH, TEMPRATURE, TDS, ORP, DO, SALINITY MEASUREMENT, CONDUCTIVITY MEASUREMENT.

Methodology:

1) Water sample collection

Water samples from four sources were collected- Aquarium, Pond, Tap, and Distilled water to assess the different physical parameters of water.

2) Measurement Procedure of various Physical parameters of water sample

Multi-parameter pH meter with pH probe, Conductivity/TDS probe, ORP (Oxidation Reduction Potential) probe, Dissolved oxygen (DO) probe, and Temperature sensor were used to assess the physical parameters of water quality. All the probes were cleaned thoroughly with distilled water and handled their sensors carefully so as not to damage them.

pH Measurement: pH probe was inserted into the water sample. Stirred gently to ensure proper contact between the probe and the sample. Waited for the pH reading to stabilize, then recorded the values.

Total Dissolved Solids (TDS) Measurement: It was immersed in the sample. Waited for the reading to stabilise, then recorded the TDS value in ppm (parts per million).

Oxidation Reduction Potential (ORP) Measurement: Inserted the probe into the water sample and waited for the reading to stabilize. Recorded the ORP value in millivolts (mV).

Dissolved Oxygen (DO) Measurement: Placed the DO probe into the water sample and ensured no air bubbles were trapped on the probe. Gently stirred the water sample, as dissolved oxygen can change quickly in stagnant water. Waited for the meter to stabilize and recorded the DO value, usually in mg/L (milligrams per litre) or percentage saturation.

Salinity Measurement: Attached the conductivity probe and after cleaning, immersed it in the sample. Allowed the reading to stabilize and recorded the salinity value in practical salinity units (PSU) or parts per thousand (ppt).

Conductivity Measurement: The same conductivity probe was used for salinity measurement. Rinsed the probe and immersed it in the water sample. Recorded the conductivity reading, usually in $\mu\text{S}/\text{cm}$ (micro siemens per centimetre) or mS/cm (milli siemens per centimetre).

Temperature Measurement: Submerged the temperature sensor in the sample (this may be built into the pH probe or another sensor). Waited for the reading to stabilize, then recorded the temperature in $^{\circ}\text{C}$

Outcomes: Water quality refers to the chemical, physical, and biological characteristics of water, which define its suitability for various uses like drinking, agriculture, industry, and the survival of aquatic life in it. Assessing water quality is essential for understanding water's impact on health, the environment, and human activities. The parameters assessed here are tabulated in Table 1.1.

DIFFERENT SAMPLES OF WATER PARAMETERS	UNITS	Aquarium	Pond	Tap water	Distilled water
pH		8.04	7.85	8.03	6.45
ORP	mV	91.2	106.3	540	430.4
DO	ppm	1.04	1.3	0.5	0.95
Conductivity	μS/cm	313	1548	274	12
TDS	ppm	156	781	137	6
Salinity	PSU	0.15	0.78	0.13	0
Temperature	°C	30.09	26.44	32.5	30.3

Table 1.1 Different physical parameters of water

Discussion: Importance of various water parameters study:

pH: pH is a measure of the acidity or alkalinity of a solution, expressed on a scale from 0 to 14. In water, pH measures the concentration of hydrogen ions (H^+). A pH of 7 is neutral, below 7 is acidic, and above 7 is alkaline (basic). Most aquatic organisms thrive within a pH range of 6.5 to 8.5. Outside this range, certain species struggle to survive due to stress, impaired reproduction, or even toxicity. pH influences the solubility and availability of many chemical compounds. At certain pH levels, nutrients such as phosphorus and nitrogen may become more available or less available to plants and aquatic life.

Oxidation reduction potential (ORP): Oxidation-Reduction Potential (ORP) measures water's ability to break down contaminants. High ORP indicates strong oxidation, which helps kill bacteria and viruses, making water safer for drinking and swimming. Low ORP suggests lower disinfection power, signalling potential contamination. ORP is crucial for monitoring water quality and treatment efficiency.

Dissolved Oxygen (DO): Dissolved Oxygen (DO) is the amount of oxygen available in water, essential for aquatic life. High DO supports biodiversity, while low DO can cause harm to the fish and organisms. DO levels indicate water quality and ecosystem health.

Conductivity: Conductivity measures water's ability to conduct electricity, indicating the presence of dissolved salts and ions. High conductivity levels suggest potential contamination from pollutants or mineral runoff, while low levels indicate purer water.

Total dissolved solids (TDS): Total Dissolved Solids (TDS) measures the combined content of all inorganic and organic substances in water, such as minerals, salts, and metals. High TDS can impact water taste, health, and suitability for drinking, agriculture, and industrial use.

Salinity: Salinity is the concentration of dissolved salts in water. High salinity levels can harm freshwater aquatic life by disrupting osmoregulation (salt and water balance), leading to dehydration and stress. Many freshwater species cannot survive in saline conditions, reducing biodiversity and affecting ecosystem stability and food chains.

Temperature: Water temperature plays a crucial role in biodiversity, influencing the metabolic rates, growth, and reproduction of aquatic organisms. It affects dissolved oxygen levels, as warmer water holds less oxygen, which can stress or kill sensitive species. Temperature shifts impact species distribution, breeding cycles, and food availability, shaping ecosystem health and biodiversity.

CONCLUSIONS AND FUTURE PLANS:

As we know the amount of microplastics in our environment, basically water bodies, is increasing at an enormous amount which are penetrating the systems of fishes and other organisms degrading their digestive, reproductive, and other functions. This is leading to decline in their species further causing extinction. It needs to be regulated to maintain a sustainable environment which is beneficial for both humans and other organisms with whom we share this planet. We aimed to understand the impact of Microplastics in our environment: their impact on fish population and Human reproduction.

Preliminary studies were done in this project with a future goal of assessment of microplastic effects on environment, fish, and human population. The objectives decided for the project work were successfully completed. This project helped in understanding of fish culture lab set-up. The fish dissection and internal anatomy of fish were learned. This learning would be utilised to achieve the future goals of the project. The water quality assessment was also done to understand the difference in water sample from various sources. This learning is essential for fish culture and related studies.