LIMNOLOGICAL AND ICTHYOLOGICAL STUDY OF UDPURIA POND AND RIGHT MAIN CANAL DISTRICT KOTA, RAJASTHAN

A
Thesis

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In the Partial Fulfillment of the Requirements for the Award of the Degree of

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Under the
Faculty of Science

Submitted By
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I feel great pleasure in certifying that the Ph.D. thesis entitled "**LIMNOLOGICAL AND ICTHYOLOGICAL STUDY OF UDPURIA POND AND RIGHT MAIN CANAL, DISTRICT KOTA, RAJASTHAN**" submitted by **Ms. Pinky Sharma** to the University of Kota in the partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy is based on the research work carried out under my guidance.

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ABSTRACT

Water is the basis of life that is also a source of energy that governs the evolution and functioning of this vast universe. Therefore, it is necessary to maintain the quality of water of all the resources that are in human use. The present study is assessment of water quality of Udpuria pond with special reference of ichthyological fauna. The Udpuria pond, under investigation is situated 40 km away from Kota (Rajasthan) near the village Nimoda sultanpur Tehsil in Kota district of Rajasthan. This pond filled from Right Main Canal.

For the assessment of water quality of Udpuria Pond water samples collected from different sites once in the Month. These samples were brought in the laboratory for further analysis for period of two years (November, 2018 to October, 2019, November, 2019 to October, 2020). Samples were collected in the morning hours between 7 am to 9 am. The samples were analyzed on the spot for some parameters (such as Temperature, depth etc.) and brought in the laboratory for further analysis. The parameters such as water temperature, pH, free carbon dioxide and dissolved oxygen used at sampling sites. However laboratory test performed for analysis of sample for total hardness, alkalinity, turbidity, conductance and major Salts, water sample brought to the departmental laboratory for analysis. The standard APHA, (2005) methods were followed for estimation of physical, chemical and biological parameters. Identification of plankton was done by using reference (Needhom). Statistical analysis was done by using ANNOVA. The primary of basic source of data is based on the fish collected from river, direct field observation and information sampling. In the present investigation seasonal variations of physico-chemical characteristics were analyzed and graphically presented. The following ranges were obtained for the parameters evaluated atmospheric temperature 16.4-42.9˚C atmospheric relative humidity 23-96 %, water temperature 16.5-30.9˚C, turbidity 6.9-70.5 cm., electric conductivity 112-460 µmhos/Cm., total dissolved solids 206-487 mg/l, pH 7.6-8.8, free carbon dioxide 0.5-2.3 mg/l, total alkalinity 122-280 mg/l, dissolved oxygen 4.2-7.8 mg/l, chloride 14.8-42.9 mg/l, total hardness 122-275 mg/l, phosphate 2.1-4.9 mg/l and nitrate 1.5-42.9 mg/l. The qualitative study of plankton was observed Phytoplankton and Zooplankton. During present study

twenty species three groups were identified, that is, Chlorophyta, Bacillariophyta, and Cyanophyta. Chlorophyta was dominating group and Bacillariophyta was second dominate group. In the pond the contribution of Chlorophyta and Bacillariophyta is much. Similarly twenty species of Zooplanktons found which are representing three groups of namely-Protozoa, Rotifera, and Arthopoda were reported. Rotifers included 5 species, Arthopoda 8 species, and protozoa 7 species. A total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed in Udpuria pond. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformes representing six species and Anabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeorohita, Catlacatla, Mystus seenghala).* In this pond some species of migratory birds spend their winter and local migrants and resident birds also make nest on trees located on the banks as well as on the mounds situated inside the pond. Mostly visible is Painted Storks that nest in the higher branches of babool trees. Another species of stork, generally seen here are open billed storks and necked storks that because of their being shy avoid communities and stay solitary Other migratory birds that offer a fascinating site to the bird watchers are white breasted waterhen, coots, moorhens, kingfishers, rollers, spot billed duck, golen oriole, Indian peafowl etc. In the present research the word guano is used for excrement of water birds of this pond.

On the basis of above it is concluded all the physico-chemical parameters under study showed considerable seasonal variations. Among the all study and sampling sites I was showing almost oligotrophic water. Sites III, IV and V showed increasing levels of nitrates and phosphates which is showing tendency towards Eutrophication. The pond exhibited good diversity of Phytoplankton and Zooplanktons, Fishes and birds which is indicating towards a healthy aquatic ecosystem.

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DECLARATION

I **Pinky Sharma** hereby certify that the research work presented in my Ph.D. thesis entitled "**LIMNOLOGICAL AND ICTHYOLOGICAL STUDY OF UDPURIA POND AND RIGHT MAIN CANAL, DISTRICT KOTA, RAJASTHAN**" which is carried out by me under the supervision of **Dr. Harish Gautam** and submitted in the partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy of the University of Kota, represents my ideas in my own words and where others' ideas or words have been included in this thesis, I have adequately cited and referenced the original sources.

The work presented in this thesis has not been submitted elsewhere for the award of any degree or diploma from any other insititution or university in Inida or abroed. I declare theat I have adhered to all the principles of academic honesty and integrity and have not misrepresented of fabricated or falsified any idea / data / fact / source in my submission.

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Date: 5.12.2022 **Pinky Sharma**
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This is to certify that the above statement made by Ms. Pinky Sharma (RS/1641/18) is correct to the best of my/our knowledge.

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At this juncture, when I am going to submit my Ph. D. thesis, I am nostalgic about **my father** who is no more to see our dream come true. The time I remember, Papa, you came back late from work after a long tiring day, yet you went off to get my wish-list without cribbing. Papa, every time I asked you for a certain amount of money, you gave me more than what I

asked for, with that perfect smile of yours. I am truly blessed to be the daughter of perfect parents. But yes, now that I have reached an age where I would like to look back and say thank you for everything you did for me. You were the only man that always encouraged to me reach for the stars were you. I am thankful for all the things you prepared me for. A heartfelt and big thank you **Papa !**

I thank the Almighty for giving me the strength and patience to work through all these years so that today I can stand proudly with my head held high.

Pinky Sharma

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ABBREVIATION

S.no.	Abbreviation	Meaning
1.	^0C	Degree Centigrad
2.	Ca^{++}	Calcium ion
3.	Cm.	Centimeter
4.	Cl^{--}	Chloride ion
5.	DO	Dissolved Oxygen
6.	EC	Electrical Conductivity
7.	Km.	Kilometer
8.	m.	Meter
9.	Mg	Milligram
10.	mg/ L.	Milligram per Liter
11.	Ml	Milliliter
12.	Nm	Nanometer
13.	NTU	Nephelometric Turbidity Unit
14.	pH	Hydrogen ion concentration
`15.	TDS	Total Dissolved Solids
16.	WHO	World Health Organization
17.	µmhos/ Cm.	Micromhos per Centimeter
18.	COD	Chemical Oxygen Demand
19.	BOD	Biological Oxygen Demand
20.	TDS	Total Dissolved Solids
21.	TSS	Total Soluble Solids
22.	ppm	Part Per Million

Chapter - 1
Introduction

CHAPTER I
INTRODUCTION

Lakes (both freshwater and saltwater), reservoirs, rivers, streams, wetlands, and ponds are all components of limnology, which is the study of inland waters as ecological systems interacting with their drainage basins and the atmosphere. Limnology describes and evaluates how physical, chemical, and biological environments regulate the functional relationship between growth, adaptation, nutrient cycles, and biological productivity, and species composition.

Limnology comes from the Greek limne, meaning "marsh" or "pond," and the Latin Linnaea, meaning "thing relating to a marsh." Limnology is the study of how the dynamic physical, chemical, and biotic environments of inland waters affect the structure and function of the organisms that live there.

Limnology encompasses an integration of physical, chemical, and biological components of inland aquatic ecosystems with the drainage basin, and biogeochemical changes that occur en route, and with lentic waters and exchanges with the atmosphere.

The foundation of life is water, which also serves as a source of energy for this vast universe’s evolution and operation. Because of this, it is important to keep the water quality of all the resources that people use in good shape.

Life on the earth is never possible without water. Water is an enormous resource of nature and essential constituents of the environment. Less than 1% water is present in ponds, lakes, rivers, dams, etc. which is used by man for industrial, domestic and agriculture purpose. Water is not only a major component but also the best solvent and a medium on which all organisms depend for their existence. Indeed the economics of all life processes and living communities are dependent on this most vital element. A body of fresh water, which provides a variety of human needs, is full of value only when it is not abused and polluted. Rapid industrialization, unchecked

urban growth, random life irrigation schemes, river diversion, dams and bunds for unplanned agricultural extensions may destroy the fibre of man's natural environment causing major hazards to his health and happiness in addition to ravaging the nature beyond repair.

In both urban and rural environments, ponds play a vital role in maintaining biodiversity. Despite their small size, ponds serve important environmental, social, and economic purposes, including providing clean drinking water and supporting local economies. However, waste water discharged from homes, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities, and agricultural pesticides from farmlands have polluted ponds, lakes, and water that recharge groundwater, act as sponges to control flooding, and support biodiversity along rivers. Unwise use, neglect, and mismanagement are causing water to become increasingly unfit for human consumption.

Discharge of urban industrial and agricultural waste has increased the quantum of various chemicals that enter the receiving water which alter considerably their physico-chemical characteristics. The study of limnology requires the consideration of physico-chemical factors in order to comprehend the trophic dynamics of water bodies. Each factor plays an individual role, but the overall effects are the result of all of the factors interacting.

Human activities disrupt the delicate balance of the aquatic ecosystem, leading to pollution that has far-reaching consequences such as fish kill, bad tasting water, offensive odours, and the unchecked growth of aquatic weeds, among other problems. Concern over water quality is now shared by environmentalists and regular citizens alike.

The management of water requires taking into account a wide range of its physical and chemical characteristics. Understanding the metabolic processes in aquatic ecosystems requires careful investigation of a wide range of physicochemical parameters. Each variable affects the others, and together they control how widely

and abundantly plants and animals can spread. Different aquatic organisms, such as planktons and fish, are affected by these variables in terms of distribution and reproduction. The body functions of aquatic organisms can be severely disrupted when these parameters deviate from their optimal ranges.

This thesis focuses on a fresh water pond in Udpuria, which is a popular spot for birdwatchers due to its proximity to a number of human settlements and a fertile agricultural area. Many villagers claim that they have seen these birds in their area for over two decades. Hundreds of young birds, all vying for food and parental attention, fill the area with their chirps during the winter when these birds are in residence. There are ecological values because of all of these features. My goals in this regard centre on investigating the limnological features of the Udpuria water pond.

Due to surrounding agriculture and agro chemical activities rains water flow mix with excess water which used for domestic and agricultural purpose have led to the overexploitation of the surface water sources. Anthropogenic activities done by surrounding people like agriculture live stock, domesticated, household work, transportation, bathing, washing clothes etc. All affect water quality because it adjoins with all above so that this site interesting for study.

Birds comes every year from different stations, live here, do nesting from September to march (Past monsoon season). Presence of bird's effect water quality. Birds excrete excreta (faecal matter), all things interact with water. When birds come here many people reach from different areas (Local and surrounding) and states (Rajasthan and outside Rajasthan). Due to tourism people interact with pond as well as surrounding that's why it is important as ecological and interesting.

Due to all above activities some polluted materials mix in water which is not a part of natural component, mix and change physical and chemical nature of water. Biological components already present in water, they interact with each other, both effect by other outside activities.

Fishes are present in water and some autotrophic and some heterotrophic animals and micro organisms are present in water. Algae, planktons, fishes and other animals and Plants included which are interacting each other and maintain equilibrium and make dynamic system.

In this backdrop we are doing study on the basis physical, chemical and biological parameters so that we can make a base and do monitoring and scientifitic management so that this pond sustain as natural resource.

Therefore we are doing study on the basis of following objectives-

(a) Identification of fish's fauna in the study area.
(b) Collection and analysis of water samples.
(c) Identification of food organism of fishes for example planktons, insects etc.
(d) Recording Seasonal variations in physio-chemical attribute.
(e) Statistical analysis of the data obtained.

Comparative study of fish fauna and limnology of Udpuria and Right Main Canal as flowing and stagnant water.

Chapter – 2
Review of Literature

CHAPTER II

REVIEW OF LITERATURE

It took nearly two centuries of research to make educated guesses about the physico-chemical and biological properties of freshwater bodies.

There is a wealth of information and literature available on all these characteristics. Considering how important water is to industries like healthcare and agriculture, researchers will likely need to work on this issue for quite some time. Literature reviews are important for two reasons: getting an overview of the history of published works and gaining insight into the topics covered in those works.

A limited number of studies have been conducted on the hydrobiological spectrum in Rajasthan. As Olaniyan and Saxena observed, open refuse damps in Jaipur pollute the city's ground water (1977). He said that it is not just the surface water that is being contaminated, but also the groundwater, due to the improper disposal of industrial waste.

CHEMICAL AND PHYSICAL FEATURES

Water quality has been evaluated using these physico-chemical indicators (Goldman and Horne 1983; Boyd and Tucker 1998). When it comes down to it, the water is what makes or breaks a farm's ability to sustain and cultivate animals and plants (Dehadrai, 1992). In order to survive and thrive, aquatic organisms require a nutrient-rich environment. The water's physico-chemical properties have a direct impact on productivity. When all of the physical factors are just right, production peaks (Huet 1986). The goal of aquaculture is to produce the maximum production for marketable species in a given volume of water in the shortest time possible at the lowest possible cost. However, if the water that these organisms depend on for survival is unfit, then they will not grow and reproduce, and the habitat will become a prime target for pathogens and parasites (Barnabe, 1994).

Water from watersheds, marginal runoff, and indoor plumbing are the primary water sources for aquatic ecosystems. A large quantity of organic material, nitrogen and phosphorus, suspended solids, chloride, and potentially harmful organisms have been found in this water. They also deal with a great deal of trash, sewage, and barbarism. These determine how the aquatic environment's flora and fauna will develop (Hynes 1975, Reddy and Graetz 1981, Smart *et al*., 1985). The eutrophication of water is accelerated by the introduction of phosphorous and nitrogen from human waste and fertilisers (Schindler 1974). Pesticides and heavy metals from agricultural and industrial effluents are known to adversely affect living organisms, despite the fact that they may be useful for the secondary production of commercially less valuable higher tropic organisms. Inland freshwater resources have come under increasing scrutiny in recent years due to the myriad ways in which they are being threatened by human activity. It is widely agreed that inland surface water ecosystems like rivers, lakes, and artificial reservoirs are some of the most productive and biologically rich on the planet (Gopal *et al*., 1981).

Three Manglorefresh water ponds' limnology was described by Trivedi (1989). According to his findings, the high pH value is because micro and macro vegetation are producing so much free CO_2 through photosynthesis that the pH balance has tipped toward the alkaline side. Using scientific methods, Gosh and Sharma (1989) evaluate the degree to which pollution has affected the Ganges. Singh (1993) investigated the relationship between the abiotic spectrum of the Ganges at Sahibganj and the density primary productivity and species composition of phytoplankton. To his knowledge, the density of phytoplankton is inversely proportional to the concentration of bicarbonate in the water. Egypt's Lake Manzala was investigated for its chemistry and physics by Khalil (1990). Seasonal changes in the bonny estuary, Niger Delta, were studied by Dublin Green (1990 and 1992). It was thanks to the work of Eronda and Chindeh (1991) that scientists have a better understanding of phytoplankton and the physico-chemical variability of the New Calobar River in Ahu, Nigeria. Holdsworth conducted research into the impact of water treatment on public

health in 1991. He helped spread the word that blue-green algae and macrophytes could be harmed by eutrophication. It's common knowledge that these chemicals are lethal to livestock farms. Abdel Hemid et al., who looked into the Nile River's water quality in Egypt (1992). The Nile River's chemical and physical properties were the focus of his research. The effects of water hyacinth on the chemistry and physics of a pond have been studied in depth by Anija and Singh (1992). According to his findings, nitrate and phosphate concentrations increase in runoff water and industrial discharge.

The limno-chemical characterization of H_2O quality in River Densu in GHANA was presented by Ansa-Asare (1992). As a result of their research, they discovered that the rising population was to blame for the decline in water quality. Most shallow lakes have become turbid due to the increased nutrients, especially phosphorus (Scheffer *et al.*, 2005). As Mathuthu *et al.*, discuss, there is a need to monitor the quality of the water in the Mukuwisi River in Zimbabwe (1993). Phosphates are the most widely recognised group of pollutants; they can cause algal blooms and other forms of excessive plant growth. Total dissolve solid as toxicants in effluents are characterised, identified, and confirmed by Mc Culloch *et al.*, (1993). O' Neil's research on environmental chemistry was published in London that same year (1993). He looked into the claim that trace metals are widely recognised as pollutant elements. Langenegger (1994) investigated the state of Africa's ground water. The research on water pollution in Nigeria that Egborge (1994) presented was groundbreaking. The role of man-made wetlands in water pollution has been studied by Wood (1995). According to his talk, it's crucial to keep an eye on a body of water's physico-chemical characteristics for both long and short-term analysis, UNESCO Water Quality Assessment Workbook by Chapman (1996). He explained European Union mandates certain pH levels as a safety net for aquatic ecosystems and fisheries. Chaudhary and Nadeem conducted research on the Indus River to determine how seasonal changes affected the river's physico-chemical parameters (1997). He noted that the environment and its inhabitants, including the blind Indus dolphin

(Plantanista minor), were affected by physical, chemical, and biological factors. To address the issue of water pollution caused by industry, Richman wrote about it in 1997. He pointed out that coliforms are a dangerous group of microorganisms commonly found in sewage, and their presence in water suggests that some water supplies may have been tainted with sewage from human or animal waste. The chemical and biological development of pollution in the Sabarmati River near Ahmdabad was investigated by Shahji and Patel (1991). The Kali River in Dhadeli, Karnataka, was the subject of an ecological study by Baharti and Krishanmurty (1991). Das and Sinha monitor the pollution levels in the Ganges River in Patna, Bihar, in 1994. The limnological profile of the Ramaganga River was studied by Chandra *et al.*, (1996).

Studies of a semipermanent pond's limnology can be found in Swarnlata and Rao (1997). The average concentrations of the elements hydrogen carbonate, bicarbonate, chlorides, dissolved oxygen, and calcium are 192.4, 194.7, 6.4, 53.7 ppm, and 53.7 ppm respectively. Total hardness averaged 269.1 ppm and silicates averaged 6.4 ppm, while organic matter iron and phosphate concentrations were low. Some physico-chemical features of the Kali River in Karnataka were also studied by Krishnamurthy and Bharti (1997). The ecosystem of Karnataka was the subject of research by Survan and Somashekar in 1997. Researchers found that changes in temperature and total solids significantly influenced the range of blue-green hues. As temperature drops, diatom concentrations rise, with the highest concentrations occurring in the winter.

The correlation between various ground water quality parameters has been investigated by Jain and Sharma (1997). There is a positive relationship between electrical conductivity and TDS, which is the strongest of any parameter examined. These findings suggest that dissolved solids contribute significantly to the ground water's electrical conductivity in this area. Chloride, nitrate, sulphate, sodium, potassium, and calcium all have a strong correlation with electrical conductivity, total dissolved solids, and total hardness. This suggests that salts of sodium, potassium, and calcium can be found in the region's ground water in the form of chloride, nitrate,

and sulphate. The presence of sodium chloride in these waters is indicated by the strong positive correlation between sodium and chloride. Total hardness correlates well with concentrations of calcium, nitrate, and chloride, suggesting that the chloride and nitrate salts of calcium are primarily responsible for the hardness of the ground water. Magnesium and pH have the strongest negative correlation. The physicochemical characteristics of the highly eutrophic temple tank in Bikaner have been studied by Bahura (1998).

Analysis of the dam's chemistry and physics was looked into by Saluja and Jain (1998). An alkaline pH and a specific conductivity ranging from 318 to 680 umho/cm were found during this investigation. Concentrations of chloride were measured to be between 66.5 and 198 mg/L. The increased chloride concentration at sampling point 3 is primarily attributable to sewage contamination. The levels of nitrite and nitrate were measured to be between 1.55 and 4.84 mg/L. Ca and mg hardness values also varied widely, between 77.1 and 125.2. Electrical conductivity ranged from 318 to 448 umhos/cm, and the percent sodium varied from 14.20 to 19.60. Clearly, the water quality at the MachnaAnnicut Dam is very high. The pH range he observed in his research was 7.30–8.2. Quantities of total solids can be anywhere from 244mg/L to 500mg/L. We measured total dissolved solids (TDS) between 170-399.5 mg/L and total dissolved solids (TSS) between 60-109.5 mg/L, and total alkalinity between 84-164 mg/L. Chloride concentrations in ground water ranged from 29.82 to 200.35 mg/L, and sulphate concentrations from 19.20 to 148.8 mg/L. The total hardness was variable, between 230 and 704 mg/L. The physico-chemical properties of Bundha-Nallah water have been analysed by Bath and Kaur (1999). Water temperatures in this study ranged from 19 to 37 degrees Celsius, with higher values observed in the summer and lower values observed in the winter. In the winter, the water had a high pH, but in the summer and monsoon, the pH was low. Increased primary productivity in the winter leads to a higher concentration of hydroxyl ions in the water. This is why carbonate, sulphate, nitrate, and phosphate all have high concentrations in the water during the winter. The dissolved oxygen level was extremely low, ranging from

0.3 to 2.4 mg/L. This is hard water, with total alkalinity readings ranging from 120 to 210 mg/L. Extremely high levels of chlorides, ranging from 300 to 1220 mg/L, were measured, with the highest concentrations occurring in the summer. The current research confirms that Bundha-water Nallah's is highly contaminated and presents a serious risk to the health of local population. Diel variation in some water quality parameters at Hnumantal Lake has been studied by Jain (1999). The pH of the entire survey sample was stable, he discovered. Carbonate and bicarbonate ions in water have a high buffering capacity, which may explain this phenomenon. While the demand for oxygen in biochemistry did not change, the amount of dissolved oxygen in the water did. The grime and perspiration of the bathers increased the concentration of chloride. The lake's alkalinity rose as a result of this.

With an eye toward fish farming, Puria and Konar (1999) evaluated the ecological status of impounds water in the Cooch Bihar and Darjeeling district. Numerous researchers have examined the qualitative and quantitative characteristics of various bodies of water. The effects of human activity on the physicochemical and biotic characterisation of freshwater bodies in Varanasi were evaluated by Gupta (1999). Hosmani*et al.*, who studied the biochemical parameters of selected Mysore lakes for their ecological significance, found that the lakes had a number of unique ecosystems (1999). Based on analyses of glycolic acid, chlorophyll, phycobili proteins, and total dissolve solids, they provided biochemical perspectives on water pollution. Cuddalore, Karuppasamy, *et al.*, studied seasonal changes in nutrient levels in the Uppahar estuary (1999). He found elevated temperatures and salinities as well as low levels of dissolved oxygen and nutrients, all of which pointed to a high pollution load caused by runoff from the SIPCOT industrial complex. Ramakrishna and Santhanam discussed the results of spatio-temporal variations in hydrogeographical features in the pichavaram Mangroves and the Mahi Aqua from the South East Coast of India (1999). A decrease in temperature, salinity, and primary production in the summer's highest pH due to sea water penetration and biological activities would explain his observed high DO levels during the monsoon. Pandey and Tyagi investigated the link

between algal productivity and the physicochemical characteristics of a tropical freshwater lake (1999). Upon closer inspection, he realisedthe levels of nitrogen and phosphorus in the lake were found to be the most important regulators of the variations in algal pigments, biomass, and productivity.

Water dissolved oxygen levels in the Godavari River were found to be dependent on ambient temperature changes, according to research by Shivanikar and Bandela (1999). He looked into the possibility that the decrease of DO level discovered at mind stream and downstream stations due to sewage discharge was caused by the summertime increase in water temperature. Tiwari conducts physico-chemical research on the water in the upper lake in Bhopal, Madhya Pradesh (1999). Physical and chemical tests concluded that the water was safe for human consumption and irrigation. Nandini (1999) found that the physico-chemical parameters and planktonic community structure of a series of sewage stabilisation ponds varied, indicating the presence of plankton blooms.

The South CGA comparison performed by Fapteau (2000). In his talk, he said that the effects of bacterial and viral infections transmitted through water are well-known, but that nitrate contamination in water in large quantities is fatal. Analysis of the chemical and physical characteristics of a man-made lake in Sindh, Pakistan.Have been completed by Nazneen and Begum (2000). It was discovered that sudden temperature drops favour phytoplankton over zooplankton. Seasonal changes in the physical and chemical properties of water from the rivers Ravi and Chenab were investigated by Ali *et al*., (2000). He said that the plants and animals are suffering because of physicochemical and biological factors.

Agarwal et alresearch's on the effects of sewage in the Varuna River, which includes domestic water and heavy metals, was published in Environmental Science and Technology (2000). He concluded that the river's nitrated and phosphates came from untreated sewage. The National Monitoring Programme implementation manual draught Pectoira was provided by Murray *et al*., (2000). Among the potential

negative effects eutrophication may have on drinking water treatment costs, he mentioned its potential elimination. Organo chlorine residues in the water of Keoladeo National Park, Bharatpur was the focus of research by Mualidharan (2000). The plankton population density in the rivers of Pune was investigated by Yazdandoost and Katdara (2000) in relation to the physico-chemical properties of the water. He saw that the native aquatic organisms' abundance, species composition, stability, productivity, and physiology were all affected by the water quality. More and Nandan conducted a hydrobiological investigation of the algae in the Panzara River in Maharashtra (2000). For measuring organic pollution in water, he noted that algal growth is a useful indicator. For example, in 2000, Pani and Mishra discussed how hydraulic detention affected the water quality features of a tropical wetland (Lower Lake). He discovered that the lower lake's water quality had deteriorated significantly more than the water in the upper lake. The impact of heavy metal pollution in Vishakhapatnam's harbour water was studied by Rao and Padmaja in 2000. Khanna *et al*., research's on the effects of abiotic factors on pond phytoplankton (2000). Some pools close to the river Tawi were studied by Dutta *et al*., (2000), who looked into the dietary variation of abiotic factos (Jammu). Kumar *et al*., looked at how contaminated water affected people (2000). Maruti *et al*., on the pollution levels in the Sarda River at Anakapli A.P. (2000). Primary production in a freshwater temple tank in Kerala was studied by Hari Krishna and Azis (2000). The potability of water in the Kattarakar region of Kerala was studied by Thomas *et al*., in 2000.

Biswas and Konar investigate how the water flow from the Nuria Nullah affects the number and variety of plankton in the Damodar River (2000). The chemistry and physics of Gandi Valley water was investigated by Marvarkar and Hosetti in 2000. (Shimoga). Human impact on water quality was discussed in the context of limnological considerations of seasonal pools in the Ahar River in Udaipur, as presented by Sharma and Vyas (2000). Some variations in the physical and chemical properties of the Ganga water at Rishikesh were studied by Gautam *et al*., (2000). Dissolved CO_2 in water is dependent on carbonates and bicarbonates, and is at its

highest in the summer and lowest in the winter, as reported by Borse and Bhave (2000) (36). Water acidity and carbon dioxide levels also played a role. They found that Chlorococcales species had the ability to survive high nutrient concentrations. Perennial wetland ecology has been investigated by Verma *et al*., (2001). They have looked at the chemical and biological makeup of the substance. In 2001, Bahura reported on the diurnal cycle of a few abiotic parameters at the Ganjar Lake Bikaner in India's arid Thar Desert. In most cases, regardless of the season, the bicarbonate alkalinity of deep water was lower than that of the surface. A higher concentration of chloride can be expected in deeper water. Umata River in South Africa had its water quality analysed by Fatoki *et al*., 2001. A greater degree of turbidity in the river was reported. Analyzing the effects of pollution from isolated sources KeisKammahoek Morrison *et al*., Keiskamma's River sewage treatment plant (2001). According to their research, fisheries and aquatic life thrive best in neutral to alkaline pH.Odzi River in the eastern highland of Zimbabwe was researched for its water quality by Jonnalagadda and Mhere (2001). According to his findings, there is a minimum temperature that must be met at a given location in order to preserve local biodiversity and curb the spread of pest species. Because of the potential for waterborne disease, the microbiological and physico-chemical analysis of different sources of drinking water in Abeokuta, Niger conducted by Edema *et al*., (2001) highlights the critical importance of preventing water contamination from any source.

Rao *et al*., (2001) analysed various physico-chemical parameters to improve the quality of drinking water drawn from ponds in the Kollere Lake region's rural communities. An efficient water quality index for lake management was developed by Cude (2001, 47). Chinmoy and Raziuddin (2002) (43) reported the water quality index of degraded waters in industrial areas; Bate *et al*., (2002) (21) conducted a comprehensive study on diatoms as pollution indicators. Hosmani (2002) (87) also described the interrelationships of phytoplankton and zooplankton, and Hosmani and Lingnnaiah (2002) (89) investigated the causes of fish mortality caused by algal blooms.

Amphibians have been the focus of Dube *et al*.,(2002a)'s research into the ecobiology of seasonal water bodies in the southeastern plateau of Rajasthan. Physicochemical characteristics of temporary water bodies in the southeastern plateau of Rajasthan were described by Dube (2002b) (i.e. Kota, Bundi, Baran, and Jhalawar district). Hydrobiological studies of two Satna ponds are conducted by Singh *et al*., 2002. (M.P.).He came to the conclusion that the need for water in all forms of life, from microorganisms to humans, is an urgent issue because water resources have been depleted to an alarming degree as a result of unchecked urbanisation and industrialization. The dismal condition of the Ganges was documented by Biswas and Konar (2002) at Hathidah (Bihar). The current state of river pollution in India was examined by Prakash (2002). The degree of eutrophication, Saprotrophicatin, and pollution in the Mouson River in Maharashtra was investigated by Nandan and Ansari (2002). Das and Ghosh created a mathematical model to predict the pollution levels in a given river (2002). The ecological status of Manipur's Barak and Jiri rivers was surveyed by Vishwanath and Kosygin (2002).

Kalff (2002) investigated the limnology of the United States' inland water ecosystem. Physical and chemical factors in algal diversity in two Faizabad ponds were investigated by Dwivedi and Pandey (2002). He explained how the circulation, cooling, and dilution of dissolved oxygen (DO) in water cause water to reoxygenate during the winter. The Physico-chemical and Microbiological Status of the Munia River was Evaluated by Chattergee and Raziuddin (2002) (West Bengal). This account focuses on the Indian context and incorporates a summary of recent literature (e.g., since the turn of the century) on the topic. When Ghaffar *et al*., (2002) fertilised two water bodies with varying amounts of urea and phosphoric acid, they found that the pond ecosystem underwent noticeable changes.

Research into the physico-chemical properties of the water sources near Jaipur has been conducted by Srivastava *et al*., 2003. The lakes of Jalmahal, Nevta, Amer, and Ramgarh all had water samples taken for testing. High levels of pH, hardness, alkalinity, free CO_2, Zn content, and low dissolved oxygen were found to be the main

causes of water pollution in Jalmahal Lake. Unlike other polluted lakes, Ramgarh Lake has high levels of dissolved oxygen and low concentrations of acidity, alkalinity, carbon dioxide, hardness, and zinc. According to Beklioglu*et al*., (2003).

Investigations into structure and function dominate the field of study. Many limnological and environmental factors that affect water systems. Recent decades have seen a surge in research into phytoplankton nutrient limitation in response to the widespread increase in anthropogenic nutrient loading into water bodies. Kasmane River Water Quality in Thiruvanantpuram District, Kerala, as Assessed by Jayaram and Vasuena (2003). Pandey and Pandey are responsible for dumping sewage into the Sarya Faizabad River (2003). Rainfall in the catchments area may have contributed to the low EC values he observed during wet seasons. Assessment of pollution in the Keiskamma River in South Africa was provided by Fatoki*et al*., 2003. The physico-chemical quality of Elechi Creek in Port Harcourt, Nigeria, was investigated in 2003 by O obire et al. They determined that dissolved oxygen was a crucial factor in regulating water quality. It was demonstrated by Hariprasad and Ramakrishnan (2003) (81), using algal assay, that organic pollution could be quantified. Diatoms were used by Juttner *et al*., (2003) (117) as a proxy for stream water quality. The ecology of the amphibians in southeastern Rajasthan has been the subject of Dube's (2003) research. Ecological parameters, behavioural parameters, and the effects of their environments are discussed. Three reservoirs in a pond in southern Orissa, India, had their physico-chemical parameters recorded by Das *et al*., in 2003.

Ahmed (2004, 6), for example, described a novel index for gauging stream water quality. The downstream wetland ecosystem of the Bidyadhari River in West Bengal was investigated by Kumar and Siddarty (2004). It was his observation that pollutants in industrial sewage could have a multiplicative effect on biological systems, increasing the risk of cancer. Artificial aeration and ozonization have been shown to have a negative effect on pathogenic bacteria in a tropical sewage-fed lake, and Varughese and Mishra (2004) add to our understanding of this phenomenon. Organic enrichment of the lake through floral offering; Idol immersion; and decomposition of

aquatic weeds are also significant causes of eutrophication, he concluded, as is the use of untreated wastewater, which contains effluents rich in Phosphate, Caustic Soda, and Detergent, etc. The fresh water status was observed by Kumar and Ghosh (2004). The Krishna River's pollution load was evaluated using a mass balance approach by Chandra and Umamahesh (2004). Non-point sources, such as agriculture, soil erosion, mineral dissolution, and other natural processes, were found to account for the bulk of the pollutants in the mass balance results. The calcium and magnesium behaviour in the Rushikulya estuary (Orissa), east coast of India, was studied by Mahapatro in 2004. Concentrations of these elements seemed to be on the rise. In 2004, Nayak *et al*.,looked into the ebb and flow of water quality in Chilka Lake, Orissa. Correlation analysis supported his findings of increased pH, high photosynthetic activity, high nutrients, and phosphate depletion due to phytoplankton utilisation in the fresh water zone, and his findings, higher pH zones with low salinity reflect the breakdown of submerged weeds.Domestic water pollution in winding town was evaluated by Paul and Mishra (2004) The Indian state of Assam. It discusses the results of his analysis of various physico-chemical parameters and their potential impact on human health in the context of water quality issues. River Irai water quality evaluated according to seasonal changes in dissolved oxygen and biological oxygen demand in Irai Valley, District. As for Chandrapur, it was completed by Sawane et al (2004). He found that the decreased DO content was caused by hot ash slurry from a thermal power plant, and the increased BOD values in the river water indicated an increase in the quantity of industrial effluents. Dissolved oxygen concentration in the Hathli stream in the Shivalik Himalayas was studied by Sharma *et al*., (2004) to determine the impact of pollution. Results of work demonstrated H_2O is unfit for human consumption, sanitation, wildlife, or aquaculture. Subramaniam (2004) investigated the condition of South Asian water supplies. According to his findings, both liquid and solid waste contributes to water quality issues, and the subcontinent also has fluoride and arsenic problems. Physical and Chemical properties of $H_2O$and its surroundings in Jaipur's Jamwaramgarh wetland were investigated by Moundotiya *et al*., (2004). Temperature, acidity, alkalinity, hardness, and chloride ion

concentration are among the parameters tracked. Perhaps because of its high buffering capacity, the water in Ramgarh Lake had a pH that varied from 6.8 to 8.5. During the summer months, the electric conductivity was at its highest, while it was at its lowest during the monsoons. The summer months had high alkalinity while the monsoon months had low alkalinity. Hard water is indicated by total alkalinity readings ranging from 102.6 to 215 mg/l. They reasoned that if things kept going the way they were, Ramgarh Lake might stop being ecologically active in the near future.

Dube (2005) investigated the pond's chemistry and physics in Baran, Rajasthan, India. Oganfowkan *et al*., evaluated the effects of point source pollution on a pond (2005). He pointed to changes in the treatment of municipal sewage as a possible cause of the rise in chemical oxygen demand. The physico-chemical properties of a semipermanent pond in Baran Rajasthan, India, have been investigated by Dube (2005a). Distribution patterns of amphibian biodiversity in the southeastern plateau of Rajasthan, India were investigated by Dube and Sharma in the same year (2005b) in relation to habitat and niche ecology. Jhalawar, in the Baran district of Rajasthan, is home to a plethora of amphibian species.

Asadi and Reddy have been tasked with evaluating and mapping water pollution indices in zone III of Municipal Co. Hyderabad (2005). Water quality in a few industrial and densely populated areas was poor, as evidenced by high concentrations of total dissolved solids, nitrates, fluorides, and total hardness, while water quality in the remaining areas was moderate to good.NORTH BENGAL TERAI RIVER KALJANI, a tributary of RIVER TORSA, was studied by Bhadra *et al*., 2005, who compared its basic water quality parameters to those of the Torsa itself. In comparison to Kaljani, he found a wider alkalinity, ammonia, and chloride distribution in Torsa.

Hydrobiological study of Natragar Pond in Dhar District (M.P.) by Dhakad and Chaudhary (2005), paying particular attention to the effect of water quality on drinking, farming, and fisheries. Due to the high concentration of califorms, the water

is good for irrigation and pisciculture but not for human consumption without purification. The toxicity of the water in Keetham Lake was evaluated by Gautam and Gautam (2005). He saw that Keetham Lake was tainted by a variety of chemicals from factories, farms, and homes. Numerous physico-chemical characteristics, such as pH, hardness, BOD, COD, etc., often affect water quality because of the relationship between water quality and aquatic toxicology, which includes biotic and abiotic components. Ground water characteristics and the effects of textile unit effluent discharge were investigated by Kannan and Sasikumar (2005). Their ion concentration is higher than what is allowed by the ISI. All the water at their locations was too hard, too brackish, and not fit for human consumption. Physicochemical characteristics of Radha Kunda Distt. Mathura, India lentic water was studied by Kumar and Sharma in 2005. Overly high levels of bacterial oxygen demand, chemical oxygen demand, and ammoniacal nitrogen were detected. The seasonal distribution of physico-chemical parameters in the effluent discharge area of Uppanar estuary, Cuddlalore, South East coast of India was studied by Rajaram and Rajasegar (2005). As a consequence, nutrient concentrations were highest during the monsoons and lowest during the summer. Research on the nutrient content of Ooty Lake was conducted by Thilaga *et al*., (2005) in relation to pollution. Eutrophication-causing nitrogen and phosphorus can be found in the water, which he attributes to the discharge of municipal sewage and runoff from the surrounding area.

Chandra and Prasad found that the water quality in Surya Kund, Lohargal, Rajasthan, deteriorated after a day of mass bathing (2005). He looked into several indicators of water quality. To stop epidemics from breaking out, proper safety measures must be taken.Based on the findings, it is clear that the nallah and the areas around it have been significantly polluted by the discharge of untreated industrial effluents and sewage into the groundwater supply. The ground water quality in SANGANER, JAIPUR Distt., was studied by Sharma and Sahu in 2005. High levels of TDS and chloride were found to correlate with high levels of pH, EC, and alkalinity across all samples.

Research on the limnological dynamics of Africa's artificial lakes was presented by Ayoade *et al.,* 2006. He said the river had lower DO levels because it was more polluted. Verma and Dixit have studied the impact of aeration devices on enhancing the quality of water in lower Lake Bhopal (2006). It controls nearly every biochemical reaction and process in the body. Upper lake Bhopal's physico-chemical status was studied by Tamet and Sharma (2006). He discovered that the washing, bathing, agricultural activities in fringe areas, joining of domestic raw sewage, cultivation of trapa, and enormous growth of aquatic Macrophytes are major contributors of phosphate and nitrate to the lake's loading. The rapid growth of aquatic plants is stimulated by these nutrients, leading to the gradual shrinking of wetland area and other complications such as low light penetration, reduced oxygen, closed water channels, and depleted oxygen levels, which kill fish. The reliance of ground water quality on precipitation was investigated by Joseph and Parameswarn (2006). Kanase and Kadam measured the sulphate concentration of the Mula and Muth rivers in Pune (2006). Seasonal variations in Maharashtra's lentic water bodies were studied by Patil and Dongare (2006). Nagaraja and Nagesh (2006) examined the connection between agricultural practises and quality of ground H_2O in the ChinnaHagari basin in Karnatak. Ojha and pandey (2006) studied the effects of fertiliser on pila in rural Chapra, paying particular attention to how it altered the pila's morphology and mortality rates. High fluoride in Orissa's ground water was analysed by Srivastava and Tiwari in 2006.

Lake Jaisamand, one of the oldest man-made lakes in India, was studied by Durve and Rao (2006), who looked at seasonal variation in primary productivity and its relationship to chlorophyll there. The lake's primary productivity showed a bimodal distribution, with the first peak occurring at a higher value (7.605 g/m^2) in July and the second at a lower value (5.851 g/m^2) in December. Hosmani (2006) (93) calculated the trophic state indices for the lakes of Mysore and deduced that values between 40 and 50 indicated mesotrophic conditions (moderate pollution), greater than 50 indicated eutrophic conditions (highly productive), and values below 40

indicated oligotrophic conditions. In their investigation of the Mysore lakes, Thomas and Deviprasad (2006) (212) concluded that sunlight, phosphates, nitrates, oxygen, and carbon dioxide all play crucial roles in Myxophyceae growth. Chaurasiya and pandey conducted a study of the physicochemical properties of water in several ponds in the Ayodhaya-Faizabaad region (2007). The Girma dam in Maharashtra's Nashik district was the focus of research by Nandan and Magar (2007), whichanalysed the dam's chemical and physical properties in detail. Ramesh *et al*., (2007) in the Coimbatore distt. Singanallur Lake, the water quality is unfit for the survival of aquatic organisms. Physical, chemical, biological, and other factors all contribute to what we call the water's "quality."

Khirgali pond, Indira pond, Vidhya kund, and Dantdhawan pond water were analysed for their physicochemical properties. It was found that the levels of TDS, BDO, alkalinity, total hardness, and total phosphate were excessive, while the levels of pH, DO, and total nitrates were within acceptable ranges. The water in Khergali Pond is the dirtiest of all of them. The author argues that because these bodies of water are fit for human consumption, they should be prioritised among Ayodhaya-water Faizabaad's resources in any efforts to restore them. All of the aquatic ecosystem's processes, including food webs, energy transfer, and nutrient cycling, are affected by zooplanktons (Park and Shin, 2007).

Gupta and Chakrapani examined the temporal and spatial variability of water flow and sediment load in the NARMADA RIVER (2007). Ground water in the upper Gunjanaeru River basin in A.P. was the subject of research by Janardhana Raju (2007), who estimated its chemical properties based on the seasons. From measuring the electrical conductance and the Silica in the ground water, he calculated the TDS. Ground water in Yavatmal, Maharashtra, has been studied for fluoride by Madhnure and Tiwari (2007). Foraminifera were provided by Siva Kumar and Kumar (2007) as a method of detecting marine pollution and environmental modification. Water quality in the Ougun River has assessed by Jaji *et al*., 2007. According to his research, rain has the potential to dilute the intensity of point source pollution during

the summer and spring. Physical, chemical, biological, and microbial indicators were compiled by Soni and Bhatt (2008).

The effects of humans on a lake ecosystem were investigated by Zutshi *et al*., (2008). Bangalore, a modern technology hub, once boasted more than two hundred and ninety lakes, but today only about eighty-one remain, only twenty-one of which are believed to be actively inhabited. There is a lot of sewage and effluents that flow into the lakes near Bangalore's cities. Oxygen depletion, elevated chlorophyll a, total dissolved solids, biological oxygen demand, phosphate, sulphate, ammonia, and high alkalinity are just some of the clear indicators that the concentration of nutrients has changed, resulting in the growth of algae that kills off fish in large numbers. Even hardy fish species like Murrels, Clarias, singhi, etc., have vanished from a handful of severely polluted lakes in and around Bangalore city. These lakes include Bellandur, Varthur, Ulsoor, Byramangla, Madivala, Agra, and Nagawala.

Aquaculture pond water discharged into the Bhitarkanika mangrove ecosystem was studied for six months by Mishra *et al*., (2008) to estimate physical-chemical parameters of pollution. The physico-chemical results were compared to those from the central and state pollution control boards as well as the Bureau of Indian Standards. There is localised variation in a number of environmental factors, including pH (ranging from 5.63 to 8.5), dissolved oxygen (from 3.0 to 8.3 mg/L), total hardness (calcium, magnesium, phosphate, and chlorine), and nitrate. According to the results, there is currently no pollution threat from aquaculture pond water to the mangrove ecosystem. Patil and Kulkarni evaluated the reservoir of fish culture in the Thodga TQ Ahmedpur district in Latur, Maharastra, for a variety of physico-chemical factors (2008). Water temperature between 23.75 and 23.07 degrees Celsius; air temperature between 31.84 and 31.84 degrees Celsius; DO between 8.27 and 8.27 milligrammes per millilitre; pH between 7.85 and 7.92; total alkalinity between 6.04 and 6.04 milligrammes per millilitre; turbidity between 39.71 and 41.42 centimetres; primary productivity between 235.04 and 241.49 milligrammes per cubic metre per hour. Since the reservoir's physico-chemical values are well within the allowable

range, it can be safely used for fish farming. Kishore Sagar Lake in Kota, Rajasthan's physico-chemical characteristics and diatoms are assessed by Kumar *et al*., (2008) as trophic status indicators. There were a total of 42 species of diatoms in the ecosystem, 8 of which were centric and 34 that were pennate. The most abundant species were Melosiragranulata, Cocconiesplacentula, Diatomaelongatum, Fragilaracrotoneinsis, Ghomphonemaolivacium, Ghomphonema sp., Navicula radios, and Synendra ulna. It was found that winter is when diatom populations are at their highest. Diatoms are able to grow in low light and low temperature, which likely explains why they are so numerous during the winter. The preponderance and saturation of diatoms Evidence of eutrophication can be seen in the wetland. The lake's water quality has deteriorated, posing a risk to both humans and aquatic life. Srivastava et al. subsequently monitored zinc and endosulfan and evaluated the physico-chemical parameters and zinc concentration of water bodies near Jaipur such as Ramgarh, Nevta, Jalmahal, and Amer, and their effect on physiological functions (2009). While Jalmahal had the highest zinc and endosulfan concentrations (1.324 and 0.197 mg 1), Ramgarh Lake had the lowest (0.020 and 1.20 mg 1). Human activity, including farming in previously wet areas, appears to be a major contributor to pollution in these lakes. Often, eutrophication and acidification are caused by human activities, and the introduction of invasive plants and animals leads to a loss of biodiversity (Kruk *et al*., 2009). Fluorescence measurement suggests that the lake water quality is influenced not by the Geological characteristic but by the combination of flora and fauna and anthropogenic degradation sources. It appears that fluorescence spectroscopy can be used to assess and keep tabs on a water system's health, opening the door to the study of meteorological and hydrological phenomena in near-real time (Guillermo, 2009). Sen (2009) reported values of physico- chemical parameters and 17 fish species after evaluating the flora and fauna of Kisan Sagar Pond Jhalawar. Kisan Sagar Pond Jhalawar's flora and fauna were evaluated in terms of their physicochemical characteristics by sen (2009). Seventeen different kinds of fish were identified by him. The production of fish in the Jhalawar district was analysed by Kashyap (2009). According to research conducted by Dubey (2009), the Kota district

is a prime location for fish farming. In total, he documented 16 species from 6 different families. According to Paras (2009), there is a correlation between temperature and the number of plankton present. Water plankton was studied by Shringi (2009). His research covers 12 different phytoplankton genera and 10 different zooplankton genera. Sharma (2009) analysed and compared the water quality at both the source (the River Chambal) and the supply level (the tap water), and found that the concentration of most parameters was within the desirable norms prescribed by Indian Standard's Bureau. Research by Bheel (2009) into the ponds' physico-chemical characteristics found that they exceeded the allowable limits for hardness, chloride, pH, and dissolved oxygen. The value of chloride in Kisan Sagar Pond's physico-chemical parameters was found to be higher than that of the other parameters necessary for fish survival and growth by Sharma (2009). A lot can be learned about an ecosystem from the state of its water. When water is tainted, it affects a wide range of physical, chemical, and biological properties. Pollutants in water can be monitored and evaluated using a wide range of parameters. The physicochemical and biological properties of an aquatic ecosystem are essential to its health (Venkatesharaju *et al.*, 2010). Numerous biologists have looked into the ponds' water quality parameters, but their focus has been on the fitness of water resources rather than the water's chemical composition. Later research analysed a wide range of physical and chemical variables. Since most lakes in the 18th century were either atrophic, nanotrophic, or oligotrophic, research focused on the detection and description of physico-chemical parameters (Dube 2002, Basavarajappa *et al.*, 2014).

Sharma (2010) analysed the physico-chemical parameters in the Kishore Sagar Tank of Kota, which demonstrates rich plankton diversity and seasonal fluctuations, as part of a perioidic ecological study of an urban pond near VADODARA, GUJARAT. Researchers Makandar and Bhatnagar (2010) looked at the variety of microalgae and cyanobacteria in Jodhpur's fresh water sources. Indices of physical and chemical diversity were compared to one another. 84 different species were spotted, and 25 samples were taken from 7 different bodies of water. There were a total of 26

different types of green algae representing 16 different genera, 9 different diatom morph types, and 48 cyanobacterial morph types representing 13 different genera. The results of Shannon and Weaver's Biodiversity Index ranged from 0.655 to 1.189, with a great value indicating a next level of generic diversity in green algae and a high level of morphotypic diversity in cyanobacteria.

Water pollution is primarily caused by chemicals that enter the water supply as water flows through various geological materials (Kataria *et al*., 2011). Water quality parameters in sixty wetland ecosystems were examined by Mukherjee (2011), and the physico-chemical characteristics of two beels were observed by Bhaumik *et al*., Recent years saw a proliferation of limnological studies-related publications, especially in the southern parts of Karnataka. In place of traditional, overarching explanations, modern statistical justifications and multivariate analysis were enlisted. When assessing the quality of the water in the lakes of Mysore, Basavarajappa*et al*., 2011(20) attempted to use fresh water diatoms as proxies. Nitrogen eutrophic tolerant species were found in all of the alkaliphic lakes. There was a broad spectrum of water quality, from alpha mesotrophic to polysaprobic. It was concluded from the study that diatoms provide valuable information about environmental conditions. Hosmani*et al*., (2011) (99) used the CCME-WQI to study water quality index for protection of aquatic life, and they found that many lakes' water quality was perpetually threatened, with conditions frequently deviating from normal. Aquatic life in the lake died because the water was too polluted to sustain it. To create conservation strategies for lake ecosystems, it is necessary to understand the structure and dynamics of biological communities and their relationship to biological stress.

Singh *et al*.,examined the impact of altering water physico-chemical parametersthroughout the year on the species composition and community structure of the diatom population in Mawatha lake, Jaipur (2011). In the time period of the study, 30 different species of diatoms were identified. To date, we have identified 19 different genera among these taxa. Several measures of water quality, including dissolved oxygen and conductivity, were found to be positively correlated with total

diatom diversity. The Birger-Parker index of dominance was highest (0.147), while the Shannon-Weiner diversity index (h) value (1.372), and the number of Events (T) (0.903) were all highest in the winter. Several lakes in the Bucharest metropolitan area were analysed for their water quality in relation to the standard and florescence measurement techniques (Gheravase *et al.*, 2011).

Researchers Anikool and Shivani examined the Physico-chemical characteristics and levels of Sewage pollution indicator bacteria in a large section of the river GOMTI in U.P. to determine the pollution status of the river (2011). Physico-chemical parameters, including temperature, total solids, total dissolved solids, total suspended solid, conductivity, pH, COD, BOD, and DO, are measured in eight water samples. Various bacteriological parameters, including total Coli (TC), faecal Coli (FC), and faecalStreptocoli (FS), were measured in these samples as part of a bacteriological analysis that revealed details about the water's suitability for consumption and other household uses. Using only bacteriological parameters as indicators of pollution, rather than a comprehensive set of physico-chemical measurements, we find that the water quality of the River Gomti deteriorates from upstream to downstream. Especially in the Lucknow and Barabanki districts, the microbiological quality of water from the River Gomti was found to be extremely poor, unsafe, and unacceptably low due tohigh levels of Sewage Pollution Indicator Bacteria found. Cities along Gomti River that do not have a wastewater treatment system are largely to blame for the river's coliform pollution.

Physico-Chemical parameters of four sites in the mangrove ecosystem ofKundapuraUdapi district in Karnataka are analysed by Kumara and K.M. (2011). We found that the physico-chemical parameters varied with the seasons, and we able to classify the changes into three distinct periods: monsoon, pre-monsoon, and post-monsoon. Anthropogenic stress from coastal development has a significant impact on seasonal changes in water quality and the biological components of these systems. As the seasons pass, the water's temperature and salinity will rise and fall, causing a shift in the water's physical and chemical characteristics. Researchers Mondal *et al.*,

(2011) looked at the air and water temperatures, the pH, Cl, hardness, alkalinity, and phosphate, and the Sediments parameter (pH, available nitrogen and phosphate) of water in the Burdwan municipality in Burdwa, West Bengal, to determine the water's nature and quality. Some correlations have been found between water-related variables. However, the pH of the water is directly related to the phosphate and nitrogen content of the sediment. One of the main factors in determining the alkalinity of a pond is the accessibility of carbonate and bicarbonate. The Physico-chemical characteristics of Jamgavan dam water in Hingoli district (M.S.) India have presented by Waghmare *et al*., (2012), who discovered substantial seasonal variation. Hosmani and Mruthunjaya (2012) (107), researchers interested in fresh water ecology, used a one-way ANOVA to analyse their data. According to the findings, the levels of carbon dioxide and dissolved oxygen in the lakes are the two most important factors. A study by Ansari *et al*., (2012) on the purity of water in a pond at a temple in Surat (Gujrat), India's state of Chhattisgarh.

Sawa pond in Vadodara, Gujarat, has been the focus of a study by Parikh and Mankodi, who analysed the chemistry and physics of the pond's water (2012). During the course of the study, significant seasonal variation was seen in a number of parameters. The pH level was consistently high and alkaline throughout the entire study. Alkalinity peaked in the first year's summer, while the second year's monsoon was the peak season. Calcium hardness was highest in the monsoon the first year, while magnesium hardness was lowest. Both years, Seminar has the highest total solids values. Both years' DO levels were within the "normal" range. Both years' summers had high nitrate levels while the winters had low phosphorous levels. The lakes at Kolhapur's Shivaji University were analysed for their chemistry and physics by Patil *et al*., 2012. Lower Manair Reservoir in Andhra Pradesh's Karimnagar District was the focus of research by Thirupathaiah *et al*., 2012. Variations in water chemistry variables every month, including temperature, acidity, turbidity, transparency, dissolved solids, hardness, chlorides, phosphates, nitrates, dissolved oxygen, and biological oxygen demand. According to the findings, the water's

physico-chemical parameters are safe for human consumption, agricultural irrigation, and fish farming. It is now known that contaminated water is a direct cause of several human diseases. Diseases spread through water are typically contracted when someone uses contaminated water for personal hygiene or cooking purposes. Very few academics (Raut *et al*., 2011; Naik *et al*., 2012; Bahekar and There 2013; Mahajan and Tank, 2013). The physico-chemical characteristics of India's various bodies of water have been analysed across the country. Effluents from factories, garbage disposals, and sewage systems, as well as drainage from fields and farms, all contribute to the contamination of water sources in our country (Shrivastava and Kanungo, 2013).

Yadav *et al*., analysed the physico-chemical parameters of the Satak reservoir in the Khargone district of Madhya Pradesh, India (2013). Nitrate and phosphate levels, among others, are high enough to support aquatic animal growth. The reservoir is classified as a mesotrophic water body with a moderately eutrophic orientation. With the exception of water, temperature, and pH, all of the parameters were well within the ranges allowed by the World Health Organization's guidelines for drinking water. Chloride levels indicated that the Pond was contaminated. Significantly high water temperatures were observed. Except for acidity and dissolve oxygen, phosphate was negatively correlated with all other variables. Most parameters, including water temperature and phosphate, correlate negatively with nitrate. There was a statistically significant inverse relationship between this and total hardness.

Aquaculture pond water and soil samples in the west Godavari region are the subject of an analysis in a paper by Devi *et al*., 2013. Indirectly, the development of fish and fisheries can be better understood through physical and chemical analyses of water and soil used in agricultural practices.

The influence of water quality on phytoplankton abundance in the Hampalam River and the fish Pond of Batanjung village was investigated by Veronica *et al*., 2014. It was discovered that Pluerosigma, a genus of Chrysophyra, was the most numerous

phytoplankton in the river, while Euglena species, a genus of Euglenophyta, were the most numerous in the pond. Keremah et al. conducted a physicochemical analysis of a fish pond in Nigeria's Bayelsa state (2014). While the NH4+-N values were higher than what would have been ideal for fish farming, all of the other parameters favoured healthy fish growth. The physico-chemical composition of a local pond was analysed by Nag and Gupta (2014). Correlation analysis revealed both positive and negative relationships between the variables (P0.001, P0.01), though these were more pronounced in the positive.

Sitapat Pond's physical and chemical characteristics are compared to those of Dhar town's drinking water by Darasing and Laxmi (2014).

The results demonstrate a dramatic decline in the standard of both pond water and municipal water supply. The pond's physical and chemical characteristics in Varanasi have been analysed by Mishra *et al*., 2014, to determine the effects of human activity. Nitrate levels of 52 mg/L, biological oxygen demand levels of 2.5 mg/L, total dissolved solids levels of 2420 mg/L, and phosphate levels of 7.5 mg/L were all significantly above the maximum allowable levels for drinking and irrigation water. Laishram and Dey conducted an analysis of Loktak Lake's water quality (2014). The ambient temperature was 11–33 degrees Celsius, the water temperature was 16–32 degrees Celsius, the pH ranged from 6.05–9.10, the dissolved oxygen concentration was 4.05–14.18 mg/L, the Biochemical oxygen demand was 1.51–10.65 mg/L, the free carbon dioxide concentration was 0–35 mg/L, and the total dissolved solids concentration was 50–150 ppm. For their study, Selvamohan et al. analysed the ponds in the Tirunelveli district, measuring their chemistry and physics (2014). Appearance, colour, turbidity, total dissolved solids, total hardness, iron, fluoride, sulphate, phosphate, pH, electrical conductivity, nitrate, calcium, chloride, magnesium, and potassium were some of the parameters tested. Udaipur, the "City of Lakes," in the Indian state of Tripura was the focus of a 2014 study by Lodh *et al*., who analysed the chemical and physical characteristics of four of the city's lakes. We looked at four different lakes: Amar Sagar, DhaniSagar, Jagannath Dighi, and Mahadeb Dighi.

Seasonal changes and water quality evaluation of Nagchoon pond in Khandwa District were investigated by Mahajan and Billore (2014). The phytoplankton diversity in Chandlodia Lake was studied by Verma *et al.*, (2014), who found that it changed with the seasons. Species of Cylinderospermum, Microcystis, Phormidium, Oscillatoria, and Chlorella, among others, were counted in the report of phytoplankton abundance. More phytoplanktons meant there was pollution present.

Research into the relationship between phytoplankton diversity and primary productivity in Lake Udai sagar Udaipur was conducted by Kumar *et al.*, 2015. There was supposed to be a 0.50 gcmh1 GPP average surface area. In a similar vein, Verma and Khan (2015) analysed the physicochemical parameters of Fateh sagar talab in Bagar, Jhunjhunu district, Rajasthan. There is a wide range of variation in the values of temperature, pH, electric conductivity, total hardness, alkalinity, TDS, chloride, and dissolved oxygen throughout the year. Singh investigates the chemistry and diversity of the plankton in Bharatpur's Konda (open pond) Pond (2015). The pond has a temperature range of 24-25.6 degrees Celsius, a transparency range of 0.2-0.4 metres, a pH range of 7.3-2.4, a total dissolved solids concentration of 0.257-56.786 milligrammes per litre, and a silicate concentration of 0.218-0.029 milligrammes per litre. There is a direct correlation between the physicochemical variables. Ganesh *et al.*, analysed the pond at the Srisanishawaran temple in Tirunallar for its physico-chemical characteristics (2015). Analyzed physico-chemical parameters were subjected to change, including pH, electrical conductivity, total hardness, calcium hardness, biochemical oxygen demand, total dissolved solids, suspended solids, oil, and grease. Compared to before, the bacterial load was higher after a large-scale washing. The ponds in the Biaspur district of Chhattisgarh, India, were studied by Dixet *et al.*, (2015), who analysed their physico-chemical parameters. During the course of the research, the following physico-chemical parameters were measured: pH (in the range of 6.50-9.69), electrical conductivity (in the range of 118.7-206.6 mhos/cm), total dissolved solids (in the range of 165.5-254.8 ppm), temperature (in the range of 20.9-33.8 degrees Celsius), salinity (in the range of 5.1-6.9 ppt), and

dissolved oxygen (in the range of 2.41-4.8 The parameters for which the correlation coefficient (r) was calculated were all found to be statistically significant at the 0.05 level or lower. Greater numbers of phytoplanktons were found to be pollution indicators.

The pond water, municipal sewage, and industrial effluent of Rajnadgaon were all analysedphysicochemically by Mahish (2015). The physico-chemical parameters of the water in Pus Dam in Pusad Tehsil in Yavatmal District, Maharashtra, were found to be within the permissible limits and to be used for domestic, irrigation, &pisciculture by Dhawale &Ghyare (2015). Mohammad *et al.*, (2015) evaluate the water quality in the Wyra reservoir in the Khammam district of Telangana, India, making use of physico-chemical parameters. The study's findings showed that the water quality in these reservoirs was within the legal limits. Based on research by Nagmani *et al.*, (2015) into the state of the city's water supply in five separate Bangalore neighbourhoods, Fresh water fish ponds in the Warangal area of Telangana state were studied by Dixit *et al.*, (2015), who analysed the physico-chemical properties of the pond water in a number of ponds.

Kashyap, 2016, "Physicochemical Properties of Rewa Water" (M.P.). Phadke Pada pond in diva, Thane, was the focus of Peyami's (2016) research into seasonal variation. Sajitha and Vijayammaanalysed the physico-chemical parameters of the pond water in AthiyannorPanchyath, Kerala (2016). The findings were analysed, and the water quality standards set by the WHO and the BIS were compared. The physico-chemical parameters of an urban pond in Raipur, Chhattisgarh, were analysed by Yadav *et al.*, 2016. Anthropogenic activities led to widespread surfactant and microbial contamination in urban ponds. Microorganisms such as bacteria, algae, and fungi were reported in water with surfactant concentrations ranging from 7.0 to 27 mg/L. The pond water in Raipur, India was analysed for its physico-chemical composition by Swarnkar and Choubey (2016). Analyses were performed on a number of physico-chemical parameters, including turbidity, pH, total dissolved oxygen, biological oxygen demand&total coliform.

Kumar *et al*., investigate how to best evaluate water quality throughout the seasons for use in aquaculture (2017). Water samples were tested for a wide range of physico-chemical characteristics, including colour, turbidity, temperature, pH, dissolved oxygen, biological oxygen demand, carbon dioxide, salinity, total alkanity, and total hardness. Physical and chemical parameter levels were determined. Calcium 7(78-108 mg/L), magnesium(58-73 mg/L), salinity(10-19 ppt), total alkanity(68-95 mg/L), nitrate(3.0-4.1mg/L), and chloride(15.3-39.8 mg/L) ranged from 7.1 to 8.5, respectively. Microbiological and physico-chemical parameters of water bodies in Desiroto de los Leones National Park, near Mexico City, were investigated by Lucas *et al*., 2017. A total of five different types of bacteria were discovered (Escherichia, Pseudomonas, Klebsiella, Shigella and Salmonella). There were the following findings from the water tests: Chemical oxygen demand (COD) 106-450 mg/L; pH 5.5-5.9; turbidity 10.7-32.3 Nephlometric turbidity units (NTUs); total coliforms 98-956 CFUs; faecal coliforms 78-807 CFUs; 90% ampicillin-resistant bacteria; 25% ciprofloxacin-resistant bacteria.

Physico-chemical parameters of four fish species in Kokrajhar, BTAD Assam, were investigated by Chakabort*yet al*., 2017. In order to determine the quality of the water, scientists measured its temperature, pH, total dissolved solids (TDS), total alkanity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), turbidity, and salinity. Dhanasekaran et al. analysed the chemistry and zooplankton population of a perennial lake in Tamil Nadu called Dharampuri (2017). During the study period, a total of 29 zooplankton species were uncovered, including 10 species of Rorifers, 8 species of Cladocera, 6 species of Copepoda, and 5 species of Ostracoda. Many zooplankton species are positively correlated with various physico-chemical parameters. The water quality index of Loktak Lake was analysed by Kangabam *et al*., (2017). The usual methods were used to analyseall of the physico-chemical variables. Water quality index values between 64 and 77 indicate that Loktak lake water is unsuitable for human consumption. Several researchers have conducted physico-chemical studies of Madhya Pradesh's water sources, including

Sharma (2017), who conducted a Limnological study of Tighra reservoir in Gwalior (M.P.). Kumar *et al*., (2017) analysed water quality during different times of the year. Color, turbidity, temperature, dissolved oxygen, biological oxygen demand, carbon dioxide, salinity, total alkalinity, total hardness, and many other physicochemical properties were among those measured in the water samples. Pond water's physico-chemical properties were evaluated by Ghosh (2018). Some Physico-chemical parameters show seasonal fluctuation, according to research by Gothwal and Gupta (2019) on limnological characteristics, planktonic diversity, and icthyofauna.

The physico-chemical analysis was studied by Choudhary *et al*., (2019). Optimal conditions for fish farming have been studied and correlated with a number of physical and chemical parameters (such as temperature, pH, dissolved oxygen, total alkalinity, free carbondioxide, transparency, hardness, total dissolved solids, conductivity, and biological oxygen demand). Freshwater reservoir's ecological and pollution status was investigated by Abhijet and Arjun (2019). Rao B. *et al*., (2019) examined the condition of the pond by measuring its acidity, turbidity, pH, and other physical characteristics. Researchers Meena and Dube (2019) found that phytoplankton communities in Similiya Village Pond were more diverse and predominated than zooplankton communities throughout the year. The major event of the discharge of pollutants and effluents into water resources after the western industrial revolution became the primary focus of limnological studies. Chemicals in water, their effects on water quality, and the organisms that live in water resources were the primary focus of scientific inquiry in the 19th and 20th centuries. Numerous reports, papers, dissertations, and theses have discussed and reviewed these studies, so this paper will focus solely on works published in this century (Dube 2002, Sharma 2010, Meena 2019, Karra, 2020).

The surface water in Mokeshbeel, Gazipur, Bangladesh, was analyzed for its physico-chemical characteristics by Jannat *et al*., (2019). While the concentrations of some physicochemical parameters, such as pH, temperature, and total dissolved solids (TDS), were within Bangladesh's legally permissible range, those of total suspended

solids, bio-chemical oxygen demand, and chemical oxygen demandwere significantly higher. Based on the findings of this study, the quality of water in Mokeshbeel is extremely poor. Communities dependent on the Beel may be put at risk, as may the surrounding environment, including plants and animals, and ultimately humans. Nair (2020) found that having access to high-quality water is crucial for disease prevention and quality of life enhancement, so it's important to have a firm grasp on the various physicochemical 20 parameters used in water quality analysis and testing, including hardness, pH, Sulphate, Chloride, DO, BOD, COD, alkalinity, nitrates, and phosphates. River Narmada was studied by Mishra and Kumar (2021), who discovered that its input waste water is contaminated with a wide range of organic and inorganic contaminants, which pose a serious biotic risk, affect the river's bio-geo-chemical cycle&worsen its ecological-health. Contamination of River water by coliform bacteria makes it unsafe for human consumption.

FEATURES WITHIN BIOLOGY

PLANKTONS

Phytoplankton abundance and health can be used as a proxy for water purity. Chlorophyte abundance is a good indicator of whether or not the water is productive. Distasteful fish, toxic substances, and a lack of chemical and thermal stratification can all result from blue-green algae blooms. The decaying phytoplankton creates an unpleasant visual effect (Boyd, 1981; Salam and Parveen, 1996). Ecologists have used the diatom bacillariophyte Bacillariophyta to detect pollution in water bodies and other changes in ecological conditions; for instance, the genera Nitzschia, Gyrosigma, and Epithemia avoid acid water and very low concentrations of Ca and Mg (Ward and Whipple 1959; Mason 1988). Stephanodisus diatoms provide valuable insight into the process of Eutorphication. A strong indicator of future productivity in a fishpond is the presence of dense surface blooms of blue green algae (Aphanizomenon) (Leonard, 1971).

As far back as 1989, Gautam has been researching the plankton ecology of Jait Sagar Lake. There was a clear connection established between the physico-chemical state and the seasonal abundance of plankton. Twenty-two genera representing the chlorophyceae, bacillariophyceae, and cyanophyceae families were discovered during his research. In a year-round analysis, these show the highest concentrations in September and May. In September there were many diatoms and chlorophyceae, and in May there was a profusion of blue-green algae. Cyanophyceae thrive in conditions of high temperature, alkalinity, calcium, and chlorides; diatoms and chlorophyceae flourish when the pH is high in the winter. Summertime was found to have the highest zooplankton concentrations. Examples of these are rotifers, cladocerans, and copepods. Rotifers were consistently the most abundant of these other groups throughout the year. Studies comparing the limnology of Sambhar and Didwana lakes were conducted by Jakher *et al.*, (1990). (Rajasthan, NW India). The number of reported genera in Sambhar Lake dropped from 20 to 11. (Nostoc, Microcystis, Spirulina, Aphanocapsa, Oscillatoria, Merismopedia, Nitzschia, Navicula, Synedra, Cosmarium and Closterium). Only nine genera, including Anabaena and Nodularia, made up Didwana's phytoplankton.

While Sharma (1991) has studied the algae of Ajmer's Anasagar Lake, this study identified 11 cyanophytes, 18 chlorophytes, and 3 euglenophytes. In addition to these other causes, it has been noted that a disproportionate amount of detergent is being added during the washing of clothes. Renu and Sharma both conducted research on the trophic status of Ajmer's Anasagar Lake in 1991. The diatoms of Anasagar Lake have been the subject of research by Sharma and Sharma (1992). Anasagar Lake is home to 22 species of diatoms from 15 different genera. Changes in dissolved oxygen and carbon dioxide level, as well as other physico-chemical parameters of the lake, may be related to seasonal changes in the diatom population. Both polluted and unpolluted environments experience seasonal shifts in diatom diversity. During the colder months, scientists have found the greatest diversity of diatom species. As a key biotic component of the aquatic ecosystem, temperature has far-reaching effects on fishes' physiological processes, including respiration, growth, and reproduction

(Dublin Green and Tabor, 2004). (1992). Dissolved oxygen (DO) levels fall as temperatures rise and rise as DO levels fall. The oxygen in the water is essential for the fish's metabolism, and thus, its survival. There were a total of one hundred different species found in the lake, including 21 cyanophyte species, 52 chlorophyte species, 3 centric diatom species, 17 pinnate diatom species, and 2 euglenophyte species.

The number of diatom species recorded was higher for polluted sites compared to non-polluted ones. Plankton productivity in the Vallabh Gardans, Bikaner sewage fish pond and adjacent oxidation pond has been studied by Agrwal *et al*., (1993). The Gandhi Sagar Lake in Bhilwara, India, has been the subject of algal diversity research by Ojha and Sharma (1994). Changes in temperature, external hydraulics, nutrient loads, and light availability are all strongly correlated with the seasonal needs of plankton assemblages (Malten *et al*., 1991). A study of phytoplanktonic primary production in the River Ganga and a pond in Patna was conducted and compared by Singh and Singh (1999). The sites that were polluted had many physicochemical parameters recorded.

Compared to less polluted sites, polluted ones had significantly higher concentrations of TDS, phenolphthalein alkalinity, total alkalinity, phosphate, total hardness, Ca, mg, chlorides, salinity, and dissolved organic matter (DOM). The breeding habits and pH correlation of amphibians in Rajasthan's southeastern plateau have been investigated by Dube and Sharma (2001). Plankton was studied by Baruah and Das in 2001 as an indicator and index of pollution in aquatic ecosystems due to paper mill pollution. Paper mill effluents were found to contain a variety of organic and inorganic chemicals, making them toxic and capable of altering the water quality of receiving bodies. Seasonal shifts in plankton abundance have been observed. Due to the high water level and low density in the winter, plankton swarms after the monsoon. Six species of blue-green algae, seven of chlorophyceae, one species each of protozoa, rotifera, and desmids, five of diatoms, three of crustacea, and one each of decapoda and cladocerans were identified after analysis. Oscillatoria, brachinous, pandorina, and nitzschia are just some of the plankton species found to be a reliable

indicator of pollution. According to Yadav and Rana (2001), the effect of temperature is proportional to phytoplankton while transparency is inversely proportional to heat. When it comes to the transfer of energy from phytoplankton to higher aquatic fauna, zooplankton is the most crucial link in the aquatic food web (Iloba, 2002). Specifically looking at amphibians, Dube *et al*., (2002a) investigated the ecobiology of seasonal water bodies in the southeastern plateau of Rajasthan. Three different locations' water was sampled for the research. In this case, the amphibians benefited from the increased humidity. Moreover, seven anuran species representing three families were documented across all three locations. To name a few: Bufo andersoni, Bufo melanostictus, Microhyla ornate, Rana breviceps, Rana cyanophlyctis, Rana limnocharis, and R. tigrrina. Dube (2002b) detailed the physical and chemical characteristics of the ponds and other temporary water bodies that dot the southeastern Rajasthan plateau (i.e. Kota, Bundi, Baran and Jhalawar district). The spawning habits and pH correlation of amphibians in the south-eastern plateau of Rajasthan have been investigated by Dube *et al*., (2002c). Breeding preferences of Bufo, Rana, and Microhyla tadpoles were found to be pH-dependent. All three species showed a strong preference for spawning in areas with a pH between 7-8.6. No reproduction took place in bodies of water with a pH level below 4.0. The amphibian fauna of southeast Rajasthan has been studied by Dube (2003), who paid particular attention to their ecobiology. Ecology, behaviour, and habitat are all discussed, as well as the effect of environmental parameters on their lifestyles.

Studying the soil bank diversity and zooplankton emergence pattern of some recently dried water bodies in the north Maharashtra region, Gaikwad *et al*., (2008) found that the permanent ponds had significantly more species (i.e. 19) than the temporary ponds (i.e. 8). During that time, we were able to identify 8 species of rotifera that were not present in the nearby permanent or ephemeral water bodies. Nineteen different species were identified, including six species of copepods, five species of cladocera, and eight species of rotifers.

The zooplankton population in Rishi Lake was analysed seasonally using physicochemical parameters by Kedar *et al*., 2008. During the summer, zooplankton

numbers are at their highest, and during the wet season, they are at their lowest. All physicochemical parameters- pH, DO, alkalinity, total hardness, chlorides, sulphates, nitrates, and phosphates reached their maximum values in summer and their minimum values in the wetter months, indicating a positive relationship between these variables and zooplankton. Protozoa (14 sp.), Rotifera (29 sp.), Copepoda (6 sp.), ostracoda (5 sp.), and Cladocera (11 sp.) are just some of the 61 species discovered during the study period (7sp.). Changes in the aquatic environment have a quick impact on the variety of zooplankton. Several species of zooplankton are used as bioindicators (Ahmad *et al*., 2011, Mola, 2011). Ana Sagar Lake in Ajmer, India, had its primary productivity and physico-chemical parameters evaluated by Koli and Ranga (2011). The daily GPP value fluctuated between 1.93 and 6.24 gc/m2. Community respiration varied between 0.26 and 3.6 gc / m2 / day, and HPP fluctuated between 0.72 and 4.99 gc / m2 / day. The water temperature ranged from 16.4 degrees to 31.2 degrees Celsius. The pH was between 6.8 and 10.2, and the visibility was between 34.5 and 65.5 cm. The DO ranged from 6.7 to 16.7 mg lt. The ranges for BOD and alkalinity were 9.2–25.2 and 176–264 mg/t respectively. Chloride, nitrate, and phosphate concentrations also varied unpredictably. Due in large part to sewage discharged industrial effluent and the agricultural run off from the surrounding city population, the lake was found to have high primary productivity and physical chemical values. The eutrophic state was also made clear by the high levels of productivity and nutrients. Kumar and Sahu conducted an ecological study of the sewage Pond in the H. E. C. industrial area of Ranchi (2012). Physico-chemical characteristics of Sewage Pond were studied to ascertain the presence and abundance of cynobacteria. Microcysoscillatoria was found to be the most common and abundant Phormidium species across all Sewage Pond sites. Maximum nitrogen up to 35.4 mg/L, 4.8 mg/L phosphate and alkaline nature of water all year favour the growth of cyanophean members and promote algal bloom formation of Microcysis aeruginosa, O. princeps, and otenus in pond. A bioindicator of organic pollution is the variety of algae in the sewage pond. Temple Pond in the Nasik District was the site of a 2012 study by Tidame and Shinde on the zooplankton diversity in that region.

During the course of the study, researchers observed a wide variety of Zooplanktons, with rotifers being the most common. Seventeen different rotifer genera were identified, with the genus Brachionus being particularly numerous and widespread in both ponds. Twenty-one rotifer species representing 15 different genera were found in Amrut kund, while 23 species representing 14 different genera were found in Pond Ram kund. During the monsoons, both Amrit Kund and Ram Kund Pond had the greatest variety of rotifers. Singh and Sharma evaluated the primary production of the aquatic macrophytes in Manipur's Kharungpat Lake (2012). The dominant macrophytic vegetation's daily and annual net primary productivity were calculated over a 24-month time span. Net Primary Productivity ranged from 0.03 to 6.10 gm^2 across all species in the first year and from 0.15 to 8.42 gm^2 in the second. The annual mean productivity (MP) of all species ranged from 682.64 to 891.13 gm^2in the first year and from 702.49.9 to 840.45 gm^2 in the second year. Since the lake was found to be significantly polluted, the authors of this study conclude that the lake is in a eutrophic state. Tiwari and Ranga conducted an assessment of the diurnal variation in the physico-chemical status of Khanpura Lake in Ajmer, India (2012). When it comes to aquatic ecosystems, macrophytes can have a major impact on both abiotic (food availability, competition, predation) and biotic (temperature, oxygen concentration, light intensity) factors (Cazzanelli *et al*., 2008; Spoljar *et al*., 2012). At the same time, macrophytes widened the range of environments that could be called home by zooplankton and benthic invertebrates, as well as offering them protection from predators (fish insect larvae and adults) through shelter and a wide variety of foods (Estlander *et al*., 2009; Spoljar, 2013). Pond zooplankton abundance was studied by Banerjee *et al*., 2014, who investigated fish farming techniques in West Bengal. These zooplankton were classified into four orders: Copepoda, Rotifera, Cladocera, and Diatoma. Copepoda and Cladocera were the most numerous and diverse of these four groups, with numerous cyclops and daphnia species each. Ansari and Khan analysed the variety and distribution of zooplankton in a freshwater body in the Aligarh area (2014). Cladocera, Rotifera, Copepods, and Ostracods were some of the zooplanktons spotted during the research. When it comes to environmental

factors, zooplanktons have a positive relationship with pH and dissolved oxygen and a negative relationship with water and temperature. The phytoplankton diversity and water quality of ONGC pond Hazira were evaluated by Ansari *et al.*, (2015). The research found that there were 73 different phytoplankton genera, and that they all belonged to one of four different classes: the Euglenophyceae, the Chlorophyceae, the Bacillariophyceae, or the cyanophyceae. The Chlorophyceae family was the most numerous of the four divisions. More phytoplankton meant there was more pollution in the water. Phytoplankton diversity in a desert village pond in Bikaner, Rajasthan was investigated by Bhupender and Kumar in 2015. Phytoplankton species belonging to the Cholorophyceae, Cyanophyceae, and Bacillariophyceae families were observed. The pond was home to many different types of algae, including Cladocera, crucigenia, murospora, chara, spirogyra, (5 green), Navicula, Nitzchia, synedra, diatom, coscrnodiscus (5 diatoms), Spirulina, Nostoc, Anabaena, Oscillatoria, (4 blue green algae). The phycoplankton and physicochemical parameters of ONGC pond Hazira were evaluated by Ansari *et al.*, 2015. Euglenophyceae, Cholorophyceae, Bacillariophyceae, and Cyanophyceae were the four classes of algae found during the study period, each with its own unique set of 73 genera. The Cholrophyceae family was the most numerous of the four groups studied. Cyanophyceae, Colorophyceae, Euglenophyceae, Bacillirophyceae, and dinophyceae are the five families of phytoplankton currently recognised in this study. Copepods, Cladocerans, and Rotifers are also recognised as distinct orders of zooplankton. Microcystis, phacus, Oscillatoria, Anabeana, and Euglena are pollution indicator species that suggest the pond is polluted. Diversity of zooplankton and macro benthic invertebrates in Jhakhand Dilli pond was investigated by Sharma *et al.*, 2015. Some 29 different types of zooplankton, including protozoans, rotifers, cladocerans, copepods, and ostracods, were discovered. Biswas (2015) looked at how the chemistry and physical makeup of Dhakuria Lake affected the zooplankton that lived there. Rotifera (17 species), Cladocera (10 species), Copepoda (3 species), and Ostracoda (11 species) are among the 31 zooplankton species that have been documented (1 species). The echinoderms (or "copepodes") were the top predators. The abundance of Cladocera, Copepoda, and

total zooplankton is positively correlated with high levels of physico-chemical parameters like total hardness, DO, BOD, COD, sulphate, and phosphate. Barur Lake is located in the Krishnanagri district of Tamil Nadu, and its zooplankton diversity and physico-chemical parameters were studied by Manikam*et al*., 2015. Of the 47 zooplankton species reported, 18 were Rotifers, 11 were Cladocera, 11 were Copepods, and 7 were Ostracods. The Rotifera were the most numerous and widespread of all the species. Pawar evaluated the diversity of the zooplankton in the Majalgaon reservoir in Maharashtra over the course of a year (2016). Twenty-three species were documented during the course of the study, including eight species of rotifers, six species of cladocera, five species of copepods, two species of ostracods, and one species of protozoa (2 species). There was more zooplankton in the summer and fewer in the winter. In 2016, Pahl *et al*., investigated the phytoplankton in Chakhan Lake in Dadu District, Sindh, Pakistan. The family Nostocaceae, which includes the genera Anabaenospsis, Anabaena, and Nostoc, was found in the phytoplankton. Species of phytoplankton, including Cylinderospermum, Microcystis, Phormidium, Oscillatoria, and Chlorella, were counted and reported. The zooplankton population was counted and analysed by Yadav and Singh (2017) in Chhapakaiya pond in Birgunj, Nepal. A total of 27 taxonomic groups representing various zooplanktons were found. In Chapakaiya pond, zooplankton concentrations were found to be highest in the summer (774.4 unit/L) and lowest in the rainy season (539.2 unit/L). Zebek and Szymansk (2017) analysed the differences between dominant species of phytoplankton in a pond in the Warmia Mazury region of northeastern Poland in terms of abundance, biomass structure, and environmental requirements. According to research conducted by Pandiammal*et al*., (2017), the diversity of phytoplankton and seasonal fluctuations in a temple pond in Thiruvottiyur, Chennai, were examined. Taxa belonging to the chlorophyceae (10), bacillariophyceae (11), cyanophyceae (6), euglenophyceae (3), dinophyceae (2), and dinophysis (two) groups were found among the phytoplankton.

In a 2017 study, Joseph analysed the abundance and distribution of phytoplankton in a simulated lake. The cyanophyceae made up 39% of the

phytoplankton population, followed by the chorophytes 34%, the bacillariophytes 23%, and the euglenophytes 4%. Research conducted by Jacob *et al*., (2017) in 30 ponds in the Maanachil taluk of the Kottayam district of Kerala looked at odanata (dragonflies and damselflies) as bio indicators of water quality. Values for the water quality index, the Simpson's diversity index, and the number of species in a given area were computed. Indicator species for clean water included Bradinopygagerminata and Trithemisfestiva, while Zyxomnapetiolatum and Ceriagrioncerinorubellum were found in polluted water. Krishna and Kumar evaluated seasonal shifts in pond zooplankton in the Lake Kollore area of Andhra Pradesh (2017). Richness, evenness, and diversity of zooplankton were noted. There were a total of sixteen species, including nine rotifers, three cladocera, and four copepods. As far as rotifers go, the genus Branchionus was the most common. Udhampur city ponds Talpad and Jonu were sampled to determine the seasonal success and role of temperature on zooplanktons by Devi (2017). There were a total of 34 distinct genera found, split evenly among five different orders: Protozoa (6 genera), Rotifera (12 genera), Copepoda (6 genera), Cladocera (6 genera), and Ostracoda (6 genera) (2 genera). Sogal pond is located in the Belagavi district of north Karnataka, and its zooplankton diversity was evaluated by Abbai (2017). There were a total of 16 species discovered, split among three families. Rotifera make up 43% of the marine community, followed by 36% of the cladoceran fauna and 21% of the copepods. The concentration of zooplankton was greatest in the winter and lowest in the summer. Adhikari et al. investigated the variety of zooplankton living in a polluted urban pond in the lower gangetic plains (2017). Municipal waste water loaded with various nutrients has likely influenced the diversity and abundance of zooplankton, as 22 species were identified, including 14 species of Rotifera, 3 species of copepods, 4 species of Cladocera, and a single species of Ostracods. A total of 144 zooplanktonic forms representing 3 phyla, 27 families, 64 genera, and 105 species have been reported from recent limnological studies of various water bodies in Rajasthan. There were 13 species of protozoa, 39 species of rotifers, 22 species of copepods, 6 species of cladocerans, and 6 species of ostracods. Values for

zooplankton biodiversity as measured by Menhinick's index have been calculated and discussed in relation to physicochemical characteristics and primary productivity.

Ukkadam Lake is located at 10° 59′ N and 76° 57′ E in Coimbatore city, Tamil Nadu, India. Manickam *et al.,* (2018) studied the effect of seasonal changes on zooplankton biodiversity there. Population densities of different kinds of zooplankton were measured, and the results revealed a clear pecking order. Rotifers > Copepods >Cladocers> Ostracods. Populations were found to be at their highest during the summer and lowest during the beginning of the monsoon. Temperature increases in Ukkadam Lake during the summer may be to blame for the lake's higher zooplankton population. This finding suggests that temperature plays a role in determining zooplankton diversity. Therefore, the production of zooplankton could be affected by the rise in temperature associated with global warming. In 2018, Meena and Dube conducted a comprehensive literature review on the zooplankton of India's lentic water bodies. When we talk about plankton, we're referring to zooplanktons. Their high numbers make them ideal for use as indicators of changes in the aquatic environment's chemistry, biology, and physics. Phytoplankton in Lotic Water of India: A Review by Karra *et al.,* 2018. Aquatic phytoplanktons are microscopic organisms, primarily algae that contain chlorophyll and reside near the water's surface, where there is adequate light, producing their own food and thus providing food for countless other aquatic dwellers. They're crucial to keeping the balance between biotic and abiotic elements stable. Phytoplankton abundance and variety, together with their association as a biological indicator, play a crucial role in determining the state of a body of water.

Sharma and Dube (2018) analysed a literature survey on Indian zooplankton. Due to their sensitivity to environmental factors and rapid response to alterations in water quality, zooplankton populations serve as a valuable indicator of these processes in aquatic systems. The literature on phytoplankton diversity and seasonal variation was reviewed in depth by Sharma *et al.,* (2018). Diatoms (Bacillariphyceae), Dinoflagellates (Xanthophyceae, Chrysophyceae, Haptophyceae, Cryptophyceae), and Nanoplankters are all crucial parts of phytoplankton (Chlorella,

Nannochlorpsis, etc.). Phytoplankton also includes two other major groups, the silicoflagellates and the coccolithophores. Different rich waste water supports the diversity and abundance of phytoplankton, as shown by a study by Das *et al*., (2018), which examined the relationship between phytoplankton abundance and five important physico-chemical parameters. Ghosh (2018) conducted a physicochemical analysis of the pond's water, noting that the air temperature ranges from 19 to 34 degrees Celsius, while the water temperature ranges from 16 to 31.8 degrees Celsius. The pH changes from 8.2 in September to 9.5 in May. In December, the DO level was 13.1 millimoles per litre, while in April it was only 4.1 millimoles per litre. The concentration of free carbon dioxide can range from 2.4% to 10.2%. Levels of chloride, alkalinity, and phosphate were as follows: 70–165 milligrammes per litre (mg/l), 82–165.5 milligrammes per litre (mg/l), and 0.40–0.86 mg/l, respectively. Gowri and Bannerjee investigated the physicochemical characteristics of a freshwater lake (2018). Gothwal and Gupta (2019) investigated limnological features, planktonic diversity, and ichthyofauna, and discovered that some physico-chemical parameters vary with the seasons. Alkaline water (pH 7.12), alkalinity of (98.50 mg/l), and a Secchi depth of 80 cm were the ideal values for the limnological parameters measured in Sant-Sarover Pond. Nitrate levels averaged 28.57 mg/l, sulphate levels averaged 22.28 mg/l, and dissolved oxygen levels averaged 5.45 mg/l. Meena and Dube's (2019) evaluation of a review phytoplankton of Indian lentic bodies demonstrates the critical need to explore novel methods for studying diversity.

The phytoplankton in the Chandloi River in Kota, Rajasthan, India were catalogued by Sharma *et al*., (2019). The researchers compiled a list of the fresh water phytoplankton found in the river throughout the year, including the 5 families, 28 genera, and 43 species that make up the ecosystem. The Chlorophyceae were the most numerous, with 17 species distributed across 12 genera; the Dinophyceae ranked last, with 3 species spread across 3 genera. Community compositions of phytoplankton and eukaryotes were studied by Yan *et al*., (2020) in a drinking water reservoir to understand the dynamics and interactions of these organisms during periods of mixing. Changes in phytoplankton and water eukaryotes were found to be

closely linked during the colder months at Jinpen reservoir. The eukaryotic and phytoplankton community composition was found to undergo substantial spatiotemporal changes. The coexistence of phytoplankton suggested that the community structure changed dramatically over time. In addition, Melosira spp., Cyclotella spp., and Chlorella spp., all members of the Bacillariophyta and Chlorophyta, accounted for more than 97% of the total relative abundance across all time periods. Karra (2020) investigated the diversity and seasonal variation in planktons in the River Chandraloi in the Kota district of Rajasthan. Chlorophyceae, Bacillariophyceae, Cynophyceae, Xanthophyceae, and Euglenophyceae were the 19 different phytoplankton species included in this study. The Chlorophyceae were the most numerous, followed by the Cynophyceae in second place. Diversity of freshwater phytoplankton: models, drivers, and implications for ecosystem properties was investigated by Borics*et al*., (2020). Several aspects of phytoplankton diversity were examined in this study, such as its definitions and measures, the mechanisms that keep it stable, its reliance on productivity, habitat size, and temperature, its functional diversity in the context of ecosystem functioning, and its molecular diversity. The phytoplankton assemblage in the Ganges River was analysed by Ahmed *et al*., (2021). It was determined that there were a total of 49 taxa representing 34 genera from the families Bacillariophyceae, Chlorophyceae, Cyanophyceae, and Chrysophyceae, with a total of 28 species. Bacillariophyceae and Chlorophyceae members dominated, making up as much as 75% of the total phytoplankton.

The zooplankton population in the lower section of the Opobo River in Rivers State, Nigeria, was analysed by Shayebi *et al*., (2020). Abundance data for zooplankton species revealed spatial and seasonal variation in zooplankton composition. The wet season (July) saw the greatest variety of zooplankton (11 species), while the dry season (March) saw the fewest (8 species). It is possible that flooding during the wet season (July) due to high rainfall recruited zooplankton from other water bodies, resulting in an increase in the zooplankton community. Dahare (2020) investigated the wide variety of zooplankton in Sindewahi Pond, Maharashtra. The zooplankton community included numerous taxonomic orders, such as the

Protozoa, Helminthes, Rotifera, Annelida, Arthropoda, and so on. The greatest diversity and abundance of arthropods has been documented, with Rotifera coming in second place. Zooplankton concentrations varied from 174 to 769 n/ L, with an average of 378.42 n/ L. 28 different species of zooplankton were studied by Mishra (2020) in Lony Dam Reservoir, indicating a moderate level of biodiversity there. Qualitative analysis of zooplankton in Lony Dam revealed that Rotifers, Protozoa, Cladocerans, and Copepods constituted the bulk of the total biomass. It was discovered that zooplankton abundance is greatest in the summer and lowest in the beginning of the monsoon season. Karra (2020) investigated the diversity and seasonal variation in plankton in the River Chandraloi in the Kota district of Rajasthan. There were 26 different types of zooplankton, split into 6 different families (Protozoa, Rotifera, Branchiopoda, Cladocera, Ostracoda and Copepoda). Zooplankton fluctuations in the estuary of a large subtropical urban river were investigated by Lee *et al*., (2021). The most common zooplankton were the 34 Decapoda, Copepoda (including Calanoida, Cyclopoida, and Harpacticoida), and "other larvae." Bestiolina spp., Corycaeus spp., Parvocalanuscrassirostris, Acartia spp., and Paracalanusparvus are the five most common Copepods, but there are a total of 44 taxa (including 8 only identified to genus) in the phylum. The zooplankton diversity in the River Jaldhaka in West Bengal, India was analysed by Sarkar and Pal (2021). Rotifers Brachionus, Filinia, and Polyarthra are indicators of slightly eutrophic conditions of the river water, and a total of 16 zooplankton genera were recorded, 5 of which belonged to Protozoa (31%), 5 to Rotifera (31%), 3 to Copepods (19%), and 3 to Cladocera (19%).

ICTHYOFAUNA

Over a million people are directly employed in the fishing industry; most of them reside in 3,937 coastal villages and fisherhanlets located near the country's major river basins and reservoirs. Each year, exports from the Sector contribute an average of Rs. 6,800 crores to annual foreign exchange earnings. Fourth largest overall, and second in inland fish production, India is a major player in the global fish industry. Although salinity is not as regulatory as temperature, it does affect the

osmoregulation and development of fish eggs, so it is at least partially dependent on salinity in determining the quantity of future stocks (Ibe, 1985).

Fishes are craniate animals found in aquatic environments that lack digited appendages on their limbs but have gills. Micronutrients and macronutrients found in fish are crucial for healthy growth and development of the brain and body. The high sensitivity of fish populations to changes in both the quality and quantity of their aquatic habitats makes them one of the most imperilled taxonomic groups. Indicators of water quality, river network connectivity, or flow regime often include these organisms. Bhatt (2000) offers reviews of Indian literature. Among the roughly 2,500 fish species known to exist, 930 are exclusively found in freshwater. In the Solapur district of Maharashtra, Sakhare (2001) looked into the presence of 23 fish species across 7 orders in Jawalgaon Reservoir. The Cypriniformes dominated the fish community with 11 species, followed by the Siluriformes with 4 species, the Osteoglssiformes with 2, the Perciformes with 2, and the Channiformes with 1.

Biradar (2002) looked at how different sampling locations affected the frequency distribution of fish species. The species were classified as either dominant (at least 80% of the time), abundant (60-80% of the time), less abundant (40-60%), or rare (less than 40% of the time) based on their frequency of appearance across all sampling sites. The Ujani fish fauna was analysed by Yazdani and Singh (2002). There were fifteen families represented by the fifty-four species discovered. Wagh and Ghate (2003) looked at the fish of the Mula and Mutha rivers that run through Pune. They found a total of 62 different species. Exotic fish populations seem to be on the rise during the seasons when fish populations are declining due to sewage and industrial pollution of river waters. Fish species in the northern Raipur district of Chhattisgarh were the subject of research by Om Prakash (2004). Sixty-four species were recorded, representing 40 genera, 19 families, and seven orders. In the Ravishankar Reservoir, located in the Dhamtari district of Chhattisgarh, 48 species were recorded, representing 32 genera and 15 families, according to the research of Desai and Shrivastava (2004). Fish species in the Nathsagar Reservoir in the Paithan district of Aurangabad were the focus of research by Khedkar in 2005. There were 67

different types of fish he saw, spread across 7 orders and 19 families. Researching fish health in relation to physicochemical parameters helps to shed light on the state of the ecosystem as a whole. The fish fauna of the River Narmada in West Nimar, M.P. was investigated by Bakawale and Kanhere (2006). There were 150 species found, from 26 different families. The ichtyofauna of the western region of the Narmada River was the focus of research by Verma and Kanhere (2007). He recorded 84 species from 45 different families. Due to differences in pollution tolerance between taxa (families, genera, and species), certain taxa can serve as useful "indicators" of water quality.

The freshwater fish resources of India were analysed by Sarkar *et al*., (2008). Human life and livelihood are critically dependent on the health of the world's biological resources, and the loss of fish species is one of the world's most pressing crises. Due to their extreme vulnerability to both the quantity and quality of change in their aquatic habitats, freshwater fish are one of the most imperilled taxonomic groups. Numerous Indian fish species were enlisted by him. The fish diversity in the rivers of the Janjgir-Champa district of Chhattisgarh was investigated by Dahire (2008). Of the 67 fish species known to science, he catalogued 41 genuses, 19 families, and 7 orders. Fish are useful for integrating the long-term effects of habitat change and environmental pollution because they span multiple trophic levels, have a long life cycle, and are highly mobile. Submerged macrophytes in the littoral zone protect potential prey in the pelagial, like large-bodied algaevorouscladocerans, from fish predators (Jeppesen *et al*., 1999; and Estlander*et al*., 2009). Despite their obvious ecological importance (a wide variety of insects, fish, and water birds), shallow lakes are rarely the focus of limnological research (Cereghino *et al*., 2008).

Fish diversity on the River Ganga in India was investigated by Singh and Johal (2009). There are a total of 76 different fish species in this section of river, spread across 10 orders, 24 families, and 53 different genera. Some of the tributaries of the Ganga River system were studied ecologically and their fish fauna catalogued by Bisht *et al*., 2009. The small hill streams can be extremely turbulent and have a wide

range of attitudes. Some of the world's largest and most diverse fish populations depend on these streams for survival. Many biological communities have been found to be organised primarily on the basis of the habitat they share.

Fish diversity and distribution in the Mullameri River, a small stream that flows into the Bheema River in the Gulbarga district of Karnataka, were investigated by Vijaylaxmi *et al*., in 2010. The research uncovered the existence of 14 fish species across 5 orders. Seven fish species were classified as belonging to the Cypriniformes order, followed by four species in the Siluriformes order, and one species each in the Channiformes, Mastacembeliformes, and Osteoglossiformes orders.

Freshwater fishes in the tributaries of the River Ramganga in the Shiwaliks of the Western Himalaya were analysed by Atkore *et al*., (2011) for their diversity patterns and conservation status. Forty-three species were documented, spread across eight families and five orders; of these, 29 were classified as endangered. The greatest number of species were from the Cyprinidae family. Lake Pichhola in Udaipur, Rajasthan was the focus of research by Sharma *et al*., 2011 on limnological characteristics, planktonic diversity, and fishes (species) (India).

Fish diversity in India's River Ravi was analysed by Kumar and Dua (2012). Changes in flow, degradation of habitat, availability of water, construction of a dam, and the emergence of two canals are the primary threats to the Ravi's fish diversity. The River Ravi was surveyed, and a total of 38 fish species were found. There are two endangered species and nine species that are considered vulnerable (according to IUCN conservation status).

The variety of fish in the River Narmada in the Western Zone was investigated by Bakwale and Kanhere (2013). There is a close relationship between the biological and physico-chemical parameters that control fish productivity and distribution and the diversity of fishes. There is an abundance of fish, and the vast majority of them are caught and used by humans. Based on the results of the survey, there are at least 51 different types of fish in this section of the river. Large carps, small carps, and cat fishes were the most numerous species observed. The various fish families, including the Clupiformes, Cypriniformes, Beloniformes,

Opiocephaliformes, Mastacambelliformes, Siluriformes, and Perciformes. With as many as 37 different species of fish from the Cypriniformes family. There was a clear decline in the populations of many fish species along this section, including Cirrihinuscirrihosa, Aspidopariajaya, Colisa asciatus, Labeobata, Oreichthyscosuatis, Osteobramacotio, etc. Fewer and fewer fish species were being seen. The diversity of fish in Bangladesh's River Choto Jamuna was investigated by Galib *et al*., (2013). A total of 63 fish species have been identified, spreading across 41 genera, 23 families, and 9 orders. The Cypriniformes family was found to contain the greatest variety of fish species and individuals. The researcher counted 41.26 percent of endangered, vulnerable, and critically endangered species in Bangladesh. The total values for the richness, diversity, and evenness indices were 0.897, 3.717, and 6.954, respectively. The Cypriniformes family was found to contain the greatest variety of fish species and individuals. The biodiversity of freshwater fish in a conserved river in India was examined by Sarkar *et al.*, 2013 and compared to a similar population in an unprotected river. The results showed that a whopping 87 species representing 8 orders, 22 families, and 52 genera were gathered in the protected area, while only a maximum of 59 species representing 6 orders, 20 families, and 42 genera were recorded in the unprotected areas. The sanctuary was found to be home to a diverse community of fish, but Cyprinids were the most common, with Salmostoma bacaila being the most numerous species overall. In addition to the countless Eutropiichthys vacha, Notopterus notopterus, Clupisom agarua, and Bagarius bagarius were also present. Compared to the unprotected area, the sanctuary harboured a greater variety of fishes, a higher abundance of individuals, larger individuals, and a greater proportion of threatened species. A comparison of the evaluated areas in the sanctuary and those without protection revealed statistically significant differences in the mean abundance of endangered and vulnerable species. For their 2014 study, Khedkar *et al.*, (2014) looked into DNA bar-codes for the fish of India's longest river, the Narmada. Fishes in India's Narmada River are described in detail here. There were a total of 820 fish samples taken. Using a combination of morphological characters and DNA bar coding based on COI gene sequences, researchers were able

to classify fish into one of 90 species. A total of 314 different COI sequences were generated and specimens were confirmed to belong 85 species representing 63 genera, 34 families and 10 orders. This investigation discovered 43 new species to science in the Narmada River basin, as well as five putative cryptic or sibling species. Five of the species are found nowhere else in the world except in India, and three of the species were not present in the Narmada River until they were introduced.

Research conducted by Satapathy and Misra (2014) on the fish population of the River Pilasalunki in the Phulbani district of Odisha revealed a surprisingly diverse array of species. Twenty-three different fish species, representing nine families, were documented. There are 35% endangered species and 52% near-threatened species in the list.There are 33 different types of fish, divided among 9 families and 21 different genera. The Cypriniformes were the most numerous (24 species), followed by the other orders: Perciformes, Ophiocephaliformes, Mastacembeliformes, and Beloniformes (1 species). The Cyprinidae family, which includes 250 individuals (75% of the total), was far and away the most common, followed by the Cobitidae family, which included 32 individuals (10% of the total). The existence of some rare and endangered fish species is also reported.

The ichtyofauna of the western section of the Narmada River in Madhya Pradesh was investigated by Pathak *et al*., 2014. The Narmada River is India's largest river that flows westward. It is the state's mainstay and the source of its economic vitality. As of this study's close, 58 fish species representing 38 genera, 16 families, and 6 orders have been uncovered in the area. Once common in the river, Tor tor and Chitalachitala are now listed as endangered.

Fish diversity in the Chambal River, Rajasthan, was investigated by Banyal and Kumar in 2015. Species of fish in the Chambal River are numerous and varied. The river is home to many species of fish, including carps, catfish, and mullet. The Chambal River in Rajasthan is home to 54 different fish species. The biodiversity and conservation of fish in the River Narmada's aquatic ecosystem was the focus of research by Bano *et al*., 2015. Depending on the scale and context, the term "ichtyodiversity" can refer to a wide range of different types of fish, including

different alleles or genotypes within a given population of fish, different types of life forms within a given fish community, and different types of life forms across different types of aquatic environments. The three Narmada stations near Hoshangabad, India, have recorded 40 different fish species across 25 different genera, 15 different families, and 6 different orders. The Cyprinidae family accounts for 63.64 percent of the total. The river's fish population is in decline because of human interference.

Sarkar *et al*., 2015 presented a paper on the fish communities of Indian reservoirs, with an eye toward improving fisheries and the aquatic ecosystem. The reservoirs in India are very important to the fishing industry. Fish populations are frequently used as proxies for environmental health. There are a lot of different fish in Indian reservoirs; 117 different species have been recorded there. The effects of these reservoirs on fish and the aquatic environment are mixed. So, the focus of this research was to compile the existing data on the fish diversity and community structure of the potential Indian Reservoirs, as well as the impacts on fisheries and the aquatic environment in these reservoirs.

Ichthyofauna diversity in Central India has investigated by Jain *et al*., 2016. Variation among populations, species, communities, and ecosystems in terms of their genetic makeup constitutes biodiversity. The ability of ecosystems to provide goods and services depends on the diversity of their component parts, which in turn is influenced by biodiversity's effect on the ability of living systems to respond to environmental changes. In Central India, they recruited a wide variety of fish.

Narmada River system in India is the focus of a case study by Bhaumik *et al*., 2017 that examines the effects of dams on the river's ecology and fisheries. According to their research, as of right now, three dams have been constructed in Madhya Pradesh and one is being built in Gujarat. Water quality, productivity & aquatic flora &fauna in river system all changed after dam was built, as shown by a comparison of conditions before and after the dam was constructed.Furthermore, in the estuarine section of the river system, Macrobrachiumrosenbergii and Tenualosailisha have seen respective percentage declines of 46% and 75% in their contributions to catches.

The diversity of fish species in Benisagar Dam was investigated by Shukla et al. (2017) of Satna, India. Benisagar Dam is home to 31 fish species from 11 different families. There are four species from the family Clupeiformes, twenty from the family Cypriniformes, three from the family Beloniformes, three from the family Perciformes, and one from the family Mugilidae. Saini and Dube (2017) investigated the variety of fish in Narmada River near Jabalpur. There is a total of 29 fish species found at these stations. Large carps, small carps, and catfish dominated the fish population. Cypriniformes, Beloniformes, Ophiocephaliformes, Perciformes, and Siluriformes are all well represented, as are their respective families of fish. The Cypriniformes family is the most numerous of these fish families, with 22 different species known to exist. There was a clear downward trend for some fish populations, including Cirrhinus cirrihosa and Labeobata. As of 2017, Sayeswara Ha investigated the ichtyofaunal diversity of the Tunga River in Mandagadde Bird Sanctuary, SHIVAMOGGA, and KARNATAKA, INDIA. There were a total of 16 fish species found in the study area, representing 4 orders, 8 families, and 12 genera. The Cyprinidae family had the most members seen with 6, followed by the Channidae family with 2, and the Cichlidae and Ciloridae families with each having 2. Fishes of the Cyriniformes order were well represented in Rajasthan's Vatrak Stream, as five different species were documented by Banyal and Kumar in 2017. Stream morphology, fish ecology, and taxonomy are all covered. The fish biodiversity and fisheries potential of Reservoir Udaisagar was investigated by Rathore *et al*., 2017. (Udaipur, Rajasthan). Up to this point in the investigation, 31 fish species representing 9 families wrererecorded from the reservoir; 12 of these species made significant contributions to the reservoir's commercial fisheries. During the time period of the study, 90 percent of all carp caught in this reservoir were Indian major carps. Catfishes were reported to make up 0.9% of the total, while minor carps made up 8.84%. Catla catla (70%) was the most common type of Indian major carp, followed by Labeo rohita (25%) and Cirrhinus mrigala (5%). Selakoti (2018) investigated the variety of fish in Kosi River in Almora, Uttarakhand, which is located in the Kumaun Himalayas. Twelve different types of fish were spotted. There

were only two families of fish that turned up in the records, and both of them were members of the cyprinid and botid families. Nine of the twelve fish species were found in the Cyprinidae family. There were three different kinds of fish in the family. There are 72 known fish species, spanning 12 orders and 27 families. About 28 percent of all fish species are classified as Cypriniformes. The family Cyprinidae has the highest proportion of members among those known to have been recorded (19%). Among the 14 most common types, catfish made up the largest group (27%). It was determined that river estuaries were the most common habitat (43%). 11 (55%) of the 20 threatened fish species in the RiverDakatia were classified as Vulnerable, 8% (40%) as Endangered, and 1% (5%) as Critically Endangered (CR).

The ichtyofauna of the Girna River was analysed by Shelke (2018). There were a total of 35 different fish species, spread across 8 orders, 27 genera, and 17 families. There were 20 species of fish belonging to the Cypriniformes order (57.14 percent), followed by 6 species of fish belonging to the Perciformes order (17.14 percent). Three species of Siluriformes (8.57%), two species of Synbranchiformes (5.71%), one species of Beloniformes (2.85%), one species of Synodontidae (2.85%), one species of Scorpaeniformes (2.85%), and one species of Osteoglossiformes (2.85%) make up the total number of fish families. That's why there could be a lot of fish in the Girna River. Twenty-nine of the thirty-five assessed fish species are classified as "least concern," while one is "near threatened," two are "Vulnerable," two are "not evaluated," and one lacks sufficient data for assessment. Hill stream fishes were the focus of research conducted by Rawal (2018) in the Sahastradhara region of the NARMADA RIVER in the KHARGONE, MADHYA PRADESH. From the Narmada River's Sahastradhara sampling station, researchers were able to collect data on eight different species of fish found in Hill Streams. Sarkar (2018) analysed the variety of fish fauna and the water quality of the Jamuna River in the South Bengal area during different seasons. Forty-six different fish species were brought in, representing 18 families and 36 different genera. The 24 species that made up the family Cyprinidae are:

Mastacembelidae family accounts for 2% of the total catch, the Bagridae family for 2%, the Siluridae family for 2%, the Ambassisae family for 2%, and the Mugilidae family for 2%. The post-monsoon period saw a dramatic increase in the catch of Cirrhinus reba and Labeo boga compared to the pre-monsoon and monsoon periods.

Fish Diversity of MAHI RIVER, RAJASTHAN has investigated by Banyal and Kumar (2019). There are five species each of Siluriformes and Perciformes, two species each of Osteoglossiformes, Synbranchiformes, and Clupeiformes, but only one species of Beloniformes. Indian researchers Sharma *et al*., (2019 b) conducted a systematic review of the literature on freshwater fish. Fish biodiversity encompasses not only the variety of fish species, but also the variety of environments in which they live and the complex webs of relationships among them. Fishes are well-suited as early warning signals of anthropogenic stress on natural ecosystem dynamics or, alternatively, as indicators of ecosystem recovery and resilience due to their unique life history traits. Their abundance and diversity in lenticular bodies suggest that the water there is fresh and safe for human use.

Influence of Tilapia (Oreochromis mossambicus) on ichtyodiversity was investigated by Sood *et al*., (2019). Tilapia is popular exotic fish in freshwater resources. As an invasive species, it threatens native fish populations. Thus Tilapia study is very important for aquatic diversity. Sharma *et al*., (2019 a) studied checklist of freshwater fishes in the Chandloi River Kota, Rajasthan. They listed 6 orders, 6 families, 11 genera, 13 species of freshwater fishes found in the river in different seasons. Family Cyprinidae is found to be most diverse and dominant family. This family has 6 genera with 8 species. With three species, the genus Labio is far and away the most numerous and dominant group in that environment. Fish diversity, abundance, and distribution in Akwa Ibom State's major water bodies (the Qua IboeRiver, the Imo River, and the Cross River) were investigated by Essien-Ibok and Isemin (2020). There are a total of 356 fish in the Qua Iboe River, distributed across 20 species and 12 families. There are 129 fish in the Imo River, spread across 4 families and 5 species. There were 19 species found in the Cross River, spanning 16

genera and 13 families. Therefore, a significant fishery can be supported by each of the three major ecosystems in the area. The Tropical Hilsa shad (Tenualosaisisha), which was the subject of a study by Hossain *et al*., (2020), makes a sizable contribution to the economies and cultures of Bangladesh, India, and Myanmar. Hilsa habitat and migration patterns can be predicted in the deltaic regions and shelf waters of the Bay of Bengal based on variations in seasonal productivity linked to nutrients and phytoplankton abundance.

Fresh water fishes in the Narmada River were the focus of research by Pathak and Lavudya (2021). Freshwater ecosystems are home to 176 unique species, with 13 orders, 46 families, 107 genera, and 176 species all represented. The Cypriniformes order had the most species, at 79, followed by the Perciformes with 35, the Siluriformes with 32, the Clupeiformes with 11, and so on. The results of studies on freshwater fish diversity may also serve as a starting point for more in-depth ecological analyses and long-term strategies for protecting and responsibly utilising inland water supplies. The ichtyofauna diversity of the Narmada River at the Maheshwar Dam was analysed by Sharma *et al*., (2021). There are a total of 36 known fish species, split between 7 orders, 12 families, and 22 genera. Cypriniformes dominated with 44.44 percent (16 species) followed by Siluriformes at 27.77 percent (10 species), Ophiocephaliformes at 11.11 percent (4 species), Perciformes at 5.56 percent (2 species), Mastacembeliformes at 5.56 percent (2 species), Beloniformes at 2.77% (1 species), and Clupeiformes at 2.77% (1 species). An in-depth limnological and ichthyological investigation of Udpuria pond and the Right Main Canal in Kota, Rajasthan was conducted by Sharma *et al*., (2022). They said that in the winter the air temperature dropped to a bare minimum and in the summer it rose to an unprecedented high. There was a correlation between water temperature and other physicochemical variables (chloride, phosphate, nitrate, dissolved oxygen, alkalinity, total hardness, free carbon dioxide, pH and total dissolved solids). There was a clear pattern to the turbidity's changes. The wet season saw an increase, while the cold season saw a decrease.

Following this review, I have come to the conclusion, Physico-Chemical parameters get effect on water quality and biotic flora &fauna of water ecosystems. This research provides useful information for figuring out how various physico-chemical factors affect water quality. Clarity of water is crucial to the well-being of the body of water.

CONCLUSION

The availability of research ublications is one of the biggest challenges in reviewing the amount of work done on a particular type of study. Numerous periodicals appear in print in various countries. However, based on the records that were retrieved and the references found among them. There are enough citations there for it to be considered a literature review. The review was written ignoring the too-early data and considering the available references from (1971) to the present day (2022).

Chapter - 3
Material and Methods

CHAPTER III

MATERIALS AND METHODS

1. STUDY AREA AND SAMPLING SITES:

1.1 Study area: The Udpuria pond, under investigation is situated 40 km away from KOTA, RAJASTHAN near village Nimoda, Sultanpur Tehsil in Kota district of Rajasthan. This pond filled from Right Main Canal. Udpuria (Nimoda) is surrounded by Sultanpur Tehsil towords East, Kota Tehsil towards West, Ladpura Tehsil towords South, Anta Tehsil towords East.This place situated near the Kota District and Baran District. Hadoti is the local language here. The geographical coordinates i.e. latitude and longitude of Nimoda (Udpuria) is 26.92 and 75.8 respectively.

1.2 Sampling sites for Collection of Water Samples

The samples of water have been collected from two collection sites i.e.RMC and Udpuria Pond.

PS I- One Km earlier then the opening point in to the Pond.

PS II- At Entry point in the Pond.

PS III- Bird observation point near road.

PS IV- Situated at 180 degree angle around PS III.

PS V- Near habitation of the village Udpuria.

PLATE – I

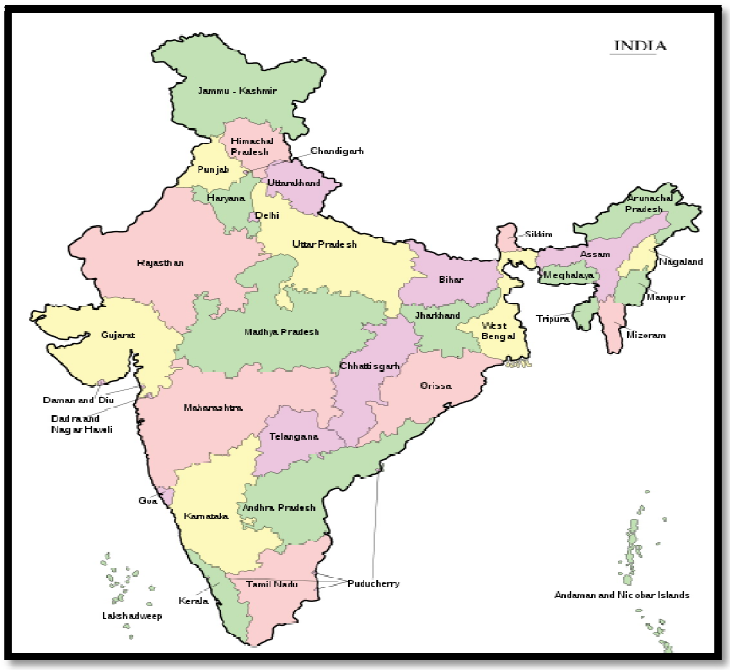


Figure: 1. Map of India

Figure: 2.Map of Rajasthan

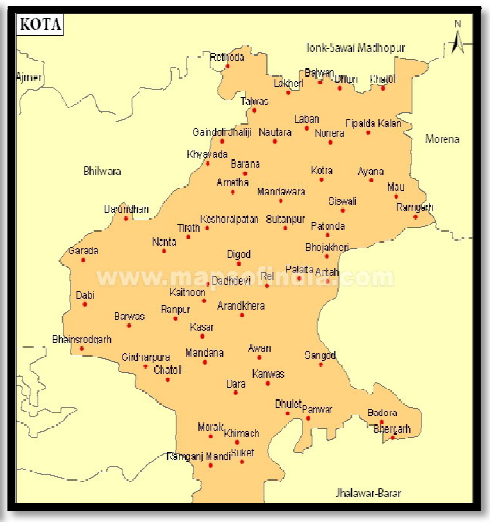


Figure: 3. Map of Kota

PLATE – II

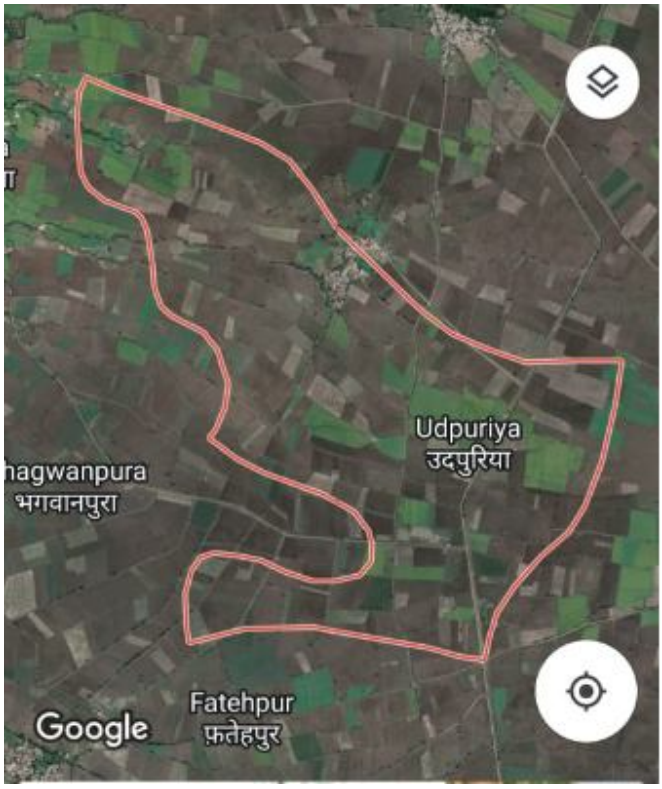


Figure: 4. Geographical representation of Udpuria Pond.

Figure 5: Map of Udpuria Pond

PLATE – III

Figure 6: PS I One Km earlier then the opening point in to the Pond.

Figure 7: PS II- At Entry point in the Pond.

PLATE – IV

Figure 8: PS III- Bird observation point near road.

Figure 9: PS IV- Situated at 180 degree angle around PS III.

PLATE – V

Figure 10: PS V- Near habitation of the village Udpuria.

PLATE VI

Figure : 11 Sample collection at observation site

Figure: 12 Data collection at observation site

The surface water sample was collected from all the sampling sites once in the Month. These samples were brought in the laboratory for further analysis for period of two years (November, 2018 - October, 2019; November, 2019 - October, 2020). Samples were collected in the morning hours between 7 am to 9 am.

The samples were analyzed on the spot for some parameters (such as Temperature, depth etc.) and brought in the laboratory for further analysis. The parameters such as water temperature, pH, free carbon dioxide and dissolved oxygen used at sampling sites. However laboratory test performed for analysis of sample for total hardness, alkalinity, turbidity, conductance and major Salts, water sample brought to the departmental laboratory for analysis and compare with two different stations:-

(1) At Right Main Canal

(2) At Udpuria.

The primary of basic source of data is based on the fish collected from river, direct field observation and information sampling. Questionnaires were administered to collect the information regarding changing pattern of the pond and fish distribution, general environment of the pond like lowering of water level and land erosion, siltation etc.

Methods of Plankton- Identification of plankton were done by using reference (Needhom). Statistical analysis was done by using ANNOVA.

The following parameters were studied from the sample collected (once aMonth) from Udpuria pond and Right main canal (study sites): -

1) Atmospheric Temperature: - Temperature is taken by Mercury Thermometer (least count $0.1^{o}C$) at sampling sites.

2) Water Temperature: - Temperature is taken by Standard Mercury Thermometer (least count 0.1^{o} C) at sampling sites.

3) Atmospheric Relative Humidity

4) Turbidity: - Turbidity is evaluated with help of SACCHI DISC at sample sites. Water sample was brought in the laboratory and turbidity was measured with the help of digital turbidity meter (NTU).

5) pH: - The pH was estimated by pH strips in the field and by digital pH meter in the laboratory.

6) Total dissolved solids (TDS):- Total dissolved solids have determined by evaporating method (APHA, 2005).

7) Conductivity: - APHA, 2005 Water temp. is recorded using good quality thermometer on the collection site.

8) Alkalinity: - Alkalinity was measured by titration method (APHA, 2005) in the laboratory. The water sample was titrated against 0.1N HCl.

9) Hardness: - Hardness was measured by titration method (APHA, 2005) in the laboratory. The water sample was titrated against 0.1N EDTA solution.

10) Dissolved oxygen: - Dissolved oxygen is achivedby modified Wrinkle's (volumetric) technique (APHA, 2005).

11) Free Carbon Di Oxide: - Free carbon dioxide was measured by titration method (APHA 2005) in the laboratory. The water sample was titrated against N/44 NaOH solution.

12) Chloride: - Chloride was measured by titration method (APHA, 2005) in the laboratory. The water sample was titrated against 0.02N $AgNo_3$ solution.

13) Nitrate: - APHA, 2005.

14) Phosphate: - APHA, 2005.

The standard APHA, (2005)methods were followed for estimation of physical, chemical and biological parameters. Details are given as under:

Methods used for physical parameters were:-

(2)Methodology: APHA 2005 methods were used for analysis of following parameters-

3. PHYSICO-CHEMICAL ANALYSIS

3.1.2 TEMPERATURE OF AIR AND WATER

The air temperature and water temperature measured by standard centigrade thermometer graduated up to 110^0C (+ -0.01)

Water samples were collected in a plastic container for the purpose of determining the temperature of the liquid, and shortly after the samples were collected, a mercury thermometer with 0.1°C accuracy was inserted. It was noted the mercury level. The thermometer was calibrated with a different thermometer of known accuracy while the reading was being taken. To determine the water temperature for each zone, a similar procedure was used.

3.3 Relative Humudity

Relative Humidity is the ratio of the amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature. Relative humidity measured by using various instruments.

1. Measurement of Dew Point
2. Measurement of Wet and Dry bulb Temperatures
3. Chemical/Physical Absorption Methods
4. Electrical Conductivity Measurements
5. Hair Hygrometer
6. Thermal Conductivity Merters.

   We used Hair Hygrometer Method and reading was directly noted from instrument.

3.4. TURBITDITY

Principle- The WHO, establishes that the turbidity of drinking water should not be more than 5 NTU, and should not be less than 1 NTU.

This is a measure of the ability of water to transmit the light that restricts light penetration and limit photosynthesis (Bhatnagar and Devi 2013).

Nephelometry is a method for determining turbidity by observing how it alters the light scattering properties of a given sample. Samples of low turbidity can be tested with a Nephelometer, while those of moderate turbidity require a turbidity metre. As the brightness of the scattered lights increases, so does the turbidity. An optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample is referred to as turbidity. The Jackson candle turbidity metre has been used as the gold standard for measuring turbidity. However, this instrument cannot measure turbidity values below 25 units. Estimating turbidity in the range of 0-5 units, where turbidities of treated water typically fall, requires an indirect method. The majority of commercially available turbidity metres for low turbidities provide relatively accurate indicators of the intensity of light scattered in a single direction, typically perpendicular to the incident light. These Nephelometers are the gold standard for measuring low turbidities because they are so resistant to changes in design parameters. The results of nephelometric measurements are reported in terms of nephelometric turbidity units (NTU).

Reagents -

'Solution I- Dissolve 1 g Hydrazine sulphate' and dilute to 100 ml.

'Solution II- Dissolve 10 g hexa methylene' tetramine and dilute to 100 ml.

'Solution III- Mix 5 ml of solution I with 5 ml of solution'II. Allow to stand for 24 hours and dilute to 100 ml. This solution should have turbidity of 400 NTU.

Solution IV - Dilute 25 ml of solution III to 100 ml to have solution having turbidity of 100 NTU.

Procedure – Calibrate the instrument (Nephleometer) at the desired range with the help of the 100 ml distilled water and then with the help of 100 ml standard solution of 100 NTU.

Now, take sample 100 ml and determine its turbidity by direct reading on the Nephleometer. Report the readings in NTU turbidity unit.

Methods involved for testing chemical parameters like.

(3.5) pH
(3.6) Total Dissolved Solids
(3.7) Electrical Conductivity
(3.8) Total Alkalinity
(3.9) Total hardness
(3.10) Dissolved Oxygen
(3.11) Free Carbon Di Oxide
(3.12) Chloride
(3.13) Nitrate
(3.14) Phosphate

3.5. HYDROGENION CONCENTRATION (pH)

This is the negative logarithm of hydrogen ion concentration (Boyd, C.E. 1979).This value is an indication of the level of acidity and alkalinity of a solution.

Principle – The pH value of water refreslogof reciprocal of H ion conc. present in H_2O. Since the pH is the log of reciprocal of H^+, the higher values of pH means lower H^+ concentrations, and thus represent alkaline solutions, whereas, the lower values of pH means higher hydrogen ion concentrations & represent acidic solutions. **(**Neutral water will, have a pH equal to: The pH value of water can be measured quickly & automatically with the help of pH meter, which measures the electrical potential measured exerted by H^+ and thus indicating their concentration.

Apparatus - pH meter: Many makes and models with separate /combined electrodes are commercially available. For their satisfactory operation the manufacturer's instructions must be followed. For many purposes reporting pH values to 0.1 pH is adequate and a pH meter accurate to +0.05 unit will suffice.

pH meter should be equipped either by manual or automatic temperature compensation. Buffer Solutions in pH meters are usually standardized with standard buffer solutions.

Reagents -The preparation of some normally required buffers are given below.

-pH 4.01 buffer solution at 25^0C- Dissolve 10.21 g anhydrous potassium bithalate, $KHC_8 H_4O_4$, in distilled water and dilute to 1000 ml in a volumetric flask .

- pH 6.86 buffer solution– dissolve 10.21 g anhydrous potassium dihydrogen phosphate KH_2PO_4 and 1.42 g anhydrous disodium hydrogen phosphate Na_2HPO_4 (both of which have been dried at 110- 150^0C for 2 hrs) in distilled water and make upto 1000 ml in a volumetric flask. Use distilled water which have been boiled for 15minutes and cooled at room temperature.

-pH 9.18 buffer solution at 25^0C – dissolve 3.8 g sodium borate ahydrate (borex), $Na_2B_4O_7$. $10H_2O$ in distilled water which have been boiled for 15 minutes and cooled to room temperature. Dilute to 1000 ml. Store the buffer solutions in polythene containers.

Procedure- Standardizesthe pH meter by using a buffer solution of known pH approaching that of the sample adjusts the temperature correction. Standardization may be counter checked by the buffer solution of a known value. Prepare the electrodes as per the manufactures instructions; insert the electrodes in the water sample. Read the reading directly on the dial of the instrument.

3.6. TOTAL DISSOLVED SOLIDS

Principle- The total amount of solid present in a water sample can be calculated by measuring its conductivity.

TDS = Conductivity x Correlation factor

Procedure-The determination of electrical conductivity provides a rapid andconvenient means of estimating the concentration of total dissolved solidsin water. If conductivity and dissolved solids concentration of the samewater sample us

found out separately and a correlation factor is found outpreviously, dissolved solids need not to be determined in future it can becompleted by multiplying conductivity with the correlation factor.

Formulae - TDS = Conductivity x Correlation factor (0.4)

3.7. ELECTRICAL CONDUCTANCE

Principle- This is a measure of the ability of water to conduct electricity. It is dependent on the ion concentration and water temperature. The total load of salts in a water body is directly related to its conductivity (Goltemam *et al*., 1980 and Delince, G. 1992). Electrical conductance estimated by using a direct reading systronics Conductivity Bridge and the values expressed in Micro Mhos/cm.

The conductance produced by different ions in the solution or water is measured using this technique. Specific conductance (in μmho/cm) can be multiplied by an empirical factor, which can range from 0.55 to 0.90 depending on the soluble components of the water and the measurement temperature, to obtain a rough estimate of the dissolved ionic contents of a water sample. A quick and useful way to estimate changes in a water body's dissolved mineral content is through conductivity measurement.

If conductivity and dissolved solids concentration of the same water sample is found out separately and correlation factor is found out previously, dissolved solids need not be determined in future as it can be computed by multiplying conductivity with the correlation factor. With waters of variable proportions of neutral salts the factor also varies. Conductivity measurements are made after proper temperature Compensation.

Conductivity = Dial reading x multiplier reading micromhos.

Sp. Conductivity = dial reading x multiplier reading x cell constantmicromhos cell constant.

Then cell constant = sp. Conductivity of the solu./measured conductivity

At 25^0C the specific conductivity of 0.01 N KCI solutions is 14^05 mcromhos. This solution is suitable for cell constant between 0.1 to 10.

3.8. ALKALINITY

Principle- Water alkalinity is a measure of its capacity to neutralize acids. It can be referred as the buffering capacity of water. Highly alkaline waters are not potable, Alkalinity value provide guidance in applying proper doses of chemicals in treatment processes particularly in deflouridation, coagulation, softening and operational control of anaerobic digestion. Here, principle involved is that the titration of the sample with N/50 H_2SO_4 to pH 4.5 or sharp change from yellow to orange of methyl orange indicator will indicate total alkalinity.

Reagents-

(i) Prepare the reagents in distilled water freshly boiled for 15 minutes.

(ii) Methyl arrange indicator – Dissolve 0.5 g in 1 litre of distilled water.

(iii) N/50 H_2SO_4 solution – Prepare approximately 0.1 N H_2SO_4 by diluting 3

ml conc. H_2SO_4 to 1 litre. Dilute 200 ml of this solution to 1 litre.

Procedure- For this purpose usual acid titration method has been followed. 100 ml of water sample has been treated with a few drops of phenolphthalein indicator. The appearance of pink colour indicated presence of carbonate alkalinity. This has been neutralized using 0.1 N HCl until the colour disappeared. The absence of phenolphthalein suggests the presence of Carbondiaoixde.

For estimating bicarbonate alkalinity a few drops of Methylorange indicator were added to the same sample and titrated with 0.1N HCl until the yellow colour changed to pink at the end point.

Alkalinity calculated with the help by this formula-

$$\text{PA as } CaCo_3 \text{ PPM} = \frac{\text{A X Normality of HCl X 1000 X 50}}{\text{Ml. of sample}}$$

$$\text{TA as } CaCo_3 = \frac{\text{B X Normality o f HCl X 1000 X 50}}{\text{Ml. of sample}}$$

Where A = ml. of HCl used with only phenolphthalein

B = ml. of HCl used with phenolphthalein and Methyl Orange

3.9. TOTAL HARDNESS

Principle- Hardnessin water is that characteristic which prevents the formation of sufficient lather or foam when such hard waters are mixed with soap. It is caused by the presence of certain salts of calcium and magnesium dissolved in water which form scum when reacts with soap. Hardness is defined as $CaCO_3$ equivalent of Ca & Mg ions present in water and expressed in mg/lit or ppm. Here, principle involved is when a small amount of Solo chrome Black-T is added to aqueous solution containing Ca^{+2} and Mg^{+2} at pH 10 ± 0.1, the solution becomes wine red in colour.

Total hardness of water is the parameters used to describe the effect of dissolved minerals (mainly Ca and Mg), determining suitability for domestic and industrial purpose which is attributed to the presence of bicarbonates, sulphates, chlorides and nitrates (Singh *et al.*, 2010 and Taylor 1949).

Reagents -

(i) Solo chrome Black T – 1 mg

(ii) Standard EDTA Solution- N/100 or 0.01 N – Dissolve 3.723 g EDTAin 1000 ml distilled water. Standard EDTA solution is stored in polythenebottle.

(iii) Ammonium buffer solution- 1 ml.

(iv) Sodium-Hydroxide solution- 1 ml.

Procedure-Total hardness has been estimated by EDTA Method 10 ml of water sample has taken in a conical flask for the estimation of total hardness and to this 1 ml of buffer solution and 1 ml of Sodium Hydroxide solution added to this mixture 200 mg of solo chrome Black T indicator has mixed. This imparts a wine red color to the solution. This has been titrated to blue end point using EDTA solution. Volume of EDTA has been placed in the following formula for calculation (Trivedy and Goel 1988).

$$\text{Total hardness as mg/ } 1CaCO_3 = \frac{\text{Volume of 0.01N EDTA used X 1000}}{\text{Ml. of sample}}$$

3.10. DISSOLVED OXYGEN

Principle- The amount of dissolve oxygen gas is highly dependent on temperature. Atmospheric pressure also has as effect on dissolved oxygen the amount of oxygen that dissolved in pure water is inversely proportional to the temperature of water. The warmer water, the less dissolved oxygen water.

Much of dissolve oxygen in water comes from the atmosphere due to wind action. Algae and rooted aquatic plant also give out oxygen into water through photosynthesis.

Reagent:

1. MnSO4:

Dissolve 480g of manganous sulphates $MnSO_4$. $4H_2O$ or 400g $MnSO_4.2H_2O$ or 364g $MnSO_4$. H_2O in distilled water, filter and dilute to 1L. The solution should not liberate not more than a trace of iodine when added to an acidified solution of KI.

2. alkali-Iodide Azide reagent:

Dissolved 500g NaOH (or 700g KOH) and 135g of NaI (or 150g KI) in the distilled water and dilute to 950 ml. dissolve 10g sodium azide in 40ml of distilled water and add to 950 ml of the first solution with constant stirring.

3. Standard sodium thiosulphate solution (0.025N). Dissolved 6.250g of $Na_2S_2O_3$. $5H_2O$ in dis. water boil, cool and make the volume to 1L. Standardize against std. potassium dichromate solution (0.1N).

4. Standardizations of sodium thiosulphate using std. potassium dichromate:

Dissolve 1.2257g potassium dichromate (previously dried at 103^0C for 1hour) in distilled water and make upto 250 ml in a volumetric flask. This is exactly 0.1N solution. Place 100Ml boiled cooled distilled water in a 500ml iodine flask. Add 3g KI_2g $NaHCO_3$ and shake until the salts dissolved. Add 6.0ml concentrate HCI. Pipette of 10ml and 0.1N potassium dichromate solution is taken to the flask. Cover the flask with watch glass and kept in dark for 5 minute. Rinse the watch glass and dilute the solution in the flask to 250ml with boiled and cooled distil water (free from oxygen). Titrate the liberated iodine with the sodium thiosulphate solution in the burette. When the solution acquire yellowish green colour, add 1ml starch indicator solution. Now a blue shade appears, rinse the side of the flask and contain the titration until one drop changes the colour to light green. Calculated normality of sodium thiosulphate solution is:

1ml of 0.025N sodium thiosulphate = 0.2mg oxygen.

5. Starch solution: -Dissolve 1 g starch in a little water with the help of glass rod, make a thin paste. Pour this paste in about 100ml boiling distil water and contain boiling for 2 minutes. Add cool and prepare daily fresh solution.

Procedure:

This method avoids the interference due to organic matter and chlorides present in the sample. Add 2ml of $MnSO_4$ solution in sample bottle followed by 2ml of iodideazide solution well below the surface of the liquid. Stopper with care to excludeair bubble if any completely and mix by inverting the bottle severalties. When the precipitate settles leaving a clear supernatant above the manganous hydroxide, repeat shacking second time. When setting has produced at least 100ml of clear supernatant carefully

remove the stopper and immediately add 2ml of conc. $MnSO_4$, allowing the acid to run down the neck of the bottle. Re stopper and mix by gently inversion.

Thus when the total of 4ml each of $MnSO_4$ and the iodide azide reagent is added to a 200ml bottle, volume taken for titrate should be 203 ml. Titrate with sodium thiosulphate solution to a pale yellow colour, add 1 to 2 ml of starch solution and contain the titrate until the first disappearance of bluecolour. Subsequent recoloration due to catalytic effect of nitrites or to the presence of traces of ferric salts which have not formed complexes should be disregarded.

Reations:-

$MnSO_4$+ 2KOH→$Mn(OH)_2$+k_2SO_4 white ppt.

$2Mn(OH)_2 + O_2$ (Do) → $2Mno(OH)_2$ brown ppt.

In absence of Do, brown colour does not appear

$MnO(OH)_2 + 2KI + 2H_2SO_4 \rightarrow MnSo_4 + 2H_2o + 2KOH + I_2$

Where $I_2 = O_2$

$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

DO calculated using formula

$$DO\ (mg\backslash liter) = \frac{V1 \times N \times 8 \times 1000}{V_2 - V_3}$$

Where Do = Dissolved oxygen

V_1 = Volume of titrant (ml)

N = Normality of titrant

V_2 = Volume of sampling bottle after placing the stopper (ml)

V_3 = Volume of Manganous sulphate + Potassium Iodine Azide

3.11.FREE CARBON DI OXIDE

Principle- A carbon dioxide gas solution in water is referred to as free CO_2. Aquatic plant life depends on CO_2, so the term is used to differentiate a gas solution from the combined CO_2 present in bicarbonate ions. The photosynthesis of plant materials uses CO_2.

Free CO_2 reacts with sodium hydroxide to from sodium bicarbonate. Complication of reaction is indicated by the development of colour of the phenolphthalein indicator. This method is based on this simple principle. All reagents were prepared in water freshly boiled at least for 15 minutes.

1. **Phenolphthalein indicator solution:** 5 gphenolphthalein disodium salt was dissolved in 1 litre distal water.

2. **Standardized 0.0227 N NaOH titrant:** 22.7 ml 1N NaOH was dil. to 1 litre with dist. water. Standardized it against standarded 0.02N using H_2SO_4 phenolphthalein indicator solution. Prepare the reagent daily and protect from atmosphere Co_2 in a Pyrex bottle.

1 ml = 1.00 mg CO_2

The sample was collected by means of rubbing discharging at the bottom of a 100 ml graduated cylinder. The sample was allowed to overflow for a few minutes and the tubing withdrawn while the sample is flowing. Flick the cylinder to throw off the excess sample above 100 ml mark.

Procedure:

5-10 drops of phenolphthalein indicator was added to 100 ml of water sample. It the sample turns pink, free Co_2 is absent. If the sample remains colourless, titrate rapidly into the cylinder with standard alkali solution stirring gently with a stirring rod until a definition pink colour persists for 30 second.

Calculation:-

Co_2 (mg/l) = A N*4000 / ml of sample

Where,

A = ml titration for sample and,

N = Normality of NaOH

3.12. CHLORIDE

Principle- Chlorides gas is highly toxic,but the chloride ion is a common constituent of all natural water and it's generally regarded as non harmful constituent (Nduka *et al.*, 2008 and Chutia *et al*., 2009).

Chlorideoccurs in natural waters in widely varying concentrations in the form of sodium chloride. Their concentrations above 250 mg/liter produce a noticeable salty taste in drinking water and are thus objectionable.

The chloride concentrations of raw waters being used for public supplies should be tested regularly, so as to immediately detect any sudden increase in its chloride content and the possibility of any organic pollution of water.

Here, principle involved is Mohr method in which silver nitrate is used as titrate and potassium chromate as indicator. In neutral or slightly alkaline solutions (p^H 7 to 8) as the solubility product of AgCl is more (K_{sp}= 3 x10^{-10}) than the solubility product of Ag_2CrO_4 (K_{sp} = 5 x 10^{-12}), therefore, the AgCl quantitatively gets precipitated before, red Ag_2CrO_4 is formed.

Reagents –

(i) Silver nitrate standard solution (0.0282 N)

(ii) K_2CrO_4 (Potassium chromate) indicator.

Procedure- 50 ml of water sample has been taken in a conical flask and 2 ml. of 5 % potassium chromate has been added. This has been then titrated against the 0.02 N silver nitrate until a persistent red tinge appeared.

This formula has been used for chloride

$$\text{Chloride (mg /L)} = \frac{\text{Volume of titrate (ml) X 1000}}{\text{Vol. of Sample}}$$

3.13. NITRATE

Principle- The nitrate represents fully oxidized organic matter and such watersmay not be harmful.

When nitrate levels in drinking water are too high, it can be harmful to infants' health and lead to a condition known as methemoglobinemia.

The nitrate concentration in domestic water supplies isgenerally limited to 45 ppm.

Procedure-In 10 ml sample add standard silver sulphate solution in theamount equal to the amount of silver nitrate solution consumed in chloride list.

Now evaporate at water bath. Coal it and add some distilled water. Now add 2 ml phenol disulphonic acid. Add 10 ml ammonium hydroxide. If yellow colour appears, nitrate is present & otherwise absent.

3.14. PHOSPHATE:

Phosphorous was determined by spectrophotometer. Samples were taking in Erylenmeyer flask and evaporate to dryness. Titrate with sodium hydroxide solution and ammonium molybdate solution.

Orthophosphate and ammonium molybdate react to produce molybdophosphoric acid in an acidic setting. Incorporating a reducing agent like stannous chloride or ascorbic acid transforms it into molybdenum blue. Once the blue colour from the ammonium molybdate has been produced, it is measured at 690 or 880nm after waiting 10 to 12 minutes in a blank. To determine concentration, just use a regular old concentration graph. As the concentration of phosphate in a sample increases, the intensity of the blue complex rises.

PHYTOPLANKTON

Collection and identification of phytoplankton

According to size, phytoplankton are classified as ultra-plankton 0.5 to 10 μm, nanno plankton 10 to 50 μm, micro plankton (net plankton) 50 to 500 μm and macroplankton 500 μm. larger phytoplankton collected by filtering a known amount of water through a plankton net made by bolting silk (no. 25 mesh size 55 μm).Take one litre of water sample in a wide mouth glass bottle. Add 10 ml of Lugol's iodine solution per litre of sample. Lugol's iodine solution speeds up the rate of sedimentation of phytoplankton, provides them stain, and preserves their flagella and cilia. For complete sedimentation sample were allowed to stand for a day. Through pippete clear sediment is removed and is examined and identified under a Nikon microscope, preferably an inverted plankton microscope using pertinent literature.

5. ZOOPLANKTON

Collection and identification of zooplankton

Zooplankton were collected by filtering a known volume of water through zooplankton made up of bolting silk (no.25; mesh size 55μ) the surface water was collected with the help of aplastic bucket or a jug of known volume. Zooplanktons were collect and identified under a Nikon binocular microscope, using pertinent literature.

6. CLASSIFICATION AND IDENTIFICATION OF FISH

The classification of fish has been done after Day (1889), Jayaram (1999), Srivastava (1980) and other standard literature. The updated recent scientific names have been recorded from www.fishbase.org (2015) and www.wikipedia.org.

Chapter - 4

Observation & Result

CHAPTER IV

OBSERVATION AND RESULT

STUDY OF PHYSICO-CHEMICAL FEATURES OF WATER

PHYSICO-CHEMICAL FEATURES OF WATER

Water is single one of the major important resource which is found around 75% in the earth's crust. The water has become an important product for human development programmed and its feature is in danger due to the contamination. The quality of water changes with the seasonal variations. These seasonal changes may have both positive and harmful impacts on the quality of water. The different seasons have various temperature variations attributed to them. Along with the temperature all other physical and chemical parameters of water fluctuates with the variation of seasons. Monitoring the water quality is essential for environmental safety. Examination of water quality and measuring for physico-chemical parameters are important to conserve and defend the natural ecosystem. The analysis of various water quality parameters help in understanding the metabolic measures of the aquatic system. Certain parameters such as pH, turbidity, temperature, alkalinity, hardness, Biochemical oxygen demand (BOD), Total dissolved solids, nitrates, phosphates are necessary for the understanding of flora and fauna presence and distribution with time.

During the investigation, Udpuria pond was selected keeping the aim of study monthly sample from November 2018 to October 2020 was taken. At least four water samples were collected every month from each site. In spite of monthly variations, seasonal variation was also calculated and illustrated in tables. Statistical tool, two way analysis of variance (F-test) was applied to see if there was any significant differences between sites and seasons or not and discuss them with relevant parameters.Theresults of analysis of physico-chemical parameters is recorded in Table No. 1 to Table No. 28 and presented diagrammatically in the form of bar diagram Graphc No. 1 to Graph No. 28.

RESULTS

Atmospheric Temperature

The seasonal variations in atmospheric temperature at various sites was recorded in table – 1 and 2 and presented in Graph – 1 and 2. The maximum (in summer season) and minimum (in winter season) values of atmospheric temperature was 41.2^0C, 16.5^0C respectively. The lowest temperature was recorded at sampling station IV 16.5^0C in winter 2018 to 2019. The highest temperature (41.2^0C) was recorded during summer 2018-2019 at site PS I. Similarly the lowest temperature was recorded at sampling station III 15.8^0C in winter 2019 to 2020 and sampling station II recorded highest temperature 42.9^0C during summer 2019-2020.

Water Temperature

During the study period seasonal water temperature was maximum in summer and minimum in winter (Table 3 and Graph 3). The maximum and minimum water temperature ranges from 30.9^0C to 16^0C. Table 3 and Table 4 depict the seasonal variations in water temperature at various sites of the pond. During year 2018 to 2019 the lowest temperature was recorded at sampling station II and IV 16.5^0C in winter season. At site PS I, the highest temperature was recorded 30.9^0C during summer in the year 2018-2019. In 2019-2020 the highest water temperature recorded at sampling station II 30.8 and lowest at sampling station V 16.4^0C.

Atmospheric Relative Humidity

The humidity amount of water vapors present in the air. Seasonally the atmospheric relative humidity varied from minimum 24 % at sampling station I and IV in summer and was maximum 95 % in monsoon at sampling station II, III, IV in year 2018 to 2019 (Table 5 and Graph 5).

In year 2019 to 2020 highest atmospheric relative humidity 96% at sampling station II and III in monsoon and Lowest 23% at sampling station I in summer (Table 6 and Graph 6).

Turbidity

The seasonal variations in turbidity at various sites was recorded in table 7 and 8 and presented in Graph 7 and 8. The maximum (in monsoon season) and minimum (in winter season) values of turbidity was 70.2NTU, 6.9NTU respectively. The lowest turbidity was recorded at sampling station PS I 6.9NTU in winter 2018 to 2019. The highest turbidity (70.2NTU) was recorded during monsoon 2018-2019 at site PS V. Similarly the lowest turbidity was recorded at sampling station I 7.6NTU in winter 2019 to 2020 and sampling station III recorded highest turbidity 70.5NTU during summer 2019-2020.

pH

The seasonal variations inpH at various sites was recorded in table 9 and 10 and presented in Graph 9 and 10. The maximum (in monsoon season) and minimum (in winter and summer season) values of pH was 8.8, 7.6 respectively. The lowest pH was recorded at sampling station PS III, IV, V 7.6 in winter and similarly 7.6 at sampling station IV in summer in 2018 to 2019. The highest pH (8.8) was recorded during monsoon 2018-2019 at site PS II. Similarly the lowest pH was recorded at sampling station III, V 7.6 in winter and station IV in summer 2019 to 2020 and sampling station II recorded highest pH 8.6 during summer 2019-2020.

Total Dissolved Solids

During the study period seasonal total dissolved solids was maximum in summer and minimum in winter (Table 11 and Graph 11). The maximum and minimum total dissolved solids ranges from 486mg/L to 206mg/L. Table 11 and Table 12 depict the seasonal variations in total dissolved solids at various sites of the pond. During year 2018 to 2019 the lowest total dissolved solids was recorded at sampling station II in winter season. At site PS III, the highest total dissolved solids were recorded 486mg/L during summer in the year 2018-2019. In 2019-2020 the highest water total dissolved solids recorded at sampling station V 487mg/L and lowest at sampling station I 207mg/L.

Electrical Conductivity

Electrical conductivity is the ability of an aqueous solution to conduct the electric current. During the study period electrical conductivity was maximum in monsoon and minimum in winter (Table 13 and Graph 13). The electrical conductivity ranges from 338μmho/cm to 112μmho/cm. During year 2018 to 2019 the lowest electrical conductivity was recorded at sampling station I in winter season. At site PS V, the highest electrical conductivity was recorded 338μmho/cm during monsoon in the year 2018-2019. In 2019-2020 the highest electrical conductivity recorded at sampling station I 460μmho/cm in monsoon and lowest at sampling station I 207μmho/cm in winter (Table 14 and Graph 14).

Alakalinity

The seasonal variations intotalalkalinityat various sites was recorded in table 15 and 16 and presented in Graph 15 and 16. The maximum (in winter season) and minimum (in summer season) values of alkalinity was 275mg/L, 122mg/L respectively. The lowest alkalinity was recorded at sampling station PS I (122mg/L) in summer in 2018 to 2019. The highest alkalinity (275mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest alkalinity was recorded at sampling station I (127mg/L) in summer 2019 to 2020 and sampling station V recorded highest alkalinity (280mg/L) during winter 2019-2020.

Total Hardness

In the present study the seasonal variations intotalhardnessat various sites was recorded in table 17 and 18 and presented in Graph 17 and 18. The maximum (in winter season) and minimum (in summer season) values of total hardness was 275mg/L, 122 mg/L respectively. The lowest total hardness was recorded at sampling station PS I (122 mg/L) in summer in 2018 to 2019. The highest total hardness (275 mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest total hardness was recorded at sampling station I (134 mg/L) in winter

2019 to 2020 and sampling station V recorded highest total hardness (190 mg/L) during summer 2019-2020.

Dissolved Oxygen

During the study period seasonal dissolved oxygen was maximum in monsoon and minimum in summer (Table 19 and Graph 19). The maximum and minimum dissolved oxygen ranges from 7.6mg/L to 4.2mg/L. Table 19 and Table 20 depict the seasonal variations in dissolved oxygen at various sites of the pond. During year 2018 to 2019 the lowest dissolved oxygen was recorded at sampling station V in summer season. At site PS I, the highest dissolved oxygen was recorded 7.6mg/L during monsoon in the year 2018-2019. In 2019-2020 the highest dissolved oxygen recorded at sampling station I 7.8mg/L and lowest at sampling station V 4.6mg/L.

Free Carbon Di Oxide

In the present study the seasonal variations inFree Carbon Di Oxideat various sites was recorded in table 21 and 22 and presented in Graph 21 and 22. The maximum (in monsoon season) and minimum (in winter season) values of Free Carbon Dioxide was 2.3mg/L, 0.5 mg/L respectively. The lowest Free Carbon Di Oxide was recorded at sampling station PS I, IV, V (0.5mg/L) in winter in 2018 to 2019. The highest Free Carbon Di Oxide (2.3mg/L) was recorded during winter 2018-2019 at site PS III. Similarly the lowest Free Carbon Di Oxide was recorded at sampling station I, IV, V (0.5mg/L) in monsoon 2019 to 2020 and sampling station II recorded highest Free Carbon Di Oxide (2.3mg/L) during summer 2019-2020.

Chloride

Chloride ion is a common constituent of all natural water and it's generally regarded as non harmful constituent. Seasonally the chloride varied from minimum 15.8mg/L at sampling station I in summer and was maximum 42.9mg/L in winter at sampling station V in year 2018 to 2019 (Table 23 and Graph 23).

In year 2019 to 2020 highest chloride 39.9mg/L at sampling station V in winter and Lowest 14.8 mg/L at sampling station I in summer (Table 24 and Graph 24)

Nitrate

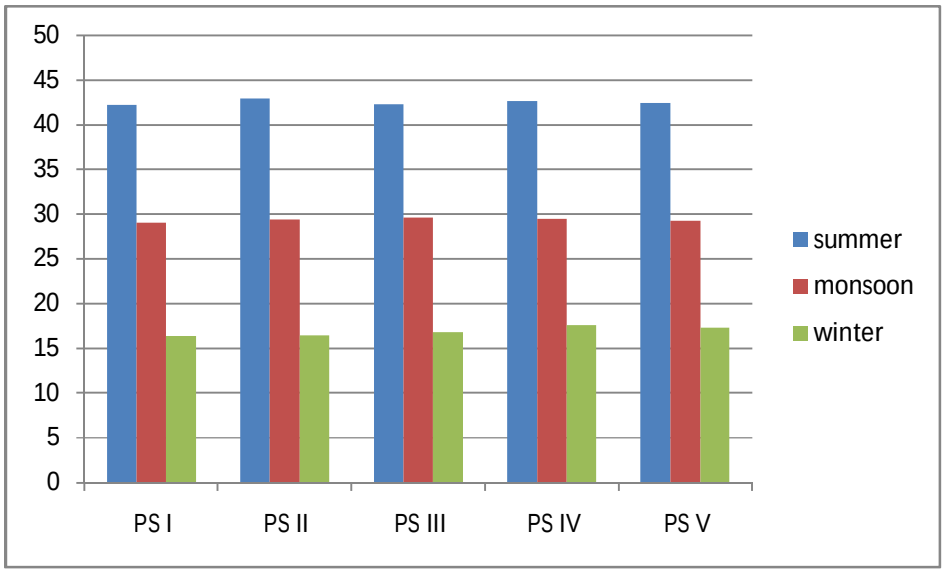
The seasonal variations innitrate at various sites was recorded in table 25 and 26 and presented in Graph 25 and 26. The maximum (in winter season) and minimum (in summer season) values of nitrate was 42.9mg/L, 1.5mg/L respectively. The lowest nitrate was recorded at sampling station PS I, II (1.5mg/L) in summer in 2018 to 2019. The highest nitrate (42.9mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest nitrate was recorded at sampling station I (1.8mg/L) in summer 2019 to 2020 and sampling station V recorded highest alkalinity (39.9mg/L) during winter 2019-2020.

Phosphate

The amount of phosphate is minimum 2.1mg/L at sampling station IV in monsoon and was maximum 4.8mg/L in winter at sampling station III in year 2018 to 2019 (Table 27 and Graph 27). In year 2019 to 2020 highest phosphate 4.9mg/L at sampling station III in winter and Lowest 2.4mg/L at sampling station IV in monsoon (Table 28 and Graph 28).

Table 01: Seasonal fluctuation in Air temperature (^{0}C)Udpuria Pond (Kota) during November, 2018 to October, 2019.

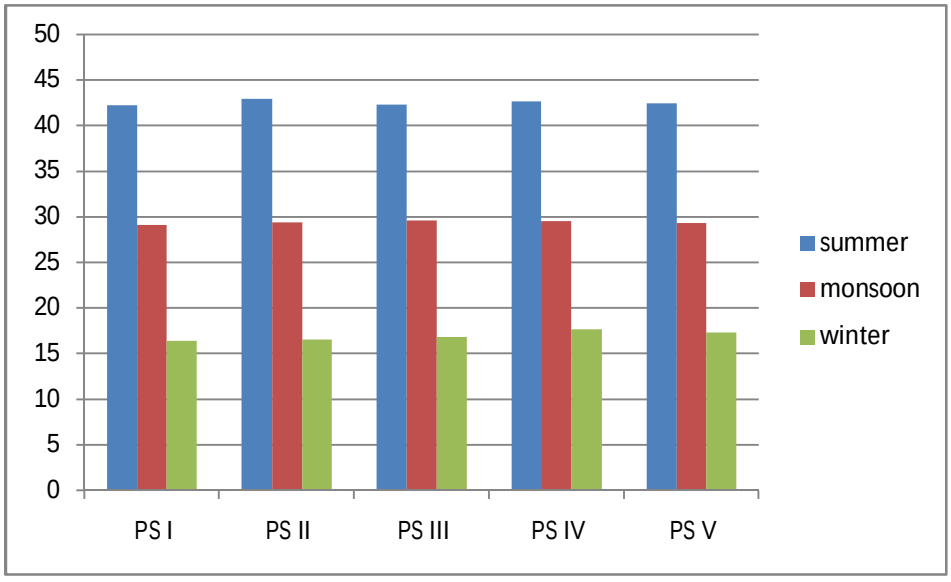
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	41.2	30.6	17.6	17.6	41.2	4.51
PS II	40.9	30.3	16.9	16.9	40.9	4.64
PS III	40.3	30.5	16.8	16.8	40.3	4.66
PS IV	40.6	30.2	16.5	16.5	40.6	4.39
PS V	40.5	30.3	16.7	16.7	40.5	4.49



Graph 1:- Showing Maximum and Minimum values of Air Temperature of Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 02: Seasonal fluctuation in Air temperature (^{0}C)Udpuria Pond (Kota) during November, 2019 to October, 2020.

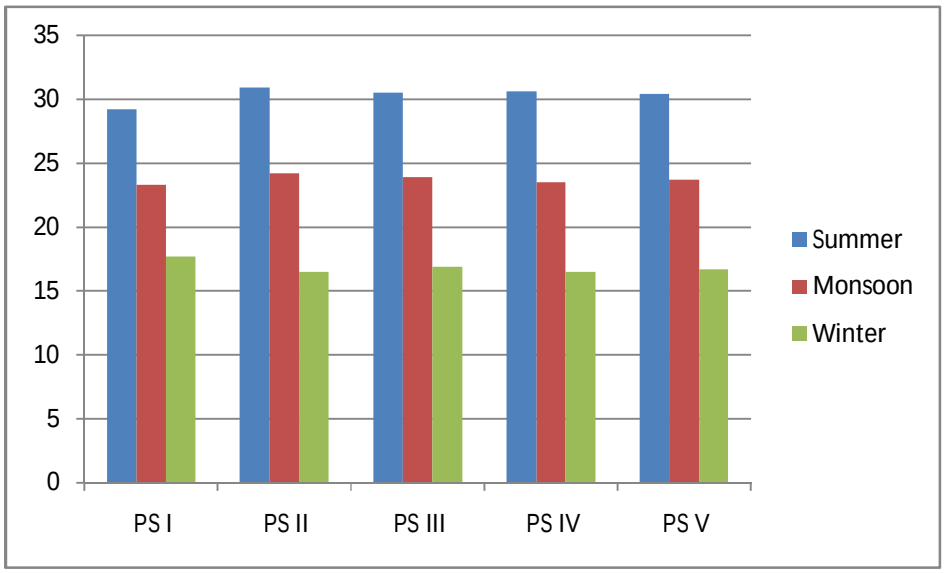
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	42.2	29.1	16.4	16.4	42.2	4.51
PS II	42.9	29.4	16.5	16.5	42.9	4.64
PS III	42.3	29.6	16.8	16.8	42.3	4.62
PS IV	42.6	29.5	17.6	17.6	42.6	4.39
PS V	42.4	29.3	17.3	17.3	42.4	4.47



Graph 2:- Showing Maximum and Minimum values of Air Temperature of Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 03: Seasonal fluctuation in water temperature (^{0}C)Udpuria Pond (Kota) during November, 2018 to October, 2019.

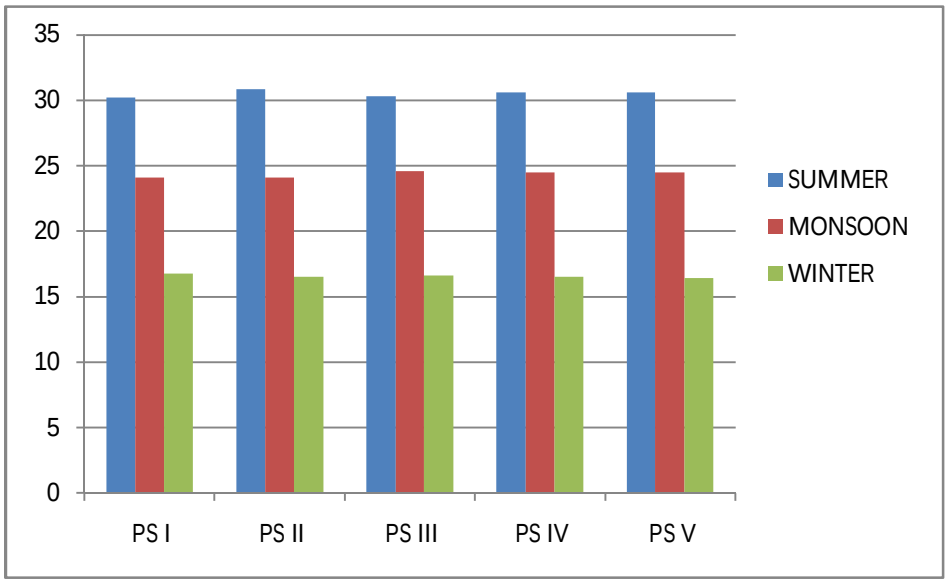
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	29.2	23.3	17.7	17.7	29.2	4.22
PS II	30.9	24.2	16.5	16.5	30.9	4.34
PS III	30.5	23.9	16.9	16.9	30.5	4.26
PS IV	30.6	23.5	16.5	16.5	30.6	4.19
PS V	30.4	23.7	16.7	16.7	30.4	4-17



Graph 3:- Showing Maximum and Minimum values of water temperature (^{0}C)Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 04: Seasonal fluctuation in water temperature (^{0}C)Udpuria Pond (Kota) during November, 2019 to October, 2020.

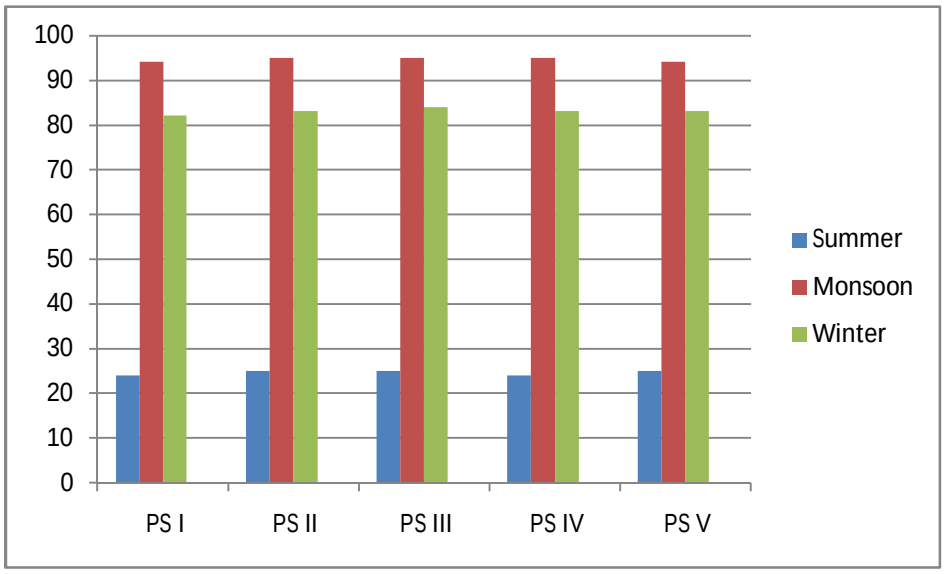
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	30.2	24.1	16.8	16.8	30.2	4.34
PS II	30.8	24.1	16.5	16.5	30.8	4.41
PS III	30.3	24.6	16.6	16.6	30.3	4.52
PS IV	30.6	24.5	16.5	16.5	30.6	4.35
PS V	30.6	24.5	16.4	16.4	30.6	4.32



Graph 4:- Showing Maximum and Minimum values of water temperature (^{0}C)Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 05: Seasonal fluctuation in Relative humidity (%)Udpuria Pond (Kota) during November, 2018 to October, 2019.

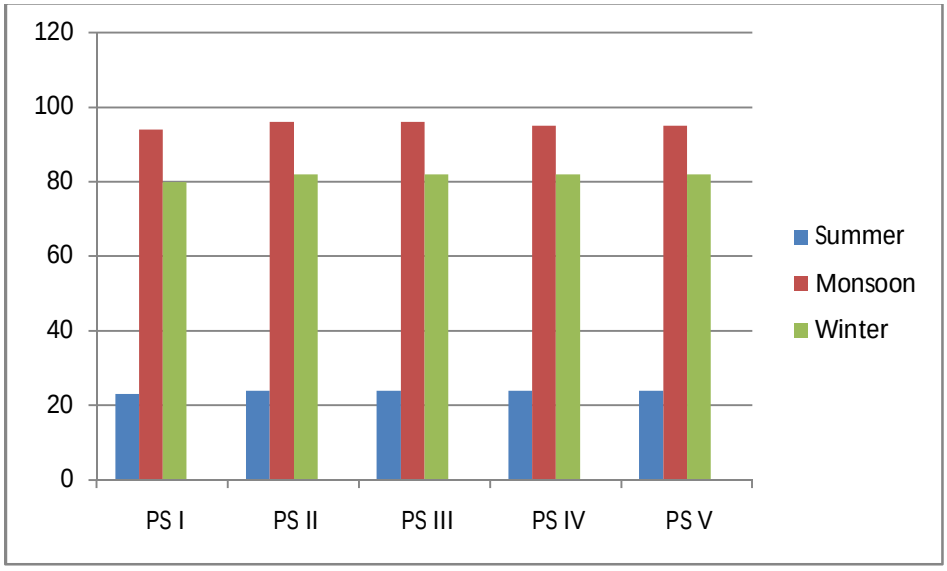
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	24	94	82	24	94	4.51
PS II	25	95	83	25	95	4.64
PS III	25	95	84	25	95	4.56
PS IV	24	95	83	24	95	4.38
PS V	25	94	83	25	94	4.35



Graph 5:- Showing Maximum and Minimum values of Relative Humidity (%) of Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 06: Seasonal fluctuation in Relative humidity (%)Udpuria Pond (Kota) during November, 2019 to October, 2020.

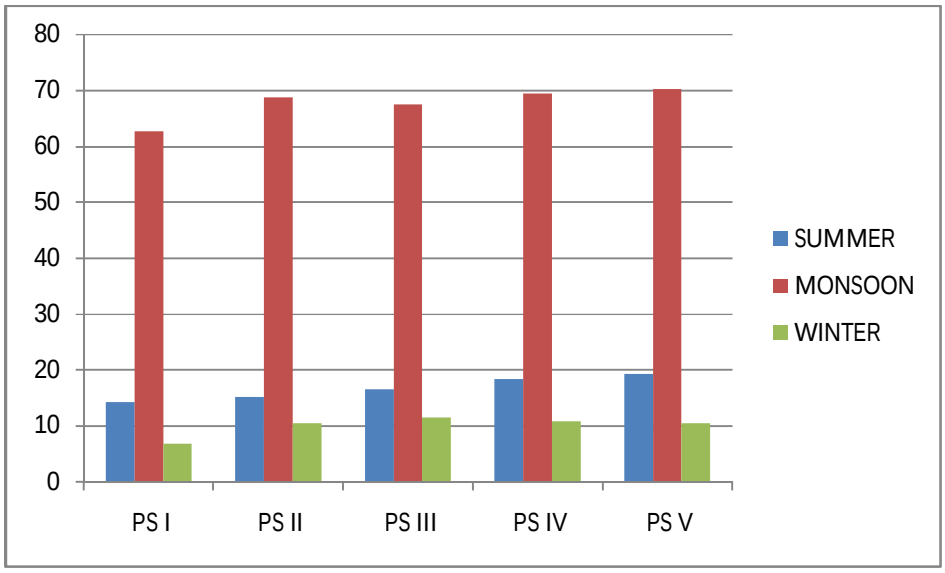
Sites &Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	23	94	80	23	94	4.48
PS II	24	96	82	24	96	4.55
PS III	24	96	82	24	96	4.32
PS IV	24	95	82	24	95	4.36
PS V	24	95	82	24	95	4.25



Graph 6:- Showing Maximum and Minimum values of Relative Humidity (%) of Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 07: Seasonal fluctuation in Turbidity (NTU)Udpuria Pond (Kota) during November, 2018 to October, 2019.

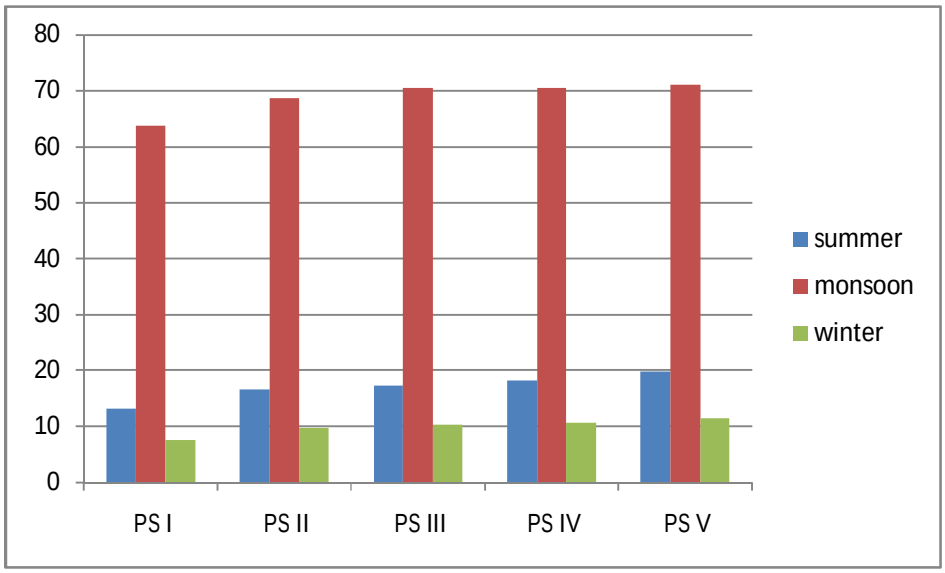
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	14.3	62.6	6.9	6.9	62.6	18.5
PS II	15.2	68.8	10.6	10.6	68.8	18.3
PS III	16.6	67.4	11.6	11.6	67.4	18.8
PS IV	18.5	69.4	10.9	10.9	69.4	19.6
PS V	19.4	70.2	10.6	10.6	70.2	19.8



Graph 7:- Showing Maximum and Minimum values of Turbidity (NTU)Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 08: Seasonal fluctuation in Turbidity (NTU)Udpuria Pond (Kota) during November, 2019 to October, 2020.

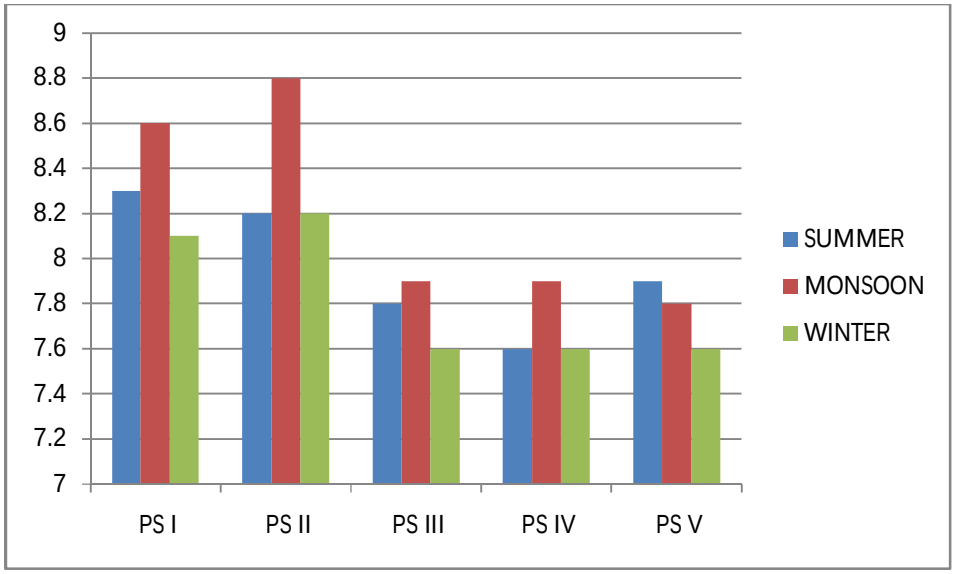
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	13.2	63.8	7.6	7.6	63.8	19.7
PS II	16.7	68.7	9.8	9.8	68.7	19.2
PS III	17.4	70.5	10.4	10.4	70.5	18.8
PS IV	18.2	70.4	10.7	10.7	70.4	19.1
PS V	19.8	71.1	11.5	11.5	71.1	19.3



Graph 8:- Showing Maximum and Minimum values of Turbidity (NTU)Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 09: Seasonal fluctuation in pH Udpuria Pond (Kota) during November, 2018 to October, 2019.

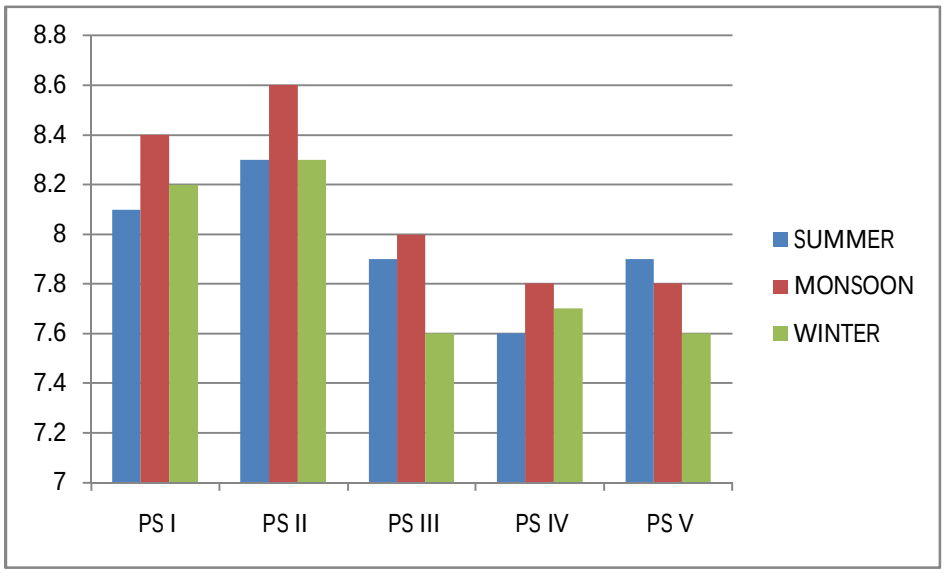
Sites &Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	8.3	8.6	8.1	8.1	8.6	1.5
PS II	8.2	8.8	8.2	8.2	8.8	1.3
PS III	7.8	7.9	7.6	7.6	7.9	1.8
PS IV	7.6	7.9	7.6	7.6	7.9	1.2
PS V	7.9	7.8	7.6	7.6	7.9	1.4



Graph 9:- Showing Maximum and Minimum values of pH Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 10: Seasonal fluctuation in pH Udpuria Pond (Kota) during November, 2019 to October, 2020.

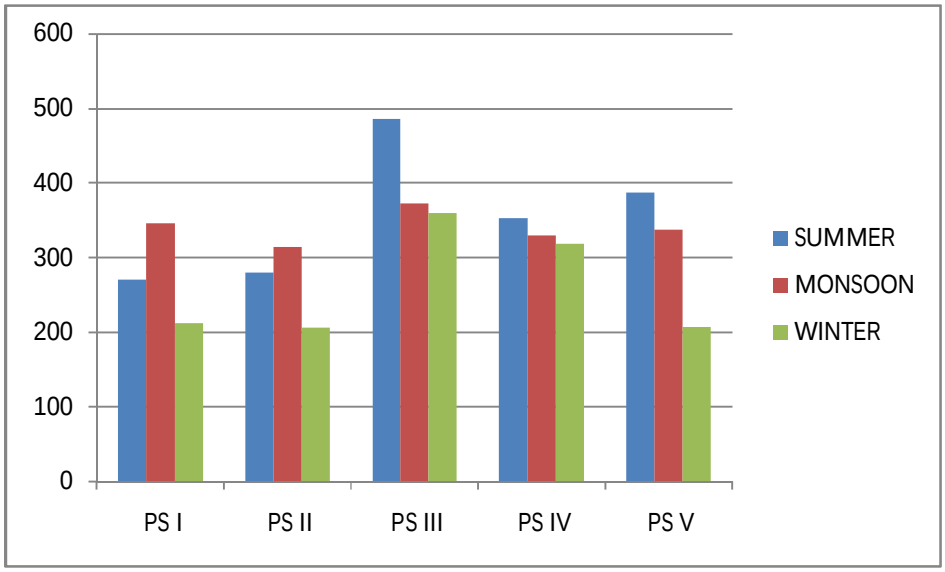
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	8.1	8.4	8.2	8.1	8.4	1.4
PS II	8.3	8.6	8.3	8.3	8.6	1.3
PS III	7.9	8.0	7.6	7.6	8.0	1.6
PS IV	7.6	7.8	7.7	7.6	7.8	1.2
PS V	7.9	7.8	7.6	7.6	7.9	1.4



Graph 10:- Showing Maximum and Minimum values of pH Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 11: Seasonal fluctuation in Total Dissolved Solids (TDS) Udpuria Pond (Kota) during November, 2018 to October, 2019.

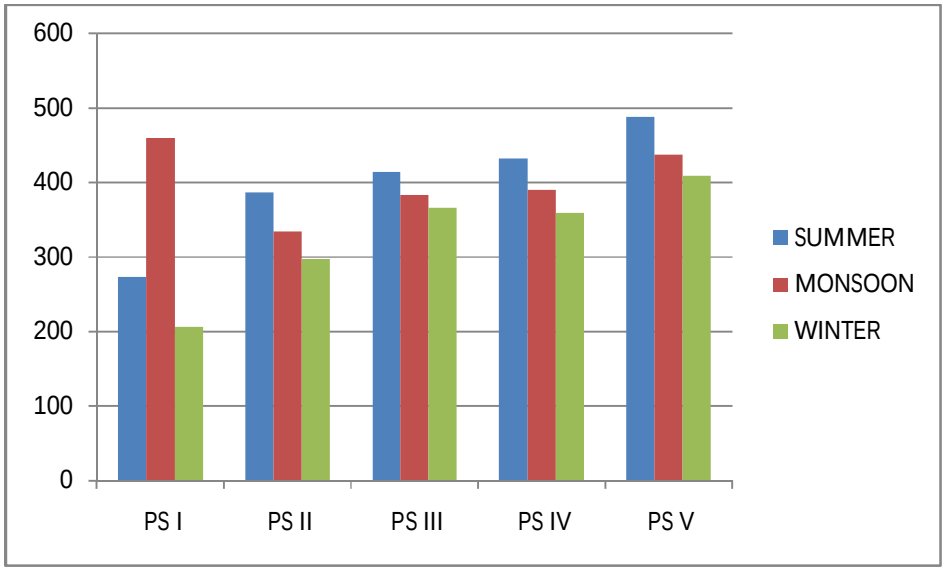
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	270	346	212	212	346	19.8
PS II	280	315	206	206	315	18.9
PS III	486	373	360	360	486	19.4
PS IV	353	330	319	319	353	19.6
PS V	387	337	207	207	387	18.8



Graph 11:- Showing Maximum and Minimum values of Total Dissolved Solids (TDS) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 12: Seasonal fluctuation in Total Dissolved Solids (TDS) Udpuria Pond (Kota) during November, 2019 to October, 2020.

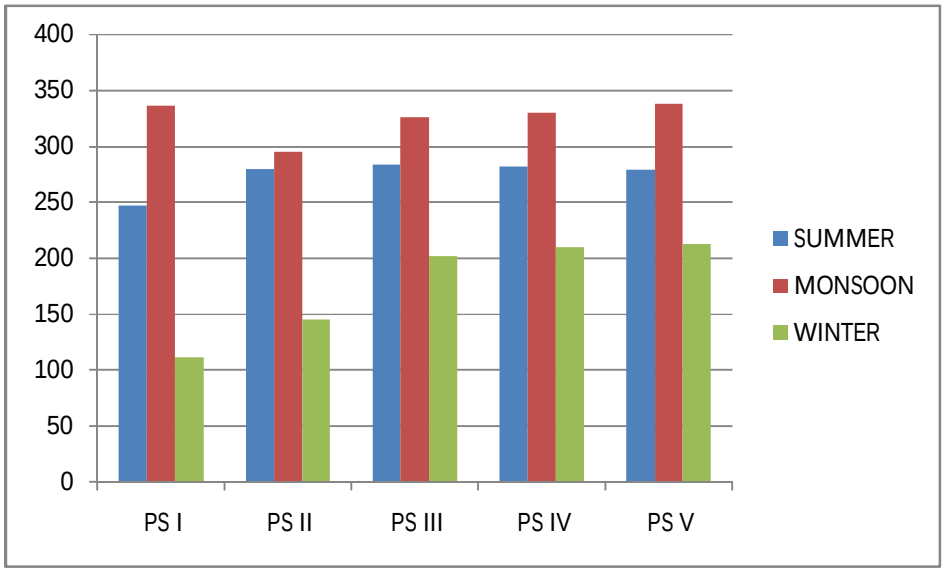
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	274	460	207	207	460	19.8
PS II	386	335	297	297	386	20.9
PS III	414	383	366	366	414	20.4
PS IV	432	390	359	359	432	21.6
PS V	487	437	409	409	487	21.8



Graph 12:- Showing Maximum and Minimum valuesof Total Dissolved Solids (TDS) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 13: Seasonal fluctuation in Electrical Conductivity (µmho/cm) Udpuria Pond (Kota) during November, 2018 to October, 2019.

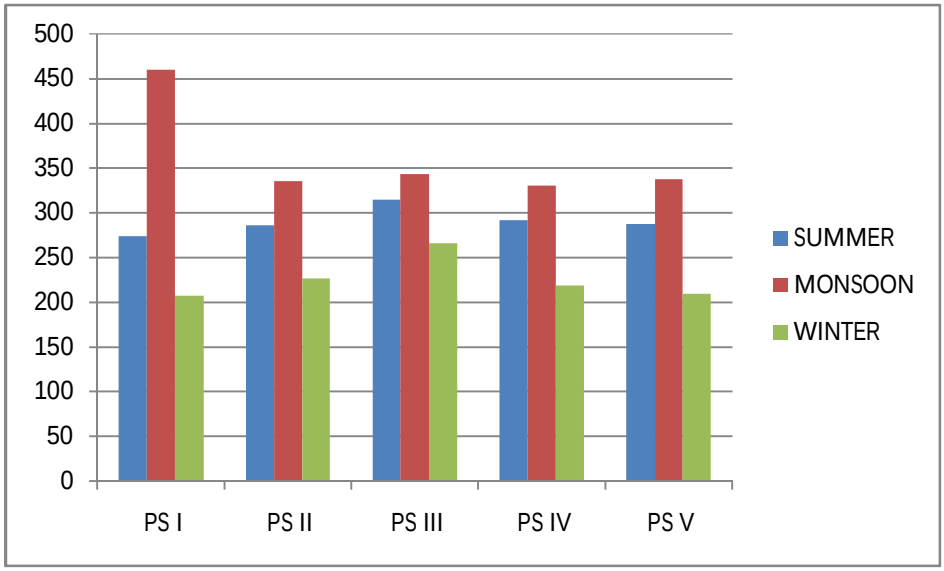
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	247	336	112	112	336	17.8
PS II	280	295	145	145	295	18.5
PS III	284	326	202	202	326	19.2
PS IV	282	330	210	210	330	18.6
PS V	279	338	213	213	338	19.6



Graph 13:- Showing Maximum and Minimum values of Electrical Conductivity (µmho/cm) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 14: Seasonal fluctuation in Electrical Conductivity (µmho/cm) Udpuria Pond (Kota) during November, 2019 to October, 2020.

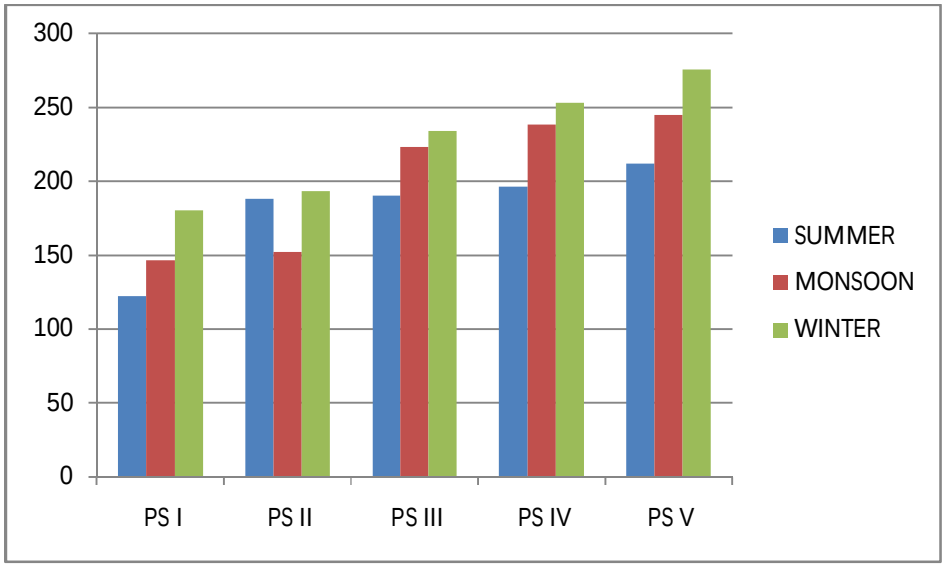
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	274	460	207	207	460	19.8
PS II	286	335	227	227	335	20.9
PS III	314	343	266	266	343	20.4
PS IV	292	330	219	219	330	21.6
PS V	287	337	209	209	337	21.8



Graph 14:- Showing Maximum and Minimum values of Electrical Conductivity (µmho/cm) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 15: Seasonal fluctuation in Total Alkalinity (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

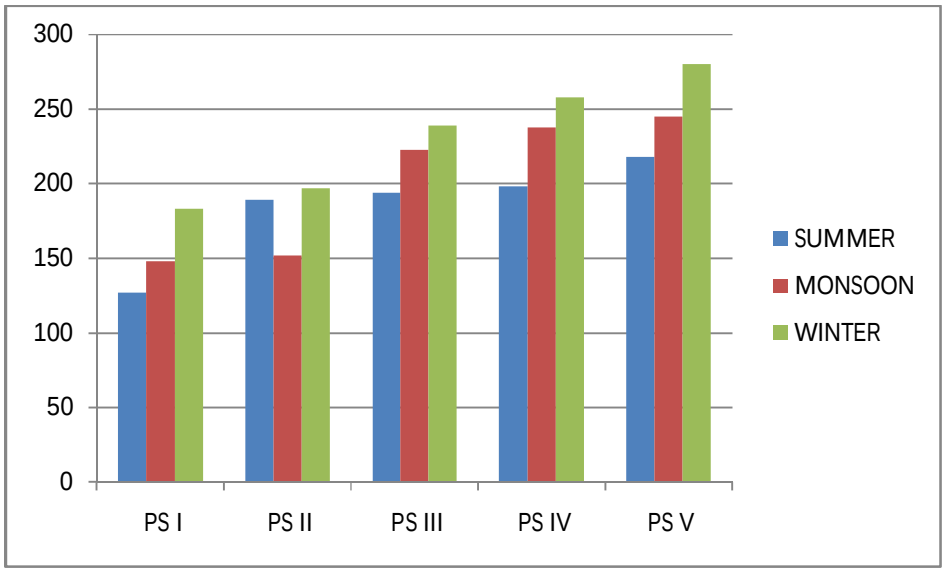
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	122	146	180	122	180	43.3
PS II	188	152	193	152	193	48.1
PS III	190	223	234	190	234	57.4
PS IV	196	238	253	196	253	58.9
PS V	212	245	275	212	275	63.7



Graph 15:- Showing Maximum and Minimum values of Total Alkalinity (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 16: Seasonal fluctuation in Total Alkalinity (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

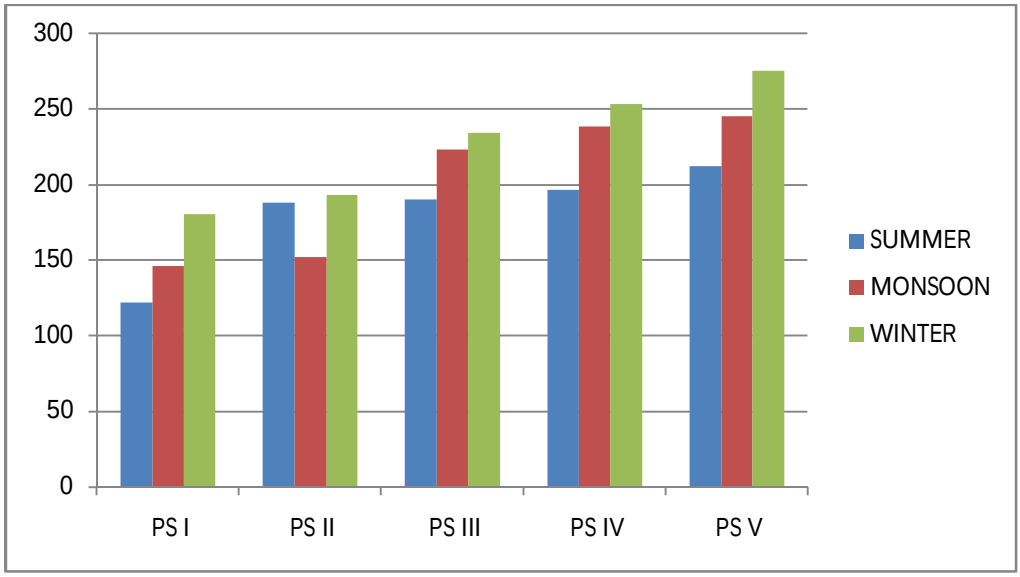
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	127	148	183	127	183	43.7
PS II	189	152	197	152	197	48.6
PS III	194	223	239	194	239	58.3
PS IV	198	238	258	198	258	59.2
PS V	218	245	280	218	280	63.8



Graph 16:- Showing Maximum and Minimum values of Total Alkalinity (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 17: Seasonal fluctuation in Total Hardness (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

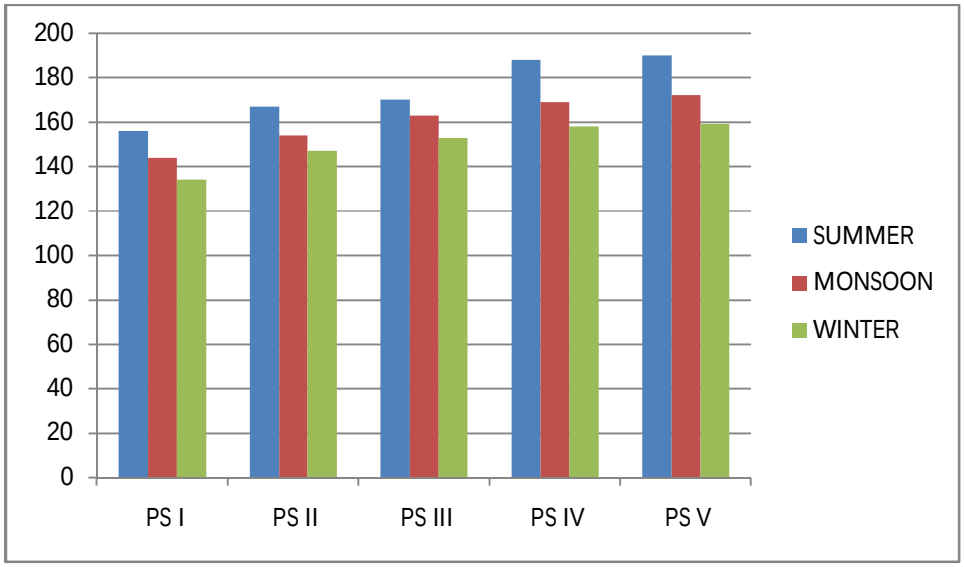
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	122	146	180	122	180	43.3
PS II	188	152	193	188	193	48.1
PS III	190	223	234	190	234	57.4
PS IV	196	238	253	196	253	58.9
PS V	212	245	275	212	275	63.7



Graph 17:- Showing Maximum and Minimum values of Total Hardness (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 18: Seasonal fluctuation in Total Hardness (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

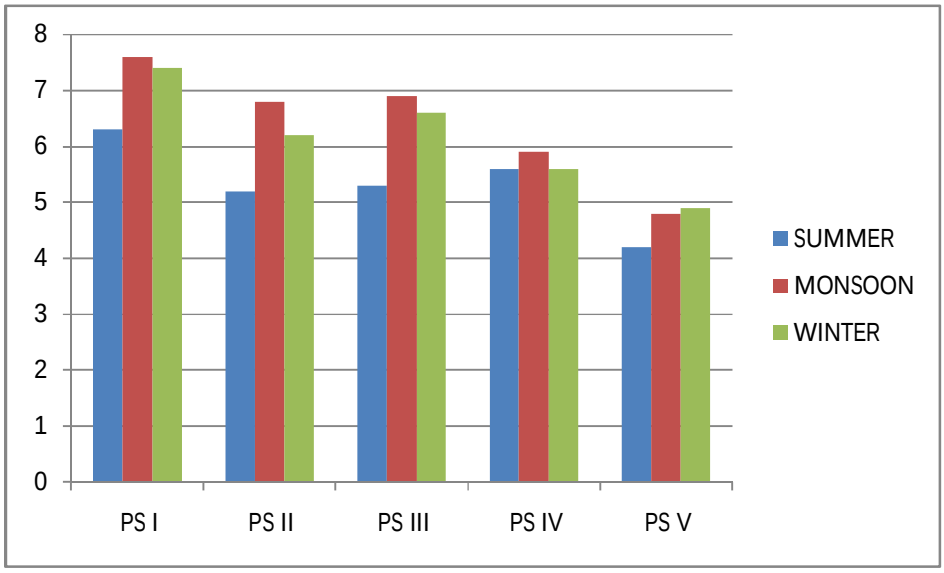
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	156	144	134	134	156	26.3
PS II	167	154	147	147	167	25.9
PS III	170	163	153	153	170	26.7
PS IV	188	169	158	158	188	25.2
PS V	190	172	159	159	190	26.1



Graph 18:- Showing Maximum and Minimum values of Total Hardness (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 19: Seasonal fluctuation in Dissolved Oxygen (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

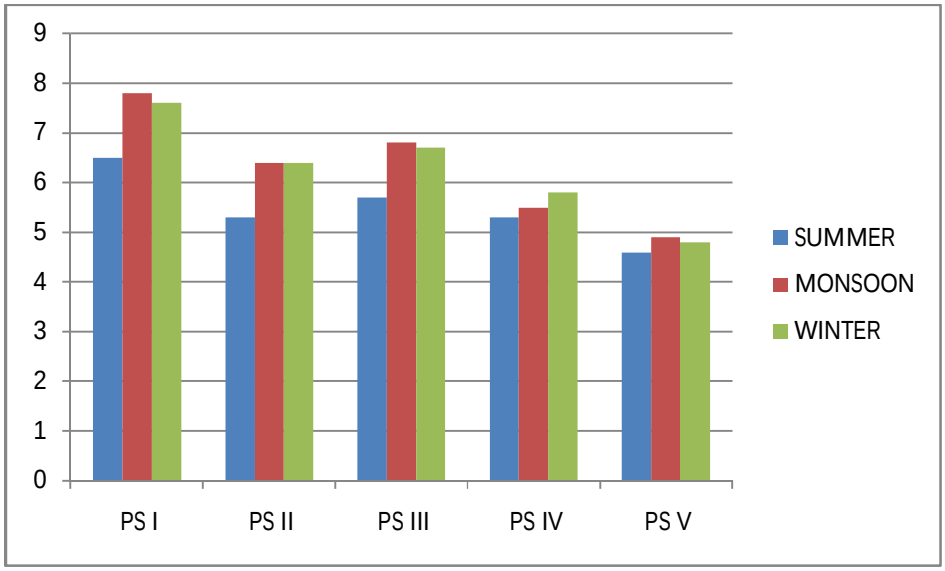
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	6.3	7.6	7.4	6.3	7.6	2.5
PS II	5.2	6.8	6.2	5.2	6.8	2.3
PS III	5.3	6.9	6.6	5.3	6.9	2.8
PS IV	5.6	5.9	5.6	5.6	5.9	2.2
PS V	4.2	4.8	4.9	4.2	4.9	2.4



Graph 19:- Showing Maximum and Minimum values of Dissolved Oxygen (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 20: Seasonal fluctuation in Dissolved Oxygen (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

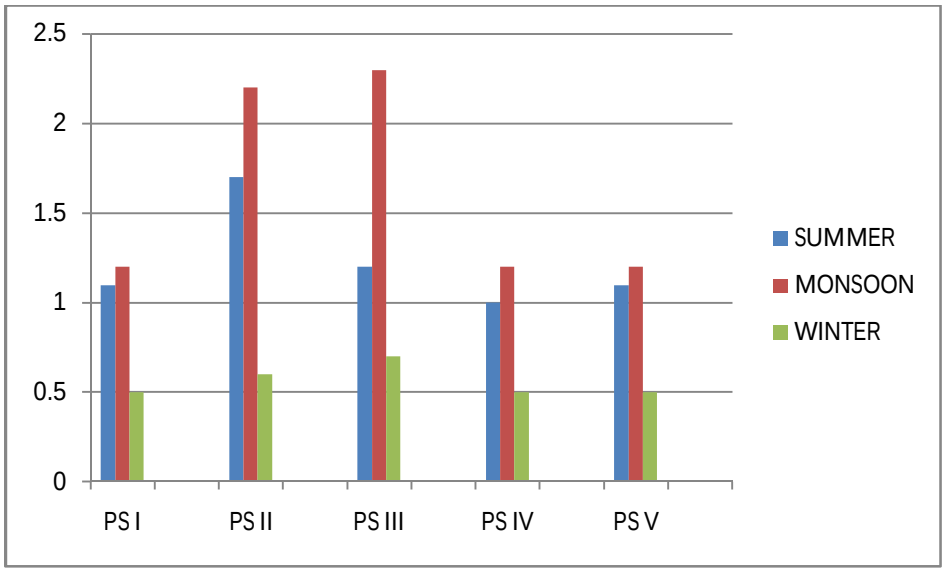
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	6.5	7.8	7.6	6.5	7.8	2.7
PS II	5.3	6.4	6.4	5.3	6.4	2.5
PS III	5.7	6.8	6.7	5.7	6.8	2.8
PS IV	5.3	5.5	5.8	5.3	5.8	2.5
PS V	4.6	4.9	4.8	4.6	4.9	2.6



Graph 20:- Showing Maximum and Minimum values of Dissolved Oxygen (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 21: Seasonal fluctuation in Free Carbon Di Oxide (mg/L) Udpuria Pond (Kota) during November, 2018 to October 2019.

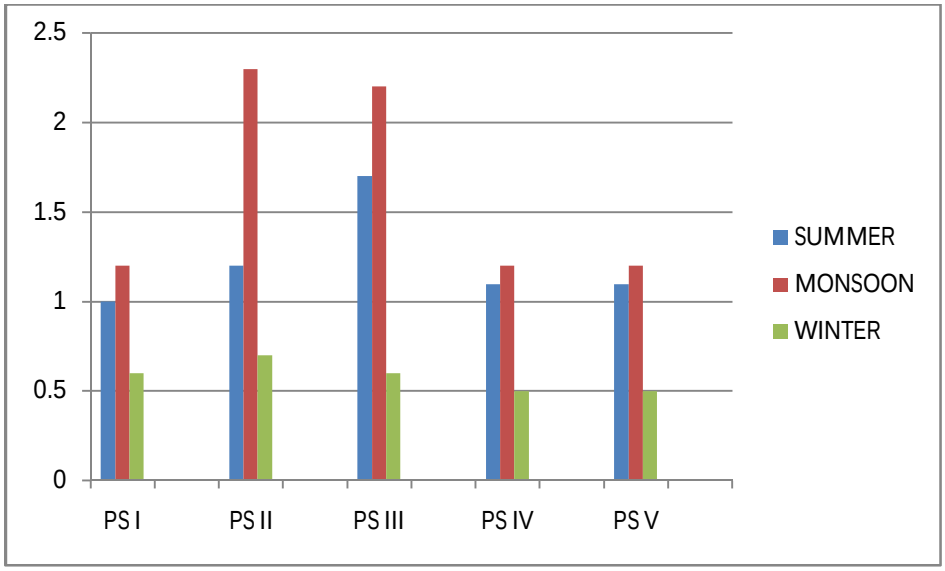
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	1.1	1.2	0.5	0.5	1.2	0.38
PS II	1.7	2.2	0.6	0.6	2.2	0.88
PS III	1.2	2.3	0.7	0.7	2.3	0.84
PS IV	1.0	1.2	0.5	0.5	1.2	0.41
PS V	1.1	1.2	0.5	0.5	1.2	0.44



Graph 21:- Showing Maximum and Minimum values of Free Carbon Di Oxide (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019

Table 22: Seasonal fluctuation in Free Carbon Di Oxide (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

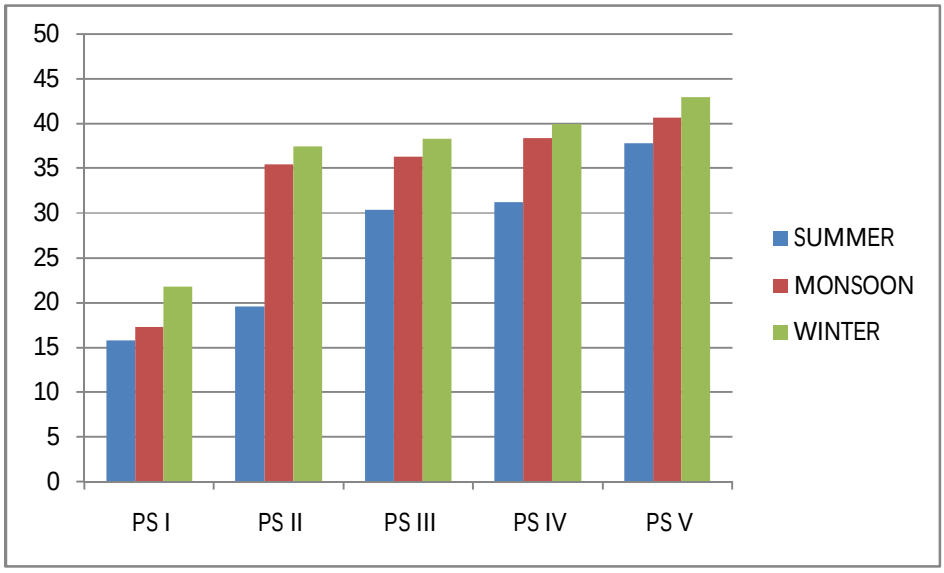
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	1.0	1.2	0.6	0.5	1.2	0.41
PS II	1.2	2.3	0.7	0.7	2.3	0.84
PS III	1.7	2.2	0.6	0.6	2.2	0.88
PS IV	1.1	1.2	0.5	0.5	1.2	0.38
PS V	1.1	1.2	0.5	0.5	1.2	0.44



Graph 22:- Showing Maximum and Minimum values of Free Carbon Di Oxide (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020

Table 23: Seasonal fluctuation in Chloride (Cl^-, mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

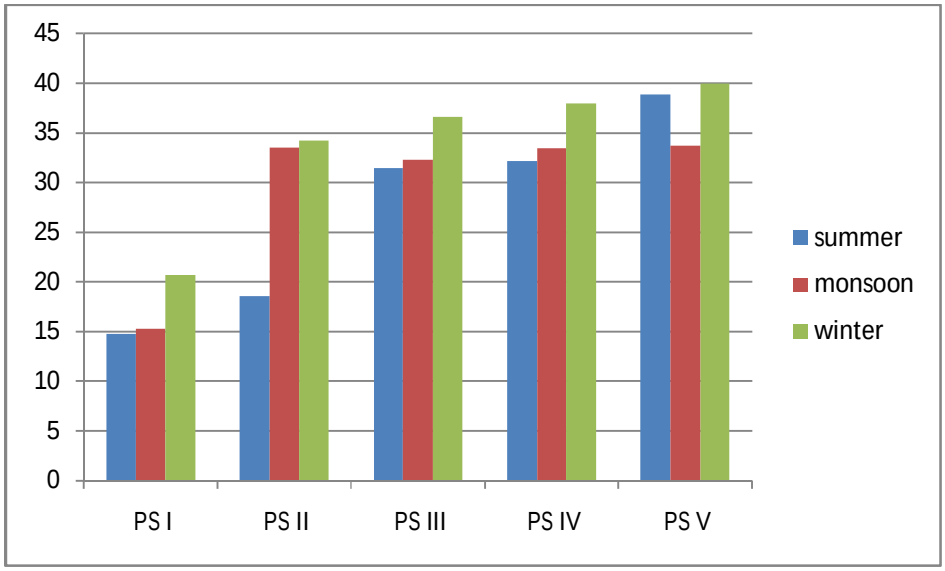
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	15.8	17.3	21.8	15.8	21.8	21.8
PS II	19.6	35.5	37.4	19.6	37.4	22.4
PS III	30.4	36.3	38.3	30.4	38.3	22.8
PS IV	31.2	38.4	39.9	31.2	39.9	23.5
PS V	37.8	40.7	42.9	37.8	42.9	23.9



Graph 23:- Showing Maximum and Minimum values of Chloride (Cl^-, mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 24: Seasonal fluctuation in Chloride (Cl^-, mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

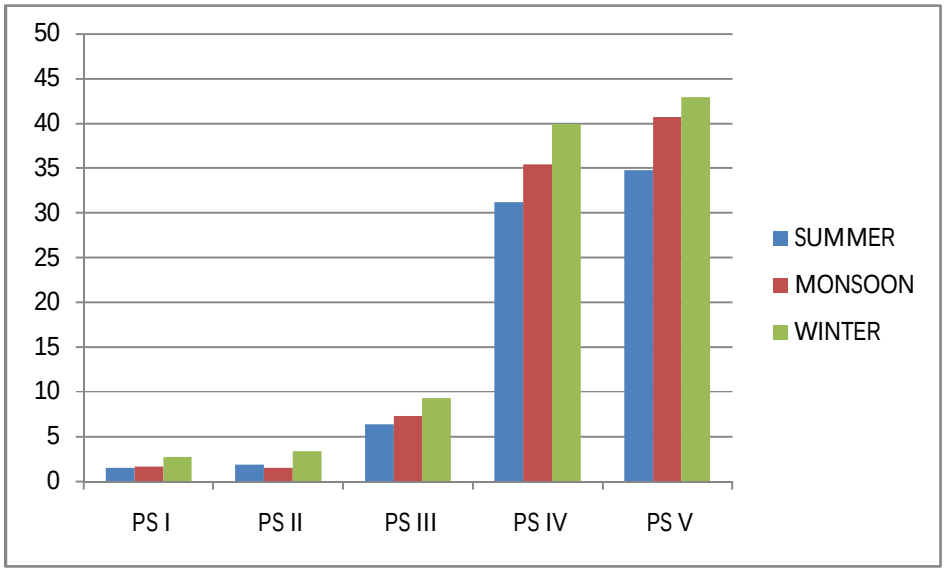
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	14.8	15.3	20.7	14.8	20.7	20.8
PS II	18.6	33.5	34.2	18.6	34.2	22.2
PS III	31.4	32.3	36.6	31.4	36.6	22.5
PS IV	32.2	33.4	37.9	32.2	37.9	23.6
PS V	38.8	33.7	39.9	33.7	39.9	23.8



Graph 24:- Showing Maximum and Minimum values of Chloride (Cl^-, mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 25: Seasonal fluctuation in Nitrate (mg/L)) Udpuria Pond (Kota) during November, 2018 to October, 2019.

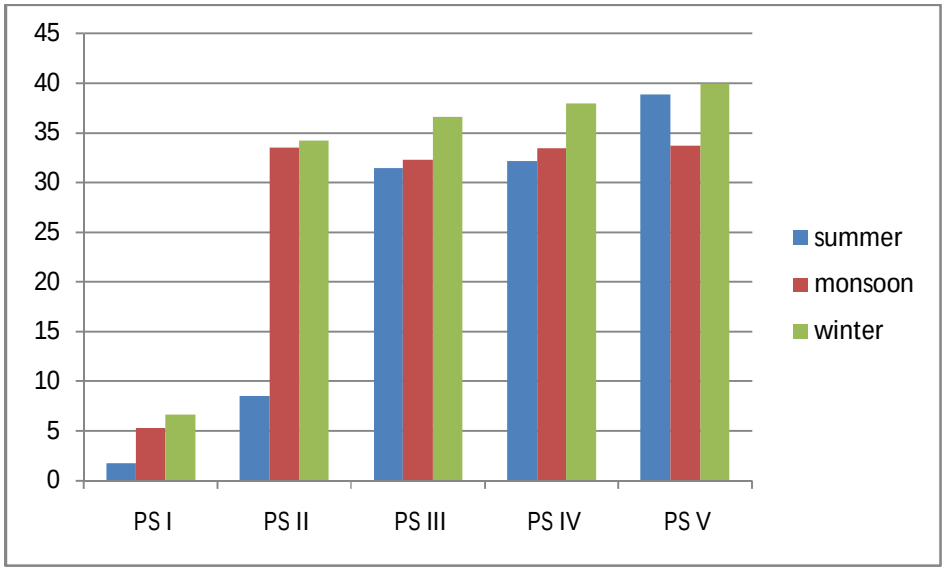
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	1.5	1.7	2.8	1.5	2.8	1.8
PS II	1.9	1.5	3.4	1.5	3.4	2.4
PS III	6.4	7.3	9.3	6.4	9.3	2.8
PS IV	31.2	35.4	39.9	31.2	39.9	13.3
PS V	34.8	40.7	42.9	34.8	42.9	13.6



Graph 25:- Showing Maximum and Minimum values of Nitrate (mg/L)) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 26: Seasonal fluctuation in Nitrate (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

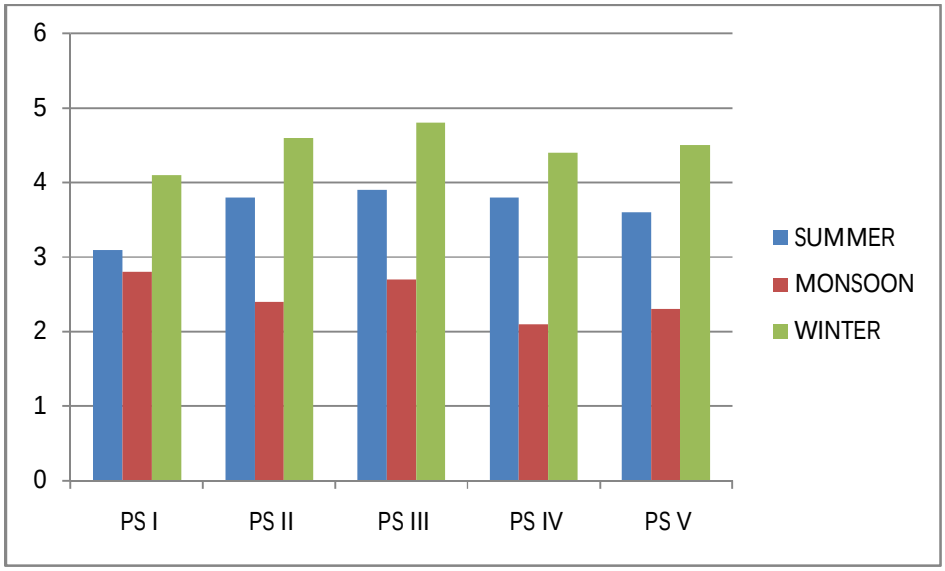
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	1.8	5.3	6.7	1.8	6.7	2.1
PS II	8.6	33.5	34.2	8.6	34.2	2.4
PS III	31.4	32.3	36.6	31.4	36.6	2.5
PS IV	32.2	33.4	37.9	32.2	37.9	12.6
PS V	38.8	33.7	39.9	33.7	39.9	13.8



Graph 26:- Showing Maximum and Minimum values of Nitrate (mg/L) Udpuria Pond (Kota) during November, 2019 to October, 2020.

Table 27: Seasonal fluctuation in Phosphate (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

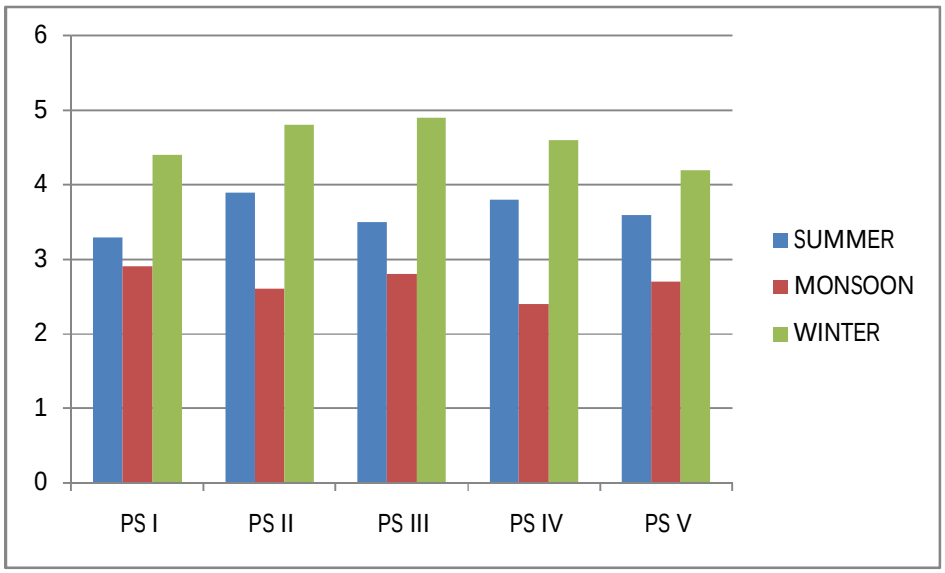
Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	3.1	2.8	4.1	2.8	4.1	0.87
PS II	3.8	2.4	4.6	2.4	4.6	1.12
PS III	3.9	2.7	4.8	2.7	4.8	1.20
PS IV	3.8	2.1	4.4	2.1	4.4	1.52
PS V	3.6	2.3	4.5	2.3	4.5	1.56



Graph 27:- Showing Maximum and Minimum values of Phosphate (mg/L) Udpuria Pond (Kota) during November, 2018 to October, 2019.

Table 28: Seasonal fluctuation in Phosphate (mg/L)Udpuria Pond (Kota) during November, 2019 to October, 2020.

Sites & Season	Summer	Monsoon	Winter	Minimum	Maximum	Standard Deviation
PS I	3.3	2.9	4.4	2.9	4.4	0.84
PS II	3.9	2.6	4.8	2.6	4.8	1.12
PS III	3.5	2.8	4.9	2.8	4.9	1.22
PS IV	3.8	2.4	4.6	2.4	4.6	1.42
PS V	3.6	2.7	4.2	2.7	4.2	1.46



Graph 28:- Showing Maximum and Minimum values of Phosphate (mg/L)Udpuria Pond (Kota) during November, 2019 to October, 2020.

PLANKTONS

The term “Plankton” refers to those minute aquatic forms which are nonmotile or insufficiently motile to overcome the transport by currents and living suspended in the open or pelagic water. The planktonic plants are called phytoplankton and planktonic animals are called zooplankton (APHA 1985).

The present study highlights good plankton diversity at all sites of Udpuria pond. Total fourty species of planktons were observed out of which 20 species were phytoplanktons and 20 species were zooplanktons (Table 29 and Table 30). High densities of planktons were recorded in summer and beginning of monsoon.

PHYTOPLANKTONS:

During present study 20 species three groups were identified, that is, Chlorophyta, Bacillariophyta and Cyanophyta. Chlorophyta was dominating group and Bacillariophyta was second dominate group. In the pond the contribution of Chlorophyta and Bacillariophyta is much. In the present study phytoplankton have been found in all the season of the study (Table 29).

ZOOPLANKTONS:

The present study highlights less zooplankton diversity at Udpuria pond, Kota district, Rajasthan. Twenty species of zooplanktons representing three groups of namely-Protozoa, Rotifera, and Arthopoda were reported. Rotifers included 5 species, Arthopoda 8 species, and protozoa 7 species. (Table30).

Table 29: Qualitative Estimation of Phytoplanktons at Udpuria pond, Kota district, Rajasthan (November 2018-October,2020).

Phylum	Class	Family	Genus and species
Chlorophyta	Chlorophyceae	Volvocaceae	*Volvox globater*
Chlorophyta	Chlorophyceae	Zygnemaceae	*Spirogyra jogensis*
Chlorophyta	Chlorophyceae	Zygnemaceae	*Spirogyra varians*
Chlorophyta	Chlorophyceae	Zygnemaceae	*Spirogyra karnalae*
Chlorophyta	Chlorophyceae	Zygnemaceae	*Zygnema sp.*
Chlorophyta	Chlorophyceae	Chlorellaceae	*Chlorella vulgaris*
Chlorophyta	Chlorophyceae	Oedogoniceaea	*Oedogonium nodulosum*
Chlorophyta	Chlorophyceae	Chaetophoreceae	*Deaparnaldiopsis sp.*
Chlorophyta	Chlorophyceae	Chlamydomonadacea e	*Chlamydomnaseugametos*
Chlorophyta	Chlorophyceae	Desmediaceae	*Closterium sp.*
Cyanophyta	Cyanophyceaea	Oscillatoriaceae	*Oscillatoria princeps*
Cyanophyta	Cyanophyceaea	Nostocaceae	*Nostoc muscoru*
Cyanophyta	Cyanophyceaea	Microcystaceae	*Microcystis aeruginosa*
Cyanophyta	Cyanophyceaea	Microcystaceae	*Microcystis flosaquae*.
Bacillariophyta	Bacillariophyceae	Pinnulariaceae	*Pinnulariaviridis*
Bacillariophyta	Bacillariophyceae	Melosiraceae	*Melosiravarians*
Bacillariophyta	Bacillariophyceae	Naviculaceae	*Naviculasubtilissima*
Bacillariophyta	Bacillariophyceae	Naviculaceae	*Naviculablacenta*
Bacillariophyta	Bacillariophyceae	Tabellariaceae	*Tabellaria sp.*
Bacillariophyta	Bacillariophyceae	Fragilariaceae	*Fragllaria sp.*

PLATE – VII

The Distribution of Different Genera of Phytoplanktons Recorded at Station UDPURIA

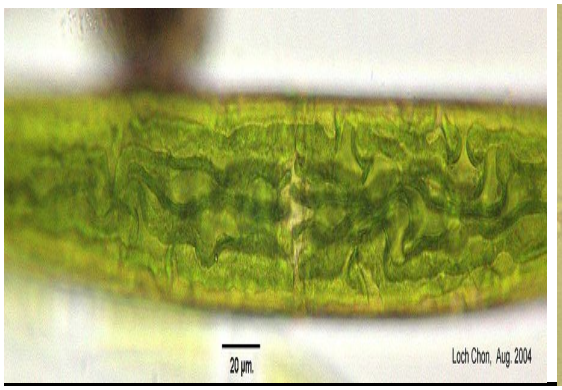


Figure 13.*Closterium aerosum*

Figure 14. *Spirogyra polymorpha*

Figure 15. *Microcystis*

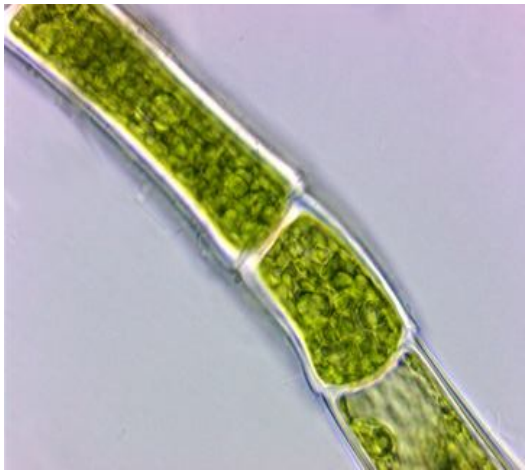


Figure 16.*Oedogonium*

Table 30: Qualitative Estimation of Zooplanktons at Udpuria pond, Kota district, Rajasthan (November, 2018- October, 2020).

Phylum	Class	Family	Genus and species
Protozoa	Ciliata	Amoebaceae	*Amoebasp.*
Protozoa	Ciliata	Vorticelldae	*Vorticella campanula*
Protozoa	Ciliata	Paramecidae	*Paramecium audatum*
Protozoa	Ciliata	Ophryoglenidae	*Ophryoglena flava*
Protozoa	Ciliata	Enchelyidae	*Lacrymariaolor*
Protozoa	Ciliata	Tracheliudae	*Trachelius ovum*
Protozoa	Ciliata	Oxytrichidae	*Oxytricha ovalis*
Rotifera	Monogonata	Brachionidae	*Kertellaprocurva*
Rotifera	Monogonata	Lacanidae	*Monostyla bulla*
Rotifera	Monogonata	Brachionidae	*Brachionuslcyflorus*
Rotifera	Monogonata	Brachionidae	*Notholca sp.*
Rotifera	Monogonata	Brachionidae	*Bbrachionusforficula*
Arthopoda	Crustacea	Cypridinidae	*Ostracode sp.*
Arthopoda	Crustacea	Diaptomidae	*Heliodiaptomus sp.*
Arthopoda	Crustacea	Diaptomidae	*Diaptomus sp.*
Arthopoda	Crustacea	Portunidae	*Nauplius larva*
Arthopoda	Crustacea	Daphinidae	*Ceriodaphnia sp.*
Arthopoda	Crustacea	Daphinidae	*Daphnia carinata*
Arthopoda	Crustacea	Daphinidae	*Moinadubia*
Arthopoda	Crustacea	Daphinidae	*Simocephalus sp.*

PLATE – VIII

The Distribution of Different Genera of Zooplanktons Recorded at Station UDPURIA

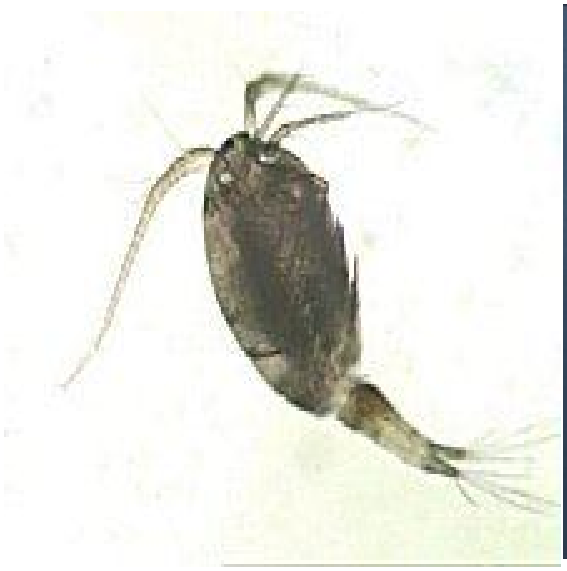


Figure 17.*C yclops*

Figure 18. *Daphnia*

Figure 19.*Hexarthra*

Figure 20.*Moina*

PLATE – IX

Figure 21. ***Polyarthra vulgaris***

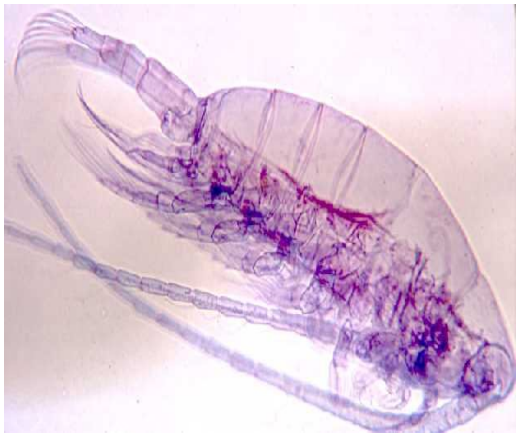


Figure 22.*Diaptomus*

PLATE – X

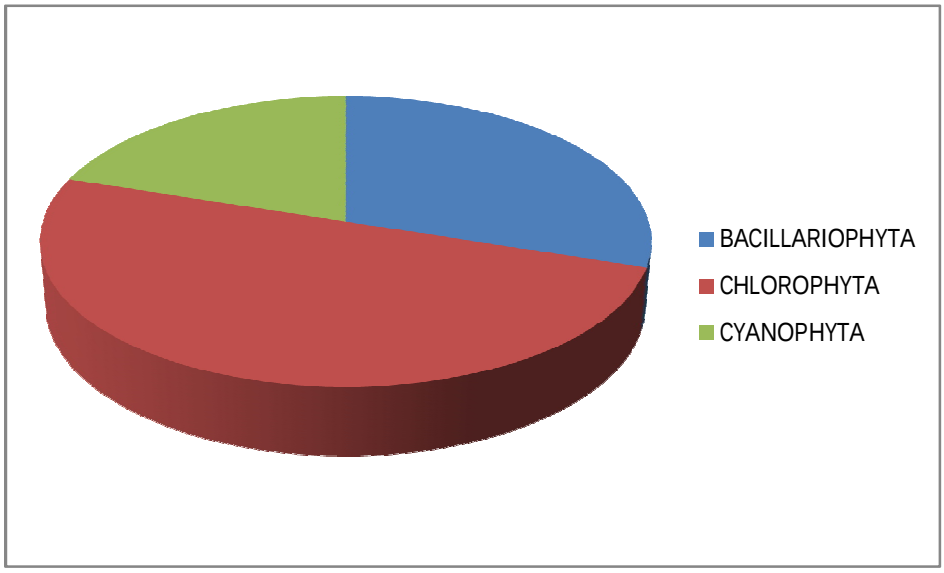


Figure 23: Phytoplankton diversity at Udpuria pond, Kota district, Rajasthan.

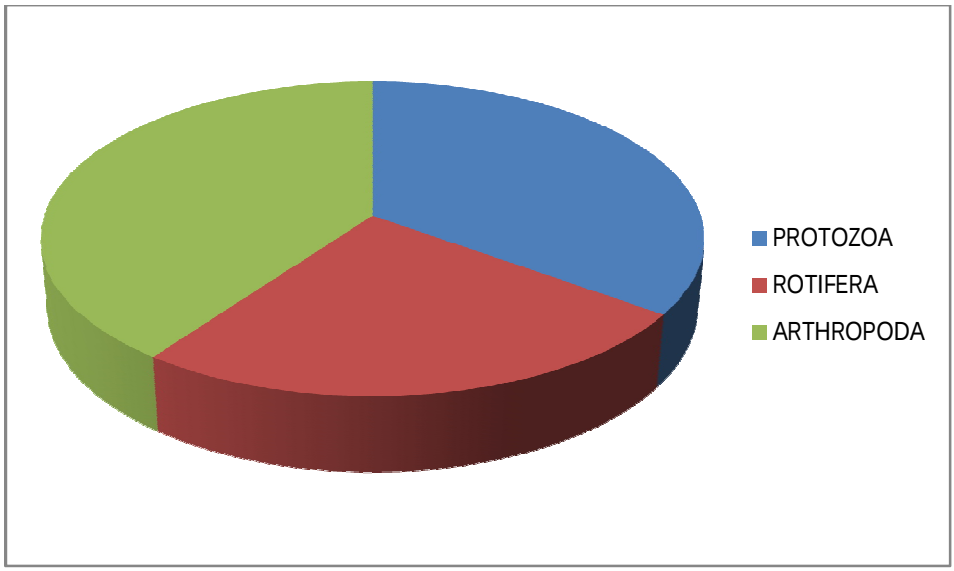


Figure 24: Zooplankton diversity at Udpuria pond, Kota district, Rajasthan.

Classification and Identification of Icthyofauna

The classification and identification has been done after Day (1889), Jayaram (1999, 2010), Gopal ji shrivastava (1980) and other standard literature. The updated recent scientific names have been recorded from www.fishbase.org (2015) and www.wikipedia.org.

At Udpuria pond, total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformesre presenting six species andAnabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*

Table 31: Fish Fauna of Udpuria Pond

S. No.	Order	Family	(Zoological Name) Genus and Species	Local Name
1	Cypriniformes	Cyprinidae	*Amblyopharayngo don mola*	Dhawai
2	Cypriniformes	Cyprinidae	*Aspidopariamarar*	Kenwachi
3	Cypriniformes	Cyprinidae	*Barilus bola*	Bhola
4	Cypriniformes	Cyprinidae	*Catlacatla*	Bhakur
5	Cypriniformes	Cyprinidae	*Cirrhinusmrigala*	Nain
6	Cypriniformes	Cyprinidae	*Garra gotyla*	Siltoka

7	Cypriniformes	Cyprinidae	*Labeobata*	Bata
8	Cypriniformes	Cyprinidae	*Labeocalbase*	Karaunchar
9	Cypriniformes	Cyprinidae	*Labeogonius*	Kursi
10	Cypriniformes	Cyprinidae	*Labeorohita*	Rohu
11	Cypriniformes	Cyprinidae	*Punctissarana*	Darahee
12	Cypriniformes	Cyprinidae	*Punctissophore*	Sidhari
13	Cypriniformes	Cyprinidae	*Punctisticto*	Sidhari
14	Siluriformes	Siluridae	*Wallago attu*	Padhani
15	Siluriformes	Bagridae	*Mystus cavasius*	SutahawaTengara
16	Siluriformes	Bagridae	*Mystus seenghala*	Dariaitengara
17	Siluriformes	Bagridae	*Rita rita*	Rita
18	Siluriformes	Saccobranchidae	*Heteropneustes fossilis*	Singhi
19	Siluriformes	Claridae	*Clarias batrachus*	Mangur
20	Anabantiformes	Channidae	*Channa marulius*	Saur
21	Anabantiformes	Channidae	*Channa punctatus*	Giria
22	Anabantiformes	Channidae	*Channa striatus*	Sauri
23	Sybranchiformes	Mastacembelidae	*Mastacembelus armaters*	Baam

PLATE – XI

Ichthyofauna observed at various sites of Udpuria

Figure 25: ***Notopterus notopteru***

Figure 26: ***Labeo rohita***

PLATE – XII

Figure 27: ***Heteropneustes fossilis***

Figure 28: ***Tor tor***

Figure 29: ***Cirrnhinus mrigal***

PLATE – XIII

Figure 30: ***Wallago attu***

Figure 31: ***Catla catla***

Figure 32: ***Channa striatus***

PLATE – XIV

Figure 33: ***Mastacembelus armatus***

Figure 34: ***Mystus seenghal***

MIGRATORY BIRDS

During the study period November 2018 to October 2020 Migrtory birds and Local birds have been seen. These are depicted on table no. 32.

Table 32: Avian fauna in Udpuria pond as recorded, in the year 2018-2020

Sl	Zoological Name	Vernacular Name	Local Name	Arrival time	Departure time
1	*Anas crecca*	Commonatal	Chhotimurgavi	Middle November	End February
2	*Anaspoecilor or hyncha*	Spot bill duck	Garnpai	November	March
3	*Anser indicus*	Baartheaded goose	Savan	Middle October	March
4	*Dendrocygnajavica*	Brahminy duck	Surkh ab	November	March/April
5	*Tandronafernuninea*	Pintail	Shinkhar	November	Feb./ March
6	*Ansa clypeatalinnaeus*	Shoveller	Shokhwr	November	Feb./ March
7	*Ansa platyrhynchos Linnaeus*	Mallard	Nilsar	November	Feb./ March
8	*Ardes cinerea*	Grey heron	Anjan	Last November	Last February
9	*Ardeolagraylli*	Pond heron	Andha Bagula	Last November	Last February
10	*Bululcusibis*	Cattle erget	Khukhia Bagula	Last November	Last February
11	*Ergettagarzeta*	Little erget	Karchia Bagula	Last November	Last February
12	*Mycteria leuccephla*	Painted stork	Jancle duck	Last November	Last February
13	*Anstomasoscitans*	Open billed stork	Ghaighil	Last November	Last February

14	*Cicomaepiscopus*	White necked stork	Laglag	Last November	Last February
15	*Ephippioragethidpieaasi atius*	Black necked stork	Loha sarang	Last November	Last February
16	*Vanellus indicus*	Red wattled lap wing	Titiri	Last November	Last February
17	*Coraciasbenghalensis*	Indian roller	Nikanth	Last November	Last February
18	*Dicurusadsimills*	Blackdrongowtht e throated	Kotwal	Last November	Last February
19	*Mota cilla*	White wagton	Dholan	Last November	Last February
20	*Mota cilla madder asopathensis*	Large pied wagtail	Dholan	Last November	Last February
21	*Hydrophasianuschirugus*	Phasant tailed	Pihophichhua	Last November	Last February
22	*Fulica atralinnaeus*	Coot	Thekari	End of October	Feb/March
23	*Parphrioporphyrio*	Purple moorhen	Karma	October	March
24	*Phalcor corax higher*	Little cornoront	Jalkaua	Last November	Last February
25	*Anuhingorufa*	Dearter	Snake bird	Last November	Last February
26	*Phcconopnotus*	Red vented bulbul	Bulbul	Last November	Last February
27	*Salicoiloedesfulicate*	Indian robin	-	Last November	Last February
28	*Sturnus pagddanum*	Brahminy myna	Brahminy myna	Last November	Last February
29	*Aeirdotheres*	Common myna	Deseimaina	Last	Last

				November	February
30	*Threskidrnisagenthidepena*	White IBIS	Safed baja	Last November	Last February
31	*Pseudibispapillaso*	Black IBIS	Kala baja	Last November	Last February
32	*Platalea*	Spoon bill	Chamcha	Last November	Last February

Plate XV

Figure 35: Local and Migratry Birds

Figure 36: Local and Migratry Birds

GUANO

The word “Guano” is derived from Spanish word Quechua: wanu. Conventionally it is used to describe excrement of sea birds and bats. Guano is described as highly effective fertilizer/ manure. Guano was also used for the production of gun powder and explosives in medieval history. In the present research the word is used for excrement of water birds of this tank.

Chemical Analysis

Excrement of aquatic birds inhabiting the Udpuria talab was analyzed and results are given in Table-34

Table 33: Chemical contents of excrement (guano) of aquatic birds of Udpuria talab (Digod, Kota)

S.No.	Contents	Piscivorous birds (Fish main food) (by mass W/w)	Others birds (Insects and Herbs) (by mass W/w)
1.	Nitrogen	10-12 %	8-11 %
1.1	Uric Acid	8-9.6 %	6.4-8.8 %
1.2	Nitrate	4-5 %	0.3-0.4 %
1.3	Ammonium	0.8-2 %	0.6-2.2 %
2.	Phosphorous	1-1.4%	1-2%
3.	Calcium	1-2 %	1.4-3 %
4.	Magnesium	0.5-0.1 %	0.8-0.12 %
5.	Protein	1-1.5 %	0.9-1.5 %
6.	Sulphur	0.1-0.8 %	0.1-0.6 %
7.	P^H	5-7	5-7

Effects of bird excrement on pond

Seasonal observations were recorded and photographed. The observations were recorded in table 33 and 34

Table 34: Seasonal observations of plants in UdpuriaPond (D-K)

Season	Algae	Floating Vegetation	Periphyton
Pre Monsoon	+	++	+
Monsoon	++	+	-
Past Monsoon	+++++ Algal Mats	++++	+++

Table-35: Seasonal Qualitative observation of Invertebrates Animals

Seasons			
Animals	Pre Monsoon	Monsoon	Past Monsoon
Nematodes	++	+	++++
Mites	++	+	+++
Spiders	++	+	+++
Fly Larvae	+	+	++++
Moths	++	+	++
Millipeds	+++	-	+
Centipeds	+++	-	+
Beetels	++	+	+++
Insects (Flying)	+++	++	++++

Chapter - 5
Discussion

CHAPTER V
DISCUSSION

One of the most important goals of limnology is providing guidelines for water management and water pollution control; it is also study ways to protect the wildlife that lives in lakes, river and ponds themselves. In the present study physico-chemical parameters, planktons, icthyofaunal diversity of a village pond udpuria was investigated. In this pond birds also nest, feed and some species of migratory birds spend there winters. In this way this pond presents an interesting ecosystem foe limnoigical studies.

5.1 Physico Chemical Parameters

5.1.1, 2 Atmospheric and Water Temperature:-

Water temperature recorded maximum in summer at site I in 2018-2019 and minimum in winter at site V 2019-2020 ranged 16.4^{0}C to 30.9^{0}C during study period November 2018 to October 2020. Similarly the atmospheric temperature in the present study ranged 15.8 ^{0}C to 42.9^{0}C during the study period November 2018 to October 2020 which is maximum in summer at site II in 2019-2020 and minimum in winters at site III 2019-2020.

Similar results were found by Bath and Kaur (1999). They recorded with high value during summers and low value during winters and similar results also noted by Patil and Kulkarni (2008), Srivastava *et al*., (2008) ,Amakari (2006), Banerjee and Mandal (2009), Yadav *et al*., (2012), Kiran (2010), Kumar *et al*., (2017), Dixit *et al*., (2015), Kamlesh (2019).

5.1.3 Relative Atmospheric Humidity:-

Lowest Relative Atmospheric Humidity recorded at site I (23%) in summers and highest in monsoon at site II, III (96%) November 2019 to October 2020 during study period.

5.1.4 Turbidity: In the present investigation turbidity of water was found maximum during monsoon 70.5 NTU at site III in year 2019-2020 and minimum during winter at site I in year 2018-2019. Highest turbidity in water during monsoon due to the presence of suspended matter such as clay, silts, finely divided organic matter, plankton and other microscopic organisms.

Similar results were found by offem*et al*., in (2011), and Tamrakar and Raj in (2013), Khan and choudhary (1994).

5.1.5 pH

The maximum pH recorded in monsoon 8.8 at site II and minimum in winter and summer 7.6 at site II, IV, V during study period November 2018 to October 2019.

High pH value was recorded in rainy season due to positive relationship with chlorinity, salinity and COD. The low pH indicates acidity nature which is due to deposition of acid forming substances. Similar results were observed by (Bisht *et al*., 2014), (Tidame and Shinde 2012), (Mishra R. R. 2008), (Jhingram, V.G. 1982), (Bhatnagar and Singh 2010), (Saluja and jain 1998), (Moundotiya*et al*., 2004), (Park and Shin 2007), (Patil and Kulkarni 2008), (Mahananda *et al*., 2010), (Ali 1991).

5.1.6 Total Dissolved Solids

In the present investigation, the total dissolved solids of Udpuria pond was found maximum during the summer season at site V 487mg/L in year 2019-20 and least during winter at site II 206mg/L in year 2018-19 during study period. Higher concentration of TDS might also due to discharge organic matter by interference of human (Mahananda *et al*., 2010), (Tidame and Shinde 2012).This observation supported by (Narayana *et al*., 2005), (jacklin and Balasingh 2007), (Saluja and jain 1998), (Sharma and Sahu 2005), (Zutsi *et al*., 2008).

5.1.7 Electrical Conductivity

Seasonal variations of the present investigation revealed that EC was high during monsoon season 480μmho/cm at site I in 2019-2020 and low in winter season at site I in 2018-2019.

Conductivity in water is affected by presence of inorganic dissolved solids such as chloride nitrate, sulphate, phosphate ions and organic compounds like oil, phenol,alcohol, sugar do not conduct electrical current very well therefore have a low conductivity. It is also affected by human influence. Relevant results found by (Sajitha *et al*., 2016), (Mishra *et al*., 2014), (Dixit *et al*., 2015).

5.1.8 Alakalinity

In the present investigation the highest value shows during winter at site V 480mg/L in year November 2019- October 2020 and lowest during summer at site I 122mg/L in year November 2018- October 2019. Alkalinity of water is generally the results of biocarbonates.

Similar trends was reported by (Dhembare 2011), (Mishra *et al*., 2013), (Darasingh and Laxmi 2014), (Laishram and Dey 2014), (Yadav *et al*., 2013), (Chakraborty *et al*., 2017), (Trivedi 1989).

5.1.9 Total Hardness

Total hardness was found minimum in summer 122mg/L at site I and maximum in winter 272mg/L at site V in year November 2018 to October 2019.

Similar results were found by Verma and Khan (2015), Kaur *et al*., (2000), Hulyal and Kaliwal (2011), NarshimhaRamulu and Benerjee (2013).

5.1.10 Dissolved Oxygen

Maximum dissolved Oxygen was recorded in the year 2019- 2020 at site I 7.8mg/L in monsoon and minimum 4.6mg/L at site V in summer in year 2019-2020 during study period. Dissolved oxygen is a very important parameter of limnochemical aquatic plants. The major fresh water reservoir plants who produce

oxygen also consume it in respiration. In an aquatic environment animal diversity largely depend upon dissolved oxygen. Results of present study similar to (Laishram and Dey 2014), (Maheshwari *et al*., 2015).

5.1.11 Free carbon Di Oxide

Free carbon di oxide was found minimum in winter 0.5mg/L at site I, IV, V and maximum in monsoon 2.3mg/L at site II, III in year November 2018 to October 2020 during study period.

Kumar *et al*., (2017) found similar results. Free CO2 recorded its presence in some winter months (November and January) which may be associated with low temperature, decrease water level and more growth of pariphyton, submerged plants and algal bloom.

5.1.12 Chloride

In the present investigation , range of chloride , minimum chloride in summer 15.8mg/L at site I and maximum in winter 42.9mg/L at site V in year November 2018 to October 2019 during study period.

Similar results were recorded (Sajitha*et al*., 2016), (Chaturbhuj *et al*., 2004), (Mishra *et al*., 2011), (Arya *et al*., 2011).

5.1.13 Nitrate

During the study period Maximum Nitrate was found in winter at site V 42.9mg/L and minimum in summer at site I, II 1.5mg/L in year 2018-2019.Similar results have been reported by Pathak and Mankodi (2013), Rajshkhar*et al*., (2007).

5.1.14 Phosphate

Phosphate was found minimum in monsoon season 2.4mg/L at site IV and maximum in winter season 4.9mg/L at site III in year 2019 and 2020 during study period.

Similar results recorded by (Mishra *et al*., 2014), (Selvamohan *et al*., 2014), (Kiran 2010), (Verma *et al*., 2012)

5.2 Phytoplanktons

The present study revealed that there were 40 species of planktons observed out of which 20 species were phytoplanktons. During present study 20 species from three groups were identified, that is, Chlorophyta was dominating group and Bacillariophyta was second dominate group. In the present study phytoplankton have been found in round the year during the study period. Among the phytoplankton the members of Chlorophyta, Cyanophyta and Bacillariophyta have been observed throughout the study period and maximum in monsoon period. Fluctuation in the plankton population recorded in different seasons.

Yadav and Rana (2001) observed effect of temperature is directly proportional to phytoplankton whereas transparency is inversely proportional to temperature.

5.3 Zooplanktons

The present study reports zooplankton diversity in Udpuria pond, Kota district, Rajasthan. Seventeen species of zooplanktons representing seven groups of namely-Protozoa, Rotifera, Arthopoda were reported. Rotifers included 5 species, Arthopoda 8 species, Protozoa 7 species. Among zooplankton Protozoans through out the study period and Rotifers in the month of August, September, October and whereas Arthopoda showed no variation.

Ecologically zooplanktons are important biotic components and play an important role in the aquatic ecosystem. They constitute the consumers trophic level of the pond ecosystem and in the energy transfer between phytoplankton and higher aquatic fauna (Iloba, 2002).

Gaikwad *et al.*, 2008 reported 19 species including copepoda 6 species, claocera 5 species and rotifers 8 species. In

Kedar *et al.*, (2008) studied the seasonal abundance of zooplankton population in Rishi Lake with physico-chemical parameters. The no. of zooplankton recorded in summer and lowest in rainy season. Total 61 species were identified during study

period such as Protozoa (14sp.) Rotifera (29 sp.), Copepoda (6sp.), Ostracoda (5sp.) and Cladocera (7sp.).

Biswas (2015) studied the 31 species of zooplankton comprising of 4 groups were reported viz. Rotifera (17 species), Cladocera (10 species), Copepoda (3 species), Ostracoda (1 species) copepodes were dominant.

Pawar (2016) studied zooplankton diversity, during study period 23 species were recorded among them Rotifers (8 species), Cladocera (6 species), copepod (5 species), Ostracod (2 species) and Protozoa (2 species). During summer season number of zooplankton were highest and lowest during winter season.

5.4 Icthiyological Studies

At Udpuria pond, total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformesre presenting six species andAnabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*

According to Dublin Green and Tabor, (1992) Temperature, an important biotic factor in the aquatic ecosystem, not only affects the abundance availability and distribution of fishes, but also influences their activities such as breathing, growth and reproduction; Temperature is inversely related to Dissolved Oxygen (DO); which decreases with higher temperature and vice-versa. Dissolved Oxygen in the aquatic system is fundamental to the basic metabolic activities of the fish, which is vital to its survival.

Chapter - 6
Conclusion

CHAPTER VI
CONCLUSION

Limnological and Icthyological Study of Udpuria Pond and Right Main Canal, District Kota, Rajasthan was concluded. The study was conducted on the physico-chemical and biological parameters with special reference on diversity of Fish. In this pond some species of migratory birds spend their winter and local migrants and resident birds also make nest on trees located on the banks as well as on the mounds situated inside the pond. These bird species feed and rest there. In this way this pond presents an interesting ecosystem for limnoloigical studies.

During study period it is found that temperature of pond water maximum in summer and minimum in winter, Relative Humidity was found maximum in monsoon and minimum in summer. Similarly turbidity of water high in summer and low in monsoon due to presence of suspended matter such as clay, silts, finely divided organic matter, plankton and other microscopic organisms. High pH value was recorded in rainy season. The low pH recorded in winter and summer. Total dissolved solids of pond were found maximum during the summer season and minimum during winter. The higher concentration of TDS was recorded due to discharge organic matter by interference of human. EC was high during monsoon season and low in winter season. Highest value of Alkalinity shows during winter is generally the results of bicarbonates. Maximum dissolved oxygen was recorded in monsoon and minimum in summer. Free carbon di oxide was found minimum in winter and maximum in monsoon.Minimum chloride in summer and maximum in winter. Phosphate was found minimum in monsoon and maximum in winter season. Nitrate was found maximum in winter and minimum in summer.

On the basis of above it is concluded all the physico-chemical parameters under study showed considerable seasonal variations. Among the all study and sampling sites PS I was showing almost oligotrophic water. Sites PS III, PS IV and PS V showed increasing levels of nitrates and phosphates which is showing tendency towards Eutrophication.

During present study 20 species three groups were identified, that is, Chlorophyta, Bacillariophytaand Cyanophyta. Chlorophyta was dominating group and Bacillariophyta was second dominate group. In the pond the contribution of Chlorophyta and Bacillariophyta is much. Twenty species of zooplanktons representing three groups of namely-Protozoa, Rotifera and Arthopoda were reported. Rotifers included 5 species, Arthopoda 8 species, and protozoa 7 species. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformesre presenting six species andAnabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*

In this pond some species of migratory birds spend their winter and local migrants and resident birds also make nest on trees located on the banks as well as on the mounds situated inside the pond. Mostly visible is Painted Storks that nest in the higher branches of babool trees. Another species of stork, generally seen here are open billed storks and necked storks that because of their being shy avoid communities and stay solitary Other migratory birds that offer a fascinating site to the bird watchers are white breasted waterhen, coots, moorhens, kingfishers, rollers, spot billed duck, golen oriole, Indian peafowl etc.On the basis of above it is concluded that the pond exhibited good diversity of Phytoplankton, Zooplanktons, Fishes and Birds which is indicating towards a healthy aquatic ecosystem.

On the basis of above I concluded that:

1. Three well marked seasons i.e. winter, summer and rainy seasons were recorded.
2. The seasonal variations in physico-chemical factors clearly observed.
3. The minimum and maximum air temperature was recorded during winter and summer season respectively.

4. The water temperature showed correlation with other physico-chemical parameter (atmospheric temperature, chloride, phosphate, nitrate, dissolved oxygen, alkalinity, total hardness, free carbon dioxide, pH and total dissolved solids).
5. Turbidity showed a well defined pattern of fluctuations. It was maximum in rainy and minimum in winter season.
6. Seasonal variations in phytoplankton, zooplanktons were conspicuous.
7. In all, twenty species of phytoplankton were observed representing fifteen families of three classes. Phytoplanktons comprised of Chlorophyta, Bacillariophyta, and Cyanophyta.
8. In all, twenty species of zooplanktons were observed representing thirteen families of three classes. Zooplanktons comprised Protozoa, Rotifers and Arthopoda.
9. Total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformesre presenting six species and Anabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*
10. Among the phytoplankton groups Chlorophyta was dominant compared to other groups of phytoplankton in the Udpuria Pond.

11. Percentage composition of phytoplankton was found as 50 percent Chlorophyta, 20 percent Cyanophyta and 30 percent Bacillariophyta.
12. Among the zooplankton groups Arthopoda was dominant compared to other groups of zooplankton in the Udpuria Pond.
13. Percentage composition of zooplankton was found as 35 percent Protozoa, 25 percent Rotifers and 40 percent Arthopoda.
14. In the present investigation no exotic fish sample was collected from Udpuria Pond.
15. During present study 32 species of water birds were also observed and recorded.
16. The guano (excreta of birds) was also chemically analysed and it was observed that this has impact on Nitrate and Phosphate values of water samples from Udpuria Pond. This factor needs further study.
17. Udpuria Pond is found to be a good, balanced and healthy lentic aquatic ecosystem.

Future Aspects:

1. Effects of migratory birds on Local fauna, flora and physico-chemical nature of water should be studied in further investigations.
2. Effect of tourism should be studied in future.
3. Role of Guano should be studied in detail.
4. A holistic socio-biological and economic study is needed for long term sustainable management of the pond and its surroundings.

Summary

SUMMARY

LIMNOLOGICAL AND ICTHYOLOGICAL STUDY OF UDPURIA POND AND RIGHT MAIN CANAL, DISTRICT KOTA, RAJASTHAN.

Limnology is the study of inland waters lakes (both freshwater and saline), reservoirs, rivers, streams, wetlands, and ponds as ecological systems interacting with their drainage basins and the atmosphere. Water is the basis of life that is also a source of energy that governs the evolution and functioning of this vast universe. Therefore, it is necessary to maintain the quality of water of all the resources that are in human use.Our inland waters are vital and important resources. They provide us drinking water, recreation, bird and wildlife, fishing, land protection and so much more. Rivers, Ponds, and Lakes are the major source of water. One of the most important features of ponds is the presence of standing water, which naturally provides habitat for wetland biota including both plants as well as animals. A large number of micro organisms and invertebrate feed on the decaying plants occur naturally.

The present investigation is concerned with the fresh water pond at Udpuria and this pond is situated 40 km away from Kota (Rajasthan) near the village Nimodasultanpur Tehsil in Kota district of Rajasthan. This pond filled from Right Main Canal. Udpuria (Nimoda) is surrounded by Sultanpur Tehsil towords East, Kota

Tehsil towards West, Ladpura Tehsil towords South, Anta Tehsil towordsEast.This place situated near the Kota District and Baran District. Hadoti is the local language here. The geographical coordinates i.e. latitude and longitude of Nimoda (Udpuria) is 26.92 and 75.8 respectively.

This pond is a well known breeding ground for painted storks and other water birds and famous for bird destination centre and habitation.These birds visit during winter months when whole area is abuzz with the calls of hundreds of young birds competing with each other for food and parental attention. Presence of bird's effect water quality. Birds excrete excreta (faecal matter), all things interact with water. When birds come here many people reach from different areas for bird watching. Due to tourism people interact with pond as well as surrounding that's why it is important as ecological and interesting.

Due to surrounding agriculture and agro chemical activities rains water flow mix with excess water which used for domestic and agricultural purpose have led to the overexploitation of the surface water sources. Anthropogenic activities of people (like agriculture live stock, domesticated, household work, transportation, bathing, washing clothes etc.) affect water quality. Micro-organisms, planktons, macrophytes, animals (especially Fishes) which are present in the pond, make a dynamic system.

With this backdrop this study was undertaken on the basis physical, chemical and biological parameters.The surface water samples were collected from five sampling sites seasonally between 7 to 9 A.M. These sampling sites are as follows:

PS I- One Km earlier then the opening point into the Pond.

PS II- Entry point in the Pond.

PS III- Bird observation point near road.

PS IV- Situated at 180 degree angle around PS III.

PS V- Near habitation of the village Udpuria.

These water samples were brought in the laboratory for further analysis. The study was carried out for period of two years (November, 2018 to October, 2020). All 14 physico-chemical parameters were taken for study.The standard APHA, (2005)methods were followed for estimation of physical, chemical and biological parameters. Biological parameters for the present study included Phytoplankton, Zooplankton and Fishes. Phytoplankton collected by filtering a known amount of water through a plankton net made by bolting silk (no. 25 mesh size 55 μm). Zooplankton were collected by filtering a known volume of water through zooplankton made up of bolting silk (no.25; mesh size 55μ) the surface water was collected with the help of aplastic bucket or a jug of known volume. Zooplanktons were collected and identified under a Nikon binocular microscope, using literature. Statistical analysis was done by using ANNOVA. The classification of fish has been done after Day (1889), Jayaram (1999), Srivastava (1980) and other standard literature. The updated recent scientific names have been recorded from www.fishbase.org and www.wikipedia.org.

Results

The seasonal variations in atmospheric temperature at various sites were recorded. The maximum (in summer season) and minimum (in winter season) values of atmospheric temperature were 41.2^{0}C, 16.5^{0}C respectively. The lowest temperature was recorded at sampling station IV 16.5^{0}C in winter 2018 to 2019. The highest temperature (41.2^{0}C) was recorded during summer 2018-2019 at site PS I. Similarly the lowest temperature was recorded at sampling station I 16.4^{0}C in winter 2019 to 2020 and sampling station II recorded highest temperature 42.9^{0}C during summer 2019-2020.

During the study period water temperature was maximum in summer and minimum in winter.The maximum and minimum water temperature ranges from 30.9^{0}C to 16.4^{0}C. During year 2018 to 2019 the lowest temperature was recorded at sampling station II and IV 16.5^{0}C in winter season. At site PS I, the highest temperature was recorded 30.9^{0}C during summer in the year 2018-2019. In 2019-2020 the highest water temperature recorded at sampling station II 30.8^{0}C and lowest at sampling station V 16.4^{0}C.

Seasonally the atmospheric relative humidity varied from minimum 24 % at sampling station I and IV in summer and was maximum 95 % in monsoon at sampling station II, III, IV in year 2018 to 2019. In year 2019 to 2020 highest atmospheric relative humidity 96% at sampling station II and III in monsoon and Lowest 23% at sampling station I in summer.

The maximum (in monsoon season) and minimum (in monsoon season) values of turbidity was 70.2NTU, 6.9NTU respectively. The lowest turbidity was

recorded at sampling station PS I 6.9NTU in winter 2018 to 2019. The highest turbidity (70.2 NTU) was recorded during monsoon 2018-2019 at site PS V. Similarly the lowest turbidity was recorded at sampling station I 7.6 NTU in winter 2019 to 2020 and sampling station III recorded highest turbidity 70.5 NTU during monsoon 2019-2020.

The maximum (in monsoon season) and minimum (in winter and summer season) values of pH was 8.8, 7.6 respectively. The lowest pH was recorded at sampling station PS III, IV, V 7.6 in winter and similarly 7.6 at sampling station IV in summer in 2018 to 2019. The highest pH (8.8) was recorded during monsoon 2018-2019 at site PS II. Similarly the lowest pH was recorded at sampling station III, V 7.6 in winter and station IV in summer 2019 to 2020 and sampling station II recorded highest pH 8.6 during monsoon 2019-2020.

The maximum and minimum total dissolved solids ranges from 486 mg/L to 206 mg/L. During year 2018 to 2019 the lowest total dissolved solids was recorded at sampling station II in winter season. At site PS III, the highest total dissolved solids were recorded 486 mg/L during summer in the year 2018-2019. In 2019-2020 the highest water total dissolved solids recorded at sampling station V 487 mg/L and lowest at sampling station I 207 mg/L.

During the study period, electrical conductivity was maximum in monsoon and minimum in winter.The electrical conductivity ranges from 338μmho/cm to 112μmho/cm. During year 2018 to 2019 the lowest electrical conductivity was recorded at sampling station I in winter season. At site PS V, the highest electrical

conductivity was recorded 338μmho/cm during monsoon in the year 2018-2019. In 2019-2020 the highest electrical conductivity recorded at sampling station I 460μmho/cm in monsoon and lowest at sampling station I 207μmho/cm in winter.

The maximum (in winter season) and minimum (in summer season) values of alkalinity was 275mg/L, 122 mg/L respectively. The lowest alkalinity was recorded at sampling station PS I (122 mg/L) in summer in 2018 to 2019. The highest alkalinity (275 mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest alkalinity was recorded at sampling station I (127 mg/L) in summer 2019 to 2020 and sampling station V recorded highest alkalinity (280 mg/L) during winter 2019-2020.

The maximum (in winter season) and minimum (in summer season) values of total hardness was 275 mg/L, 122 mg/L respectively. The lowest total hardness was recorded at sampling station PS I (122 mg/L) in summer in 2018 to 2019. The highest total hardness (275 mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest total hardness was recorded at sampling station I (134 mg/L) in winter 2019 to 2020 and sampling station V recorded highest total hardness (190 mg/L) during summer 2019-2020.

The maximum and minimum dissolved oxygen ranges from 7.6 mg/L to 4.2 mg/L. Table 19 and Table 20 depict the seasonal variations in dissolved oxygen at various sites of the pond. During year 2018 to 2019 the lowest dissolved oxygen was recorded at sampling station V in summer season. At site PS I, the highest dissolved oxygen was recorded 7.6 mg/L during monsoon in the year 2018-2019. In 2019-2020

the highest dissolved oxygen recorded at sampling station I 7.8 mg/L and lowest at sampling station V 4.6 mg/L.

The maximum (in monsoon season) and minimum (in winter season) values of Free Carbon Dioxide was 2.3 mg/L, 0.5 mg/L respectively. The lowest Free Carbon Di Oxide was recorded at sampling station PS I, IV, V (0.5 mg/L) in winter in 2018 to 2019. The highest Free Carbon Di Oxide (2.3 mg/L) was recorded during monsoon 2018-2019 at site PS III. Similarly the lowest Free Carbon Di Oxide was recorded at sampling station I, IV, V (0.5 mg/L) in winter 2019 to 2020 and sampling station II recorded highest Free Carbon Di Oxide (2.3 mg/L) during monsoon 2019-2020.

Seasonally the chloride varied from minimum 15.8 mg/L at sampling station I in summer and was maximum 42.9 mg/L in winter at sampling station V in year 2018 to 2019. In year 2019 to 2020 highest chloride 39.9 mg/L at sampling station V in winter and Lowest 14.8 mg/L at sampling station I in summer.

The maximum (in winter season) and minimum (in summer season) values of nitrate was 42.9 mg/L, 1.5 mg/L respectively. The lowest nitrate was recorded at sampling station PS I, II (1.5 mg/L) in summer in 2018 to 2019. The highest nitrate (42.9 mg/L) was recorded during winter 2018-2019 at site PS V. Similarly the lowest nitrate was recorded at sampling station I (1.8 mg/L) in summer 2019 to 2020 and sampling station V recorded highest alkalinity (39.9 mg/L) during winter 2019-2020.

The amount of phosphate is minimum 2.1 mg/L at sampling station IV in monsoon and was maximum 4.8 mg/L in winter at sampling station III in year 2018

to 2019. In year 2019 to 2020 highest phosphate 4.9 mg/L at sampling station III in winter and Lowest 2.4 mg/L at sampling station IV in monsoon.

The present study highlights good plankton diversity at all sites of Udpuria pond. Total fourty species of planktons were observed out of which 20 species were phytoplanktons and 20 species were zooplanktons. The diversity and seasonal variations of aquatic communities (Planktons, Fishes, and Birds) identified by various standard keys and books.

During present study 20 species of phytoplanktons from three groups were identified, that is, Chlorophyta was dominating group and Bacillariophyta was second dominate group. In the present study phytoplankton were found in round the year during the study period. Among the phytoplankton the members of Chlorophyta, Cyanophyta and Bacillariophyta have been observed throughout the study period and maximum in monsoon period. Fluctuation in the plankton population was recorded in different seasons.

The present study reports zooplankton diversity in Udpuria pond, Kota district, Rajasthan. Twenty species of zooplanktons representing four groups of namely Protozoa, Rotifera, Copepods and Cladocera were reported. Rotifers included 5 species, Arthopoda 8 species, and protozoa 7 species. Among zooplankton, members of Protozoa, Rotifera and Arthopoda showed explicit variation.

At Udpuria pond, total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order

Siluriformesre presenting six species andAnabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*

During the study period November, 2018 to October, 2020 Migrtory birds have been seen. Most conspicuous bird is Painted Storks that nest in the higher branches of babool (*Acacia sp*.) trees. Another species of storkswere also seen here. Common are open billed storks. Migratory birds that offer a fascinating site to the bird watchers are white breasted waterhen, coots, moorhens, rollers, spot billed duck, golen oriole, Indian peafowl etc.

Conclusions

1. Three well marked seasons i.e. winter, summer and rainy seasons were recorded.
2. The seasonal variations in physico-chemical factors clearly observed.
3. The minimum and maximum air temperature was recorded during winter and summer season respectively.
4. The water temperature showed correlation with other physico-chemical parameter (atmospheric temperature, chloride, phosphate, nitrate, dissolved oxygen, alkalinity, total hardness, free carbon dioxide, pH and total dissolved solids).

5. Turbidity showed a well defined pattern of fluctuations. It was maximum in rainy and minimum in winter season.

6. Seasonal variations in phytoplankton, zooplanktons were conspicious.

7. In all, twenty species of phytoplankton were observed representing fifteen families of three classes. Phytoplanktons comprised of Chlorophyta, Bacillariophyta, and Cyanophyta.

8. In all, twenty species of zooplanktons were observed representing thirteen families of three classes. Zooplanktons comprised Protozoa, Rotifers and Arthopoda.

9. Total of 23 species of fish diversity belonging to 4 orders, 7 families and 15 genera have been observed. Fish fauna of Udpuria is dominated by Order Cypriniformes and species followed by Cyprinidae 13 species. Order Siluriformes representing six species andAnabantiformes represent 3 species. While Sybranchiformes represent one species only. At Right Main Canal only 6 species observed and out of 6, 3 were major carp *(Labeo rohita, Catla catla, Mystus seenghala).*

10. Among the phytoplankton groups Chlorophyta was dominant compared to other groups of phytoplankton in the Udpuria Pond.

11. Percentage composition of phytoplankton was found as 50 percent Chloophyta, 20 percent Cyanophyta and 30 percent Bacillariophyta.

12. Among the zooplankton groups Arthopoda was dominant compared to other groups of zooplankton in the Udpuria Pond.

13. Percentage composition of zooplankton was found as 35 percent Protozoa, 25 percent Rotifers and 40 percent Arthopoda.

14. In the present investigation no exotic fish sample was collected fromUdpuria Pond.

15. During present study 32 species of water birds were also observed and recorded.

16. The guano (excreta of birds) was also chemically analysed and it was observed that this has impact on Nitrate and Phosphate values of water samples from Udpuria Pond. This factor needs further study.

17. Udpuria Pond is found to be a good, balanced and healthy lentic aquatic ecosystem.

Future Aspects:

1. Effects of migratory birds on Local fauna, flora and physico-chemical nature of water should be studied in further investigations.
2. Effect of tourism should be studied in future.
3. Role of Guano should be studied in detail.
4. A holistic socio-biological and economic study is needed for long term sustainable management of the pond and its surroundings.

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Full Length Research Article

Udpuria Pond as an important Ecotourism site in South Eastern Rajasthan India

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ABSTRACT

The Udpuria pond under investigation is situated 40 km away from Kota (Rajasthan) near the village Nimoda, Tehsil Sultanpur, District Kota, Rajasthan. This pond gets filled from Right Main Canal of River Chambal. It is very important bird breeding site which is not very popular in the wild life tourist circuit of India. It has favourable climate for birds, suitable Acacia trees for nest building, typical scenic beautiful landscape, diversity of avian fauna along with many type of fishes and plants. This ecological treasure is supplemented with the rich traditional rural life style of Hadoti region which includes regional crops, agricultural traditions, food, festival, fair, local deity, costumes, folk Lores and, folk songs. This all makes Udpuria and its pond a complete package to attract and sustain not only foreign tourist but also Indian tourists. With the introduction of tiger in Mukundara Hills Tiger Reserve (MHTR), tourism will be increased in Hadoti region. If this increased tourist traffic has information about Udpuria Bird Breeding site, this traffic could be easily be diverted towards Udpuria and it can be popularised. In the present paper all these aspects have been discussed elaborately.

Introduction

Ecotourism is a form of tourism involving visiting fragile, pristine, and relatively undisturbed natural areas, intended as a low-impact and often small Scale alternative to standard commercial mass tourism. It means responsible travel to natural areas conserving the environment and improving the well-being of the local people. Its purpose may be to educate the traveller, to provide funds for ecological conservation, to directly benefit the economic development and political empowerment of local communities, or to foster respect for different cultures and for human rights. Since the 1980s, ecotourism has been considered a critical endeavour by environmentalists, so that future generations may experience destinations relatively untouched by human intervention (Tuohino and Hynonen, 2001).

Udpuria-

The Udpuria pond under investigation is situated 40 km away from Kota (Rajasthan) near the village Nimoda sultanpur Tehsil in Kota district of Rajasthan. Udpuria (Nimoda) is surrounded by Sultanpur Tehsil towords East, Kota Tehsil towords West, Ladpura Tehsil towords South, Anta Tehsil towords East. This place situated near the Kota District and Baran District. Hadoti is the local language here. The geographical coordinates i.e. latitude and longitude of Nimoda (Udpuria) is 26.92 and 75.8 respectively. The pond covers an area of about 2 ha. The pond is predominantly rain-fed but is also connected to the Right Main Canal of the Chambal River and receives water from it in the summers when the canal is operating.

Diversity of faunna and socio-economic cultural aspects

The pond is a well-known breeding ground for painted storks. According to the villagers these birds have been coming for more than 20 years. The painted stork breeding colony of Udpuria village is worth a visit during winter months when whole area is abuzz with the calls of hundreds of young birds competing with each other for food and parental attention. Some species of tortoise, snack and fish also found here.
Varies shades of rural life of Hadoti is seen here and agriculture fields also attract for their scenic beauty.

Plant diversity

So many plants are found here which two types are-

1. Agricultural plants diversity-

Being a part of Rajasthan state, the region of Hadoti, Udpuria is agrarian and the majority of its people work in agriculture. Wheat (Triticum aestivum), barley (Hordeum vulgare), pulses (urad dal-Vigna mungo) and sugarcane (saccharum officinarum) are the main staple crops. The region too is enriched with the resources of oil seeds (Brassica) and minerals.

2. Natural plant diversity-

At Udpuria mainly Babool (Vachellia nilotica), tamarind (Tamarindur indica), banyan (Ficus benghalensis), peepal (Ficus religiosa) and neem (Azadirachta indica) are some of the tree species found here along with certain grasses

(Poaceae), aquatic (Water hyacinth, Hydrilla), semi aquatic plants (duckweed,Sago pondweed).

Animal diversity

1. Domestic animal diversity

Udpuria has a rich and varied fauna. Here cow (Bos Taurus), buffalo (Bubulus bubalis), hens (Gallus gallus), rabbit (Oryctolagus cuniculus) are domesticated.

2. Non-domestic or wild animal diversity

The painted stork at Udpuria is found engaged in breeding in numbers greater than those of in Ghana Bird Sanctuary, Bharatpur. Among the migratory birds that reach areas near Kota during winter are various species of geese (Anserini) and ducks (Anas platyhynchos) with their two species. There are about 200 birds in the pond. Five species of storks out of world`s total seventeen can be spotted in this region during winter. Mostly visible is Painted Storks (Mycteria leucocephala) that nest in the higher branches of babool (Vachellia nilotica) trees. Another species of stork, generally seen here are open billed storks (Anastomus oscitans) and necked storks (Marabou storic) that because of their being shy avoid communities and stay in solitary. Other migratory birds that offer a fascinating site to the birdwatchers are white-breasted water hen (Amaurornis phoenicurus), coots (Fulica), moorhens (Gallinula), kingfishers (Alcedinidae), rollers (Coraciidae), spotbilled duck(Anas poecilorhyncha), golden oriole (Oriolus oriolus), Indian peafowl (pavo cristatus) etc. In this way, animal diversity present here rounds the year which may attract local as well as tourists.

Socio cultural diversity

Normally Hindus live here and the villagers belong to the Brahmin, meena, berwa, bawari and nandwana communities and all villagers are mostly vegetarian. Various dance forms and musical melodies are quite popular amongst the People of Udpuria region, which recreate them and thus elevate their spirits.

They wear traditional dresses like the turban, variously called Pagari, Pencha, Sela or Safa depending on style, an Angrakhi or Achakan as the upper garment and Dhoti or Pyjama as the lower garment make up the male outfit.

The standard design is a four-piece dress which includes the ghagra (skirt), the pila (An odhni) with a yellow background and a central lotus motif in red called a pila, is a traditional gift of parent to their daughter on the birth of a son wear by females. But now a days due to social changes, male wear jeans t-shirts in place of traditional dress, similarly females wear saree, salwar –kurta in place of traditional dress and they enjoyed developing life. The main food of Udpuria is Dal-batti, katt but now they used to like dosa, pizza, burger etc dishes in food.

Conclusion

After the discussion above things concluded that this place rich in diversity and birds are shown important value and this place have traditional culture which attract local people as well as tourist. Fortunately due to the introduction of tiger in Mukundara Hill Tiger Reserve (MHTR), tourism will be increased in Hadoti region. If this increased tourist traffic has information about Udpuria Bird Breeding site, this traffic could be easily be diverted towards Udpuria and it can be popularised.

Suggestions

1. Various species can be saved by involving the people living around them.

2. To developed the roads and introduce the food zone at entry or exit point.

3. Need to do maintenance the pond through local people, sarpanch, MLA etc. because due to keeps changing regularly in environment by the interference of human.

4. Need to periodical desilting of pond.

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A Review of Recent Studies of Water Quality of Perennial Ponds of India

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ABSTRACT

This paper reviews the recent published literature on the status of physico-chemical parameters regarding water Excellency of perennial pond of India. Water is the basis of life that controls the process of development and carries out the cosmos, is also the resource of energy. Therefore, it is necessary to maintain the quality of water of all the resources that are in human use. The physico-chemical specifications of expense of water attracted researchers. The present paper scientific published literature from the onset of this century is critically reviewed, with some important works of last few years of 20th century.

Keywords: Physico-chemical parameters, Water quality, India, Seasonal variation.

1. INTRODUCTION

Life on the earth is never possible without water. Water is an enormous resource of nature and essential constituent of the environment. Less than 1% water is present in ponds, lakes, rivers, dams, etc. which is usable by man for domestic, industrial and agriculture purpose. Ponds are vital sort of city life and rural ecosystems. They are smaller in proportion; ponds execute important environmental, social and economic reasons, moving from being a source of drinking water, recharging groundwater, and acting as sponges to curb flooding, upholding biodiversity and contributing livelihood. The water resources (ponds, lakes and river) are polluted principally owing to discharged waste water from residential surroundings, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing affability and agricultural pesticides from farmlands (Hasan *et al.* 2007).

2. LITERATURE REVIEW

Several researchers have conducted many researches on the basis of many previous works in the field of limnological study. It is such as as follows:

Day by day water is becoming more and more unfit for human consumption due to unwise use, negligence and mismanagement. Water bearing layer present in any ecosystem gives important information about that ecosystem. Many physical, chemical and biological factors change due to contamination of water. Many parameters are used to monitor and assess pollutants present in water. The vigorous watery ecosystem relies on the physico-chemical and biological characteristics (Venkatesharaju *et al.* 2010). The water quality parameters of ponds has received the attention by number of biologists but the study was mainly concerned in relation to fitness of water resources, chemical composition of water was not studied in detail.

In later studies various physical and chemical parameters were studied. In 18th century most of the lakes were atrophic, nanotrophic or oligotrophic, therefore study revolved around the detection and description of physic-chemical parameters (Dube 2002, Basavarajappa *et al.* 2014). After industrial revolution in western word the pollutants and effluents were discharged in water resources and this big happening acquired main focus of limnological studies. In 19th and 20th century studies were mainly concentrated on extent of chemicals in water and their effects on water quality and living beings present in water resources. These research works have been discussed and reviewed in several reports, papers, dissertations and theses so this paper restricts itself to review published works of current century only (Dube 2002, Sharma 2010, Meena 2017, Karra 2020).

Now in twenty first century, water resources are more distressed. Pollution level and diversity of pollutants have increased many folds. The lotic and lentic water bodies are metamorphosed in terms of trophic level (atophic to eutrophic) and their existence is threatened. Perennial water bodies are now no more so, but converted into epimeral and seasonal. Therefore such studies are seen more (Meena and Dube 2019, Sharma and Dube 2019, Karra *et al.* 2018).

Borse and Bhave (2000) stated that eradicated carbon dioxide was highest degree in summer time and lowest degree in winter time and was reliable on carbonates and bicarbonates in water, Carbon dioxide and pH of water also had a significant. They said that group of Chlorococcales had enough tolerance to highest consolidation of nutriements. Verma *et al.* (2001) have studied the ecology of perennial wetland. They have conducted physico-chemical characteristics study and biological study. Dube *et al.,* (2002a) have studied on ecobiology of seasonal water bodies in southeastern plateau of Rajasthan with special reference to amphibians. Dube (2002b) described physico-chemical attributes of various ponds and temporary water bodies of southeastern plateau of Rajasthan (i.e. Kota, Bundi, Baran, and Jhalawar district). Cude (2001) created a water quality index for managing the lakes. Bate *et al. (*2002) studied diatoms as pointers of pollution. Chinmoy and Raziuddin (2002) stated the water level of excellence reduced water of industries. Hosmani and Lingnnaiah (2002) stated reasonable agents of fish kills owing to algal blooms and Hosmani (2002) narrated interconnection of phytoplankton and zooplankton. Mahadev and Hosmani (2002) applied Langlier's index as an agent of dispensation phytoplankton. Hariprasad and Ramakrishnan (2003) applied algal assay conviction of eutrophic. Juttner *et al.* (2003) utilized diatoms gauge as stream water quality. Ahmed (2004) illustrated avant-garde to evaluate water quality of brooks. De la Rey *et al.* (2004) used diatoms for water signals. Dube (2003) has studied on Amphibians fauna of southeastern Rajasthan with special reference to their ecology. This paper describes the ecology, habit, habitat and impact of environment parameter on their life activities. Das *et al.* (2003) recorded physico-chemical parameters of three reservoirs in pond of southern Orissa, India.

Mahadev and Hosmani (2004) evaluated qualitative water built on the index of Langlier and ceased lakes had an inclination as hard water having light scale settlings. Others having inclination of heavy scale. Upadhayay and Verma (2004) studied on the physical characteristics of Subernarekha River.

Dube (2005) has studied physico-chemical characteristics of a semi permanent pond at Baran, Rajasthan, India. Trophic state indicates Mysore's Lake, reckoned by Hosmani (2006), concluded that amount of 40-

50 were deliberated mesotrophic, more than 50 were eutrophic and less than 40 were assigned oligotrophic. Thomas and Deviprasad (2006) studied Mysore's lakes introduced sunshine, phosphates, nitrates, oxygen and CO_2 having major impact on the growth of Myxophyceae.

A study of physico-chemical characteristics of some water ponds of Ayodhaya-Faizabaad was carried out by Chaurasiya and pandey (2007). Physico-chemical parameters of the Girma dam of Nashik district from Maharashtra were examined by Nandan and Magar (2007). Ramesh *et al.* (2007) examined qualitative water of Singanallur Lake located in Coimbatore district and mentioned that water was inappropriate for survival of water organisms. Water quality is determined by different factors which may be categorised as physical, chemical, biological etc.

Soni and Bhatt (2008) researched the non urban pond for ecological swot close to Vadodara, Gujrat with the physico-chemical, biological and microbiological parameters. Physico-chemical parameters and fauna of Kisan Sagar Pond Jhalawar were assessed by Sen (2009) who reported values of physico-chemical parameters and 17 fish species.

Fertilizers and pesticides are major contributors to water pollution. Weathering of rocks, leaching of soils and mining processing, etc., these are contaminate natural water (Manjare *et al.*, 2010). Determinant in water body include dissolve oxygen, hardness, turbidity, alkalinity, nutrients, temperature etc. others like biological oxygen demand and chemical oxygen demand point pollution level water body (Ehiagbonare and Ogunrinde YO, 2010). Chemicals are significant resources of water contamination which was introduced during water deviation through geological possessions (Kataria *et al.*, 2011). Mukherjee (2011) studied water quality parameters of sixty wetlands.In the southern corner of Karnataka there has been a great amount of publications related to limnological studies. More techniqual explanations and different analysis were applied in the modern era. Basavarajappa *et al.* (2011) assesed good water diatoms as pointers of qualitative water in some Mysore's lakes. Most of the lakes founded alkaliphic, and nitrogen eutrophic. The quality of water scaled from alpha mesotrophic to polysaprobic. Diatoms are significant ecological indicators according recent study. Hosmani *et al.* (2011) examined qualitative water for aquatic life using the CCME-WQI, and concluded that the lakes of qualitative water were at risk, beyond normal circumstances. Now it was not possible for Lake Water to support and defend aquatic life. Biological communities related to stress develops preservation planning in lakes ecosystems.

Hosmani and Mruthunjaya (2012) used ANOVA data of fresh water ecology. They stated that CO_2 and dissolved O_2 were the most important indicators working in lakes. Ansari *et al.* (2012) studied on water quality of a Temple pond of Surat (Gujrat) India. Patil *et al.* (2012) studied the physico-chemical properties of Shivaji University lakes of Kolhapur city. Thirupathaiah *et al.* (2012) studied physico-chemical characteristic at Manair Reservoir in Karimnagar District, Andhra Pradesh. Changes in physico-chemical parameters for instance water temperature, pH, turbidity, transparency, total dissolved solids, total hardness, chlorides, phosphate, nitrates, dissolved oxygen and biological oxygen demand. The results showed that physico-chemical parameters of water were in limits and may be used for domestic, irrigation and pisciculture. There are numbers of diseases have been classified amid the human beings, caused by contaminated water. Infections done by water born diseases during washing, bathing and consumption of

contaminated food and drinking water. Few researchers (Kiran, 2010; Raut *et al.* 2011; Naik *et al.* 2012; Bahekar and Ther 2013; Mahajan and Tank, 2013) physico-chemical indicators have been studied in various field of india of water bodies. Water in our country is polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural drainage (Shrivastava and Kanungo, 2013). The determination and frequency of qualitative water realise on the rearing intensity of the production system (Solomon *et al.* 2013). Lodh *et al.* (2014) studied physicochemical parameters of four lakes of Udaipur known as the "City of Lakes". The studied lakes are Amar Sagar, Dhani Sagar, Jagannath Dighi and Mahadeb Dighi. Mahajan and Billore (2014) studied seasonal differences and measurement of qualitative water of Nagchoon pond of Khandwa District (M.P.). Dhawale and Ghyare (2015) studied the physico-chemical status of water in Pus Dam of Pusad Tehsil of Yavatmal District, Maharashtra. They found that physico-chemical pointers of water were in limits and could be used for domestic, irrigation and pisciculture. Mohammad *et al.* (2015) assess the quality of water by using physico-chemical parameters of Wyra reservoir of Khammam district, Telangana, India. Results indicated that the quality of water from this reservoirs within the acceptable values. Nagmani *et al.* (2015) on water quality in five blocks of Bangalore, Dixit *et al.* (2015) on physico-chemical parameters of different pond water of Bilaspur physico-chemical properties of some selected fresh water fish ponds in Warangal area of Telangana state. Kashyap (2016) published account on physico-chemical properties of water of Rewa (M.P.). Peyami (2016) studied seasonal variation from Phadke Pada pond at diva, Thane. A number of workers have made physicochemical analysis of various water bodies of Madhya Pradesh in which Sharma (2017) have done Limnological study of Tighra reservoir, Gwalior, (M.P.). Kumar *et al.* (2017) assessed seasonal water quality. The water samples were examined for various Physico-chemical characteristics like colour, turbidity, temperature, DO, BOD, COD, carbondioxide, salinity, total alkalinity and total hardness etc. Ghosh (2018) assessed physico-chemical Analysis of pond water. Gothwal and Gupta (2019) studied Limnological characteristics, Planktonic diversity and icthyofauna and found that some Physico-chemical parameters shoe seasonal fluctuation. Choudhary *et al.* (2019) studied Physico-chemical parameters i.e. temperature, pH, dissolved oxygen, total alkalinity, free carbondioxide, transparency, hardness, total dissolved solids, conductivity, and biological oxygen demand has been studied and correlated with ideal conditions of for fish culture. Abhijet and Arjun (2019) studied the ecological and pollution status of freshwater reservoir. Rao *et al.* (2019) investigate the status of pond and measured pH, turbidity, acidity and few more physical properties. Meena and Dube (2019) studied the diversity and seasonal variations of Similiya Village pond which shows variation in the various physico-chemical parameters and phytoplankton species were more diverse and dominant than zooplanktons communities.

3. CONCLUSION

At the end of this review I can conclude that physical chemical parameters affect the quality of water and biotic flora and fauna of water ecosystem. This study provides an informative data and helps us to understand that how does physico-chemical parameters effect the quality of water. Health of the water body depends on clarity of water.

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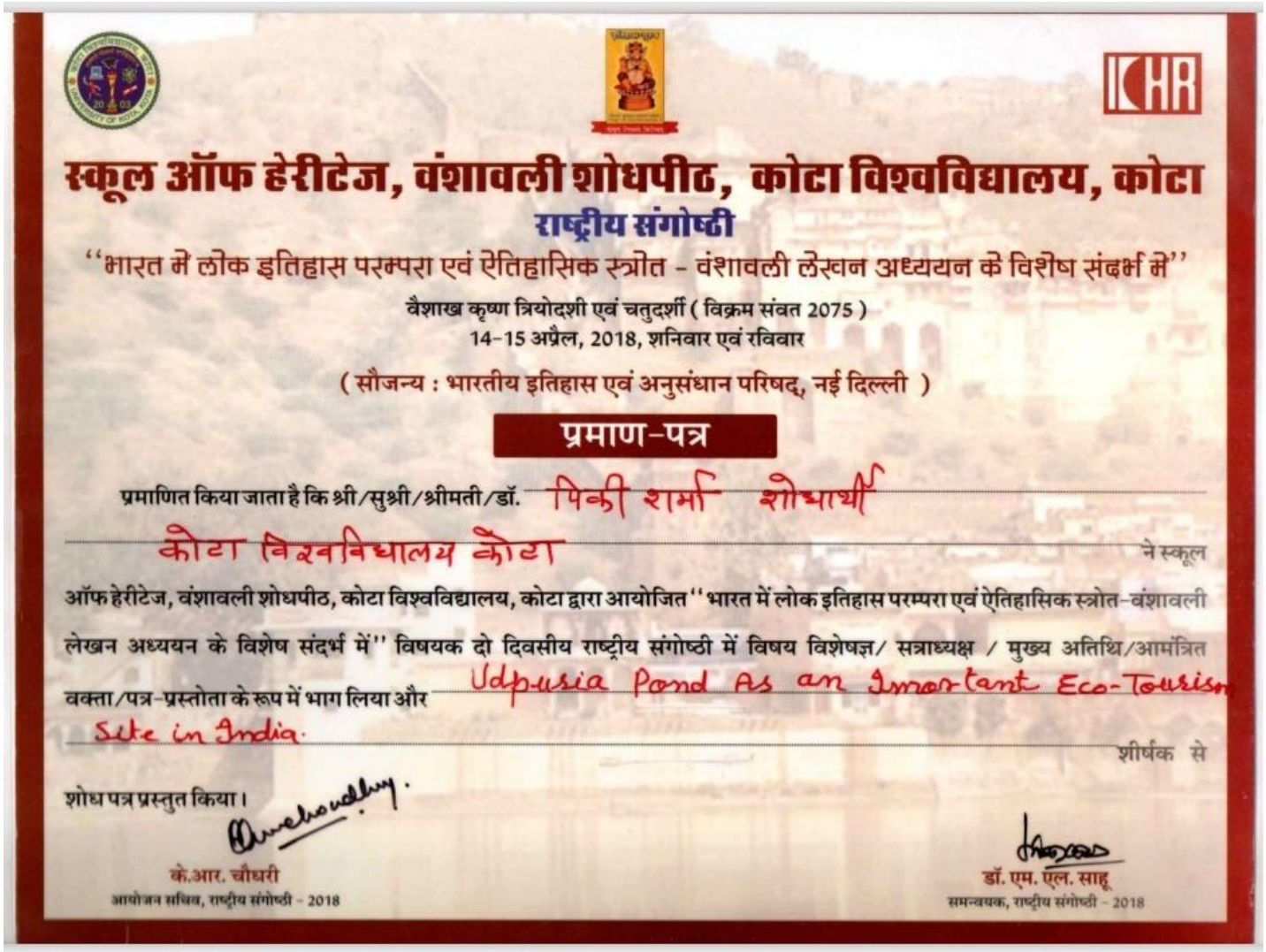
Attended Seminars



स्कूल ऑफ हेरीटेज, वंशावली शोधपीठ, कोटा विश्वविद्यालय, कोटा

राष्ट्रीय संगोष्ठी

"भारत में लोक इतिहास परम्परा एवं ऐतिहासिक स्त्रोत - वंशावली लेखन अध्ययन के विशेष संदर्भ में"

वैशाख कृष्ण त्रियोदशी एवं चतुदर्शी (विक्रम संवत 2075)
14-15 अप्रैल, 2018, शनिवार एवं रविवार

(सौजन्य : भारतीय इतिहास एवं अनुसंधान परिषद्, नई दिल्ली)

प्रमाण-पत्र

प्रमाणित किया जाता है कि श्री/सुश्री/श्रीमती/डॉ. पिंकी शर्मा शोधार्थी
कोटा विश्वविधालय कोटा ने स्कूल ऑफ हेरीटेज, वंशावली शोधपीठ, कोटा विश्वविद्यालय, कोटा द्वारा आयोजित "भारत में लोक इतिहास परम्परा एवं ऐतिहासिक स्त्रोत-वंशावली लेखन अध्ययन के विशेष संदर्भ में" विषयक दो दिवसीय राष्ट्रीय संगोष्ठी में विषय विशेषज्ञ/ सत्राध्यक्ष / मुख्य अतिथि/आमंत्रित वक्ता/पत्र-प्रस्तोता के रूप में भाग लिया और Udpusia Pond As an Important Eco-Tourism Site in India. शीर्षक से शोध पत्र प्रस्तुत किया।

के.आर. चौधरी
आयोजन सचिव, राष्ट्रीय संगोष्ठी - 2018

डॉ. एम. एल. साहू
समन्वयक, राष्ट्रीय संगोष्ठी - 2018

National Conference

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Recent Trends in Environmental Sustainability and Green Practices

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November 15-16, 2019

CERTIFICATE

This is to certify that Prof. / Dr. / Ms. Pinky Sharma

of Govt. College Kota

has participated in the National Conference organized by **Department of Botany, Government College, Bundi (Rajasthan)** in collaboration with **The Society of Life Sciences Satna (M.P.)** as a ~~Keynote Speaker~~ / ~~Chairperson~~ / ~~Invited Speaker~~ / Oral Paper Presenter / Poster Presenter / ~~Delegate~~. The title of his / her research paper was Assessment of Water Quality In Udpuria Talab, District Kota Rajasthan

His / her particpation was highly appreciated.

Dilip K. Rathore	S.M. Meena	O.P. Sharma	Prahlad Dubey	J.K. Jain
Organizing Secretary	Co-Ordinator	Convener	Chairman	Patron

A
WORKSHOP
ON
ACADEMIC ETHICS AND INTEGRITY
(JULY 27, 2017)

Internal Quality Assurance Cell
University of Kota
Kota, Rajasthan

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This is to certify that Dr. / Mr. /Ms. Pinky Sharma
from University of Kota has participated / presented a paper/ delivered invited talk entitled —in the WORKSHOP ON *ACADEMIC ETHICS AND INTEGRITY* organized by the Internal Quality Assurance Cell, University of Kota on July 27, 2017.

Member Secretary, IQAC

Director, IQAC