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ANALYTICAL INVESTIGATION OF THE BIO-CHEMICAL PARAMETERS OF WATER QUALITY AND THEIR INFLUENCE ON FISH GROWTH

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ABSTRACT

Water is the primary determinant in shaping the terrain and regulating the climate. Water resources are crucial for both ecosystems and humanity. Environmental pollution is a substantial concern in both developed and developing countries. Throughout a period of 17 months, equal quantities of water and fish samples were gathered from each pond. In addition, the bacterial, parasite, survival, and growth rates of fish were also assessed. The findings indicated that farm (II) exhibited the greatest mean values for NH3-N, total coliform, and fecal coliforms, with values of 3.150.65, 59.0, and 18.5, respectively. This was followed by ponds of farm (III). Conversely, the lowest average values for the estimated parameters were seen in farm (III). Contrarily, fish in farm I exhibited the least amount of germs and parasites, resulting in the best rates of weight gain and survival, specifically 35.2 4.4 g and 97.0 1.6%, respectively.

KEYWORDS Water Resources, Physio-Chemical, Bio-Chemical, Impact and Water Quality

INTRODUCTION

India is currently facing a tremendous challenge of natural resource shortage, namely in regards to water, due to population growth and economic advancement. Most freshwater bodies globally are experiencing contamination, leading to a decrease in the water's drinkability. Water is the fundamental element that sustains all living organisms and can be found in various natural forms such as the ocean, river, lake, clouds, rain, snow, and fog. However, it is important to note that naturally occurring chemically pure water does not persist for a significant duration. Pure water, in practical terms, is characterized by minimal amounts of dissolved or suspended particles, noxious gasses, and biological organisms. A lake is an expansive expanse of water encompassed by land and serving as a habitat for a diverse range of aquatic organisms. In other contexts, such as agriculture and industry, the standards for water quality can be more lenient, allowing for a certain level of pollution before considering it pure. This high-quality water may be required solely for drinking. The well-being of almost every component of the ecosystem is directly linked to the vitality of lakes and their biodiversity. Lakes are not only susceptible to many natural environmental processes such as the hydrologic cycle, but they are also highly impacted by extensive human development, resulting in the suffocation of several lakes. Common mechanisms by which various nutrients enter aquatic ecosystems and contribute to their decline include storm water runoff and sewage discharge into lakes.

Water resources are crucial for both ecosystems and humanity. In order to maintain our well-being, we depend on the continuous and hygienic provision of drinking water. In addition to its essential role in sustaining life, water is also crucial for recreational activities, energy generation, and agricultural practices. Water pollution and its impacts on the environment are significant challenges for the contemporary world. The level of pollution in urban rivers has escalated in recent years, with organic pollution emerging as a prominent form of contamination. Novel techniques for treating wastewater are being devised to diminish water pollution and reinstate water purity. Heavy rainfall leads to an increase in river pollutants and silt due to surface runoff. Anthropogenic activities, such as the disposal of domestic waste, plastic equipment, dumping of automotive batteries, untreated sewage from treatment plants, and mining operations, are causing a decline in the water quality of rivers. The hydraulic conditions have a considerable impact on the dispersion and reaeration processes in a river. The Bagmati River is currently facing water quality challenges such as low dissolved oxygen levels, bacterial contamination, and metal toxicity [6]. Industrial wastewater treatment plants do a water quality assessment by monitoring specific elements to mitigate the risks associated with untreated wastewater entering freshwater resources. Diverse measures are employed to evaluate the caliber of river water. Various approaches, including physicochemical, biological, and other strategies, have been documented in the literature for safeguarding river water.

Environmental pollution is a substantial concern in both developed and developing countries. A multitude of environmental pollutants in Egypt have been found to infiltrate natural water sources, such as lakes, rivers, and oceans, via domestic, agricultural, and industrial discharges. In recent decades, there has been significant focus on the environmental pollution issues and their harmful effects on aquatic organisms, including fish. There is growing concern about the presence of many pollutants in the aquatic environment. An increasing amount and volume of commercial, agricultural, and industrial chemicals discharged into the aquatic environment have resulted in various detrimental effects on fish and individuals who consume them. Fish exhibit various responses to alterations in the natural characteristics of the aquatic environment. Heavy metals are the main factor responsible for these negative alterations in water quality.

LITERATURE REVIEW

JakirHussain et.al (2017) The Narmada River holds a sacred status as the official river of Madhya Pradesh. A study was conducted to develop a water quality index using eight parameters: pH, Temperature, Total Dissolved Solids (TDS), Turbidity, Nitrate-Nitrogen (NO3-N), Phosphate (PO43), Biological Oxygen Demand (BOD), and Dissolved Oxygen (DO). These parameters were measured at six different sites (S1-S6) along the river Narmada. Three approaches, namely the weighted arithmetic water quality index, the water quality index established by the National Sanitation Foundation, and the water quality index developed by the Canadian Council of Ministers of the Environment, were used to calculate the water quality index. Water quality along the Narmada River was determined to be excellent to very good during the summer and winter seasons, but poor to unsuitable for human consumption during the monsoon season. The degradation of water quality during the monsoon season was mostly attributed to inadequate sanitation, turbulent flow, soil erosion, and increased human activity.

Mrs. Swati Sarwa et.al (2018) This research comprehensively analyzes all facets of water quality and highlights specific regions in India and Chhattisgarh that require enhancement. Individuals immediately utilize this task review to assess the renowned rivers' cleanliness and water quality. Various national and international authorities have established distinct requirements for the quality of drinking water used in residential situations. The document primarily addresses concerns regarding water quality and its impact on agriculture, public health, and the environment. In addition, they are offering information regarding the correlation between effluent requirements and the quality of wastewater originating from industry, communities, and agriculture.

Nayla Hassan Omer (2019) The discovery of new sources of pollution has occurred practically daily since the industrial revolution began in the late 18th century. As a result, contamination of both the air and water can happen anywhere. We don't know much about how pollution rates change. An accurate assessment of environmental contamination can be made feasible by the growth in water-related disorders. This chapter provides an ecological overview of the features of water quality, including how it affects humans and other organisms. There are four distinct types of water that are defined by their quality. After examining the commonalities among the four water quality categories—including physical, chemical, and biological factors—we present them. Investigating the history, definition, sources, effects, results, and methods of measurement for these water quality metrics.

Nur Hanisah Abdul Malek (2021) The World Health Organization reports that some 2 billion people worldwide use water that is polluted with various toxins. Cholera, typhoid fever, dysentery, hepatitis A, jaundice, and other waterborne diseases are a big concern, and polluted water is a known source of these problems. Researchers from all around the globe are interested in the water quality because of this. One of the most common approaches is to use machine learning. Many academics have taken an interest in machine learning in recent years due to its capacity to analyze massive volumes of data using complicated mathematical computations. Consequently, this study used a meta-analysis approach to look at how different water quality metrics relate to the Water Quality Index (WQI) in machine learning-based water quality research. This study made use of the estimated variance, chi-squared test for heterogeneity, heterogeneity index, and random effects model. Research in the selected journals indicates that pH, DO, and BOD are often used metrics in water quality research powered by machine learning. This study found that pH is the most influential chemical factor on the Water Quality Index, with the highest mean correlation and the lowest estimated variance due to sampling error. The results showed that the association between pH and WQI varies throughout research, based on the Chi-squared of heterogeneity (Q) and the heterogeneity index (I^2).

Anwar Yousif Zaeen et.al (2020) Natural chemical and biological species whose composition vary depending on their location are known as impurities, and they are usually present in water from rivers and faucets. Our study's main objective is to find and remove contaminants from water using a column composed of sterilised activated

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carbon (both powdered and granular) that has been enhanced in adsorption efficiency by potassium permanganate. Several chemical and biological methods were used to analyze four samples. Near the point where the Euphrates River runs from Ramadi to Fallujah, two samples were collected: one from the area around Ramadi (RR0) and another from the area around Fallujah (FR0). For the second and third samples, we used the municipal water systems in Ramadi (RT0) and Fallujah (RT0) (FT0). Before passing through an activated carbon column that was 5 cm thick twice, the four water samples were treated with a 0.1 w/w potassium permanganate solution. All sorts of parameters were measured in the samples, such as turbidity, pH, total dissolved solids (TDS), chloride, phosphate, dissolved oxygen (DO), and electrical conductivity (EC). The samples do not meet the criteria for usage as drinking water due to the high concentrations of pollutants found in them. Some of the results of treating with activated carbon include removing chemical pollutants and the microorganisms found in one sample.

METHODOLOGY

From April 2006 to September 2007, researchers in the governorates of Behera (I&II) and Mamounia (III) monitored three fish farms to determine the effects of water quality. The water we used was of varying quality and came from three sources: brackish, agricultural, and underground. While tilapia Nilotic's was the sole species being farmed in farms I and II, three species of carp and Claris Lazear were housed in the ponds of farm III, with stocking densities of 10.5, 14.6 and 18.2 /m, respectively.

Study site.

First farm: The one clay pond there is 1.4 meters deep, 180 by 42 meters on average. There was a 27% protein level in fish that were given a commercial pelleted diet. The water in the pond was changed twice a week. Part II of the farm. There are two man-made ponds there, each around 150 by 50 meters and 1.2 meters deep. Fish grown with farm-prepared pelleted feed, which contains 22% protein The procedure involved exchanging water three times weekly.

Residence (III): Located in a French town, it features two circular ponds made of concrete that are, on average, 80 by 70 meters in diameter and 1.2 meters deep. Commercially farmed fish have an extra 25% protein and pyrogen in their diet to help them perform better. Only when the monitoring program's oxygen level dropped below 4 and water loss due to evaporation and infiltration was more than compensated for. All told, 325 fish samples were collected from the three farms under scrutiny, and 300 samples of water were collected from various sources and ponds as part of the research. The collected samples were promptly sent to the Animal Health Research Institute's Department of Fish Diseases in Doka for further water examination. Two locations, one near the inlet and one in the middle, were used to collect water samples from each pond. As stated before by (Boyd, 1998), samples were taken weekly at a predetermined time of day (9.0 h). We averaged the results per month.

Physicochemical analysis of water samples: Using the methods described in (APHA, 1998), the following water quality parameters were determined: temperature, dissolved oxygen (DO), pH, NH3-N, NO2-N, NO3-N, alkalinity, and salinity. To take the reading, a mercury thermometer was employed. In order to monitor the pH immediately, a handheld pH meter (Hanna Instruments) was utilized. The YSI DO metering system measured the dissolved oxygen (DO) using polarographic sensor probes. Ammonia (UIA-N), NO2-N, and NO3-N were estimated using commercial kits; alkalinity was tested with an alkalinity test kit; and salinity was measured in milligrams per liter using a hand refractometer (Cole-Parmer instrument Co., Atago-60648- Chicago, USA). bacteria testing of water samples. A 250 ml sample of water was collected weekly in sterile glass bottles. Using samples for total bacterial count, total coliform, and faucal coliform measurement, as outlined in the standard procedure for the evaluation of water and waste water analysis (APHA, 1998)

While total viable aerobic mesophile counts were conducted on plate-count agar (PCA, Ooid, UK) and nutritional agar, total coliforms and fecal coliforms were counted on MacConkey agar following the specified protocol. Take a sample of fish. a clam net that was employed for the purpose of collecting fish specimens from various ponds. Following the protocol outlined by (AOAC, 1999), five live tilapias (Oreochromis niloticus) were selected at random from the catch for each pond at each sampling interval. Sterile polypropylene bags containing pond water were used to transport the fish to the laboratory. Evaluation of bacterial contamination in fish samples. We measured total coliform, fecal coliform, and total bacteria in fish samples using the methodology outlined in the APHA's 1998 standard procedure for the examination of water and wastewater analysis. Upon arrival at the lab, a surface swab was taken from each fish. assess the parasitology of fish. Using the method outlined by (Abd El Khaled, Fish performance), a parasitological study was carried out to search for indications of an external parasite infection. Five fish each pond had their average weight (or 0.01 g) assessed every two weeks, and the initial live body weight and survival rates were averaged. In contrast, the remaining elements were identified subsequent to that (Hargreaves and Semrad, 2001). Increase in body mass index. As to the formula proposed by Bhaaji and Gobind (1998), the daily percentage gain in weight is equal to 100 divided by the difference between the initial and final weights in grams. frequency of survival. Multiplying (Nf / Ni) by 100 is the survival percentage. According to the method outlined in (Etienne et al., 2001), the quantities of fish captured and added to the aquarium are denoted as Nf and Ni, respectively. Number crunching. To statistically investigate all of the gathered numerical data, the one-way ANOVA (F test and T test) was utilized.

DATA ANALYSIS

With a dissolved oxygen (DO) level of 3.6 0.7, the water temperature, pH, nitrite, and nitrate readings were highest in farm (III)'s subterranean supply, while those readings for farm (II) were 30.4 1.1, 8.1 1.1, 3.15 0.65, and 0.3, respectively. The three farms that were studied had these average values of physio-chemical characteristics of water near the pond inlet, and they are Nevertheless, compared to farm (III)'s 13.8 and ND, the total coliform and fecal coliform counts were 59.0 and 18.5 in agriculture water supply farm (II), respectively. The water supply at farm (I brackish) had the lowest average physic-chemical and microbiological parameters compared to other farms. The only exceptions were salinity (65.0 mg/l) and dissolved oxygen concentration (6.8 mg/l), respectively.

Results of the physio-chemical parameters of water from various sources were within the average suitable range for Tilapia culture (III), with the exception of ammonia in farm (II) and nitrite and nitrate in farm groundwater. Konjic and Acholia (2005) and Frei et al. (2006) provided further validation of this finding.

The results of the physicochemical and microbiological tests conducted on water samples collected from fishponds showed that farm (III) had the highest water temperature, pH, nitrite, total alkalinity, and dissolved oxygen (DO) content at 3.6 0.7, while farm (II) had the lowest at 30.4 1.1, 8.1 1.1, 3.15 0.65, and 0.35, respectively. But when it came to salinity and DO content, farm (I) had the lowest average levels at 6.8 and 65.0 mg/l, respectively. The data gathered demonstrate that the biological, chemical, and physical properties of pond water are directly affected by the water supply. This is because agricultural water typically results in higher average coliform and fecal count levels. Furthermore, it is evident that the water conditions in farms II and III do not promote the health, growth, or productivity of the fish. This result agreed with what Wickes (2006) found.

Table showing the outcomes of the quantitative estimate of the bacterial level in fish samples

Farm (III) had the greatest total bacterial count (42.55.4), total coliform count (29.63.6), and fecal coliform count (11.33.1), as shown by the mean values. Following farm (I) with the lowest values was farm (II), followed by fish in farm (II) with 29.753.5, 11.53.3, and 7.41.1, respectively.

The rise in fish bacterial loads (Farm II) can be attributed to the significantly higher concentrations of NH3-N, a dramatic increase in water NO2-N and NO3-N, and low DO levels (Farm III). (Saeed and SEAKR 2009; Abu El-Wafaa, 1988; Al-Harbi, 2003) came to similar conclusions, speculating that the fish's fragility rendered them more susceptible to bacterial illnesses.

The findings in Table (3) demonstrate the percentage of fish infestation with external parasites in the farms that were investigated. The range was from 0% (Farm I) to 31.5 percent. (Hub III). Among the ectoparasites found on farms (I & II), 66.03 percent were trichodynia. The following three categories, with corresponding prevalence rates of 51.03.7, 17.52.0, and 13.52.75, were monogenic infection, mixed infection, and epistyles. Consistent with previous research (Nahla, 1989; Abd El Khaled 1998; Frei et al., 2007), the results demonstrate a strong correlation between parasite infestation and water temperature, Do content, NO3-N, NO2-N, and bacterial pollutants in (Farm III) and NH3-N, total coliform counts, and fecal coliforms in (Farm II).

Tabulated in Table 4 are the typical rates of fish survival at harvest and percentages of body weight gain. Of the farms, Farm (I) had the highest averages at 35.2% and 97.0%, followed by Farm (II) at 28.5 and 89.0%, and Farm (III) at 22.5 and 85.8%, and Farm (IV) at 2.0. The high fish productivity on farm I can be explained by the favorable water conditions (physic-chemical and bacterial) and the lack of parasite infestation, in contrast to the ponds on farms III and II, which are primarily affected by bacteriological and parasitic stressors. George (1999) and Alejandro et al. (2000) found similar results. A study conducted by Saeed and SEAKR (2009) also found that tilapia fish reared in brackish water were unaffected by an increase in salinity. The rate of fish stocking densities, amount and kind of parasite infestation, body weight gain (%), and survival rates of the fish were also examined.

Table (1): The average values of physic-chemical and bacteriological findings of different water supplies in three examined fish farms.

Water parameters		Farms		
		I	II	III
Physicochemical	Temperature (^{0}C)	28.50 ± 1.00	29.00 ± 1.20	28.70 ± 1.50
	Dissolved oxygen (mg/l)	7.10± 0.50^a	5.80 ± 1.03^b	5.20 ± 0.70^b
	pH	7.50 ± 0.50	7.80 ± 0.80	7.80 ± 1.00
	NH_3 -N (mg/l)	0.07± 0.04^c	0.86 ± 0.12^a	0. 16± 0.07^b
	NO_2 -N (mg/l)	0.20± 0.17^b	0.22± 0.06^b	1.83± 0.82^a
	NO_3 - N (mg /l)	0.06± 0.03^c	0.27 ± 0.15^b	8.50 ± 0.28^a
	Total Alkalinity (mg/l) as $CaCO_3$	50.70 ± 2.80^b	53.70 ± 2.30^b	60.30 ± 2.60^a
	Salinity (mg/l)	63.00 ± 3.00^a	40.70^b ± 3.00	48.00 ± 3.60^b
Bacterial Finding	T.B.C. (x103)	3.40± 2.00^c	10.60 ± 3.00^a	5.80 ± 1.00^b
	Total Colifom T.C (/100ml).	< 3.00	23.40 ± 3.80	< 3.00
	Faecal Coliform (/100ml).	ND	ND	ND

Results are expressed as mean ± S.E. a, b and c superscripts within rows differ significantly at $p < 0.05$ ND: Non-detected

Table (2): The average values of physic-chemical and bacteriological findings of different ponds water in three examined fish farms.

Bacterial findings	Farms		
	I	II	III
Total viable bacterial count T.B.C. (x10^3)	7.80 ± 1.80^c	29.75± 3.50^b	42.50± 5.40^a
Total Coliform (/ 100ml)	3.0± 1.10^c	11.50 ± 3.30^b	29.60 ± 3.60^a
Fecal Coliform (/ 100ml)	ND	7.40± 1.10^b	11.30± 3.10^a

Results are expressed as mean ± S.E. a, b and c superscripts within rows differ significantly at $p < 0.05$ ND: Non-detected

Table (3): The average values of bacterial findings of fish samples in three examined fish farms.

Farms	Parasitic infestation				
	% of infestation	% of distribution of parasitic species			
		Trichodina	Monogenia	Epistylis	Mixed infection
I	ND	ND	ND	ND	ND
II	10.80	22.00 ± 3.00^b	8.00 ± 2.00^b	5.00 ± 1.50^b	12.00 ± 2.50^b
III	31.15	44.00± 3.50^a	43.00± 4.50^a	12.50± 2.50^a	15.00 ± 3.00^a
Total	21.00	66.00 ± 3.20	51.00 ± 3.70	17.50 ± 2.00	13.50 ± 2.75

Results are expressed as mean ± S.E a, b and c superscripts within rows differ significantly at $p < 0.05$ ND: Non-detected.

Table (4): Relationship between stocking density and parasitic infestation of the three examined fish farms with fish performance.

Parameters	Farms		
	I	II	III
Stocking density / m^3	10.50 ± 2.50c	14.60 ± 3.40^b	18.20 ± 1.80^a
Parasitic infestation (%)	ND	10.80 ± 2.70^b	31.15 ± 4.50^a
Initial body weight (g)	7.10 ± 2.60	6.50 ± 2.00	7.10 ± 2.00
Final body weight (g)	218.80 ± 8.00^a	185.00 ± 4.00^b	162.00 ± 4.00^c
Body weight gain (%)	35.20 ± 4.40^a	28.50 ± 3.50^b	22.5 ± 3.50^c
Survival rate (%)	97.00 ± 1.60^a	89.00 ± 2.00^b	85.80 ± 2.70^b

Results are expressed as mean ± S.E. a, b and c superscripts within rows differ significantly at $p < 0.05$ ND: Non-detected

Fisheries (III) and (II) in terms of stocking density, bacterial content, and parasite infection, respectively The results corroborate the findings of Shehata (1993), who found that stocking rates and water quality greatly affect the specific growth rate during the growing season. In addition, Amoako (2006) and Abdel Thawab and Selim (2004) linked an increase in bacterial and parasite infestation to the rise in fish mortality in ponds with low dissolved oxygen and high nitrite levels.

The results shown above suggest that parameters related to the water quality of fish ponds affect the levels of bacterial contamination and ectoparasite infection in fish. This is probably due to the fact that water quality has an effect on fish performance, which in turn reduces fish yield. More and better fish tend to emerge from a pond with better water quality than from one with worse water quality.

CONCLUSION

The quality of water can vary greatly, and often, it is still possible to drink water that has been polluted up to a specific point. Advanced wastewater treatment methods are now under development with the aim of reducing water contamination and restoring water quality. There has been a lot of focus on environmental contamination and its negative impacts on fish and other aquatic life in recent decades. For seventeen months, beginning in April 2006 and ending in September 2007, researchers in the Behera governorates examined the effects of water quality on three different fish farms. We collected water samples from the inlet and the center of each pond on separate occasions.

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