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# Limnological Investigation of Lower Himalayan Water Pond with Special Reference to Productivity

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**ABSTRACT: Life on earth is not possible without water, it is most precious substance on earth and ponds are traditional sources of water. The present study investigates the primary productivity of pond water ecosystem. The Light and Dark bottle method is used to measure the primary production and it depends on the planktonic biodiversity. In the present study monthly variations of physico-chemical parameters were statically analyzed and graphically presented. The pond was selected for a period of three months March to May 2024. The different physico-chemical parameters like air temperature (23°C to 30°C), water temperature (11ºC to 18ºC), EC (60 µS/cm to 76 µS/cm), T.D.S (31 ppm to 38 ppm), alkalinity (21mg/l to 25 mg/l), hardness (31 mg/l to 34 mg/l), calcium hardness (4 mg/l to 4.8 mg/l), magnesium hardness (4.32 mg/l to 5.76 mg/l), Chloride content (2 ppm to 5 ppm), pH (7.2 to 8) dissolved oxygen (6.80 mg/l to 13.90 mg/l) as well as Gross primary productivity (GPP) (0.22 mg C/l/h to 0.33 mg C/l/h), Net primary productivity (NPP) (0.15 mg C/l/h to 0.37 mg C/l/h) and Community respiration (CR) (0.18 mg C/l/h to 0.56 mg C/l/h) were also analyzed. The study concluded that the water of Sourabh van vihar pond showed variations in physico-chemical parameters and primary productivity as well as productivity status in these three months.**

**Keywords:** productivity, reservoirs, conductivity, planktons.

## INTRODUCION

Water is one of the most vital element of the human environments. It is being used for many purposes e.g., industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of hydro-power plants. Water is the main source of energy and governs the evolution on the earth. 71% of earth surface is covered by water (Sahoo and Patra 2015), 96.5% of the world's water is sea water which is salty that is not to be directly useful for irrigation, drinking, domestic and industrial purposes. Less than 1% water is present in ponds, lakes, rivers, dams, etc., which is used by man for Industrial, domestic and agricultural purposes. Chemicals are a major source of water contamination that introduced during water movement through geological materials (Omar and Maznah 2010). Fertilizers and pesticides are major contributors to water pollution. Weathering of rocks, leaching of soils and mining processing, etc. also contaminate natural water (Rao and Sharma 2019). Unrestrained and unrestricted dumping of contaminants in to water bodies lead to their poor quality and should not be used for the purpose of consumption (Bilewu *et al.,* 2022). The study of primary productivity helps to understand the water quality, food chain, food web and the productivity of the ecosystem. Primary productivity is further distinguished as gross primary productivity (GPP) and net primary productivity (NPP). The productivity of the aquatic ecosystem also depends on the age of the water body. Newly formed or oligotrophic water body has less productivity as compared to the older ones (mesotrophic and eutrophic). Primary productivity is an important parameter hat describes the energy potential of aquatic organisms and determines the quality and self-purifying capacity of water environment. It is crucial for the functioning of ecosystem as it provides the fundamental source of energy for food web and ecosystem. The estimation of primary productivity of an ecosystem is of great importance for aquatic animals as helps to understand the food chain and food web relationship that prevails in ecosystem. By considering the importance of the primary productivity in an aquatic ecosystem, present study was carried out at Saurabh van vihar, Palampur, Himachal Pradesh (Dhauladhar ranges of Himalaya) which is geographically located at 32.12° N latitude, 76.53° E longitude and an altitude of 1300 m above Mean Sea Level to understand the relation of productivity with physicochemical parameters.

**Study Area.** Himachal Pradesh has 12 districts and one of them is district Kangra. It is the most popular district among all district of the state. Kangra is situated in the western Himalayan ranges 31°2′ to 32° N and 75° to 77°45′ E. The district has a Geographical area of 5739

km square and the altitude ranges from 427 to 6401m MSL. Saurabh van vihar is a very popular tourist place located at Palampur town of District Kangra in Himachal Pradesh, built in memory of Kargil hero, the late Captain Saurabh Kalia. The Vihar is built and managed by the Forest Department of H.P. Palampur is a popular hill station situated about 35 km away from Kangra. Saurabh van vihar is a nature park lying in the lap of snow-clad Dhauladhar Mountains, surrounded by lush green forest.

## MATERIAL AND METHOD

Present investigation entitled "Limnological investigation of lower Himalayan water pond with special reference to productivity" was conducted during March to May 2024. The study was carried out based on analysis of Saurabh van vihar, pond water Palampur (H.P.). The experiment was carried out in departmental laboratory of IPH department Palampur (Panchrukhi), Himachal Pradesh. Water sample was collected from study area *i.e.* Saurabh van vihar, Palampur. The sampling was carried out during morning hours between 10 am to 12 pm. Water sample were taken two times a month at fortnight interval for testing.

**Analytical Method.** Parameters such as TDS, EC, pH, water temperature and air temperature were monitored on the study area. The water temperature was measured with the help of electrical lab thermometer and digital meters were used to measure the EC, TDS and pH. Some other tests *viz.*, dissolved oxygen, alkalinity, hardness, calcium hardness, magnesium hardness and chloride content were tested in laboratory. For the analysis of chemical variables, the method prescribed by Strickland and Parson (1972) were used.

**Estimation of productivity.** The productivity was estimated using the light and dark bottle methods. Three BOD bottles; two white and one black bottle were used for the sampling process. Sample were taken and analysed as a protocol directed by Sexena (2001).

**Saurabh van vihar pond**

## RESULTS

### Physico-chemical Parameters of the pond water

**(a) Air temperature.** It affects the surroundings of water body and plays an important role. Maximum temperature was recorded in second half of May 30ºC while minimum temperature was recorded in the second half of April *i.e.* 23ºC. Air Temperature showed positive significant co-relation with Water Temperature, TDS and EC. The correlation of Air Temperature is non-significant with pH, DO, Hardness, Alkalinity and Chloride Content. Calcium and Magnesium Hardness has negative correlation with Air Temperature.

Temperature is the measurement of how hot or cold the air is. It is an abiotic parameters that describes the kinetic energy of the gases found in air. Atmospheric heat transfer occur at the water surface and the temperature of water has an essential effect on productivity. During our experimental research period, highest air temperature recorded was 30ºC in May and lowest was 23ºC in April. Temperature is an important biological significant factor, which place an important role in the metabolic activities of the organism (Sirajudeen and Mohamad 2013). Air temperature reaches its maximum during summer and minimum during monsoon and winter.

**(b) Water temperature.** Water temperature is an important factor of water body it effects the other parameters such as alkalinity, total dissolved solid, electrical conductivity and dissolved oxygen etc. Maximum water temperature 18ºC was recorded in second half of May although minimum temperature 11ºC was recorded in second half of April. Water temperature is positively influenced by Air Temperature, TDS, EC, pH, DO, Hardness, Alkalinity and Chloride Content. Although the correlation is positive and highly significant in case of TDS and Air Temperature and non- significant in case of EC, pH, DO, Hardness, Alkalinity and Chloride Content. The Water Temperature is negatively non-significantly influenced by Calcium Hardness and Magnesium Hardness.

Water temperature is an important factor that influences the concentration of dissolved oxygen in the water. Water temperature promotes the growth and reproduction of biological organisms. Temperature of Saurabh van vihar ranges from 13ºC to 18ºC. The lowest water temperature was recorded in April (11ºC) and highest was recorded in first half of May (18ºC). Water temperature usually depends on the season, geographic location, sampling period and temperature of effluents entering in to the stream (Ahipathi and Puttaiah, 2006). The variability is primarily related to atmospheric temperature and wheather condition (Adebowale *et al.*, 2008) Water temperature has a strong positive correlation with salinity, chloride, sulphate content, electrical conductivity, alkalinity and pH (Tripathi *et al*., 2014).

**(c) Electrical Conductivity.** It is the measurement of dissolved material in an aqueous solution which is related to the ability of the material to conduct electrical current through it. It is a numerical value and measured in units called seimens per units area. The maximum value of electrical conductivity was recorded in first half of March *i.e.* 76 (µS/cm) and minimum value was recorded in second half of April *i.e.* 60 (µS/cm). EC is positively non-significantly influenced by pH, DO, Hardness, Alkalinity, Chloride and Magnesium Hardness (non-significant) and negatively influenced by Calcium Hardness while its correlation with Air and Water Temperature is positive and highly significant.

Water has ability to transport electric current which is known as electrical conductivity and it is used to assess the water purity (Murugesan *et al*., 2006). Electrical

conductivity values are mainly determined by ionic concentration or dissolved inorganic compound (Mohanraj *et al*., 2000). In our experiment maximum value of electrical conductivity in Saurabh van vihar pond water was observed in the month of March *i.e.* 76 µS/cm and minimum values was observed in the month of April *i.e.* 60 µm/cm. The maximum conductivity during the summer and minimum during the monsoon season in Yedshi Lake in Mangarulpir tehsil of Washin district, Maharashtra (Laskar and Susmita 2009). The maximum conductivity during the summer season in Basavan bole tank at Sagar taluk of Shimoga district. Conductivity is measured in simple and effective way to monitor temporal or spatial variations in salt concentration, such as those that occur in salinized catchment (Bandyopadhyay, 2002).

**(d) Total Dissolved Solid (T.D.S).** T.D.S. is the oldest determination in water analysis and has apparently always been represent the amount of organic and inorganic material dissolved in water. The maximum value of T.D.S *i.e.* 35ppm was observed in second half of May and minimum value 31 ppm was recorded in second half of April. T.D.S showed positive and highly significant correlation with Air Temperature, Water Temperature, EC and pH while the correlation of T.D.S is positive non- significant with DO, Hardness, Alkalinity, and Chloride Content. Total dissolved solid also exhibit negative co-relation with Calcium Hardness and Magnesium Hardness.

Total dissolved solid (TDS) content of fresh water is calculated by adding the concentration of dissolved major ions (Allan and Castillo 2007). These parameters are helpful in defining the chemical elements of water and can be described as a general edaphic relation that contributes to the productivity within the water body (Gohor, 2002). During our study period the highest values of TDS was recorded in first half of March at 38ppm and lowest was observed in April at 31ppm.

**(e) Power of Hydrogen (pH).** pH is a measurement of the concentration of hydrogen ions in a water based solution. A lower pH means that there are more hydrogen ions in liquid where as, higher pH indicates fewer hydrogen ion in the liquid. The maximum value 8 was observed in the first half of March and minimum value of pH was in second half of April *i.e.*7.2. pH is strongly influenced by TDS, Dissolved Oxygen, Hardness and Alkalinity while positively non-significantly influenced by Water Temperature, Air Temperature and Chloride Content and negatively non-significant influenced by Calcium Hardness and Magnesium Hardness.

pH measures the concentration of hydrogen ions in water. An ion is an atom or molecule that has gained or lost electrons and thus has a negative or positive charge. The pH scale measures the concentrations of those charges assigning them a value from 0 to 14. Pure water at room temperature (77 degrees Fahrenheit) has pH of 7.0 and is considered as neutral. Water with a pH below 7 is defined as an acid *i.e.* above 7 is alkaline. The pH of a water body has importance in determination of water quality as it chemically reacts with remaining factors (Deka, 2017). The pH value increased due to activity of photosynthetic algae which consumes carbondioxide dissolved in water (Kang *et al.,* 2001). In Sourabh van vihar pond maximum value of pH *i.e.* 8 was observed during the month of March and minimum value *i.e.* 7.2 was seen in second half of April.

**(f) Dissolved Oxygen (DO).** It refers to the level of free, non-compound oxygen present in water or other liquid. Dissolved oxygen concentration is the most important water quality parameter because of its direct effect on the food consumption and metabolism of aquatic animals. The maximum value *i.e.* 13.90 mg/l was observed in second half of March while, minimum value *i.e.* 6.80 mg/l was observed in the month of May. DO is positively significantly influenced by Hardness and Alkalinity except Chloride Content which showed non-significant correlation and is negatively influenced by Calcium Hardness as well as Magnesium Hardness. This negative correlation is non-significant.

The amount of dissolved oxygen in water depends on the surface area exposed, temperature and salinity. Where organic matter is very high has very little amount of dissolved oxygen and self purification of water system depends on the presence of sufficient amount of oxygen dissolved in it. Solubility of oxygen is dependent on temperature and it increases with decreases in water temperature (Gohar, 2002). Higher amount of dissolved oxygen during the winters have also been reported by Vyas (1968); Babar and Raje (2015). Minimum content of dissolved oxygen was observed during the rainy season and summer, same result was observed by Verma *et al.* (2010). During the observation period in Sourabh van vihar pond maximum value of dissolved oxygen was recorded in the month of March (10.5mg/l) and minimum was observed in May (5.65mg/l). Dissolved oxygen affects the nutrient availability resulting in altered productivity of the entire water body (Solanki *et al*., 2006).

**(g) Alkalinity.** Alkalinity is a chemical measurement of a water's ability to neutralize acids. Alkalinity is also a measure of a water's buffering capacity or its ability to resist changes in pH upon the addition of acids and bases. Maximum value *i.e.* 25 mg/l was observed in second half of April *i.e.* 25mg/l while, minimum value 20 mg/l was observed in first half of March. Alkalinity exhibited positive significant relation with pH, DO, Chloride Content, Hardness and positive non-significant relationship with Air Temperature, Water Temperature, TDS and EC while, the correlation is negative non-significant with Calcium and Magnesium Hardness.

Alkalinity of water is it ability to neutralize strong acids and is primarily determined by the carbonate, bicarbonate and hydroxide content created as a result of carbon dioxide dissolved in water (Dallas and Day 2004; Verma *et al*., 2010). In our experiment maximum value of alkalinity was noticed in the month of April *i.e.* 25mg/l and minimum value was observed in month of March (20mg/l). Lower value of alkalinity in lakes may be related to rainfall during those months (Tidame and Shinde 2012). Higher alkalinity results could be related to the addition of detergents and sewage due to overflow and leakage (Singh and Sharma,1999). Alkalinity exhibited positive significant relation with

chloride content and negative and non significant relationship with calcium and magnesium hardness.

**(h) Chloride.** Chloride contents are present in almost every kind of water body such as ground water, canal water, ponds, reservoir and rivers etc. Normal concentration of chloride in fresh water body is about 1-100ppm and sea water usually contains 35,000 ppm Chloride Contents. The maximum value of Chloride Content was observed in first half of March and minimum Chloride Content was observed in second half of May (5 ppm and 2 ppm, respectively). Chloride content has positive significant co-relation with Alkalinity, positively non –significant co-relation with Air Temperature, Water Temperature, TDS, EC, pH, DO and Hardness and has positive non-significant correlation with Magnesium Hardness.

Chloride play a very important role to determine the water quality in a water body, indicate the presence of high organic matter. Chloride occur in most fresh water, as the salt of sodium or calcium. Chloride ions are essential for plant and animals. In our experiment the minimum value of chloride was obtained in the month of May *i.e*. 2mg/l and maximum value of chloride was recorded in March *i.e.* 5mg/l. Chloride has positive non- significant correlation with magnesium hardness. Many results are also reported in different studies by Swarnalatha and Rao (1998); Tripathi *et al*. (2014) showed that higher concentration of chloride indicates the increased levels pollution in water bodies.

**(i) Hardness.** It is the most important component of water quality. Hardness represents the overall concentration of divalent salts (calcium, magnesium and iron) etc. Calcium and Magnesium are the most common source of water Hardness. In the present experiment maximum value was recorded in the second half of May *i.e.* 34mg/l and minimum value was recorded in first half of March *i.e.* 30 mg/l. Hardness It showed positive significant relationship with pH, DO and Alkalinity, a non-significant relationship with Air Temperature, Water Temperature, TDS, EC and Chloride Content and a negative non-significant correlation with Calcium Hardness and Magnesium Hardness.

Present investigation the value of hardness range from 31mg/l to 34mg/l. Maximum value of hardness was recorded in March *i.e.* 30mg/l. Total hardness of water is due to the presence of bicarbonate, sulphate, chloride and nitrates of Ca and Mg (Kumar *et al*., 2010). Ghatak and Konar (1992) observed that the total hardness was higher in summer than in the monsoon and winter seasons. Summer hardness values are high due to decrease in water volume and an increase in water evaporation rate.

**(j) Calcium Hardness.** Calcium hardness is a measurement of amount of calcium ions present in the water. The maximum value was recorded in the first half of May 4.5 mg/l while, minimum value was recorded in the second half of April 4 mg/l. Calcium Hardness is positively non -significantly influenced by Magnesium Hardness and Chloride Content. It possess negative non-significant co-relation with Air Temperature, Water Temperature, TDS, EC, pH, DO, Hardness and Alkalinity.

Calcium is the basic element required for formation of shell in freshwater mussels (Rao and Sharma 2002). The optimum level of calcium reported was 16 ppm for rearing freshwater mussels (Das, 1995). Janki and Tripathi (1992) reported that in freshwater pearl culture ponds, calcium salts concentration should be in the range of 20 to 54 ppm. However, Sengupta *et al*. (2000) opined that pearl culture pond water should have calcium concentration of 10 to 25 ppm. During the analysis, the magnesium hardness was observed to be minimum *i.e.* 4.32 in the month of March and maximum was recorded 5.76 in the month of April.

**(k) Alkalinity.** It exhibited positive significant relation with pH, DO, Chloride Content, Hardness and positive non-significant relationship with Air Temperature, Water Temperature, TDS and EC while, the correlation is negative non-significant with Calcium and Magnesium Hardness.

**(l) Magnesium Hardness.** In Sourabh van vihar, pond the maximum value of hardness was observed in second half of April *i.e.* 5.76 mg/l although minimum value has observed in first half of March *i.e.* 4.32 mg/l. Magnesium Hardness is positively non-significant co-relation with Calcium Hardness and Chloride Content while, negatively non-significant co-relation with Air Temperature, Water Temperature, TDS, EC, DO, pH, Hardness, Alkalinity.

Like calcium, magnesium is also found in all natural water sources and is generally low in concentration then calcium. Magnesium is a necessary constituent of chlorophyll without which no ecosystem could operates (Kamboj *et al*., 2016). During the analysis, the magnesium hardness was observed to be minimum *i.e.* 4.32 in the month of March and maximum was recorded 5.76 in the month of April.

**Productivity**

**(a) Gross Primary Productivity (GPP).** Total photosynthesis or total assimilation is the energy stored in the food material synthesized by the green plant or total rate of photosynthesis including the organic material used up in the respiration. During the study period maximum value of GPP was observed in pond at second half of April (0.33) while, minimum value was observed in month of May (0.20). Gross primary productivity (GPP) showed non-significant relationship with Air Temperature, Water Temperature, TDS, pH, Hardness, Alkalinity, Chloride and Calcium Hardness. GPP showed negative correlation with EC and DO while the correlation is highly significant with Magnesium Hardness.

**(b) Net Primary Productivity (NPP).** It is the total gross productivity energy used up in the metabolic processes. It is also known as apparent photosynthesis or net assimilation. During the study period maximum value of NPP in pond was observed during the first half of April *i.e.* 0.37 and minimum value was observed in May *i.e.* 0.15. Net Primary Productivity (NPP) showed non-significant relationship with Air Temperature, Water Temperature, TDS, pH, Hardness, Alkalinity, Chloride Content and Calcium Hardness while, they showed negatively non-significant correlation with EC and DO and highly significant relationship with Magnesium Hardness.

**(c) Respiration (R).** It is the rate at which the biomass energy is used during the respiration by the organism of higher trophic levels like primary consumers and secondary consumers. During the study period maximum value was observed in the month of March and May *i.e.* 0.56 while, minimum value was observed in the month of April *i.e*. 0.18.

The light and dark bottle method is commonly used to evaluate phytoplankton primary productivity (Garder and Gran 1997). Primary productivity is the first fundamental stage in ecosystem function and producing chemical energy and organic matter (Baber and Raje 2015).The higher rate of primary productivity during summer has also been reported by (Mohan *et al.,* 2009). Primary productivity also known as gross primary productivity and it is the total rate of photosynthesis which includes the organic matter used in respiration. The higher value of NPP and GPP is related to increased light intensity penetration which gives a faster rate of photosynthesis and ultimately the productivity (Sharma and Walia 2017). Primary productivity decreases at high temperature due to cloudy weather, high turbidity, low light penetration and low phytoplankton density as reported in Renuka wetland sirmour (Jindal and Thakur 2015). According to Kumari (2017) temperature, solar radiation and available nutrients, all are important limiting factors for primary production and contribute to variations in the seasons in any aquatic ecosystem. Net primary productivity is the rate of organic matter storage in plant tissues that exceeds the plant's respiratory rate during the measuring period and is known as apparent photosynthesis or net assimilation (Sontakke and Mokashe 2014). Bandyopadhyay (2002) also observed high phytoplankton pulses in monsoon and spring season associated with high level of nutrients. Community respiration is the process of reducing net primary productivity from gross primary productivity and converting it into carbon dioxide emission (Sontakke and Mokashe 2014). Chinnaiah and Madhu (2010) reported that seasonal records of respiration was higher in winter and summer while lower in monsoon seasons at Darmasagar lake in Adilabad.

**Table 1: Physico–Chemical variable of Pond water (Sourabh van vihar, pond) situated in District Kangra H.P. (March 2024 - May 2024). Values are expressed in mg/l in water, except otherwise mentioned.**

| Sr. No. | Month → / Parameters↓ | March 1 | March 2 | April 1 | April 2 | May1 | May 2 |
|---|---|---|---|---|---|---|---|
| 1. | **Air Temperature (°C)** | 27 | 25 | 24 | 23 | 29 | 30 |
| 2. | **Water Temperature (°C)** | 13 | 15 | 12 | 11 | 17 | 18 |
| 3. | **TDS (ppm)** | 38 | 34 | 33.5 | 31 | 32.2 | 35 |
| 4. | **Electrical Conductivity(µs/cm)** | 76 | 72 | 66 | 60 | 64 | 70 |
| 5. | **pH** | 8 | 7 | 7.6 | 7.2 | 7.4 | 7.5 |
| 6. | **Dissolved Oxygen(mg/l)** | 13.90 | 11.11 | 10.14 | 10.76 | 7.58 | 6.80 |
| 7. | **Hardness** | 30 | 33 | 32 | 34 | 31 | 34 |
| 8. | **Alkalinity** | 20 | 24 | 22 | 25 | 21 | 23 |
| 9. | **Chloride** | 5 | 3 | 2 | 3 | 4 | 2 |
| 10. | **Calcium Hardness** | 4.8 | 4.3 | 4.4 | 4 | 4.5 | 4.1 |
| 11. | **Magnesium Hardness** | 4.32 | 4.70 | 5.04 | 5.76 | 5.08 | 4.90 |

**Table 2: Monthly analysis of Productivity status of Pond (March 2024 - May 2024). Values are expressed in mg C/l/hour.**

| Sr. No. | Parameters / Month | GPP | NPP | Respiration |
|---|---|---|---|---|
| 1. | **March 1** | 0.22 | 0.16 | 0.56 |
| 2. | **March 2** | 0.24 | 0.20 | 0.40 |
| 3. | **April 1** | 0.21 | 0.37 | 0.37 |
| 4. | **April 2** | 0.33 | 0.31 | 0.18 |
| 5. | **May 1** | 0.20 | 0.16 | 0.37 |
| 6. | **May 2** | 0.20 | 0.15 | 0.56 |

**Table 3: Correlation between productivity and physicochemical parameters of pond water.**

| Parameters | Air temp | Water temperature | TDS | EC | pH | DO | Hardness | Alkalinity | Chloride | Calcium hardness | Magenesium hardness |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Air temperature** | 1.000 | 0.982** | 0.947* | 0.920* | 0.781NS | 0.689NS | 0.727NS | 0.542NS | 0.365NS | -0.351NS | -0.126NS |
| **Water temperature** | | 1.000 | 0.884* | 0.832NS | 0.706NS | 0.639NS | 0.691NS | 0.460NS | 0.251NS | -0.457NS | -0.257NS |
| **TDS** | | | 1.000 | 0.973** | 0.925* | 0.832NS | 0.848NS | 0.756NS | 0.606NS | -0.287NS | -0.086NS |
| **EC** | | | | 1.000 | 0.878NS | 0.765NS | 0.769NS | 0.697NS | 0.621NS | -0.068NS | 0.132NS |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **pH** | | | | | 1.000 | 0.972** | 0.967** | 0.947* | 0.836NS | -0.255NS | -0.203NS |
| **DO** | | | | | | 1.000 | 0.996** | 0.966** | 0.864NS | -0.285NS | -0.345NS |
| **Hardness** | | | | | | | 1.000 | 0.944* | 0.816NS | -0.352NS | -0.399NS |
| **Alkalinity** | | | | | | | | 1.000 | 0.931* | -0.200NS | -0.258NS |
| **Chloride** | | | | | | | | | 1.000 | 0.162NS | 0.014NS |
| **Calcium Hardness** | | | | | | | | | | 1.000 | 0.869NS |
| **Magnesium hardness** | | | | | | | | | | | 1.000 |

## CONCLUSIONS

Physico-chemical parameters and productivity of Sourabh van vihar, pond, Palampur Himachal Pradesh was studied from March 2024 to May 2024. The primary goal of this study was to investigate the interrelationships between the physico-chemical parameters and productivity. The primary productivity of pond can be affected by physico-chemical parameters of pond water. The nature of the water body is oligotrophic. The oligotrophic pond are small aquatic community. The water is clear and the bottom is sandy and physical characteristics of oligotrophic pond include blue or green highly transparent water having low dissolved nutrients and low primary productivity.

**Author's contribution.** All the authors jointly designed the experiment. Dr. Sapna Devi designed the experiment, analysed the data and drafted the manuscript with input from all authors. Dr. Sapna Devi (Major advisor) collaborated closely in the whole process from data observation to data analysis and manuscript interpretation and analysis. Sageeta Devi, Shailja Devi Kapoor and Vaishnavi Sharma read and modified manuscript paper writing according to journal format. All authors read and approved the final manuscript.

## FUTURE SCOPE

From identifying changes over time, detecting present and emerging water quality issues, designing pollution prevention strategies, determining whether or not compliance goals are being met and responding to environmental emergencies, monitoring data plays an integral role in keeping our planet's water source healthy.

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**Conflict of Interest.** None.

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