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RESEARCH ARTICLE

ANALYSIS OF SURFACE WATER QUALITY BY PHYSICO-CHEMICAL PARAMETERS IN RICE (*Oryza sativa*L.) FIELDS IN ONATTUKARA WETLANDS REGIONS, KERALA

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Abstract

This report presents a study of surface water physico - chemical parameters in rice fields in the Onattukara wetland zone. The research was carried out for a year, from July 2017 to June 2018. Water is highly polluted with different contaminants. Human existence depends on the availability of water. Water samples were taken monthly from surface water and examined for Temperature(°C), pH, Electrical conductivity, Turbidity(JTU), Chloride(mg/l), Fluoride(mg/l), Sodium(mg/l), Potassium(mg/l), Nitrate(mg/l), Total alkalinity(mg/l), Magnesium(mg/l), Iron(mg/l), Calcium(mg/l), Sulphate(mg/l), DO (Dissolved oxygen) (mg/l), BOD (Biological oxygen Demand) (mg/l). The goal of this research was to determine the present state of Physico-chemical properties.

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Introduction:-

Water is one of the ecosystem's most vital and abundant substances. Water is required for the life and growth of all living organisms on the planet. Only the planet Earth currently has around 70% of its surface covered in water. However, it has been extremely polluted with various toxins as a result of rising human population, industrialization, agricultural fertilizer use, and man-made activity. It is difficult to understand the biological phenomenon fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro-biological relationship [5].

Water quality refers to the elements of water that must be present for aquatic life to thrive. The productivity is determined by the water body's physico-chemical properties. Dissolved oxygen, hardness, turbidity, alkalinity, nutrients, temperature, and other factors all influence how well a water body grows. Other metrics, such as biological oxygen demand and chemical oxygen demand, show the extent of pollution in a certain water body. Various chemical characteristics are present in modest concentrations in the majority of water bodies. However, discharged waste water from residential areas, sewage outlets, solid wastes, detergents, motor oil wastes, fishing facilities, and agricultural pesticides from farmlands damage the water in ponds, lakes, and rivers [6]. Water supplies are depleting at a quicker pace every day as a result of increased urbanization and population growth. The degradation of water quality has become a major issue. Increasing water pollution not only affects water quality but also poses a threat to human health, aquatic ecological balance, economic development, and social prosperity. As a result, it is critical to take the critical step of implementing an effective quality management plan to eliminate water contamination.

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Material And Methods:-

Water's physico-chemical properties are a key factor of the aquatic system. The climatic vegetation and the overall composition of water have a significant impact on their properties. To avoid unanticipated changes in different physico-chemical characteristics, water samples were collected from various locations in plastic bottles and delivered promptly to the laboratory in bottles. The samples were examined at the Kerala Government's ground water laboratory in Ambalamukku-Kowdiar to identify some physico-chemical parameters. Temperature, pH, EC (Electrical conductivity), Turbidity, Chloride, Fluoride, Sodium, Potassium, Nitrate, Total alkalinity, Magnesium, Iron, Calcium, Sulphate, DO (Dissolved oxygen), and BOD (Biological oxygen demand) were among the characteristics examined.

The present study was carried out in the 2017-2018 in three seasons post monsoon, pre monsoon, monsoon for these Onattukara wetland region. Observation and analysis were done every month however; the results are expressed on seasonal basis as variation was of less magnitude. The sampling was done during morning hours (8:00 to 11:00 am).

Study Area

Onattukara region is a peculiar agro ecological zone with specific soil and climatic conditions. This region comprised of Muthukulam, Harippad, Bharanickavu, Mavelikkara and Ambalapuzha blocks of Alappuzha district and Chavara, Ochira, Sasthamcotta blocks in Kollam District (Fig 1). The area lies on both sides of NH 66 (previously NH 47) and spread from south end of Thottappally Spillway to the north end of Neendakara bridge. This region lies in the lowland tract between $8^{\circ}55'44''$ to $9^{\circ}21'09''$ N latitude and $76^{\circ}23'13''$ to $76^{\circ}41'16''$ E longitude. Average rainfall is about 2700mm. The temperature varies from 19.2 to 33.7 $^{\circ}\text{C}$. The terrain is more or less even and the garden lands a mean elevation of 1.0-3.5 meter above Mean Sea Level (M.S.L).

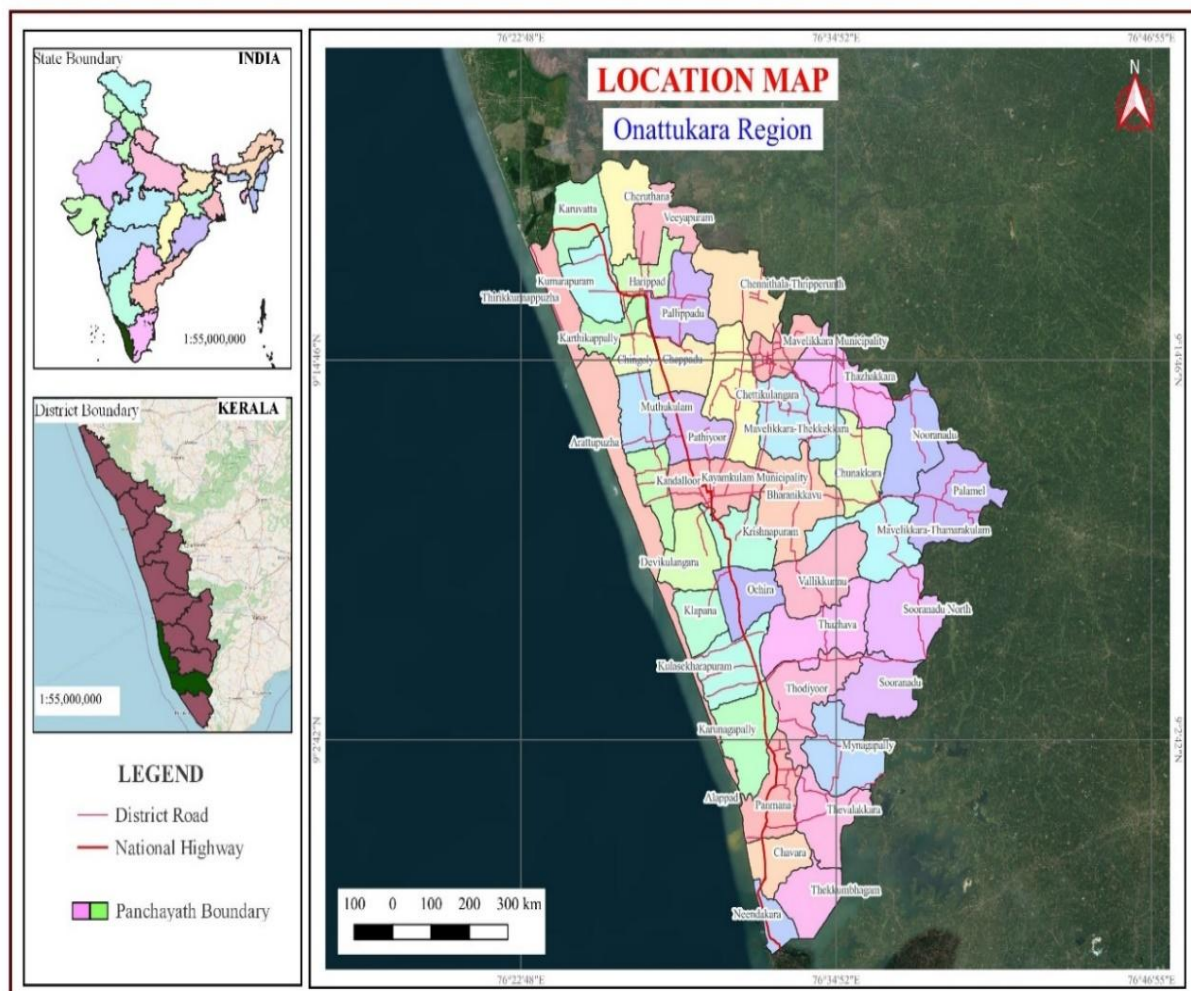


Fig 1:- Map of the study area.

Results And Discussion:-

Temperature:

The most significant environmental element affecting plants and animals is temperature. Water has various distinct thermal qualities that work together to keep temperature changes to a minimum. The temperature of the water is affected by the depth of the water column, as well as climatic and geographical factors [19].

pH: pH is a critical ecological element that is determined by the interaction of numerous compounds in solution in water. It is a scale that measures the concentration of H^+ ions in water and measures the strength of acidity and alkalinity. The pH was measured to be between 6 to 7.9 in this study. The greatest pH was 7.9 in Chavara block during monsoon season, while the lowest pH was 6 in Ambalappuzha block during monsoon season (Fig 2). The reduction in pH levels was attributed to precipitation dilution during the monsoon season. Summer has the highest pH, according to [9], who explain it by correlating temperature increases with increased photosynthetic rates, which leads in higher carbon dioxide consumption. According to [10], the highest pH in May suggests a high rate of photosynthesis.

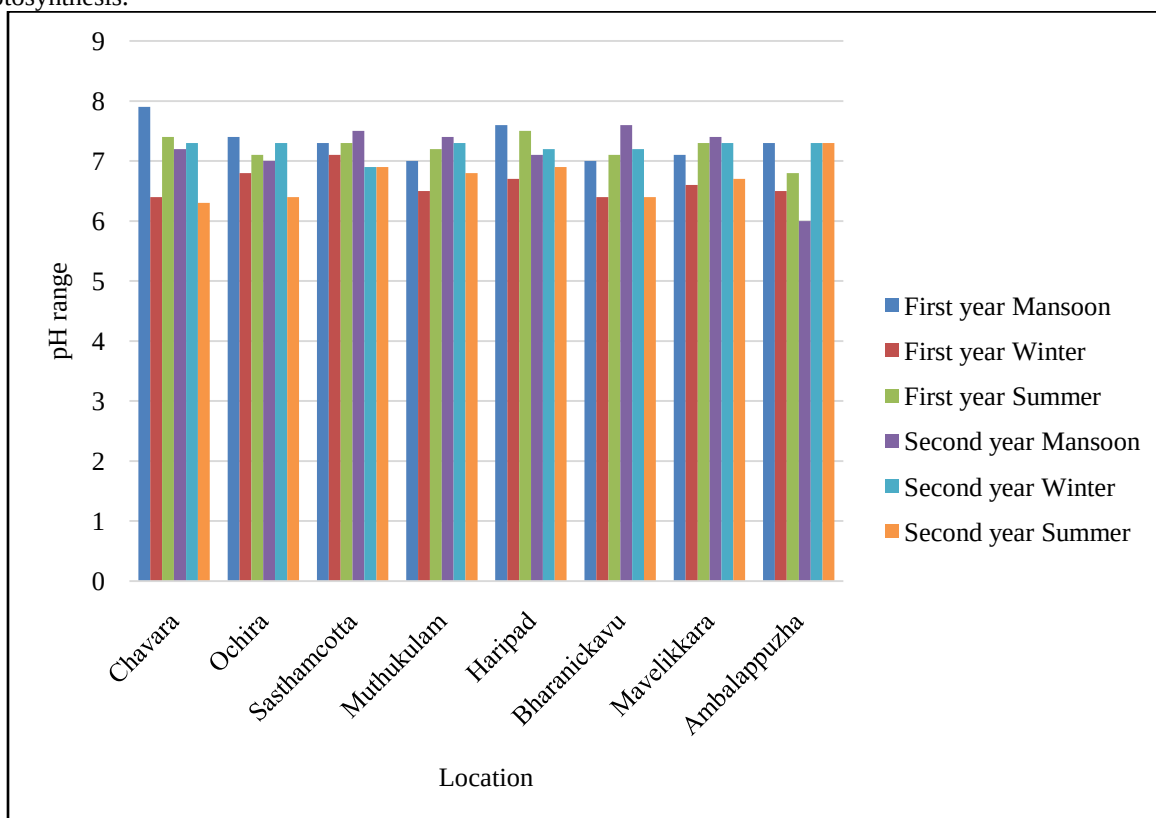


Fig 2:- pH present in Onattukara region.

Electrical conductivity:

The type and quantity of ionised salts determine the ability of water or a solution to conduct electric current. A sample's conductivity is a numerical representation of its capacity to transport electric current, which is determined by the ionic strength. Seasonally, highest conductivity was observed during the monsoon season and minimal conductivity was reported during the summer season in this study. It was in the 65-7040 range (Table 1). During the summer season, [14] measured the highest conductivity in Basavanbole tank in Shimoga district's Sagartalu. In Yedshi lake in Mangarulpirtahsil of Washim district, Maharashtra, [11] found that conductivity was highest in the summer and lowest in the monsoon season.

Table 1:- Electrical conductivity present in Onattukararegion.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	210	83	72	95	78	69

2	Ochira	112	96	145	102	113	85
3	Sasthamcotta	85	73	74	73	82	65
4	Muthukulam	92	98	72	298	246	76
5	Haripad	7038	759	94	111	96	97
6	Bharanickavu	150	84	145	82	63	94
7	Mavelikkara	76	79	87	108	98	143
8	Ambalappuzha	7040	849	471	102	91	79

Turbidity:

During the summer, the turbidity in the Onattukara area was at its lowest. Due to the melting of snow and rainfall, the water becomes murky from the winter season onwards. In the mavelikkara block the greatest turbidity was 16 JTU during the monsoon season, while the minimum was 9 JTU during the summer season (Table 2).

Table 2:- Turbidity present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	10	11	13	14	14	10
2	Ochira	0	10	11	10	0	9
3	Sasthamcotta	13	13	12	0	13	10
4	Muthukulam	0	0	0	0	10	11
5	Haripad	0	11	13	0	0	10
6	Bharanickavu	0	0	0	0	13	11
7	Mavelikkara	0	0	13	16	13	10
8	Ambalappuzha	12	11	0	15	15	11

Chloride:

Chloride is found as an anion in all natural waters at variable concentrations. Weathering and leaching of sedimentary rocks, home and industrial waste discharge, municipal impact, and other factors all contribute to the presence of chloride in surface water. The chloride concentrations measured in this study range from under 8 mg/l to 2098 mg/l (Table 3). The chloride is thought to be a pollution indication. Higher chloride concentrations in the summer might be attributed to sewage mixing, increased warmth, and water evaporation. [16] achieved a similar result.

Table 3:- Chloride present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	48	28	36	34	20	16
2	Ochira	20	24	21	19	13	84
3	Sasthamcotta	18	12	11	24	19	13
4	Muthukulam	15	8	74	19	15	14
5	Haripad	10	11	19	13	240	65
6	Bharanickavu	24	72	23	18	75	14
7	Mavelikkara	14	16	61	19	11	19
8	Ambalappuzha	47	130	2098	15	60	54

Fluoride:

Fluoride levels were highest in the winter season (7.9 mg/l) in the Bharanickavu block and lowest in the monsoon season (0.2 mg/l) in the Ambalapuzha block (Fig 3).

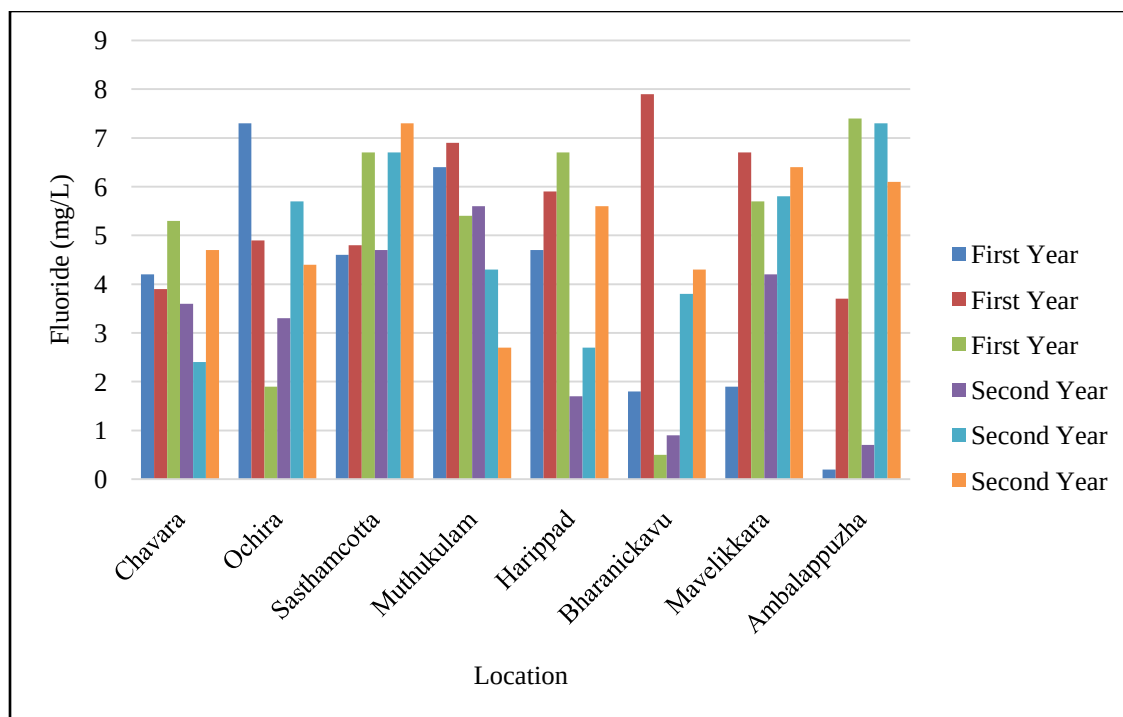


Fig 3:- Fluoride present in Onattukara region.

Sodium:

Although sodium is a natural component of raw water, pollution sources such as rock salt, precipitation runoff, soapy solution, and detergent raise its content. The presence of a high quantity imparts a bitter flavour to the water. The salt contents in the research region ranged from 4.6 mg/l to 112 mg/l (Fig 4), significantly below the permitted limit (200 mg/L) set by Indian norms. As a result, it is appropriate for residential use. [13] investigated the sodium content of pond water in Varanasi, finding that it ranged from 40.8 mg/L to 93.5 mg/L

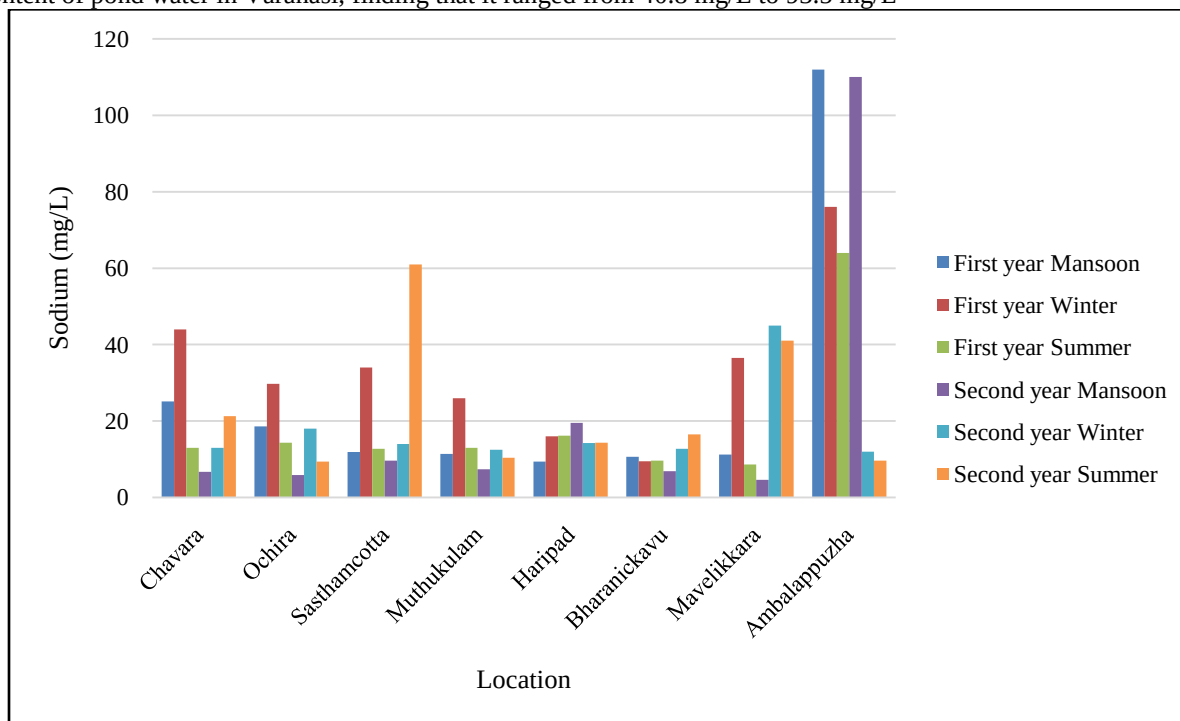


Fig 4:- Sodium present in Onattukara region.

Potassium:

Feldspar, micas, and clay minerals are the main natural sources of potassium in ground water. Potassium concentrations in surface water samples from the current research region ranged from 0.8 mg/l to 21.6 mg/l, as shown in the (Table 4). According to Indian norms, all surface water in this research is below the allowed level (200 mg/l). [12] discovered a pond in Varanasi with potassium levels ranging from 6.05 mg/l to 24 mg/l in water samples.

Table 4:- Potassium present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	11.4	14.3	9.6	13.1	9.3	11
2	Ochira	7.4	21.6	7.6	0.9	12.4	13
3	Sasthamcotta	4.6	10.4	15.4	16.4	13	17
4	Muthukulam	13.7	13.6	15.7	10.7	9.7	9.4
5	Haripad	17.6	7.8	8.4	18.5	12.5	13.4
6	Bharanickavu	0.9	9.7	7.5	0.8	12.5	9
7	Mavelikkara	1.9	6.4	3.6	1.9	3.2	14
8	Ambalappuzha	19.7	18	12.6	11.7	13	8.5

Nitrate:

Nitrate concentrations vary from 0.2 mg/l to 4.2 mg/l. The highest concentration (4.2 mg/l) was found in the summer season in Ochira block, while the lowest concentration (0.2 mg/l) was found in the winter season in Muthukulam block (Table 5).

Table 5:- Nitrate present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	1.8	0	1.2	1.6	0.3	0.95
2	Ochira	1.9	2.4	1.32	2.9	1.5	4.2
3	Sasthamcotta	0.6	0.7	1.85	1.9	4.1	0.7
4	Muthukulam	0.9	0.8	0.64	1.9	0.2	1.35
5	Haripad	0.4	1.7	0	0.6	0.5	1.4
6	Bharanickavu	0.6	1.4	0.9	1	0	0.7
7	Mavelikkara	0.6	3.4	1.4	0.4	2.1	1.7
8	Ambalappuzha	2.7	0.9	1.14	2.5	1.9	2.8

Alkalinity:

The buffering capability of water is measured by alkalinity. Carbonates, bicarbonates, phosphates, nitrates, borax, silicates, and other salts, as well as hydroxyl ions in free forms, are common sources. [8]. The total alkalinity in this study ranged from 7 mg/l to 49 mg/l (Table 6). The alkalinity readings in the Muthukulam block were highest during the monsoon and lowest during the summer in the Bharanickavu block. The rise in alkalinity during the monsoon and winter was caused by nutrient content in the water. The drop was due to dilution from precipitation over the summer. The findings of [12], [4] are also quite similar.

Table 6:- Total alkalinity present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	39	12	15	16	9	34
2	Ochira	11	14	9	15	24	16
3	Sasthamcotta	15	17	12	16	21	17
4	Muthukulam	17	19	23	49	34	35
5	Haripad	17	24	18	39	11	14
6	Bharanickavu	14	8	7	9	26	16
7	Mavelikkara	11	17	28	17	19	41
8	Ambalappuzha	13	24	14	14	18	34

Magnesium:

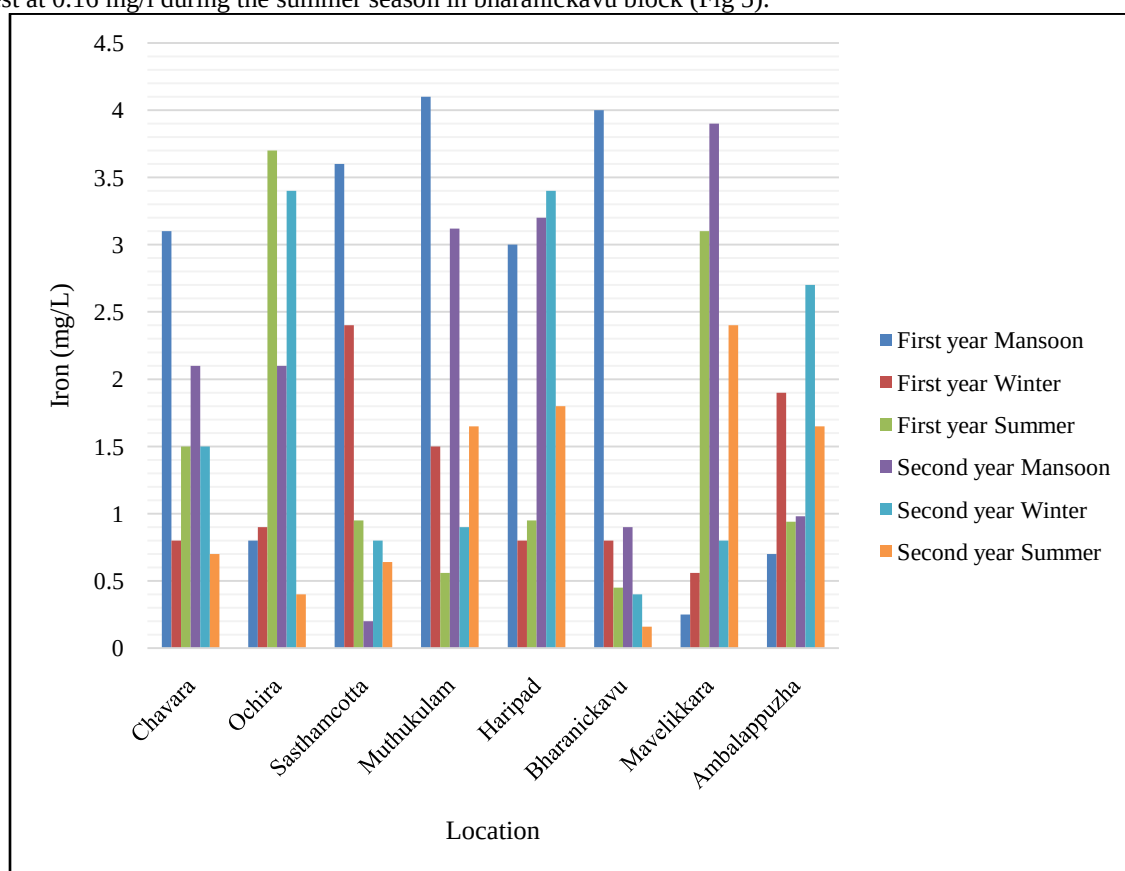
Magnesium concentrations in the study region varied from 0.6 mg/l to 21 mg/l (Table 7). Calcium hardness has a maximum allowed level of 30 mg/l [7]. Magnesium is frequently found in conjunction with calcium in all types of water, but its concentration is typically lower than that of calcium. [17], The phytoplankton population is reduced when Mg levels are low.

Table 7:- Magnesium present in Onattukara region.

SI no	Name of block	First Year			Second Year		
		Mansoon	Winter	Summer	Mansoon	Winter	Summer
1	Chavara	7.1	3.8	3.8	6.1	1.9	0.7
2	Ochira	2.5	2.9	4.5	6.1	4.6	14
3	Sasthamcotta	2.1	0	1.5	2.1	12	2.9
4	Muthukulam	7.2	9.6	21	7.9	4.6	11
5	Haripad	5.7	1.94	0.9	3.9	17.4	6.4
6	Bharanickavu	2.8	2.92	13	0.9	6.4	0.8
7	Mavelikkara	1.9	3.4	17	6.9	0.9	0.6
8	Ambalappuzha	7.3	1.6	0.9	6.7	4.5	1.6

Iron:

Iron levels were highest in the Onattukara area, at 4.1 mg/l during the monsoon season at muthukulam block, and lowest at 0.16 mg/l during the summer season in bharanickavu block (Fig 5).

**Fig 5:-** Iron present in Onattukara region.**Calcium:**

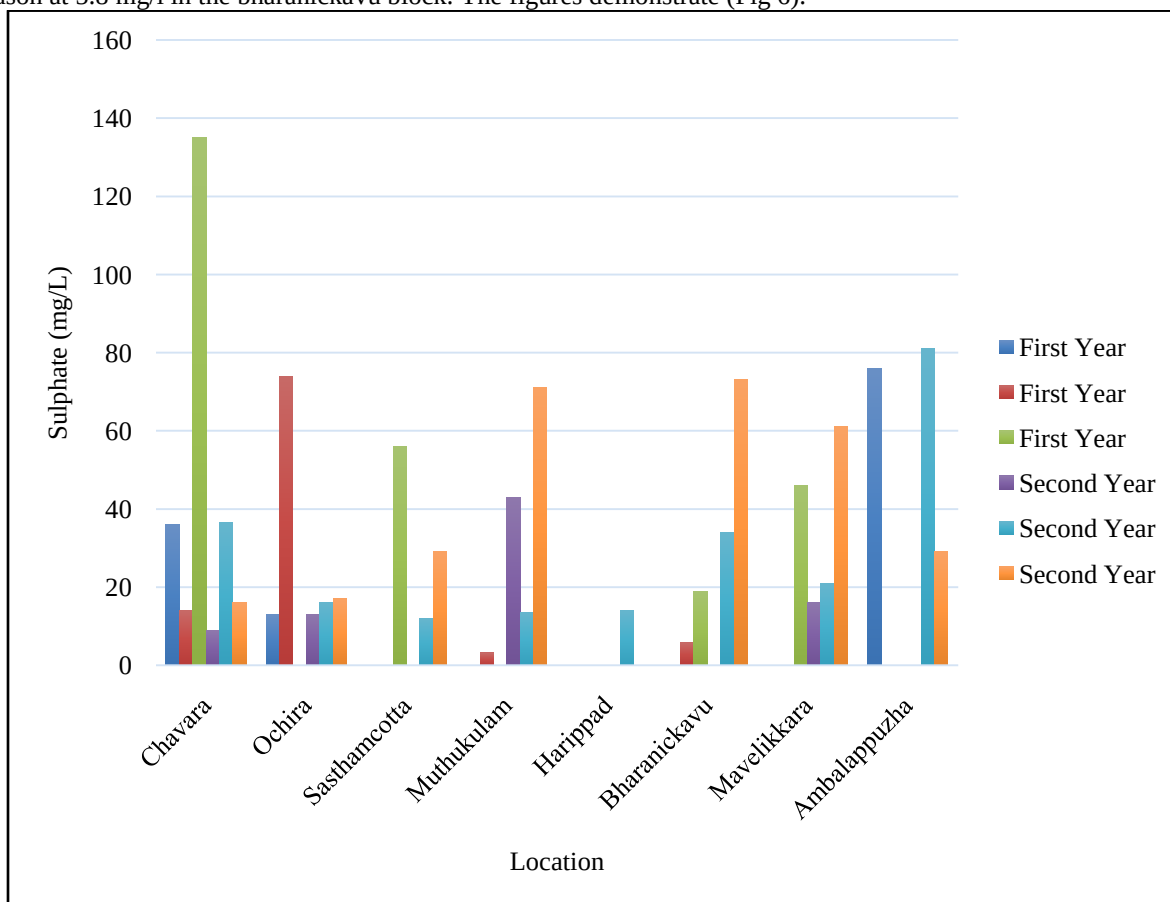
Calcium is a crucial nutrient for aquatic organisms and is found in abundance in all bodies of water, according to [3]. The calcium concentrations in this investigation ranged from 3.15 mg/l to 64 mg/l, as shown in the figures (Table 8). Summer season has the highest calcium content and the lowest calcium content.

Table 8:- Calcium present in Onattukara region.

Sl no	Name of block	First Year			Second Year		
		Monsoon	Winter	Summer	Monsoon	Winter	Summer
1	Chavara	36	3.2	17	9	6.5	31
2	Ochira	7	23	19.5	13	15	3.15
3	Sasthamcotta	6	21	7.15	12	4.8	8
4	Muthukulam	44	3.2	16	16	24	25
5	Haripad	39	4.8	14	23	14.65	21
6	Bharanickavu	9	11.2	64	6	14	17
7	Mavelikkara	4	12.5	9.5	13	4.6	21.65
8	Ambalappuzha	7	4.8	26.5	10	11.5	13

Sulphate:

Total sulphate levels were highest in the summer season at 135 mg/l in the chavara block and lowest in the winter season at 5.8 mg/l in the bharanickavu block. The figures demonstrate (Fig 6).

**Fig 6:-** Sulphate present in Onattukara region.**Dissolved oxygen:**

The most essential and widely used test of water quality and indicative of a water body's potential to maintain suitable aquatic life is dissolved oxygen levels. In the precipitation and dissolution of organic compounds in water, dissolved oxygen plays a crucial function. The values of dissolved oxygen measured in the current study ranged from 2.9 mg/l to 8.1 mg/l in the Onattukara area (Fig 7). The high values of dissolved oxygen during the winter season were due to low temperatures and high photosynthetic activities, whereas the low values of dissolved oxygen during the monsoon were due to high temperatures and high rates of organic matter oxidation, lower solubility of gases at high temperatures, and high metabolic rates of organisms. The concentration of oxygen drops as the salinity rises. [2], [15] both made similar observations.

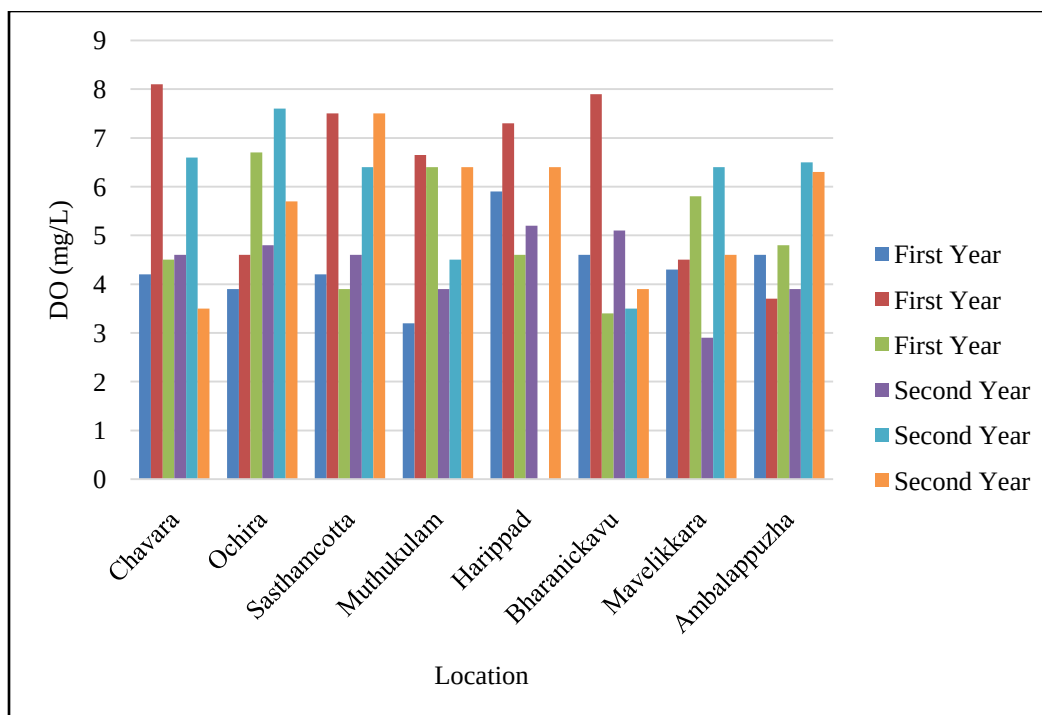


Fig 7:- DO present in Onattukara region.

Biological oxygen Demand:

Biological Oxygen Demand is a measurement of the oxygen in water that aerobic organisms require. The biodegradation of organic molecules raises the biological oxygen requirement by increasing oxygen tension in the water [1]. The greatest BOD value was 1.9 mg/l in the monsoon and summer season in Sasthacotta, Muthukukulam, and Mavelikkara, and the lowest BOD value was 0.3 mg/l in the summer season in Chavara block (Fig 8).

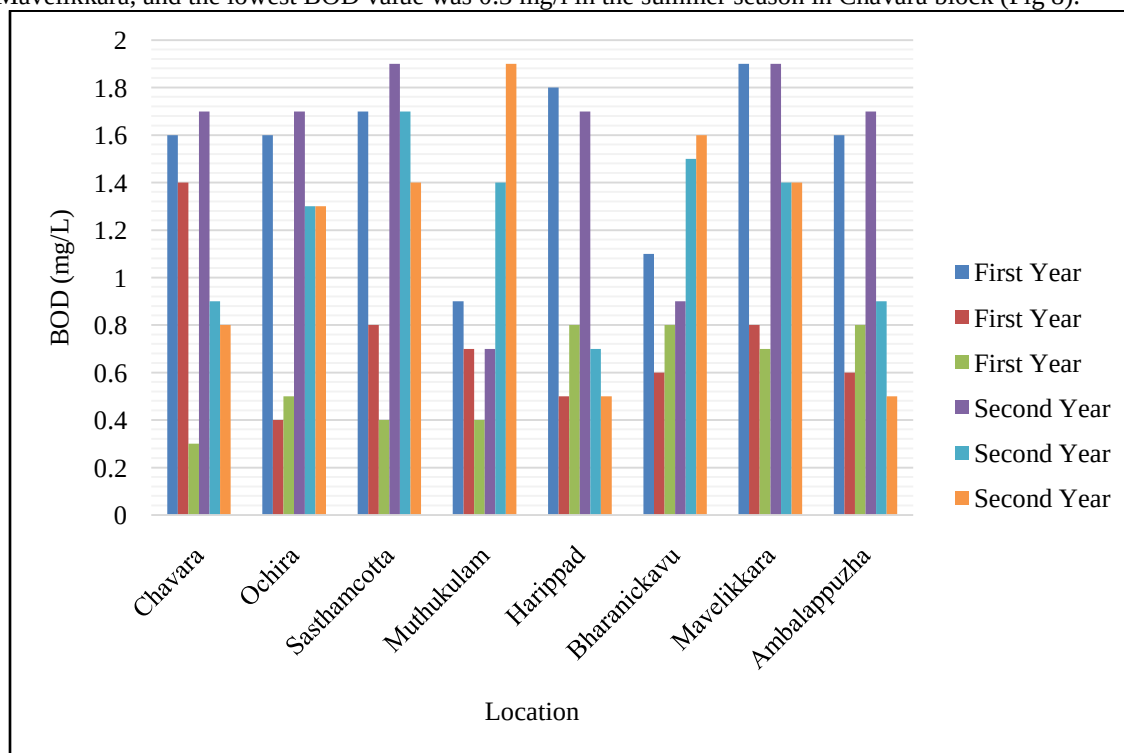


Fig 8:- BOD present in Onattukara region.

Conclusion:-

Understanding water quality is just as essential as knowing how much of it there is, because it is one of the most critical variables in deciding whether water is suitable for agriculture, drinking, or home industrial use[18]. The current research establishes a baseline for the protection and monitoring of the wetland paddy zone in the Onattukara area. Water that has been contaminated is unfit for agricultural use. It degrades the scenic value of rivers and canals. Simple housekeeping and management techniques can assist individuals and communities reduce water pollution by reducing the quantity of garbage created.

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