Original Research Article

TEMPORAL VARIATION OF PHYSICO CHEMICAL CHARACTERISTICS OF GROUND WATER IN KASARGOD DISTRICT, KERALA, INDIA

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ABSTRACT: Water resources are most often polluted by increasing industrialization and human activates. Water quality issues have recently become a major concern. Therefore, it is essential to assess the quality of drinking water sauces. The present study was carried out in the different area of Kasargod district, Kerala. The ground water samples were collected during different seasons namely, pre monsoon, monsoon and post monsoon periods (2016-2017). Water samples collected in at selected locations were analyzed for its physico chemical properties such as pH, color, Total dissolved solids, Electrical Conductivity, Chemical oxygen demand, Total Hardness, Calcium Hardness, Magnesium Hardness, Chloride, Sodium, Potassium, Phosphate, Sulphate and Nitrate. The water slightly acidic as the pH was below 7 in the monsoon at Cheemani and Perla (5.32 ± 0.121 and 5.40 ± 0.02). The TDS level slightly is higher in the monsoon at Swarga and Perla were 267.3 ± 6.025 and 255 ± 14.80 respectively. The analysis of the water quality parameter of the Kasargod district clearly indicated that all the parameter is within the limits. However, it is necessary to monitor the quality of drinking water regular interval on regional scale in order to ensure that the drinking water is safe for human consumption.

KEYWORDS: Ground water, Seasonal variation, Physico- chemical parameter, Water pollution, Kasargod.

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1. INTRODUCTION

Water is the most abundant and precious compound in the earth system. All the living things in the

earth need water for their existence. Availability of the fresh water on the earth only 3%, while 97%water is sea water. Groundwater pollution mainly due to pollutants is released to the ground and makes their way down into groundwater. The physico-chemical parameters of ground water and the reliance of all life method of this factor make it enviable to take as an environment. In India at the present a number of researchers have done study on physico-chemical and biological status and management water resources [1]. The sources of contamination of ground water human activity. Increasing population density is highly affecting the ground water quality, ground water is especially defenseless. Almost any activity whereby chemicals or wastes may be released to the environment, either intentionally or accidentally, has the potential to pollute ground water [2]. Ground water pollution highly affect the human in various kind of disease where cholera, typhoid fever, diarhoea, dysentery etc. In India about 36%of urban and 65%of rural population is without access to safe drinking water [3]. Condition of safe and uncontaminated drinking water to the sufficient should be the primary importance of every government as it is the essential human right [4]. Water quality assessment is the difficulty to relate with analyzes the large quantity of measured variables [5], and high unpredictability due to anthropogenic and natural influences [6]. Kasargod is the northernmost district of Kerala, bordering Karnataka State. Out of the total cropped area of 1381.65 sq. km, only 401.30 sq. km is being irrigated by different sources. Coconut is the main crop irrigated which covers one third of the total irrigated area followed by areca nut. Paddy cultivation in the district is now reduced the total irrigated area. Among source of irrigation, ground water is the principal source of irrigation accounting for about 64% of the area under irrigation and the rest by lift and other methods of irrigation [7]. Now a day's ground water is polluted due to the industrialization, urbanization and human activity, it is highly affected the ground water quality. Water quality give information about the concentration of various solutes at a given place and time. Water quality parameters give the source for assessing the appropriateness of water for its selected uses and to improve existing circumstances [8]. Seasonal concentrations of phosphates, total nitrogen and ammonium nitrogen indicated high degree of water pollution [9]. Fast raise in urbanization and industrialization leads in to worsening in groundwater quality [10]. The availability of good quality water is necessary for next generation to preventing diseases and improving quality of life [11]. It is very necessary and significant to check the water before it is used for drinking, domestic, agricultural or industrial purpose in order to minimize the adverse consequences associated with its contamination [12]. The main objective of this study was to evaluate seasonal variation of quality parameter in kasargod district and to compare the quality of water with drinking water standards prescribed by WHO and Indian Council for Medical Research.

2. MATERIALS AND METHODS

2.1 Study area

The physiochemical parameter was studied for 24 water samples collected from 8 different locations

in Kasargod area. Such as Badiaduka, Periya, Malakallu, Rajapuram, Perla, Panathady, Cheemani, Swarga. The district is agrarian with cash crops of Areca nut, cashew and rubber dominating over food crops. Kasargod district is an area, which receives maximum rainfall in the state in a short duration during southwest monsoon and northeast monsoon periods. Though this area receives large quantity of rainfall, the same area suffers maximum due to drought. Geographically Kasargod area mainly occupies by crystalline rocks and is extensively lateralized [13]. The main purpose of the study was assessment of water quality and comparing the water quality parameters with water quality standards.

2.2 Water sample

Water samples from the selected sites were collected from November 2016 to May 2017. Samples were taken in 1 liter capacity pre-cleaned polythene bottles. Collection and analysis of samples was done pre-monsoon monsoon and post monsoon. Water samples were tested for different physicochemical parameters. Physicochemical parameter such as pH, Electrical Conductivity, Total Dissolved Solids, Phosphate and Nitrate were measured according to the standard procedures [14]. Flame photometer (Model Systronic 128) was used for determination of metal ions Na^+ and K^+. Silver nitrate method was used to estimate the chloride present in water samples. Sulphate was determined by turbid metric method. Total hardness was calculated by complex metric titration using EDTA. Magnesium content can be determined from the value of total hardness and calcium hardness of water. Chemical oxygen demand (COD) was estimated according to the procedure of Vogel (1978) [15].

3. RESULTS AND DISCUSSION

pH of water denoted the acidic and basic nature of water. Present study had recorded pH ranged between 5.32±0.121mg/l to 7.70±0.23 mg/l. This shows the acidic as well as alkaline nature of water in the study location s. pH was the maximum at Panathady in pre monsoon season and the minimum at Cheemani at post monsoon season. In general low was measured in monsoon season compare to post monsoon and pre monsoon. Precipitation and other environmental factor may be reason for season vise variation of pH Electrical conductivity gives the presence of ionized substance in water. Electrical conductivity was very low at Swarga in pre monsoon season. (402 ±7.211 mg/l) which exceeds the standard guideline of 300 mg/l by WHO/ ICMR standards. It shows the water's capacity to convey an electrical current high in water sample collected from Swarga

Table .1 Drinking water standards by WHO / ICMR Standards

PARAMETER	Permissible limit	
	WHO	**ICMR**
pH	6.5-8.5	6.5-7.5
Electrical conductivity (µs/S)	-	300
Total dissolved solids (PPM)	500	500
Chemical oxygen demand (mg/l)	10	10
Total Hardness (mg/l)	200	300
Calcium hardness(mg/l)	75	75
Magnesium Hardness(mg/l)	150	30
Chloride (mg/l)	250	250
Sodium(mg/l)	200	200
Potassium(mg/l)	-	-
Sulphate (420nm) (mg/l)	250	150
Nitrate (410nm) (mg/l)	45	45
Phosphate (690nm) (mg/l)	-	-

TDS is used to show the aesthetic properties of drinking water which is considered wide collection chemical contaminants. Although not consider as a primary pollutant, as per as the drinking water standard guidelines it give more attention on the quality of water [16]. Concentration of dissolved solids is within the limit in all station. In Swarga dissolved solids was high in pre monsoon season which directly related to the electrical conductivity (267.3±6.02 mg/l). Chemical oxygen demand (COD) values were ranged from 4.58 mg/l to 64 mg/l. The lowest COD was recorded in Badiaduka in pre monsoon season. COD relatively low in monsoon compared to post monsoon and pre monsoon season. The maximum COD was because of oxygen depletion on reason of decomposition by microbes to level detrimental to aquatic life [17]. During the monsoon and post monsoon season COD value was high which means a greater amount of oxidizable organic material in the sample in these seasons. Since the standard value prescribed for COD is 10 mg/l, COD values detected for monsoon and pre monsoon season water of these area wasn't safe for drinking. In this study chloride ion concentration was ranged from 54.5 to 7.09 mg/l in the Kasargod district. The maximum concentration of chloride (54.5 mg/l) was recorded in Badiaduka in post monsoon season.

Table.2 Water quality parameters (Mean and SD) analyzed in water sample collected from different location and season in Kerala.

PARAMETER	SEASON	BADIADUKA		MALAKALLU		PANATHADY		PERLA	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
pH	PR	6.67	0.38	6.61	0.21	7.70	0.23	7.61	0.15
	M	6	0.25	6.08	0.16	7.61	0.10	5.40	0.02
	PM	6.12	0.12	5.89	0.21	6.60	0.21	6.22	0.09
EC (µs/cm)	PR	60.30	1.57	50.67	1.46	236.67	17.47	167.30	10.59
	M	331.67	6.03	338	5.51	328	3.61	391.33	8.33
	PM	219.00	13	180	8.14	174	21.13	255.67	7.51
TDS (PPM)	PR	40.17	1.92	33.06	2.05	165	18.76	109.77	8.96
	M	223.67	2.08	220	1.00	215	3.61	255	14.80
	PM	142.67	3.21	127.67	5.51	118.67	5.13	164	10.54
COD (mg/l)	PR	4.58	0.73	9.78	1.46	11.08	1.12	4.80	1.22
	M	23.83	2.55	16.56	2.05	16.21	1.65	15.80	0.26
	PM	43.06	0.82	12.50	1.25	31.73	1.62	14.43	0.55
Total Hardness (mg/l)	PR	18.12	2.06	32.74	3.11	144	11.02	89.73	4.65
	M	220	5	61.33	6.11	160.67	7.02	90	6
	PM	79.67	17.62	77.50	4.44	88	7.00	87.33	3
Ca(mg/l)	PR	6.50	0.56	8.99	0.21	57.37	8.40	18.62	1.23
	M	39.67	9.07	26	6	90.33	4.51	43	3
	PM	36.67	7.02	22	2	54	7.21	62	9.17
Mg	PR	10.71	1.12	23.75	2.90	87.30	2.61	71.11	3.57
	M	80.33	11.93	35.33	5.03	70.33	2.52	47	7.94
	PM	43	20.95	55.50	3.28	34.30	12.76	25.33	8.082
Chloride (mg/l)	PR	8.46	0.81	7.04	0.18	8.50	0.19	8.51	0.11
	M	26.85	3.01	25.53	3.14	17.66	1.63	8.71	1.01
	PM	51.83	2.75	15.63	3.30	38.03	2.59	45.68	6.20
Sodium (mg/l)	PR	5.33	0.57	3.36	0.10	4.78	0.12	4.14	0.09
	M	2.81	0.60	6.68	0.56	6.75	0.54	4.57	0.91
	PM	9.54	1.23	7.65	1.49	10.56	0.93	8.45	1.02
Potassium (mg/l)	PR	0.48	0.14	0.35	0.05	1.84	0.09	0.77	0.11
	M	56.73	6.03	71.94	2.00	25.43	2.50	52.05	2.94
	PM	0.95	0.08	1.68	0.21	3.34	0.09	0.53	0.11

PARAMETER	SEASON	BADIADUKA		MALAKALLU		PANATHADY		PERLA	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Sulphate (mg/l)	PR	0.52	0.01	0.04	0.00	0.03	0.01	0.47	0.01
	M	0.45	0.2	0.45	0.10	0.57	0.07	0.23	0.03
	PM	0.51	0.31	0.51	0.09	0.54	0.08	0.55	0.09
Nitrate (mg/l)	PR	0.01	0.004	0.04	0.01	0.02	0.01	0.02	0.002
	M	0.014	0.003	0.035	0.01	0.03	0.01	0.04	0.01
	PM	0.03	0.007	0.074	0.02	0.02	0.01	0.01	0.003
Phosphate (mg/l)	PR	0.05	0.008	0.01	0.002	0.05	0.00	0.02	0.003
	M	0.27	0.04	0.387	0.064	0.45	0.07	0.28	0.04
	PM	22	2	32.3	2.51	76.33	13.50	52	5.29

PARAMETER	SEASON	PERIYA		RAJAPURAM		CHEEMANI		SWARGA	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
pH	PR	6.64	0.11	6.15	0.09	6	0.21	6.15	0.10
	M	5.53	0.03	6.15	0.10	5.32	0.12	5.52	0.11
	PM	6.53	0.24	5.7	0.39	5.65	0.21	5.7	0.13
EC (µs/cm)	PR	42.17	2.30	100.7	9.015	68.0	2	39.8	1.26
	M	348.3	5.86	328	12.49	369	4.04	402	7.2
	PM	173.	8.50	182	7.50	252	18.55	184.6	8.7
TDS (PPM)	PR	31.7	5.05	62.1	8.87	35.02	4	26.67	1.55
	M	228	15	222	3.06	231	2	267.3	6.02
	PM	120	1.53	122	4.35	159	6.02	135.3	3.51
COD (mg/l)	PR	23.10	0.95	21.73	3.60	4.96	0.35	13.33	1.15
	M	33.35	0.83	27.2	0.99	6.74	1.07	22.51	1.55
	PM	13.97	0.15	22	2.64	7.32	0.49	23.66	1.72
Total Hardness (mg/l)	PR	20.05	2.08	24.66	3.05	23.03	3	11.01	1.01
	M	112.67	2.52	109.66	6.50	153	12.22	116.67	3.06
	PM	81.33	4.16	52.66	9.29	110	9.01	86	2
Ca(mg/l)	PR	8.23	1.88	8.35	1.98	10.07	2.01	4.08	0.912
	M	80.67	13.61	72	5.29	89.33	8.32	88	8
	PM	22	2	32.3	2.51	76.33	13.50	52	5.29

PARAMETER	SEASON	PERIYA		RAJAPURAM		CHEEMANI		SWARGA	
		MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
Mg (mg/l)	PR	11.82	0.21	16.31	1.49	12.95	0.99	6.93	0.12
	M	32	13	37.667	2.52	64	6.92	28.66	11.01
	PM	59.33	5.03	20.33	10.50	34.33	19.85	34	5.29
Chloride (mg/l)	PR	8.53	0.09	14.53	0.57	8.58	0.30	9.47	1.08
	M	25.90	3.49	8.73	0.44	34.30	1.12	26.27	3.01
	PM	31.33	3.21	39.07	3.15	34.13	3.5	29.39	2.15
Sodium (mg/l)	PR	1.60	0.30	10.57	1.05	44.11	0.04	3.13	0.16
	M	1.10	0.11	1.50	0.32	7.19	0.99	2.38	0.17
	PM	4.43	0.77	6.15	0.14	15.06	3.17	10.79	1.55
Potassium (mg/l)	PR	0.20	0.02	3.12	1.04	2.81	0.28	0.75	0.1
	M	62.06	2.14	72.09	1.06	57.25	1.05	96.74	2.43
	PM	0.69	0.15	1.78	0.197	1.41	0.103	1.36	0.124
	PM	0.69	0.15	1.78	0.197	1.41	0.103	1.36	0.124
Sulphate (mg/l)	PR	0.47	0.01	0.45	0.032	0.012	0.003	0.022	0.002
	M	0.45	0.09	0.24	0.015	0.78	0.020	0.46	0.036
Nitrate (mg/l)	PR	0.03	0.01	10.167	1.010	0.015	0.005	5	1
	M	0.04	0.01	0.039	0.022	0.002	0.001	0.013	0.003
	PM	0.05	0.01	0.061	0.015	0.153	0.042	0.053	0.011
Phosphate (mg/l)	PR	0.03	0.001	0.010	0.003	0.010	0.002	0.0516	0.0076
	M	0.37	0.06	0.257	0.074	0.167	0.031	0.26	0.05
	PM	0.66	0.12	2.740	0.137	1.55	0.130	1.35	0.05

*SD Standard Deviation, * PR Pre monsoon; * M Monsoon; *PM Post monsoon

Chloride was very low in pre monsoon season in all station, while it pre monsoon season concentration ranged from 7.04±0.18 mg/l to 14.52 ±0.577 mg/l. In all the station chloride was within the standard value. The results obtained by Hardness water is mainly caused by naturally occurring minerals, which dissolve as water moves through soil and rock deep underground and into ground water supply. Hardness of the water generally referred as dissolving calcium and magnesium. Presence of those minerals finally gives the whether the water is hard or not. The mean value of hardness was ranged from 220 ±5 mg/l to 11.01±1.015 mg/l among the study locations. Hardness of water is generally classified as, soft water (0 to 75 mg/l), moderately hard water (76 to 150 mg/l) and hard water (151 to 300 mg/l) [18]. Accordingly, water of Badiaduka, Chemani and Panathady were classified as hard water. The mean value of hardness is 220 ± 5 mg/l, 153.3 ±12.2 mg/l and 160.67±7.02 mg/l in monsoon. This is because of the dominant limestone rock in the area

and also the topography. Calcium and Magnesium are beneficial minerals and if presence of these Ca and Mg in drinking water can help average daily requirements. In the monsoon season the Ca hardness was higher than the standard value of Ca hardness 75 mg/l. The maximum mean value of Ca hardness detected were 90.33 4.51 mg/l, 89.3 ± 8.327 mg/l ,88 ± 8 mg/l, 80.67 ±13.61 mg/l at Panathady, Cheemani, Swarga, Periya respectively. Mg hardness is very high in Panathady (87.3±2.61 mg/l). Mg was higher than the desirable limit 30 mg/l. The value of Mg is higher in the monsoon season in all area except Swarga 28.66±11.01 mg/l. Sodium is essential nutrient in plant and human. Sodium also present in rocks and soils. Not only seas, but also rivers and lakes contain significant amounts of sodium, however are much lower. Concentrations of sodium in the water samples were within the permissible limit in all season. This is because of geological conditions of sampling stations. The mean values of potassium ion ranged from 0.197±0.02 mg/l to 2.123±1.042 mg/l in pre monsoon season. In the case of monsoon mean value of potassium ion concentration ranges from 25.43 ±2.50 mg/l to 96.74 ± 2.43 mg/l. The natural absorption of sulphates in mainly surface water is within the range of 2 to 80 mg/L [19]. The sulphate value is very low in all the season because of their no industries in nearby area. The nitrate concentration in surface water is normally low (0–18 mg/l) but can reach high levels as a result of agricultural runoff, refuse dump runoff or contamination with human or animal wastes [20]. The nitrate concentration detected was within the permissible limit of 45mg/l in all the station. The phosphate concentration was varying among seasons. Higher concentration in post monsoon season compare to pre monsoon.
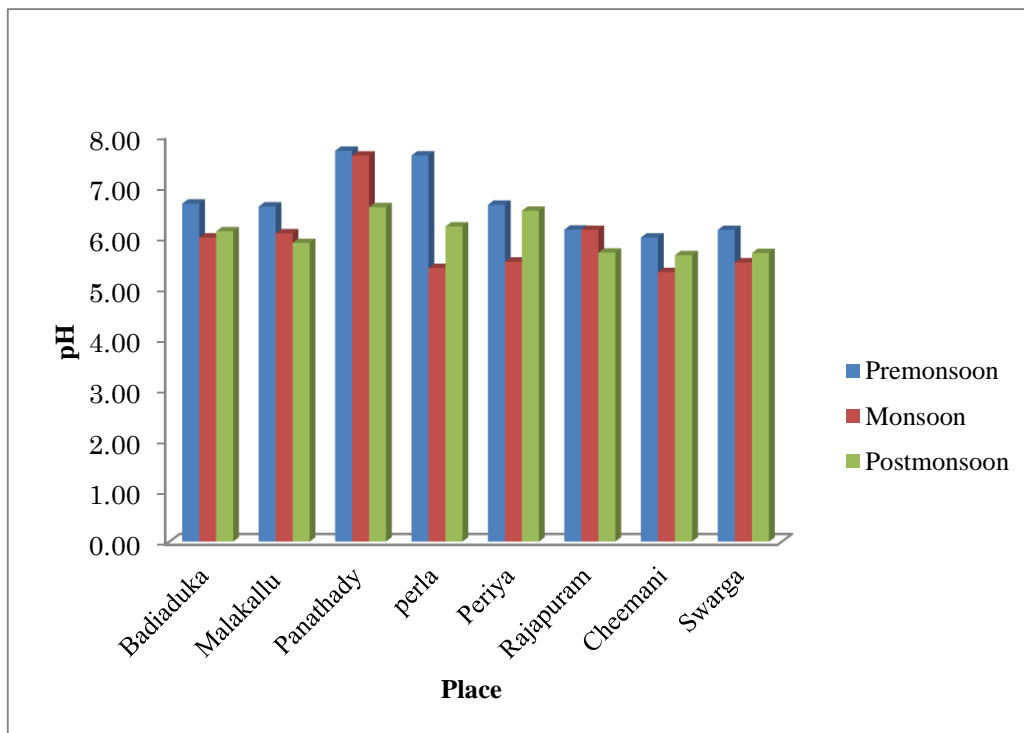
Fig .1 Mean value of pH in different season
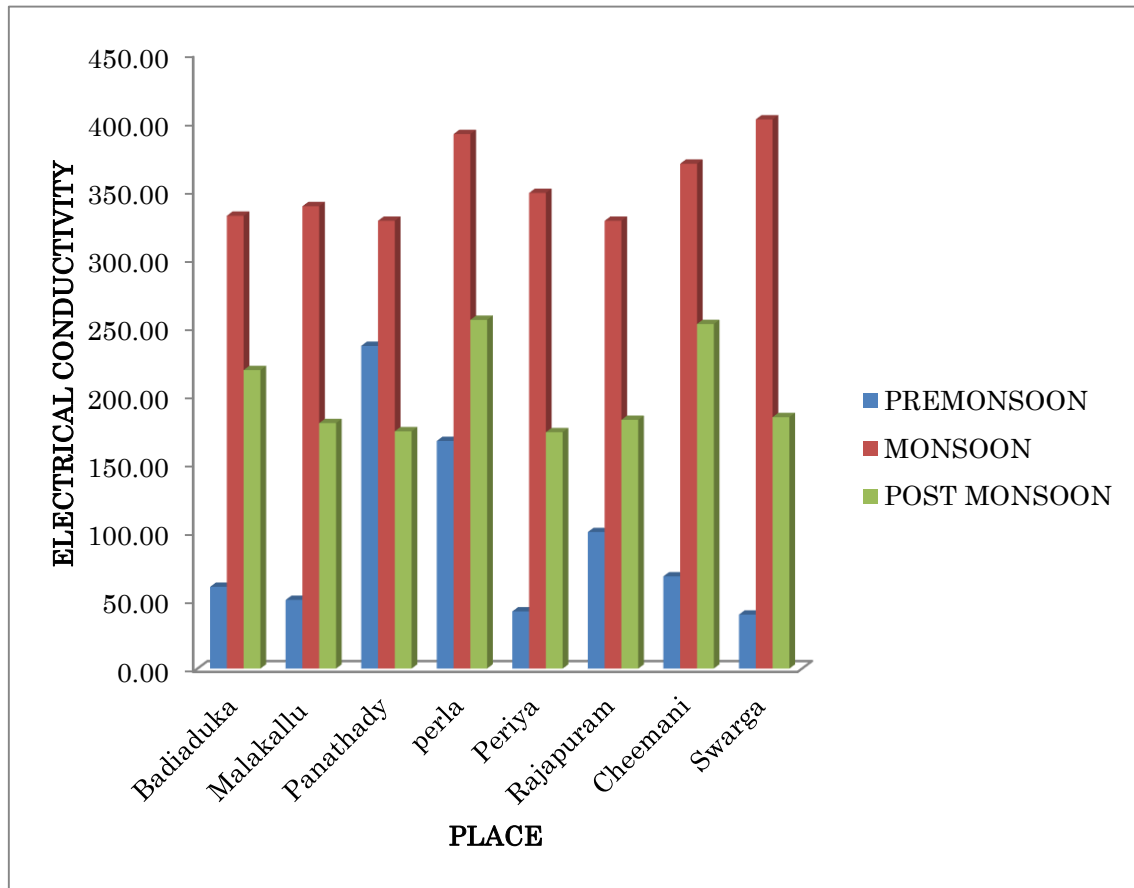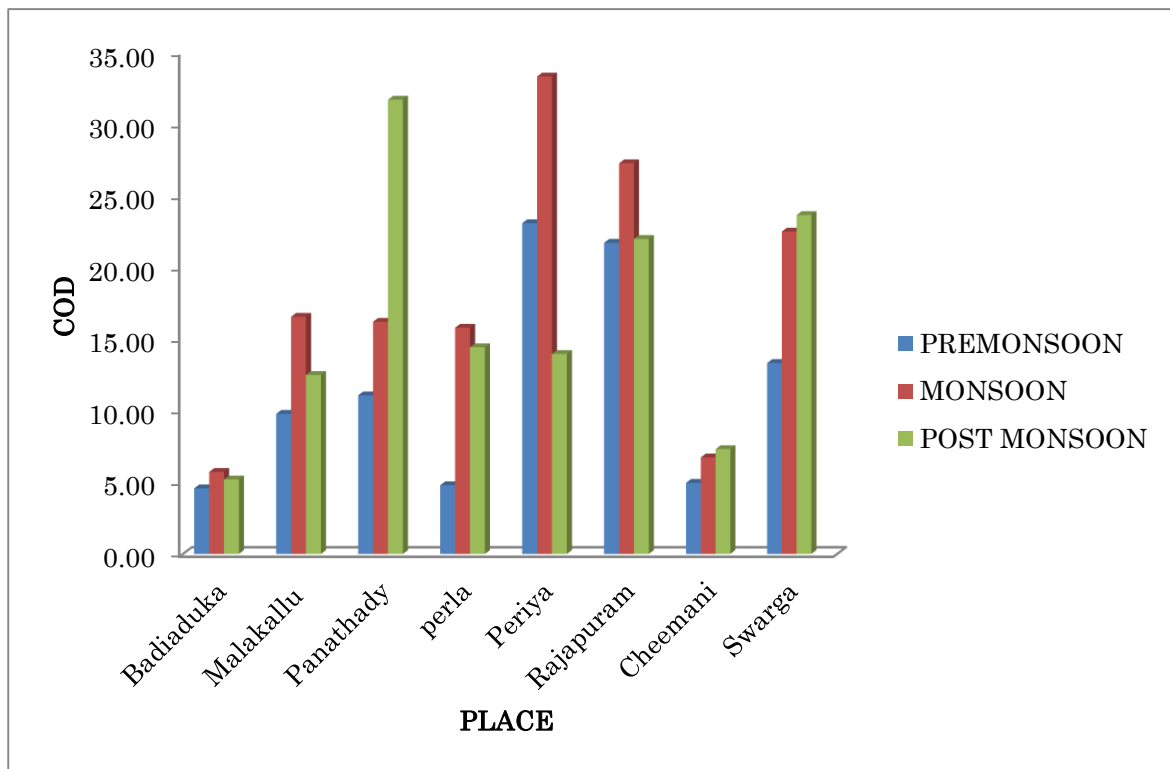
Fig .2 Mean value of EC in different season

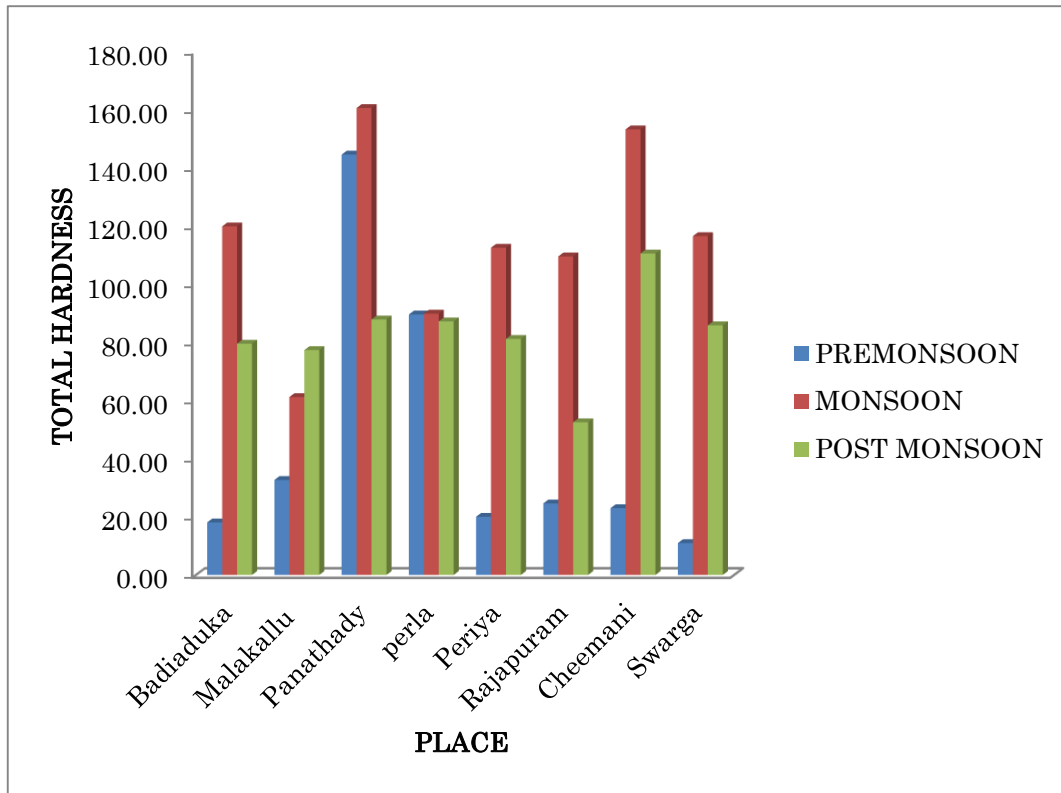**Fig .3** Mean value of COD in different season

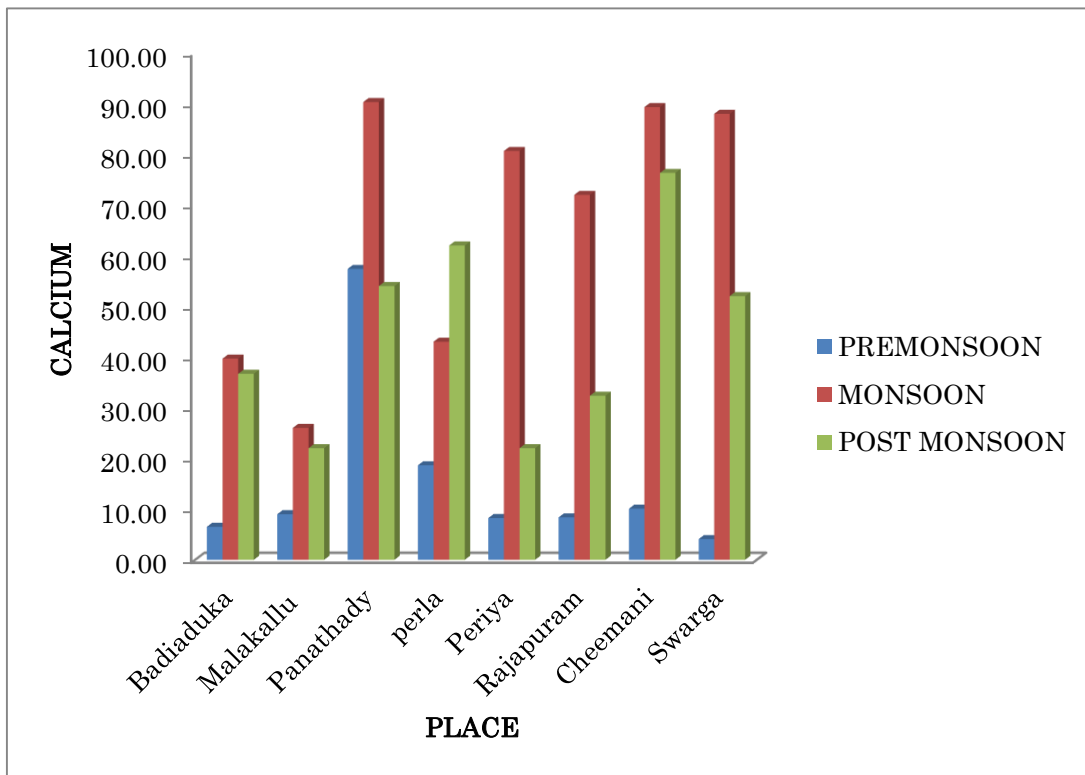**Fig .4** Mean value of total hardness in different season
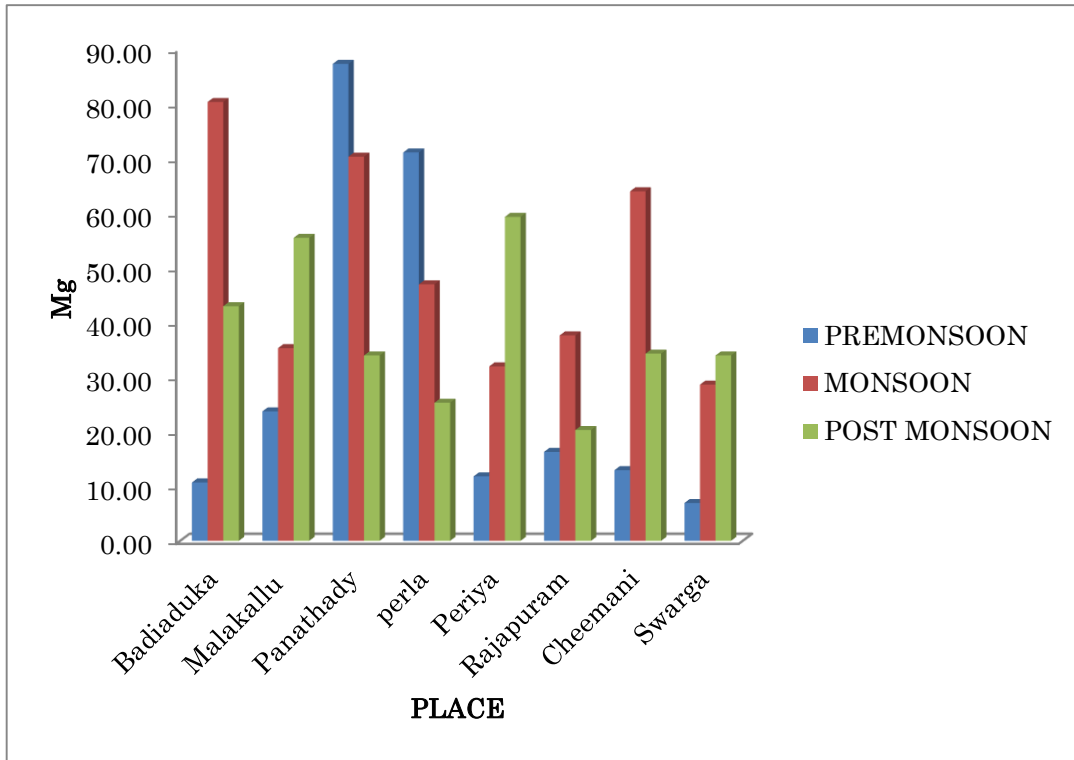

Fig .5 Mean value of Calcium in different season

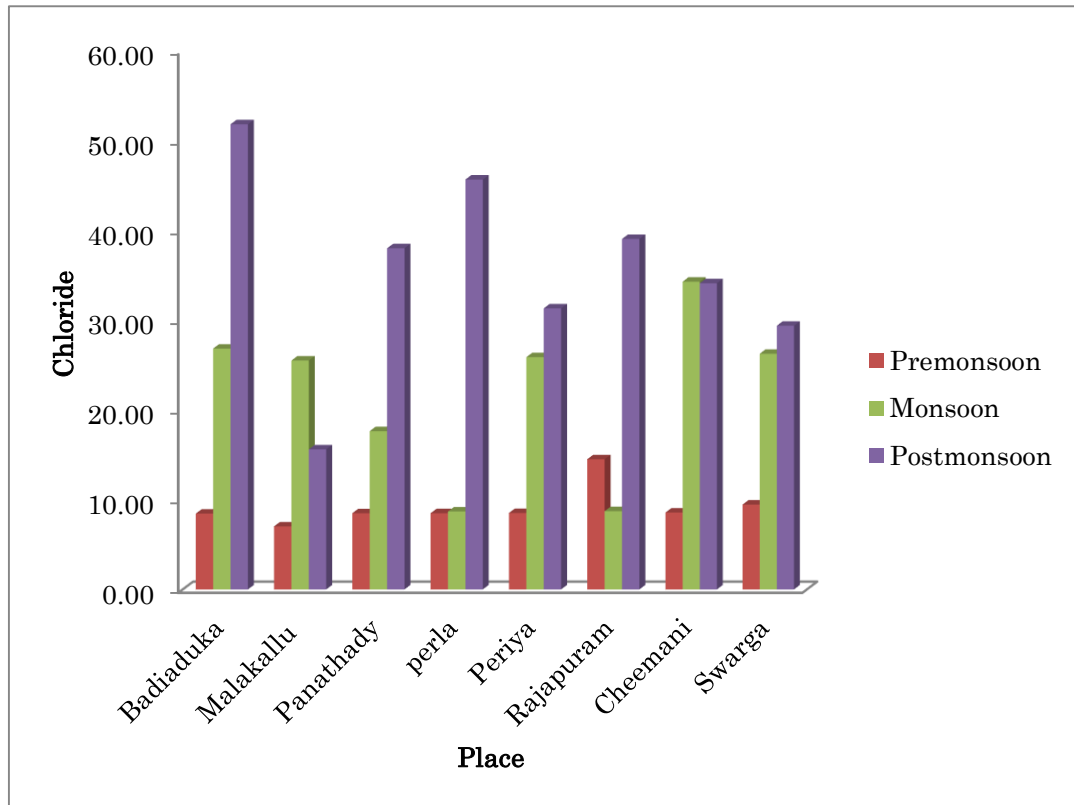**Fig .6** Mean value of Magnesium in different season

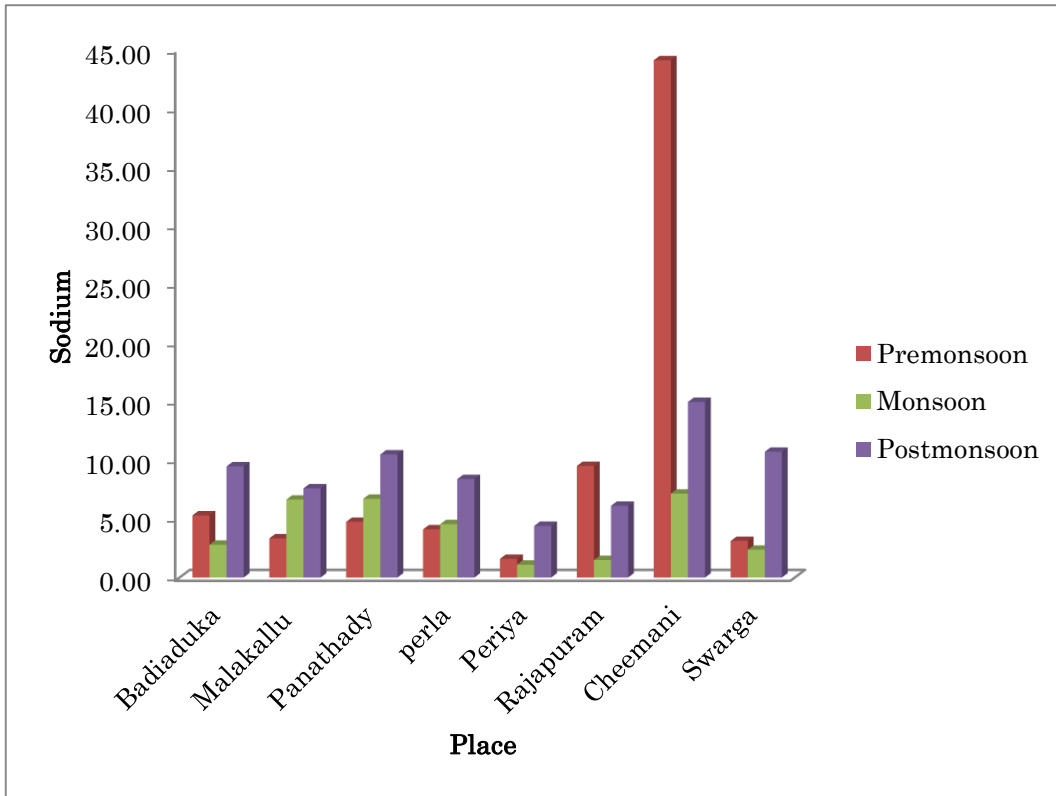**Fig .7** Mean value of Chloride in different season

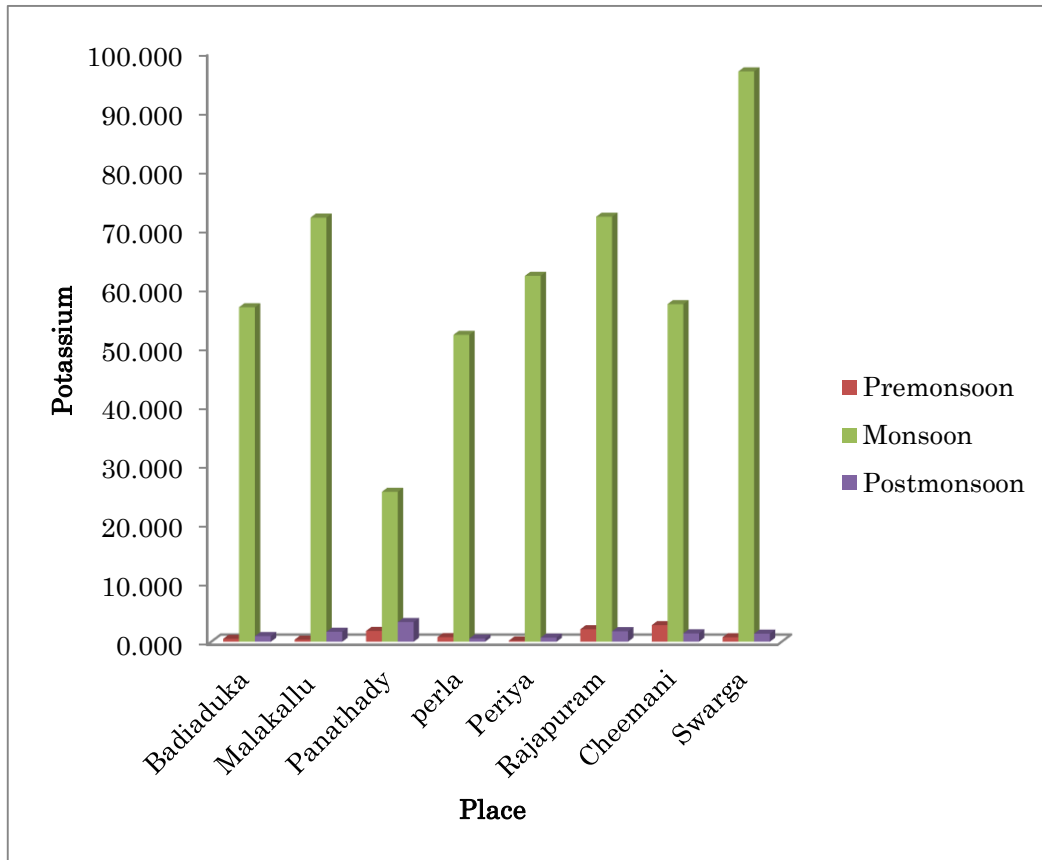**Fig .8** Mean value of Sodium in different season

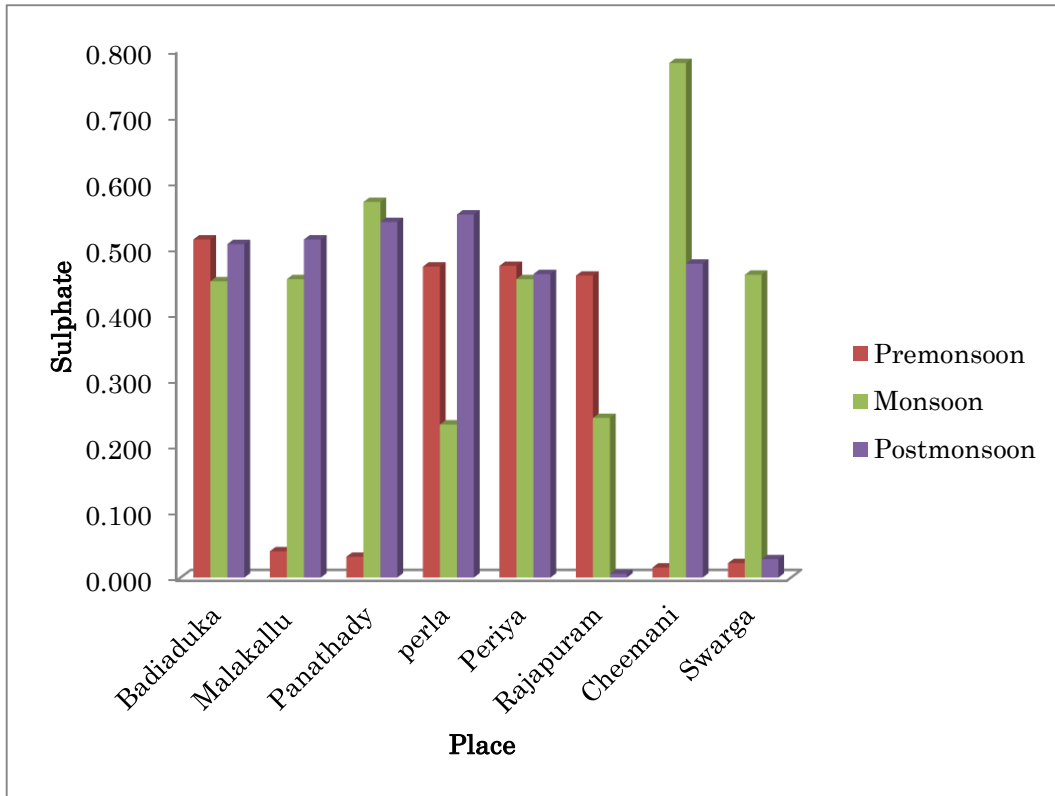**Fig .9** Mean value of Potassium in different season
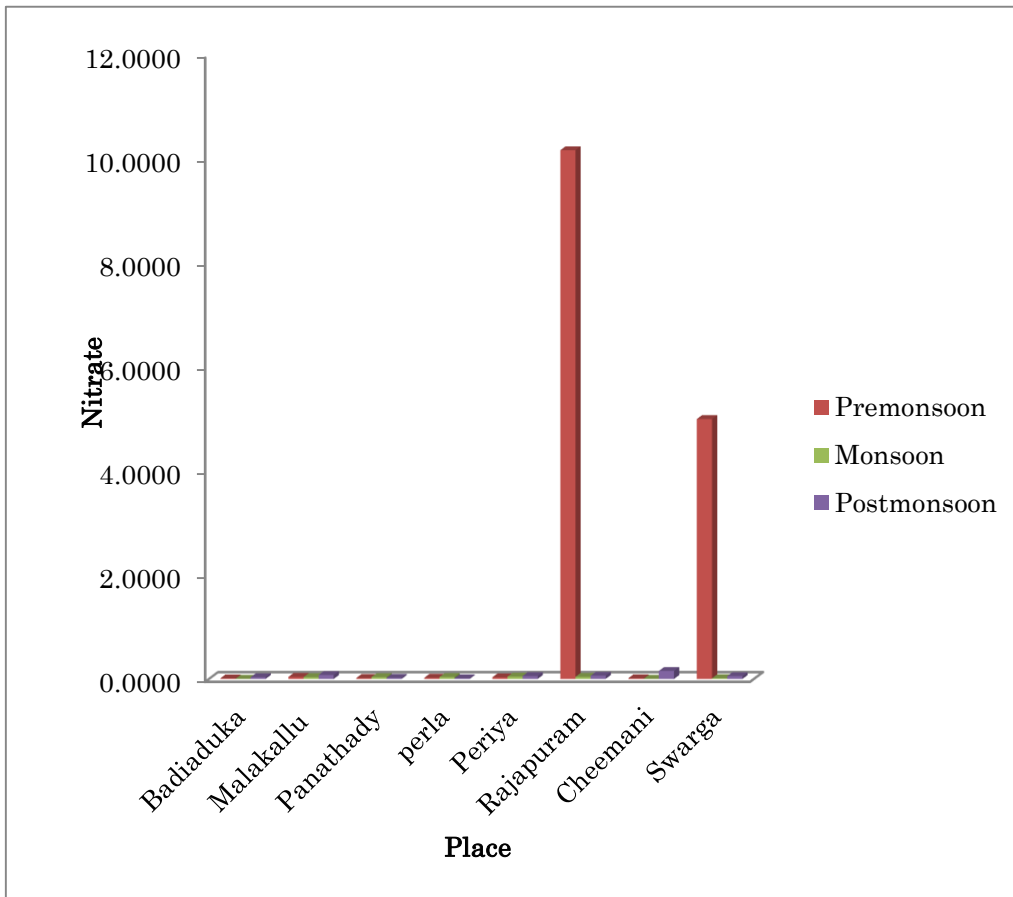
Fig .10 Mean value of Sulphate in different season

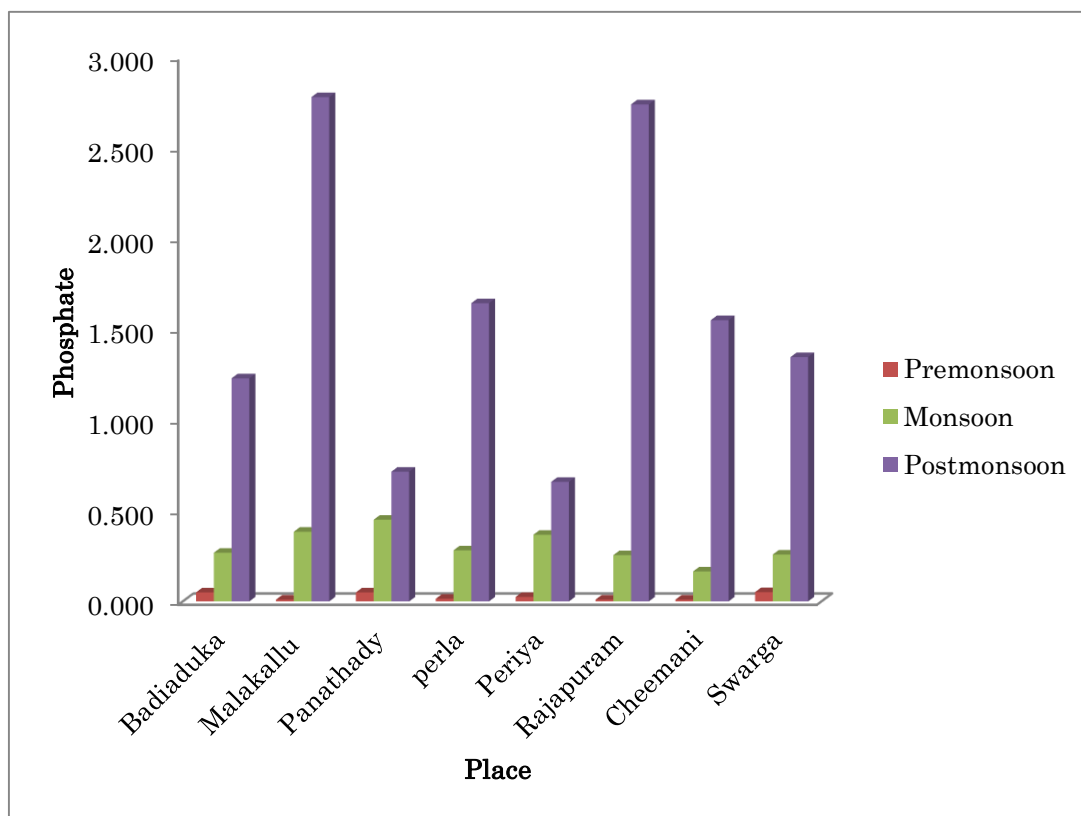**Fig .11** Mean value of Nitrate in different season

Fig.12 Mean value of Phosphate in different season

4. CONCLUSION

The present study assesses the physicochemical parameter in ground water samples collected from different season at Kasargod district, Kerala The water quality parameters were compared to the ICMR and WHO standard guidelines for drinking water. The present study revealed that the quality of water was polluted during rainy season because of agricultural runoff. High degree of agricultural activity might have influenced the water quality parameter in Monsoon and Post monsoon season. The uses of fertilizers and detergent caused the higher value of hardness in water. However, the nutrients are within desirable limit in the all the season. Water quality parameter was within the permissible in pre monsoon season and water is good for drinking in this season. There is also need effective management system and proper treatment of agricultural and domestic usage of water.

CONFLICTS OF INTEREST

No conflicts of interest

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