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Evaluation of Physico Chemical Parameters of Kanher Dam on River Venna in Satara District (Maharashtra) India

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A B S T R A C T

The present investigation is deals with the physico-chemical parameters of water of Kanher dam constructed on river Venna in Satara district. The water from the dam is utilized for agricultural irrigation, electricity generation, drinking purpose, and aquaculture practices. The river Venna is a tributary of river Krishna and it is originated in Mahabaleshwar. The present work is carried out for complete one year from July 2018 to June 2019. The Satara district has a rich network of rivers. The physico-chemical parameters of Kanher dam such as temperature, pH, CO_2, DO, BOD, COD, TDS, TS, TSS, phosphates, chlorides, alkalinity, electrical conductivity, total hardness etc. All these physicochemical parameters were analyzed by standard methods of APHA (1992). The results show significant alterations in the physiochemical parameters of water.

***Key words*:** Physico-chemical parameters, Aquaculture, Water quality status

Water has unique property of dissolving and carrying suspension. A huge variety of chemicals has undesirable consequence that water can easily become contaminated. Water is the most important natural resource for the survival of human as well as plants [1]. The river and dams are the major sources of water for various purposes but improper civilization and exploitation of population made water scarcity. Urbanization and immersion of idols during festivals is the root cause of contamination of water [2]. To avoid this condition there is a need of continuously monitoring and careful management of water resources. Aquatic animals need to healthy and non-polluted environment for their proper growth. The maximum growth and productivity depends upon optimum levels of physicochemical parameters [3]. The Dams are major part of freshwater resources. The water resources store rain water received from adjoining catchment area during rainy season. The stored water is utilized for drinking, irrigation and fresh water aquaculture and also for industrial use. Taking the account of vast release of contaminants and other harmful chemical substances the authors are decided to analyze the quality of water. It made available the data to take preventive measures and made available a healthy environment to aquatic life in the study area for sustain.

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MATERIALS AND METHODS

Study area with geographical features: Satara district is a district of Maharashtra state in western India with an area of 10,480 km² and a population of 3,003,741. This district comes under Pune Administrative Division along with Pune, Sangli, Solapur and Kolhapur

Collection site: Kanher Dam, is an earth fill and gravity dam on Venna river near Satara in Maharashtra. It is an artificial minor irrigation project built on Venna river. The height of the dam above lowest foundation is 50.34 m (165.2 ft) while the length is 1,954 m (6,411 ft). The volume content is 6,308 km³ (1,513 cu mi) and gross storage capacity is 286,000.00 km³ (68,615.05 cu mi). The river Venna rises in Mahabaleshwar, and is a tributary of the Krishna River in Satara district of Western Maharashtra, India.

Water samples were collected in between 09.00 am to 12.00 pm during the study period. They were collected in air tight plastic containers of 05 liters of capacity from the reservoir. The Physicochemical parameters such as temperature, pH, alkalinity, Turbidity, Chloride, Total Hardness, CO_2, COD, BOD, DO, TDS, TS, TSS, Phosphates and Electrical conductivity were analyzed regularly during all the three seasons by using the standard methods as APHA [4], Trivedy and Goel [5], Kodarkar [6]. The objective of the present study was to assess the water quality of Kanher dam. The main purpose of reservoir is to supply water for drinking, domestic purpose and irrigation as well as fishing practices (culture and

capture fishery) are carried out by fishery development officer, Satara, (Kanher).

RESULTS AND DISCUSSION

Physico-chemical parameters

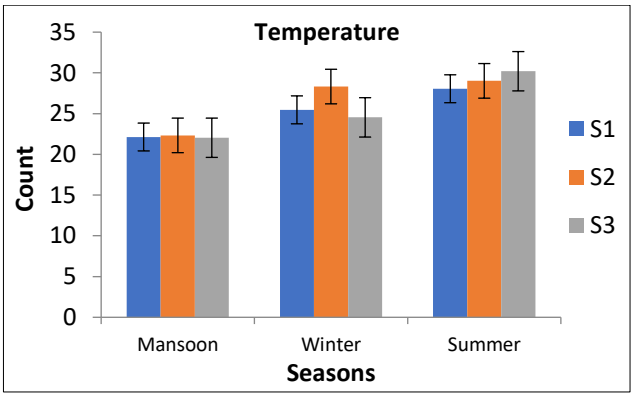
The physico-chemical properties of water clearly explain its geological profile, soil water interstices, pollution status as well as human and animal health problems and important to maintain the aquaculture practices. The various parameters were analyzed during the present work were discussed and correlated with relevant references. They were summarized in (Table 1).

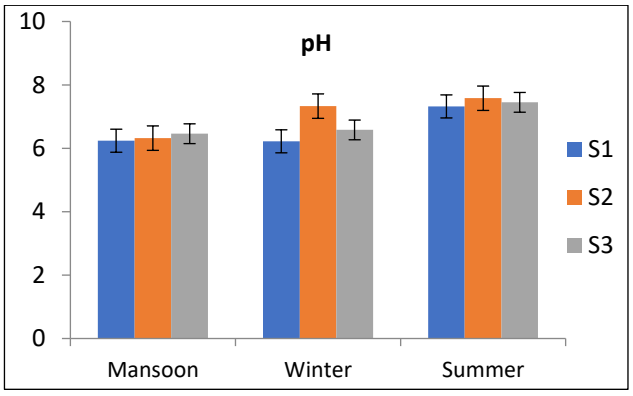
Table 1 Physico-chemical parameters of water from Kanher Dam

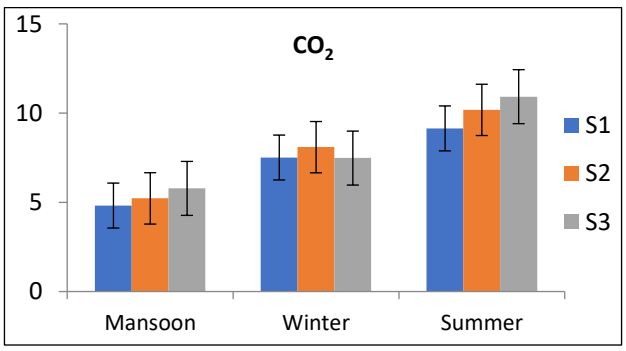
Parameters	Sites	Seasons		
		Monsoon	Winter	Summer
Temperature	S_1	22.13	25.46	28.05
	S_2	22.33	28.32	29.02
	S_3	22.04	24.54	30.2
pH	S_1	6.24	6.22	7.32
	S_2	6.32	7.33	7.58
	S_3	6.46	6.58	7.45
CO_2	S_1	4.82	7.51	9.14
	S_2	5.22	8.09	10.18
	S_3	5.78	7.48	10.92
Dissolved oxygen	S_1	5.5	7.14	4.75
	S_2	5.72	8.02	3.5
	S_3	5.67	6.44	5.67
Biological oxygen demand	S_1	6.33	9.52	14.58
	S_2	6.72	11.33	17.12
	S_3	6.75	10.17	21.48
Chemical oxygen demand	S_1	5.23	9.1	11.42
	S_2	5.78	8.62	15.25
	S_3	5.58	9.12	17.44
Total dissolved solids	S_1	1400	996.14	672.6
	S_2	1282	710.8	415.2
	S_3	1290	725.04	300.9
Total solids	S_1	2440	2018	1978
	S_2	2315	1745	1215
	S_3	2850	1722	866
Phosphates	S_1	0.01	0.02	0.024
	S_2	0.01	0.02	0.036
	S_3	0.03	0.018	0.042
Chlorides	S_1	22.12	30.55	30.66
	S_2	25.14	30.82	32.85
	S_3	23	32.46	35.66
Alkalinity	S_1	27.22	36.16	55.14
	S_2	29.33	44.15	65.88
	S_3	30.13	50.4	72.52
E.C	S_1	0.013	0.13	0.16
	S_2	0.012	0.15	0.18
	S_3	0.12	0.12	0.18
Total hardness	S_1	54.8	60.17	75.04
	S_2	53.15	63.28	78.73
	S_3	48.62	62.92	85.55

All the parameters were expressed in mg/l except electrical conductivity

Temperature: The all metabolic and physiological activities of life processes such as feeding, reproduction, movement and distribution of aquatic organisms are greatly influenced by water temperature. The temperature was varied at different sampling sites depending up on their locations and exposure to the sun [1]. The temperature of all three sites (S_1, S_2 and S_3) of Kanher reservoir shows average water temperature range between 22.04°C to 30.02°C from Mansoon to Summer season (June 2018 to May 2019). The temperature was decreased in Mansoon and increased in winter and summer. It varied at different sampling sites depending up on their locations, season and exposure to the sun. Many workers have given different range of temperature of water and air for various water bodies in Maharashtra. It has recorded between 21.03°C to 30.4°C for reservoirs of North district of West Bengal [7]. The high temperature during summer is due to clear atmosphere, greater solar radiation and low water level. The fluctuation in water temperature had relationship with air temperature which shows positive correlation with air temperature and negative correlation with dissolved oxygen [8-10]. The temperature exerts a strong influence on many physical and chemical properties of water including solubility of oxygen and other gases, rate of chemical reaction and toxicity with microbial activity [11]. The fluctuation in temperature was dependent on the types and concentration of polluted matter, especially during summer.

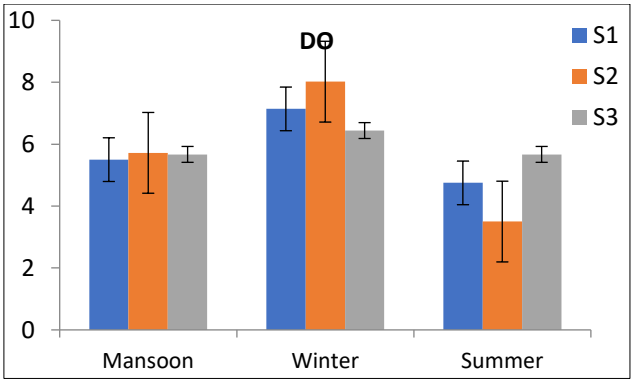


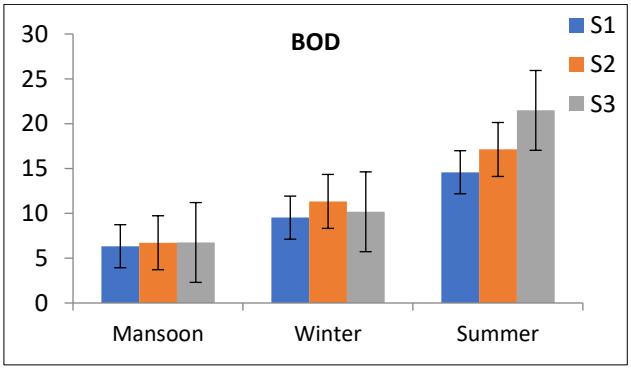


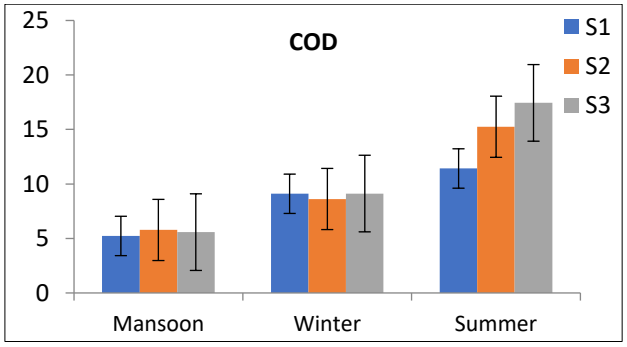


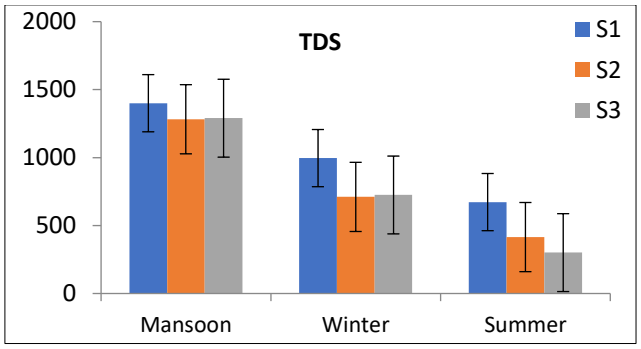
pH: Change in alkalinity may be result of change in pH. The pH value found increased due activity of photosynthetic algae which consumes CO_2 dissolved in water [12]. pH of Kanher reservoir was recorded at the sampling sites S_1, S_2 and S_3 (Table 1). Kanher reservoir shows average pH range between 6.22 to 7.58 from Monsoon -June 2018 to Summer May 2019.

The pH range 6.15 to 7.67 is used for fish culture [1]. The present water body shows pH within ICMR standard (6.5-8.5) and ISI standard (6.5-9.2). If the pH is less than 6.5, it discontinues the making of vitamins and minerals in the human body. More than 8.5 pH values cause the taste of water more salty and causes eye irritation and skin disorder for pH of more than 11 pH in the range 3.5–4.5 affects the aquatic life [13]. pH increases due to consumption of oxygen and rapid release of carbon dioxide by aquatic animals. In biological activity hydrolysis of carbonates must have occurred forming hydroxide leading to increase in pH [14].

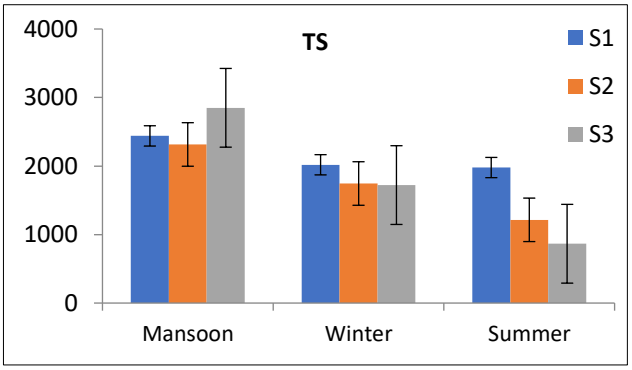


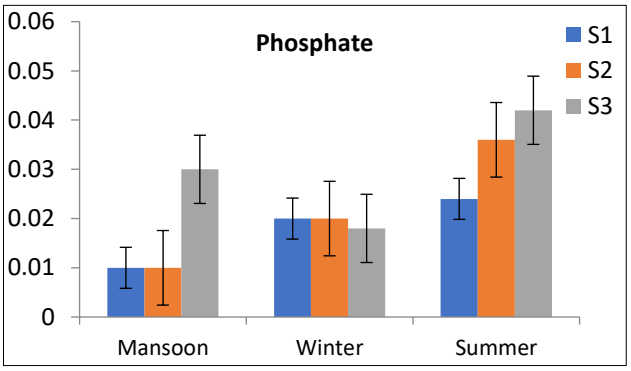


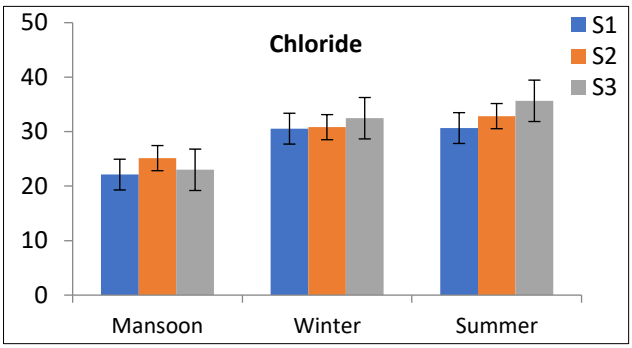


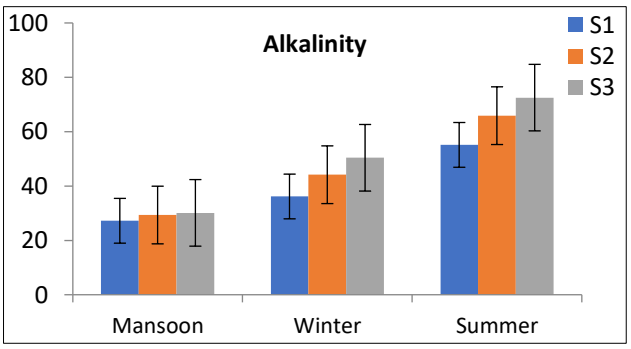


Carbon di-oxide: Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism [15]. Free CO_2 of Kanher reservoir was recorded at three sampling sites S_1, S_2 and S_3 and results are summarized in (Table 1). The lower values of free CO_2 observed during monsoon and winter season is due to complete utilization of free CO_2 by the phytoplankton. CO_2 values ranging between 4.82 mg/L minimum and 10.92 mg/L maximum during the study period. The inverse relationship of dissolved oxygen and free CO_2 was observed. Similar results were reported by [4].



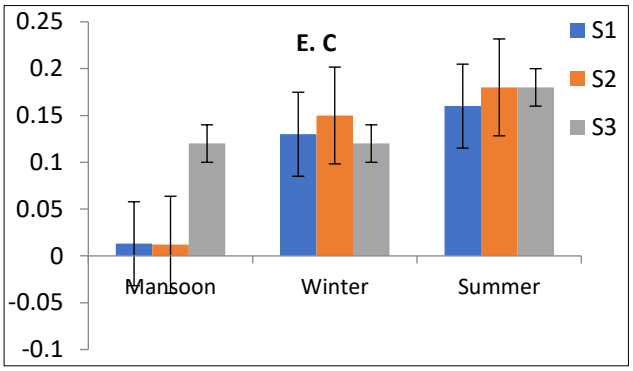


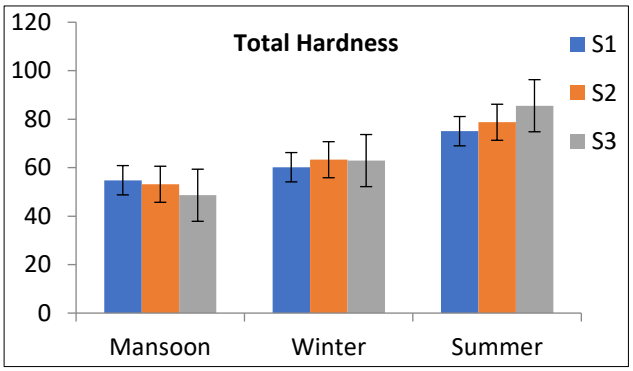




Dissolved oxygen: The dissolved oxygen content is one of the most important factors in stream health. Its deficiency directly affects the ecosystem of a river due to bioaccumulation and biomagnifications. The oxygen content in water samples depends on a number of physical, chemical, biological and microbiological processes [16]. It is the prime necessity for aquatic organisms. In the present investigation dissolved oxygen of Kanher reservoir was recorded at three sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of dissolved oxygen was between 3.5 mg/L to 8.02 mg/L from Monsoon-

June 2018 to Summer-May 2019. The 6 mg/L to 9 mg/L range of DO is supported for potability and aquaculture. The presence of oxygen demanding pollutants (like organic wastes) cause rapid depletion of dissolved oxygen from water. Dissolved oxygen shows inverse relationship with BOD and temperature [17].





Biological oxygen demand: The BOD test is widely used to determine the degree of pollution. It is important that low BOD content indicates of good quality water, while a high BOD indicates polluted water. When BOD level is high, DO level decrease because the oxygen available in the water get consumed by the bacteria [18]. Biological oxygen demand of Kanher reservoir was measured at the sampling sites S_1, S_2 and S_3 (Table 1). Results shows average range of biological oxygen demand between 6.33 mg /L to 21.48 mg /L from June 2018 to May 2019. The BOD values show negative relationship with dissolved oxygen similar relationship has also been reported by [19].

Chemical oxygen demand: COD gives out the amount of organic pollutants found in surface water, proving COD as useful measure of water quality which indicates the mass of oxygen consumed [5]. Chemical oxygen demand of Kanher reservoir was measured at sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of chemical oxygen demand between 5.58 mg /L to 17.44 mg /L from June-Monsoon 2018 to May-Summer 2019. Similar findings were recorded by [10].

Total dissolved solids: Total dissolved solid depends on various factors such as geological character of watershed, rainfall and amount of surface runoffs. It gives an indication of the degree of dissolved substances [20-21]. Total Dissolved solids of Kanher reservoir were recorded. Results show average range of TDS between 710.8 mg /L to 1400 mg /L from June-2018 to May- 2019. The maximum TDS observed in monsoon, minimum in summer and moderate in winter season.

Total solids: Total solids were the measure of the all kinds of solids (suspended, dissolved, volatile etc.) in water. Total solids of Kanher reservoir were recorded at the three sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of total solids between 866 mg /L to 2850 mg /L.

Phosphate: Phosphorus has proved one of the limiting nutrients for floral growth in freshwater bodies which regulate the phytoplankton production [2]. In fresh water phosphorus is present in very small quantities. Phosphate level of Kanher reservoir was measured at the three sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of phosphate level between 0.01 mg /L to 0.042 mg /L from June 2018 to May 2019. Minimum in monsoon and maximum in summer. The values recorded in the present investigation is very closely corroborated with findings of earlier workers [22].

Chloride: Chloride occurs naturally in all types of water. In natural fresh water its concentration remains quite low. It's very high concentration gives a salty taste to the water. It's lower concentration during rainy season is mainly due to dilution by rapid inflow of water [23]. In present investigation chlorides of Kanher reservoir were recorded at the three sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of chlorides between 22.12 mg/L to 35.66 mg/L from June 2018 to May 2019. The potable water may contain small quantity of chloride without any harmful effects. The acceptable range for chloride is 200-600 mg/L [24]. The chloride level is directly related with the pollution level [1]. The maximum values of chloride were recorded during summer season because of scanty rain, high rate of evaporation. It has significant positive correlation with water temperature and electrical conductance. It was also observed that high level of chloride is an indication of higher degree of pollution and low-level chloride content indicates absence of any substantial pollution [1].

Alkalinity: Alkalinity of water is mainly due to carbonates and bicarbonates in any the samples which may be resulted due to the weathering of rocks, waste discharge and microbial decomposition of organic matter in the water body [25]. Alkalinity acts as a stabilizer for pH. Alkalinity, pH and hardness affect the toxicity of many substances in the water [26]. SMP- Total alkalinity of Kanher reservoir was recorded at the sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of total alkalinity between 27.22 mg/L to 72.52 mg/L from June-Monsoon 2018 to May-Summer 2019. Alkalinity has ranging from 78 to 230 mg/L in river Godavari reported by [27].

Electrical conductivity: Electrical conductivity is used for indicating the total concentration of ionized constituents of water [28]. During the present investigation electrical conductance of the Kanher reservoir was measured at the sampling sites S_1, S_2 and S_3 (Table 1). Results show average range of electrical conductance between 0.012 µmhos to 0.18 µmhos from June-Monsoon 2018 to May-Summer 2019. However lowest values were recorded during monsoon season as compared to winter and summer season. In the present study maximum EC was recorded in summer which may be due to fast evaporation of water and minimum EC was recorded in monsoon indicating dilution of water due to rain. The present values of electrical conductance indicate that water is suitable for drinking as well as aquaculture practices.

Total hardness: Hardness is a property of water which prevents a foam formation with soap and increases the boiling point of water. Total hardness of water is due to the presence of bicarbonate, sulphates, chloride, and nitrates of Ca and Mg [29]. The maximum permissible limit for total hardness in water is 500 mg/L. Results show average range of total hardness

between 48.62 mg/L to 85.55 mg/L from June 2018 to May 2019. Hardness is highest in summer as compared to winter and monsoon season. Hardness shows direct relationship with temperature, electrical conductivity and transparency.

CONCLUSION

Evaluated Physico chemical parameters (temperature, pH, CO_2, DO, BOD, COD, TDS, TS, TSS, phosphates, chlorides, alkalinity, electrical conductivity, total hardness) of Kanher Dam on river Venna in Satara District (M.S) India. Performed study suggests that no excessive values were recorded during the search period July 2018 to June 2019. The physico chemical properties of Kanher dam were within tolerance limits according to the given standards by ICMR, ISI and APHA. Hence this water is suitable for irrigation, power generation, and aquaculture. And after purification it can be useful for drinking purpose.

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