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Studies on Physico-Chemical Parameter Analysis of Sina Dam from Ahmednagar District of Maharashtra in Relation to Fish Culture

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KEYWORDS

Sina dam, water quality, fish culture.

ABSTRACT:

Changes in water quality characteristics of a rain-fed Sina dam lake were explored to determine its potential for pisciculture. Several factors, including temperature, dissolved oxygen, pH, total alkalinity, chloride, hardness, magnesium, nitrite, sulphate, iron, and phosphate, were evaluated for a year, from June 2023 to May 2024. All of the physicochemical data measured showed that changes in water temperature, dissolved oxygen, pH, total alkalinity, chloride, magnesium, and nitrate were within acceptable levels for fish and fishing operations. However, a low quantity of iron, salinity and manganese significant level of hardness and phosphate were detected. These settings must be modified to promote fish culture.

INTRODUCTION

There are numerous freshwater bodies in India that have the ability to support fish cultivation. However, these water sources are mostly contributing to increased agricultural output in agriculture. Their proper application for aquaculture and management has not received adequate thought and attention (Usha et al, 2006).

The success of a pisciculture depends mainly on the quality of the water. It improves the growth and survival rates of raising and culturable organisms. However, many contaminants are now being introduced directly or indirectly into water bodies, which may cause a change in their trophic status and render them unsuitable for aquaculture. Any changes in the physicochemical properties of water not only modify its quality, but they also disrupt the aquatic ecosystem and have an impact on aquatic life. Water pollution produced by human activities has an impact on fish species. Several physical, chemical, and biological elements can operate as stressors, affecting fish growth and reproduction (Iwama et al, 2000). As a result, continuous monitoring of physicochemical and biological water quality indices is needed to establish the status relationship between water body and fish culture.

Earlier investigations on water quality parameters of several freshwater bodies in relation to fish culture were conducted by Usha et al (2006), Kadam et al (2007), Ranjan et al (2008), Nooralam et al (2009), Pawar and Pandarkar (2011), Biswas et al (2012), Bawane and Jadhav (2013), and Singh et al (2014). The current study seeks to investigate the monthly variations, if any, in physicochemical water quality indicators of Sinadam lake, and whether or not they are within desired limits for fish and fishery operations.

MATERIALS AND METHODS

The man-made perennial lake known as Sina Dam, which is 12,834 km2 (4,955 sq mi) and situated in Nimgaon Gangarde Village, Taluka Karjat, Ahmednagar District, Maharashtra, was chosen as the fresh water body for the current study. This lake was built over a tiny Sina River, one of Sina's tributaries. This lake, which is a year-round freshwater reservoir supplied by rainfall and situated in a hilly area, is a significant source of water for home use as well as agricultural, fishing, and drinking. The lake is always filled with water during the winter months and rainy seasons.

Water samples were taken every month from June 2023 to July 2024 between 10.30 a.m. in order to assess the physico-chemical conditions of Sina Dam for the current study. Polythene bottles were used to gather water samples. Before samples were collected, a sample bottle was washed with sample water. While some water characteristics, such pH and temperature, were measured in the field, samples of the water were taken into the lab to measure other parameters. A centigrade thermometer was

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used to measure the temperature of the air and water. An Elico LI 613 pH meter was used to measure the pH. Dissolved oxygen was fixed in DO bottles in the field and estimated in a lab setting using a modified version of Winkler's method (Golterman et al., 1978). Titration was used to evaluate alkalinity, chloride, hardness, calcium, and magnesium. Nitrite, sulphate, and iron and phosphate in the laboratory on the same day using a spectrophotometer (Elico, SI 171 miniSpec) (Golterman,1978;APHA,*etal*,1985).

RESULTS AND DISCUSSION

Table 1 ,2 and 3 displays the monthly variations in the physico-chemical characteristics of Sina Dam. Tables 1,2 and 3 show the data that was separated into four seasons: monsoon (June–September), post monsoon (October,November) winter (December–February), and summer (March-May).

Water temperature has an impact on the solubility of gases and salts in the water as well as the behavior of aquatic creatures (Singh et al, 2014). The current study found that the Sina Dam water temperature varied from 15°C (December S3) to 33°C (May,s2), with the lowest temperature recorded during the winter and the highest during the summer. The range of the air temperature was 15°C (December) to 33°C (May S2). Temperature variations in the water were observed in correlation with seasonal variations. According Badiru, (2005) He stated that fish readily tolerate gradual changes in temperature. For example, fish farmer could raise the temperature from 15°C c to 33°Cover several hours without harming the fish.Air temperature range is 21°C (January S2,February S2) to 36°C (May S3) lowest valu is during monsoon seasion and higest is summer.

In the present study water colour varied from greenish, clear, light muddy and muddy brown. It was muddy brown during monsoon, light muddy during post-monsoon, greenish during winter and light muddy during summer

In June S1, the transparency measured 18 cm, in (December S1), it was 60 cm,in (January S2,S3.February S3.March S3) At its minimum point was during the winter. , with winter being the peak. Khan and Chowdhury claim that because there was less precipitation, runoff, and floodwater during the winter and summer, and because suspended particles progressively settled, there was an increase in transparency. Kadam and associates.

Electrical conductivity (EC) is an effective method for determining the purity of water. It depends on ionic concentration and water temperature. The total salt load in a water body is directly proportional to its conductivity. Conductivity indicates the freshness of a water body. High conductivity can indicate pollution. According to Verheust (1997), conductivity can be utilized to determine primary productivity and thus fish production.The EC was highest rang is 517 µS/cm in summer seasion and lowest valu is 100 µS/cm during the monsoon season. Ramulu and Ancy Mol had similar results.

Tarzwell (1957) asserted that a minimum of 4.9 mg/l of dissolved oxygen is necessary to sustain aquatic life. The current study found that the dissolved oxygen level changed during the summer, reaching a minimum of 4.9 ml/l in May S2 and a maximum of 9.13 ml/l in June, during the monsoon. Singh et al. (2014), Bawane and Jadhav (2013), and Biswas et al. (2012) all published findings that were comparable. A drop in dissolved oxygen could have been caused by a summertime increase in water temperature (Ellis, 1973). Low dissolved oxygen levels throughout the summer may also be supported by the water's poor ability to retain DO because of the higher respiratory demands of organisms at hot temperatures (Rao, 1986). There was a slight increase in DO concentration during the monsoon, which may have been caused by nearby water influx. 2008; Ranjan et al. Monsoon-related increases in DO are most likely caused by the increased solubility of O2 and the decreased metabolic rate of aquatic organisms, particularly microorganisms, at low temperatures (Sukumaran and Das, 2002). A sub-optimal level was very traumatic for fish and shrimp (Qian et al., Citation2012), making it critical to maintain D.O levels above 4.0 ppm. In the current examination, D.O was found to be adequate (above 4.0), making it appropriate for fish culture, as reported in a similar study in (Rani, Citation2019).

The pH range was 7.0 (Jun S2.July S2.November S1,S2) to 8.5 (May S3.Sept S3 June S1), with summer being the highest and monsoon and post-monsoon being the lowest. Singh et al. (2014), Pawar and Pandarkar (2011), and Kadam et al. (2007) all reported findings that were comparable. Summertime values were the highest, which may have been caused by the lake's low water level and the diversity of wastes present. Throughout the study period, the pH was determined to be alkaline, which is favorable for fish growth (Swingle, 1967). The water's

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equilibrium has moved to the alkaline side due to increased photosynthesis in the vegetation, which produces a lot of free CO2 (Singh et al., 2014). In general, fish that live in acidic environments are more vulnerable to parasite attacks and sickness (Kadam et al, 2007). Fish in Sina Dams without this kind of risk have pH levels between 7.0 and 8.5.

Chlorides range was 33.6 mg/l (January S1) to 60.3 mg/l (May S2) generally minimum values winter and maximum in summer similar result were reported by Manjare et al (2010), similar results were reported by Swarnalatha et al. (1998)

Total alkalinity was 110.5 mg/l (December S3) to 255 mg/l (May S1.Jun S1), being minimum in Winter and early monsoon and maximum in summer. Results are in concurrence with the findings of Basavaraja et al, in Hosahalli tank in Dist-karnataka. Hujare.M.S. also reported similar result that it wase maximum in summer and minimum in winter deu to high concentration photosynthesis. Higher concentration of bicarbonate during summer season might be due to decrease in water level by evaporation (Ranjan et al, 2008) and excess CO2 production by decomposition process. Highly productive water body has alkalinity over 100 mg/l (Jhingran, 1982). Banerjea (1967) stated that, alkalinity less than 100 mg/l and pH more than 9 and less than 6.5, not suitable. In the present study variations in total alkalinity and pH were desirable, as they were within the levels conducive for fish culture.

In the present study the total hardness varied between 301.4 mg/l (June S1) and 127.3 mg/l (November S1. December S1), minimum in post monsoon or early winter and maximum in winter. The observed decrease in hardness during monsoon months may be attributed to dilution of water by rain (Noor Alam et al, 2009).

Added in water as a disinfectant to fight dangerous bacteria, chlorine (Cl-) is a gas; chloride is the same element found in the form of a salt; both have rather different chemical characteristics. The majority of waterways contain chloride, which helps fish keep their osmotic equilibrium.Chloride, the same element that is found in salt, and chlorine (Cl-), a gas that is added to water as a disinfectant to reduce hazardous germs, have quite distinct chemical properties. The majority of waterways contain chloride, which helps fish keep their osmotic equilibrium. Stone,(N. M. and Thomforde H. K., 2004.) ranged between 33.6 mg/l (January S2) and 60.3 mg/l (May S2), minimum during winter and maximum during summer. Sudarshan. (2018) It is main component of different aquatic shell and bones of vertebrates.

Manganese varied between 0.28 mg/l (January S2, S3) and 0.95mg/l (July, S2, S3, Aug S2), minimum in winter and maximum in monsoon. In this study, low levels of Mn can potentially lead to a decrease in overall animal growth Prasad AS (1984)

Sulphate levels ranged from 100.2 (November S1, December S1) to 193 mg/l (Augest). The concentration was lowest (100.2 mg/l) during post monsoon and early winter and highest (15 mg/l) during monsoon. Aher et al. (2007) observed similar results from the Kagdipura Swamp.

Iron is found in water body high concentration iron causes bad test, discoloration. (Vigneswaran and Vishvathan 1995) minimum range of summer is 0.1 mg/l in (May S2 and April S3) maximum value is 0.67 mg/l in (July S2) monsoon

Nitrate level varied from 2.0mg/l(May) to 5.2 mg/l (December), which was being higher in winter and lower in summer. Phosphates are the key factor for the eutrophication of the lakes and are mainly contributed through anthropogenic sources such as sewage, agricultural run-off and run-off from unsewered residential areas.

In the present study, phosphate ranged between 1.4mg/l (Jun S1) to 5.6 mg/l (May S1), being higher in the summer and lower in the monsoon. The high available phosphate level in summer is an indication of internal loading of phosphorus from sediment, a common phenomenon in lakes (Sondergaard *et al,* 1999).

COD (Chemical oxygen demand) ranged between. 102.3mg/l (March S3) to 224.0mg/l (Jun S1). It was minimum (102.3mg/l) during summer and maximum (224 mg/l) during monsoon. A high COD value is caused by increasing organic matter in water.

BOD (Biological Oxygen Demand) BOD is the measure of degradable organic matter present in water. The BOD and other microbial activities are generally increased by the introduction of sewage (Hynes, 1970). In the present study BOD varied from 13.2 mg/l (July) to 25.0 mg/l (January). It was minimum value is recorded the 13.3 mg/l in monsoon season and maximum value is 25.0 mg/l winter season.BOD level is more in monsoon season then winter and summer due to less quantity of solid and microbial population reported by Singhai et.al (1990.

The evaluation of water quality of Sina dam and its suitability for fish and fisheries practices was thought to be essential in present study. The comparison of the water quality of Sina dam lake with limits laid down by fresh water quality criteria for fish and fisheries practices (Chandra Prakash, 2001) suggested that, most of the physico-chemical parameters viz., fluctuations in water temperature, dissolved oxygen, pH, total alkalinity, and nitrate, biological oxygen demand, were within the desirable limits for fish and fisheries practices. However, low level of iron, salinity, manganese and high-level EC, COD, SO4, alkalinity, hardness were recorded. These parameters need to be modifying in order to favour fish culture.

The study showed organic pollution in Sina dam lake. The water was turbid, medium hard and moderately alkaline. In order to maintain the water quality of Sina dam lake there is need to proper management of water body, a regular monitoring of physico-chemical characteristics of water should be done. In addition, the discharge of agricultural run-off should be checked.

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Months	Parameter/ Sampling sites	Temp. (0C)		colour	Transp-arency (cm)	Electrical Condu-ctivity (µS/cm)	TDS (mg/ lit)	pH	Salinity (ppm)	COD (mg/l)	BOD (mg/l)	D.O. (ml/l)	So4 (mg/l	Alkalinity (mg/l)	Cl (mg/l)	Hardness (mg/l)	Iron (mg/l)	Mn (mg/l)	No3 (mg/l)	Po4 (mg/l)
		Air	Water																	
June	S1	33	17	M.B	31	203	222	8.5	0.28	224	19.20	9.10	140.30	225	56	301.4	0..4	0.37	3.40	1.40
	S2	32.5	18	M.B	32	205	223	7.0	0.30	230	12.4	9.13	142.1	220	50.6	300	0.6	0.35	3.36	3.60
	S3	35	15	M.B	33	231	220	8.0	0.33	198.0	20.6	9.20	141.3	231	55.3	301	0.5	0.30	3.03	4.50
July	S1	30	28.2	M.B	34	142	220	8.15	0.31	205.30	12.4	8.0	145.66	197.5	53.0	146	0.6	0.86	4.2	4
	S2	34	30.0	M.B	35	100	222	7.0	0.30	208.3	15.4	8.13	148.66	190	48.6	145.8	0.67	0.95	4.8	3
	S3	31	32	M.B	27	110	221	8.0	0.34	200.3	13.2	8.7	150	196	50.6	144.3	0.5	0.95	5.0	3.1
August	S1	31	28	M.B	30	411	197	7.4	0.18	197	18.8	8.0	150	190	48.0	129	0.5	0.87	2.9	3.2
	S2	31.6	28	M.B	33	444	127	7.1	0.20	197.6	19.1	8.8	193	188	45	128	0.6	0.95	3.0	3.0
	S3	31.8	30	G. R	32	442	180	7.5	0.19	190.2	20.1	7.69	178	144	47	147.3	0.4	0.56	2.8	3.1
September	S1	36	30.1	M.B	33	432	126.3	8.0	0.18	179.5	16.4	4.8	185.5	168	39	140	0.4	0.83	3.0	4.98
	S2	31	28	GR	30	445	120	8.3	0.20	182.3	17.5	5.0	147.5	165	40	144.8	0.3	0.82	3.9	4.94
	S3	31	27	C.L	50	445	127	8.5	0.19	187.2	20.6	6.3	110	169.3	52	145.6	0.4	0.81	3.6	3.0
October	S1	30	27	G. R	45	436	175	8.0	0.18	176.20	18.6	4.1	146.8	146	42	130.0	0.5	0.52	4.0	3.53
	S2	30.2	28	G. R	44	428	145	7.5	0.18	172.3	18	5.0	145.3	147.6	49	135.6	0.6	0.62	4.1	3.50
	S3	30.4	26	G. R	30	422	150	7.9	0.20	201.60	20.1	5.66	130.3	136.3	48	133.0	0.5	0.30	4.8	3.30
November	S1	29.4	19.40	G. R	28	430	113	7.0	0.19	107.2	23	6.0	129.5	130.5	40.98	127.3	0.6	0.37	3.0	2.21
	S2	26.2	18	G. R	25	420	136	8.3	0.18	105.5	19.9	6.18	110	133.3	45.48	130.0	0.4	0.41	3.6	2.28
	S3	28	17	G. R	18.4	400	139	7.0	0.18	114.6	20.4	5.0	100.2	110.6	31.99	133.6	0.3	0.30	3.8	2.24
December	S1	25	19.6	G. R	18	315	157	8.0	0.18	140.30	19	5.5	100.2	112.2	29.99	127.3	0.3	0.48	4.0	2.23
	S2	24	18	C.L	18.3	318	148	8.4	0.20	138.2	23.5	6.10	105.3	110.5	34.5	130.6	0.2	0.58	5.0	2.20
	S3	25.3	15	C.L	19	300	152	8.1	0.20	130.5	21.4	6.11	115.2	130	48.49	133.6	0.4	0.41	5.2	2.21
January	S1	27.2	21	G. R	58	400	104.26	8.3	0.24	119.10	25	6.7	145.7	122	35.3	141.2	0.5	0.30	3.0	2.10
	S2	21	20	C.L	60	430	213	8.2	0.20	120.2	23	6.2	140.2	128	33.6	140.0	0.6	0.28	2.9	2.15
	S3	21.6	21	C.L	61	440	203	8.0	0.21	103.0	20	6.8	141.4	111	37.5	140.2	0.4	0.28	2.7	2.18
February	S1	32.2	24	C.L	45	480	176	7.6	0.16	118.10	24	7.2	125.2	120	49.99	181	0.3	0.33	2.0	2.0
	S2	31	26	C.L	50	475	177	7.8	0.17	119.30	22	6.9	130	115	51.55	180	0.2	0.30	2.9	1.95
	S3	31.6	27	C.L	60	460	167	7.3	0.16	101.4	19	7.0	132.3	133	47.49	181	0.3	0.30	2.6	2.5
March	S1	33	30	C.L	30	490	136	7.5	0.14	118.4	23	7.0	145.6	130	45.99	194	0.2	0.37	2.9	1.80
	S2	32	32	C.L	50	480	140	7.8	0.13	120.2	21	7.0	146	131	44.00	130	0.2	0.39	3.0	1.85
	S3	31.2	31	C.L	60	495	142	7.6	0.13	102.3	19	7.13	150.2	142	55.38	186	0.3	0.35	3.5	2.0
April	S1	35	33	C.L	50	500	136	7.8	0.25	110.4	20	7.7	144	141	50.3	179	0.3	0.38	3.0	4.14
	S2	35.3	31	C.L	55	505	133	8.8	0.20	111.4	22	7.0	142	142	48.5	142	0.2	0.38	2.9	3.0
	S3	35.1	30	C.L	50	510	115	8.3	0.20	110.5	20	5.10	140	150	49.6	150	0.1	0.36	3.2	3.98
May	S1	35	30	C, L	45	515	177	8.1	0.20	106.0	21	5.10	155	255	58.9	140	0.2	0.31	3.1	5.6
	S2	35.8	33	C.L	48	517	170	8.3	0.20	107	22	4.9	156	244	60.3	142	0.1	0.37	2.1	5.4
	S3	36	30	C.L	42	510	167	8.5	0.19	110	23	5.2	116	230	55.3	138	0.3	0.36	2.0	5.52

Table 1: Monthly variation of Physico-chemical parameters of Sina dam at different stations during June 2023 to May 2024

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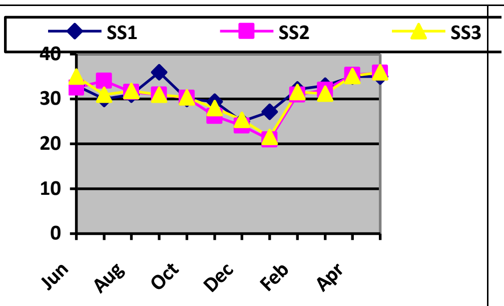

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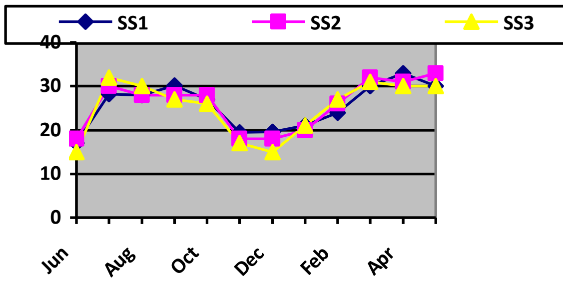

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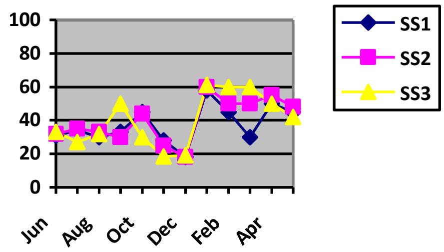

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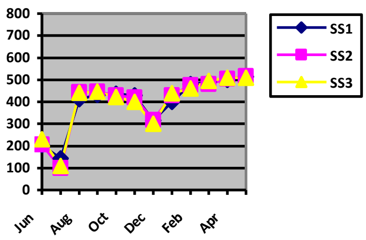

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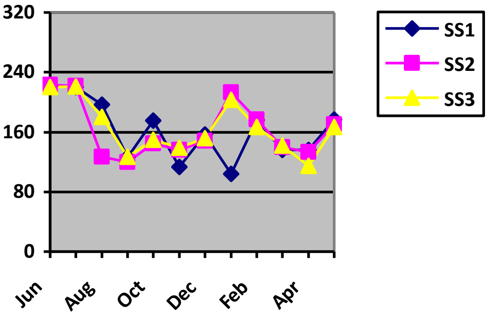

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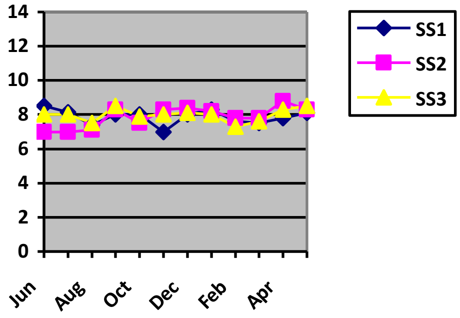

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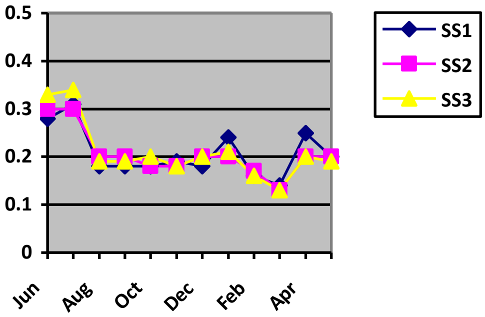

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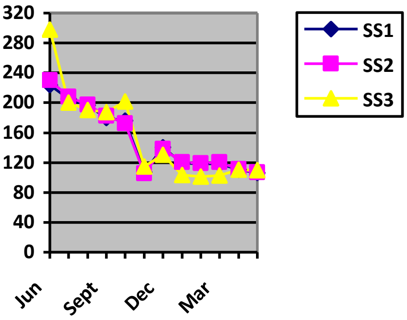

COD

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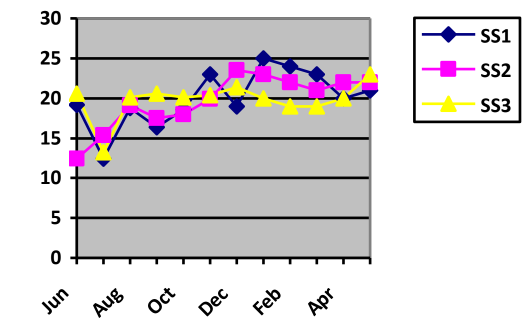

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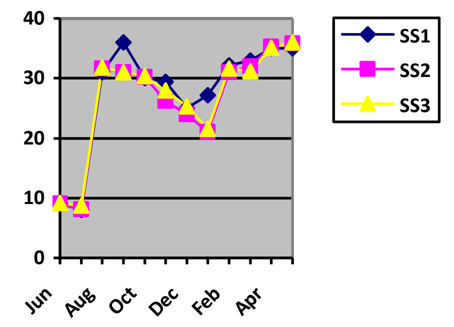

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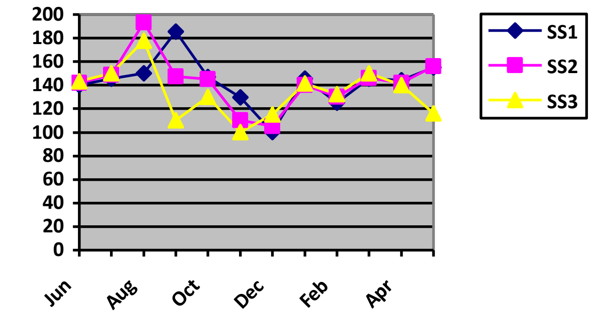

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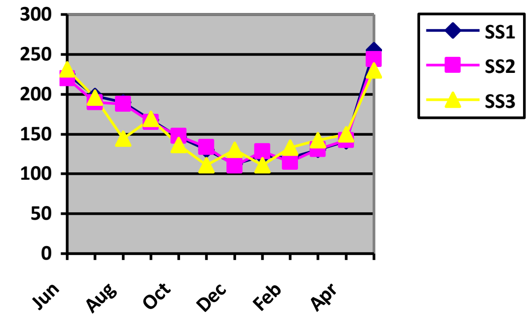

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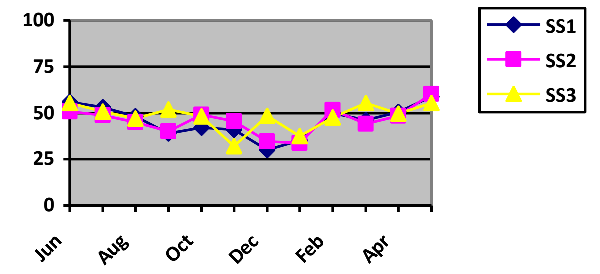

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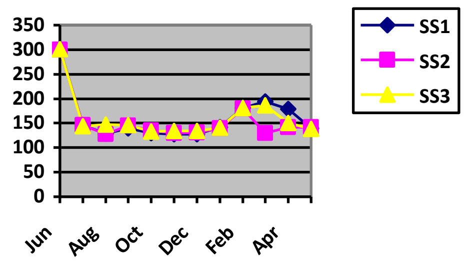

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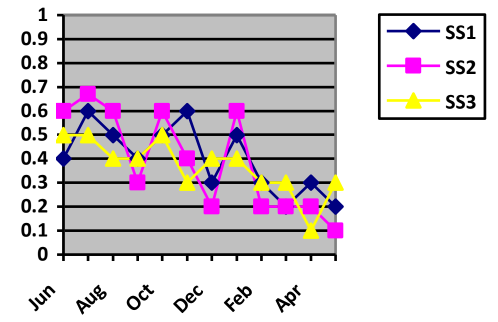

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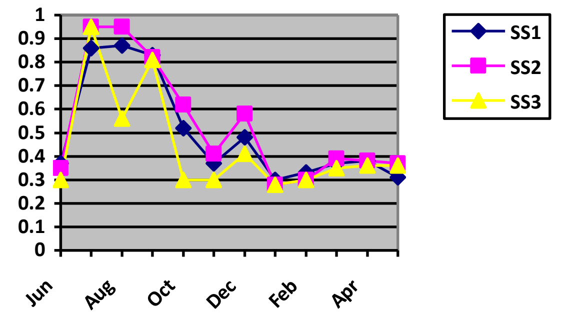

Mn

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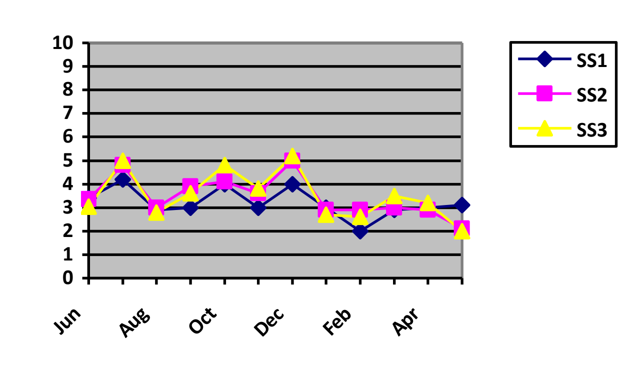

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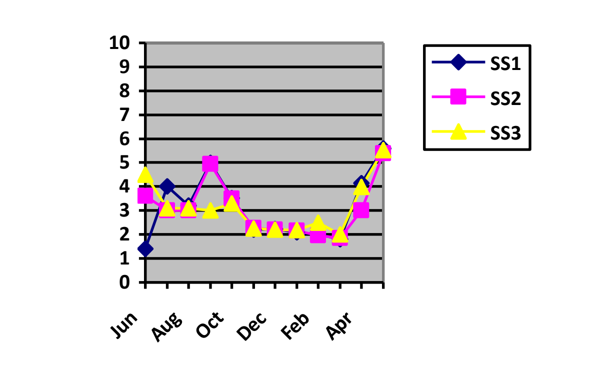

Po4

Table 2: Seasonal variation of Physico-chemical parameters of Sina dam at different stations during June 2023 to May 2024. Seasonal means ± S.D. are given. (Bracket values represent range of variation).

Months	Parameter/ Sampling sites	Temp. (0C)		colour	Transparency (cm)	Electrical Conductivity (µS/cm)	TDS (mg/lit)	pH	Salinity (ppm)	COD (mg/l)	BOD (mg/l)	D.O. (ml/l)	So4 (mg/l	Alkalinity (mg/l)	Cl (mg/l)	Hardness (mg/l)	Iron (mg/l)	Mn (mg/l)	No3 (mg/l)	Po4 (mg/l)
		Air	Water																	
Monsoon (June-Sept)	S1	32 ±2.33 (33-36)	25.82 ±5.16(17-30.1)	M.B	32 ±1.58 (30-24)	297 ±56.63(142-432)	191.32± 21.9(197-222)	8.01 ±0.41 (8.0-8.15)	0.95±0.35(0.18-0.31)	201.45±16.0(189.5-224)	16.7±2.71(12.4-19.20)	7.47±4.33(4.8-9.10)	155.36±17.73(140.3-185.5)	195.1± 20.37(168-225)	49± 6.44 (39-56)	174.1±35.53(129-301.4)	0.47 ±0.08 (0.3-0.6)	0.75 ±0.21 (0.37-0.95)	3.37 ±0.51 (2.9-3.40)	3.3± 1.32 (1.40-4.98)
	S2	32.27 ±1.05(31-34)	26 ±4.69 (18-30)	M.B	32.5± 3.07(30-35)	298 ±150.64 (100-445)	173± 17.51(120-223)	7.35 ±056 (7.0-8.3)	0.20±0.22(0.20-0.30)	204.55±17.36(182.3-230)	16.1±2.51(12.4-19.1)	7.76±1.63 (5.0-9.13)	157.8±20.03(142.1-193)	192.7± 19.73(165-220)	46.05± 4.27(40-50.6)	143.4±78.64(128-300)	0.54 ±0.18 (0.3-0.6)	0.66 ±0.91 (.35-0.95	3.76 ±0.67 (3.0-4.8)	3.6± 0.79 (3.0-4.94)
	S3	32.2± 1.64(3	26 ±6.60 (15	M.B	35.5± 8.67(2	307 ±143.05 (110	187± 24.70(	8.0± 0.53 (7.5-8.5)	0.25±0.64(0.1	193.92±6.83(187.2-	18.6±3.14(13.	7.97±4.28(6.3-	144± 24.26 (110	196.5± 22.20(	51.2±2.97(47-	184.55±38.35(144.	0.45 ±0.05 (0.4-	0.63 ±0.22 (0.30	3.60 ±0.85 (2.8-	3.4± 0.54 (3.0-4.50)

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		1-35)	-32)		7-50)	-445)	127-220)		9-0.34)	200.3)	2-20.6)	9.20)	-178)	169.3-231)	55.3)	3-301)	0.5)	-0.87)	5.0)	
Post-monsoon (Oct-Nov)	S1	29.7±0.3(29.4-30)	23.2±3.8(19.4-27)	G.R	26.5±8.5(28-45)	433±3(430-436)	144±3.1(113-145)	7.5±0.5(7-8)	0.185±0.005(0.19-0.18)	141.7±34.5(107.2-176.2)	20.8±2.2(18.6-23)	5.05±0.95(4.1-6)	138.15±8.65(129.5-146.8)	138.3±7.8(130.5-146.1)	41.49±0.51(40.98-42)	128.65±1.35(127.3-130)	0.445±0.075(0.5-0.6)	0.47±0.05(0.42-0.52)	3.5±0.5(3-4)	2..87±0..66(2.21-3.53)
	S2	28.2±2(26.2-30.2)	23±5(18-28)	G.R	34.5±9.5(25-44)	424±4(420-428)	140.5±4.5(136-145)	7.9±0.4(7.5-8.3)	0.18±0(0.18-0.18)	138.9±33.4(105.5-172.3)	18.95±0.95(18-19.9)	5.59±0.95(5-6.18)	127.65±17.65(110-145.3)	140.45±7.15(133.3-147.6)	47.24±1.76(45.48-49)	132.5±2.5(130-135)	0.515±0.105(0.4-0.6)	0.46±0.16(0.30-0.62)	3.85±0.25(3.6-4.1)	2.89±0.61(2.28-3.5)
	S3	29.2±1.2(28-30.4)	21.5±4.5(17-26)	G.R	24.2±5.8(18.4-30)	411±11(400-422)	144.5±5.5(139-150)	7.45±0.45(7-7.9)	0.19±0.01(0.18-0.20)	158.1±43.1(114.6-201.6)	19.55±0(19-20.1)	5.33±0.33(5-5.66)	115.25±15.05(100.2-130.3)	123.45±12.85(110.6-136.3)	39.99±8.05(31.99-48)	133.3±0.3(133-133.6)	0.3±0(0.3-0.5)	0.39±0.09(0.30-0.48)	4.3±0.5(3.8-4.8)	2.77±0.53(2.24-3.3)
Winter (Dec-Feb)	S1	28.14±2.83(25-32.2)	21.8±1.84(19.6-24)	C.L	40.33±16.8(18-58)	398.33±67.37(315-480)	175.75±30.34(104.26-1)	7.96±0.28(7.6-8.3)	0.20±0.03(0.16-0.24)	126.6±10.6(118.10-140.30)	22.66±2.62(19-25)	6.46±0.7(5.5-7.2)	123.7±18.60(100.2-145.7)	118.06±4.22(112.2-12)	38.42±8.45(29.99-49.9)	149.83±22.75(127.3-181)	0.37±0.094(0.3-0.5)	0.37±0.078(0.30-0.48)	3±0.8(2.0-4.0)	2.23±0.075(2-2.23)
	S2	25.33±4.19(21-31)	21.33±3.40(18-26)	C.L	42.76±17.7(18.3-60)	407.66±66.01(318-475)	179.33±26.5(148-213)	8.16±0.26(7.8-8.4)	0.19±0.014(0.17-0.20)	125.9±8.7(119.30-138.2)	22.83±0.62(22-23.5)	6.4±0.35(6.2-6.10)	125.16±14.65(105.3-140.2)	117.83±7.41(110.5-128)	39.88±8.25(33.6-51.55)	150.2±21.41(130.6-180)	0.33±0.18(0.2-0.6)	0.38±0.1(0.28-0.58)	3.6±0.99(2.9-5.0)	2.75±0.10(1.95-2.20)
	S3	26.16	21.01	C.L	39.5±	400±71.	174±	7.8±0.32	0.19±0	111.63±1	20.13±	6.63±0	129.64±1	124.66	44.49±	151.6±20	0.36±0.0	0.33±0.0	3.5±1.21	2.35±0.1

		±4.12(21.6-31.6)	±4.89(15-27)		19.89(19-61)	18((300-460)	21.40(152-203)	(7.3-8.1)	.021(0.16-0.21)	3.35(101.4-130.5)	0.98(19-21.4)	.38(6.8-7.0)	8.86(115.2-141.4)	±9.74(111-133)	4.96(37.5-48.49)	.96(133.6-181)	47(0.3-0.4)	57(0.28-0.41)	(2.6-5.2)	4(2.5-2.21)
Summer (Mar-May)	S1	34.33±0.94(33-35)	31±1.41(30-33)	C.L	41.66±8.49(30-50)	501.66±10.27(490-515)	149.66±19.32(136-177)	7.8±0.24(7.5-8.1)	0.20±0.044(0.14-0.25)	111.6±5.13(106-118)	21.33±1.25(21-23)	6.6±1.098(5.10-7.7)	148.2±4.85(144-155)	136.33±98.85(130-255)	51.73±5.36(45.99-58.9)	171±22.71(140-194)	0.23±0.047(0.2-0.3)	0.36±0.030(0.31-0.38)	3±0.081(2.9-3.1)	3.85±1.56(1.80-5.6)
	S2	34.36±1.68(32-35.8)	32±0.81(31-33)	C.L	51±2.94(48-55)	500.66±15.41(480-517)	147.66±16.04(133-170)	8.3±0.40(7.8-8.8)	0.18±0.032(0.13-0.20)	112.86±5.48(107-120.2)	21.66±0.47(21-22)	6.3±0.98(4.9-7.0)	148±5.88(142-156)	172.33±50.87(130-244)	49.66±832(40-60.3)	138±5.65(130-142)	0.16±0.047(0.1-0.2)	0.38±0.08(0.37-0.39)	2.66±0.41(2.1-3.0)	3.42±1.47(1.85-5.4)
	S3	34.1±2.08(31.2-36)	30.33±0.47(30-31)	C.L	50.66±7.36(42-60)	500.5±7.7(495-510)	141.33±21.33(115-167)	8.13±0.38(7.6-8.5)	0.17±0.030(0.13-0.20)	107.6±3.75(102.3-110.5)	20.66±1.69(19-23)	5.81±0.93(5.2-7.13)	135.4±14.33(116-150.2)	174±39.73(142-230)	53.42±2.70(49.6-55.38)	158±20.39(138-186)	0.23±0.094(0.1-0.3)	0.36±0.01(0.35-0.36)	2.9±0.65(2.0-3.5)	3.84±1.44(2.0-5.52)

Table 3: Average seasonal variation of Physico-chemical parameters of Sina dam during June 2023 to May 2024. Seasonal means ± S.D. are given. (Bracket values represent range of variation).

Months / Parameter	**Temp. (0C)**	**colour**	**Transparency (cm)**	**Electrical Conductivity (µS/cm)**	**TDS (mg/lit)**	**pH**	**Salinity (ppm)**	**COD (mg/l)**	**BOD (mg/l)**	**D.O. (ml/l)**	**So4 (mg/l**	**Alkalinity (mg/l)**	**Cl (mg/l)**	**Hardness (mg/l)**	**Iron (mg/l)**	**Mn (mg/l)**	**No3 (mg/l)**	**Po4 (mg/l)**

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	Air	**Water**																	
Monsoon (June-Sept)	32.32 ±0.12(32.2-32.27)	26.5 ±1.05 (29.07-30.25)	M.B	33.3 ±1.54 (32.0-35.5)	300.8±4.4 (297-307)	183.7±7.23(173-191.32)	7.79±0.31(7.35-8.01)	0.47 ±0.35 (0.20-0.95)	199.98±4.47(193.92-204.55)	17.13±1.06(16.1-18.6)	7.73 ±0.20(5.77-7.73)	152.39±6.01(144-157.8)	194.8±1.5(192.75-196.57)	48.7 ±2.1 (46.05-51.225)	167.37±17.4(143.48-184)	0.49 ±0.039(0.45-0.54)	0.68 ±0.051((0.63-0.75)	3.57±0.16(3.37-3.76)	3.43 ±0.089(3.39-3.6)
Post-monsoon (Oct-Nov)	29.03 ±	22.57±0.76(21.5-23.2)	M.B	28.4 ±4.41(24.2-34.5)	422.67±9.035 (411-433.)	422.67±9.031(140.5-144.5)	7.62±0.21(7.4-7.9)	0.185±0.00447(0.00-0.005)	146.248.4(33.4-43.1)	19.77±0.78(0-2.2)	19.76±0.77(0.33-0.95)	127.02±9.36(8.65-17.65)	134.07±7.56(7.8-12.85)	42.91±3.13(0.51-8.05)	131.493±2.030(0.3-2.5)	0.42 ±0.090(0.0-0.10)	0.44 ±0.036(0.39-0.47)	3.89±0.33(3.5-4.3)	2.853±0.053(2.77-2.89)
Winter (Dec-Feb)	26.54 ±1.18(25.33-28.14)	21.38±0.33(21.0-21.33)	G.R	40.87± 1.38(39.5-42.76)	401.99± 4.063(398.33-407.66)	176.36±2.22(174-179.33)	7.98±	0.19 ±0.0015(0.19-0.19)	121.19±6.76(111.63-126.6)	21.83±1.2346(20.13-22.83)	225.2±309.5(6.46-6.63)	126.16±2.5221(123.7-129.63)	120.18±3.166(117.83-124.66)	40.93±2.58(38.42-44.49)	150.5±0.7(149.83-151.6)	0.35 ±0.01414(0.33-0.36)	3.36 ±0.262(0.33-0.38)	3.36±0.26(3-3.6)	2.443±0.2(2.23-2.75)
Summer (Mar-May)	34.26 ±0.11(34.1-34.36)	31.11±0.686(30.33-32)	C.L	47.7 ±4.32(41.66-51)	502.44±1.855 (500-505)	146.2±3.55(16.04-21.23)	8.07±0.20(7.8-8.13)	0.18 ±0.012(0.17-0.20)	110.6±2.242(107.6-112.86)	21.2 ±0.41(20.66-21.66)	6.2± 0.32(5.81-6.6)	143.86±5.98(135.4-148.2)	160.88±17.37(136.33-174)	51.58±1.56295(49.60-53.45)	155.66±13.572(158-171)	0.21 ±0.033(0.16-0.23)	0.36 ±0.0094(0.36-0.38)	2.83±0.169(2.6-3.0)	3.70 ±0.2003(3.42-3.85)