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Rajesh Kumar Dubey
SSSVS Government Post Graduate College, Chunar Mirzapur, Uttar Pradesh, India.

Correspondence
Rajesh Kumar Dubey
SSSVS Government Post Graduate College, Chunar Mirzapur, Uttar Pradesh, India.

Pollution studies on Government fish seed farm-Maharajganj, Bhadohi: Physico-chemical analysis

Rajesh Kumar Dubey

Abstract
Government fish seed farm Vikarmpur, which is situated 1.5 km. distant from Maharajganj, Aurai, has been studied for pollution with special emphasis on physico-chemical analysis for all the four seasons. The various physico-chemical parameters were determined. The study indicates an increase in the pollution level in all the nine-pond water of the fish farm. The level of pollution was found to be maximum at brood pond site and it reached to maximum during summers. The chlorides Nitrate and TDS were well within the permissible range. The pond water contains high level of pH, alkalinity, BOD, COD, total suspended solid and total solids. The chromium exceeds the permissible limits at all the sampling stations.

Keywords: Fish seed, pollution, physico-chemical characteristics

1. Introduction
Pollution is a major culprit in environmental degradation with rapid growth of population, industrialization and urbanization; the pollution let out in the environment has greatly increased. Various aspects of water pollution and its managements have been studied by a number of workers Chacko [1]; George [5, 6]; Kaur [9]; Chakravarti and Gupta [2]; Kudesia [11]; Dutta [3]; Tyagi [20]; Mohapatra [12]; and Kartihikeyniet [10]. Fish culture has assumed greater significance and improved remarkably in India. In recent times, due to the advent of "Blue revolution" fish culture being taken up on a large commercial scale by several entrepreneurs by converting agricultural land into fish farms. Fish are very sensitive to even slight changes in their natural agricultural land surroundings. Therefore, it is essential to conserve our fishery resources a priority basis.
The Government Fish Seed Farm Vikrampur, situated 1.5 km distant from Maharajganj (a township on national highway No.-2) In Aurai Tahsil, district Sant Ravidas Nagar (Bhadohi), Uttar Pradesh, India. It was established in 1965-66 and since then it is a major source of fish seed supply like fishes *Labeo rohita, Catla catla, Cirrhinus mrigala and Channa punctatus* etc. Therefore, the present work has been undertaken to evaluate the pollution status of the aforesaid fish farm and its impact on hydrobiology of the pond so that fish productivity can be raised.

2. Materials and Methods
All over the Uttar Pradesh (India) and is an important center of induced breeding aquaculture. The U.P. state Government proposes to double the existing level of fish production by the end of the current Five-year plan. To meet the demand of fish seed it is imperative to monitor already existing fish seed farm cautiously. The water samples were collected with the help 200 ml plastic bottles, for physic-chemical analysis from nine sampling stations and analysed using standard method for physico-chemical examination of water and waste water (APHA, 1986 and Trivedy and Goel, 1984). Samples were collected in a routine manner from all the nine sampling stations during winter, summer, rainy and autumn seasons. The pollution study stretch starts from fishpond No. NP-1 (Nursery Pond-1, NP-2 (Nursery pond-2), NP-3 (Nursery Pond-) 3, NP-4 (Nursery Pond-4), NP-5 (Nursery Pond- 5), RP-1 (Rearing pond-1), RP-2 (Rearing Pond-2), RP-3 (Rearing Pond-3) and BP (Brood Pond). The samples were analyzed once every month.

3. Results and Discussion

Physico-chemicals analyses are shows in following tables.

Table 1: Physico-chemical determinants of Governments Fish seed farm Maharajganj Aurai (Bhadohi) during winter seasons (November 2015 February 2016)

S.N.	Parameters				Sampling Stations					Standards for water quality parameters WHO 1993 (minimum acceptable units)	
		NP-1	NP-2	NP-3	NP-4	NP-5	RP-1	RP-2	RP-3	BP	
1	Temperature	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.8	
2	pH	9.1	9.3	9.2	9.2	9.2	9.2	9.2	9.1	9.2	6.5 to 8.5
3	Alkalinity	503.6	502	503	506	5612	502	499.3	506.	508.6	120 mg/l
4	DO	5.6	5.5	5.5	5.6	5.5	5.6	5.8	5.6	5.7	5 mg/l
5	BOD	49	50.3	50.3	50.3	49.3	49.6	49.6	44.6	43.3	30 mg/l
6	COD	84	87.3	83.3	87	84.6	85	87.6	81	86	10 mg/l
7	T.SS.	145	139	140.3	137.6	136.3	139.3	134.3	144	140	100 mg/l
8	TDS	442.6	438	438	438	438.3	439.6	417.6	429	472	500 mg/l
9	T.S.	587.6	577	578.3	575.6	574.6	579	522	573	612	500 mg/l
10	Chlorides	64	59.6	58.3	60.6	59	60.3	62.6	61.6	63	250 mg/l
11	Nitrates	40.3	40.3	37	41	40	40.3	46.3	41	38.8	50 mg/l
12	Chromium	2.4	2.5	2.2	2.5	2.3	2.3	2.4	2.5	2.6	0.5 mg/l

Table 2: Physico-chemical determinants of Governments Fish seed farm Maharajganj Aurai (Bhadohi) during winter seasons (March 2016 to June 2016)

S.N.	Parameters				Sampling Stations					Standards for water quality parameters WHO 1993 (minimum acceptable units)	
		NP-1	NP-2	NP-3	NP-4	NP-5	RP-1	RP-2	RP-3	BP	
1	Temperature	31.3	31.3	31.2	31.3	31.4	31.3	31.4	31.3	31.4	
2	pH	9.3	9.4	9.4	9.4	9.4	9.5	9.4	9.4	9.4	6.5 to 8.5
3	Alkalinity	579	585.5	584.3	584.5	593.7	584.2	579.7	592.2	582.2	120 mg/l
4	DO	4.1	4.3	4.2	4.3	4.1	4.3	4.2	4.2	4.3	5 mg/l
5	BOD	89	89.7	89.7	788.5	87.2	88.7	84.5	88.2	88.2	30 mg/l
6	COD	142.2	145.5	145.2	142.5	145	143.7	150.2	145.2	149.7	10 mg/l
7	T.SS.	279.2	280.7	2797	279.7	278.2	280.7	290	275.2	286	100 mg/l
8	TDS	532.7	535.2	531.2	532	529.2	530.7	532.5	533.7	556.7	500 mg/l
9	T.S.	817	816	811	811.7	807.5	811.5	809	809	842.7	500 mg/l
10	Chlorides	97.2	95.7	96.5	96.7	97	97.2	96.2	94.5	92.7	250 mg/l
11	Nitrates	24	23	22.7	23.7	22	23.2	30.2	20.2	23.5	50 mg/l
12	Chromium	4.07	4.3	4.03	4.05	4.05	3.7	4.1	3.9	4	0.5 mg/l

Table 3: Physico-chemical determinants of Governments Fish seed farm Maharajganj Aurai (Bhadohi) during winter seasons (July 2016 to September 2016)

S. N.	Parameters				Sampling Stations					Standards for water quality parameters WHO 1993 (minimum acceptable units)	
		NP-1	NP-2	NP-3	NP-4	NP-5	RP-1	RP-2	RP-3	BP	
1	Temperature	29.3	28.9	29	28.9	29.1	29.3	29	28.9	28.8	
2	pH	8.4	8.4	8.4	8.4	8.4	8.2	8.3	8.2	8.6	6.5 to 8.5
3	Alkalinity	320.3	326.3	323.3	325	335.3	325	331.3	302.3	394	120 mg/l
4	DO	8.4	8.7	8.6	8.5	8.5	8.4	8.4	8.3	8.2	5 mg/l
5	BOD	24.6	24.3	24	24.3	22.6	23	22	25	21	30 mg/l
6	COD	35.6	36.3	34	36	35.6	34.6	34	34.3	40.3	10 mg/l
7	T.SS.	297.6	303	301.3	300	296.3	298.6	310.3	300.3	291.3	100 mg/l
8	TDS	321	321.3	328.6	320.3	321.6	321	317.6	315.6	329.3	500 mg/l
9	T.S.	618.6	624.3	630	620.3	618	619.6	628	616	620.6	500 mg/l
10	Chlorides	35	35	3406	33.3	35.6	34.6	33.3	31.3	33.3	250 mg/l
11	Nitrates	61.6	62	61.3	61.3	62	62.6	65.6	60	59.3	50 mg/l
12	Chromium	1.1	1.2	1.3	1.23	1.3	1.2	1.5	1.4	1.3	0.5 mg/l

Table 4: Physico-chemical determinants of Governments Fish seed farm Maharajganj Aurai (Bhadohi) during winter seasons (September 2015 to October 2016)

S.N.	Parameters				Sampling Stations					Standards for water quality parameters WHO 1993 (minimum acceptable units)	
		NP-1	NP-2	NP-3	NP-4	NP-5	RP-1	RP-2	RP-3	BP	
1	Temperature	25.2	25.2	25.1	25.2	25	25	25.2	25.1	29.9	
2	pH	8.8	8.8	8.8	8.8	8.7	8.8	8.5	8.8	8.9	6.5 to 8.5

3	Alkalinity	437.5	439.5	437.5	414	437.5	423	442.5	437	463	120 mg/l
4	DO	6.6	6.5	6.3	6.6	6.4	6.3	6.3	6.3	6.7	5 mg/l
5	BOD	31	30.5	30	30.5	29	31	25.5	31.5	30	30 mg/l
6	COD	59	59	59.5	57	58.6	59	45	51	60	10 mg/l
7	T.SS.	2425	247.5	252	249.5	249	250	220.5	226	191	100 mg/l
8	TDS	381	372.5	372	374	374.5	373	419.5	372	411.5	500 mg/l
9	T.S.	623.5	620	624	624	623.5	623	640	598	602	500 mg/l
10	Chlorides	47	47	49.5	48.5	47	48.5	42.5	46.5	45.5	250 mg/l
11	Nitrates	51.5	52.5	50.5	53.5	51.5	51.5	51.5	53.5	52.5	50 mg/l
12	Chromium	1.3	1.6	1.7	1.7	1.7	1.5	1.9	1.7	1.3	0.5 mg/l

4. Changes of water quality

1. **Temperature:** The temperature of the pond water showed fluctuations, both month wise and season wise. The fluctuations were found between 20.8 to 31.4 ^{0}C (table 1 to 4); which is within the tolerance limit for the phytoplankton's and the developing frys, fingerlings and maturing fish inhabiting the different ponds. Average temperature differences during different seasons were generally small (table 1 to 4). A comparison of dissolved oxygen content (DO) of water with temperature revealed that of high temperature coincided with those of low oxygen content.

2. **pH:** The average pH value of those pond water under investigation were in the alkaline range during all the seasons. The recorded pH value ranged within 9.3 to 9.5 during summer, 8.2 to 8.6 during rainy seasons, 9.1-9.3 during winter and 8.5 to 8.9 during autumn at all the nine sampling stations. It is known that pH of water does not cause any severe health hazard, however high pH induces the formation of trihalomethanes which are toxic (Trivedy and Goel, 1986). In the present investigation, pH valued were slightly above the WHO standards 1993 (6.5-8.5)

3. **Alkalinity:** The observed values of total alkalinity were found within 499.3 to 508.6 mg/l during winter seasons; 579 to593.7 mg/l during summer; 302.3 to 394 mg/l during rainy and 414 to 463 mg/l during autumn in all the nine ponds (table 1-4). Higher values of total alkalinity registered during summer might be due to the presence of excess of free CO_2 produced as results of decomposition process. Phillipose (1960) has classified the confined water of India in three broad categories viz.; (a) 4-50 ppm alkalinity as "low. (b) 50-100 ppm alkalinity as "moderate" and (c) 100-+600 ppm alkalinity as "high". Accordingly, the ponds under present investigation with its alkalinity could be of placed in "high" category of nutrient type.

4. **Dissolved Oxygen (DO):** The seasonal variations in DO of the all nine ponds have been furnished in (Table 1 to 4). Low DO content was observed in the ponds. The depletion of DO in different season may be ascribed to the combined effect of rising temperature, rapid decomposition of organic material and involvement of aquatic plants. The amount of oxygen available in natural water is governed by several factors like temperature, biochemical degradation of organic matter, respiration, photosynthesis and salinity. The rate of depletion of organic content has been used as criteria to evaluate the quality of water bodies. Dissolved oxygen of an aquatic biota is critical attribute as its low concentration adversely affects fish population even at level which do not cause mortality making them more susceptible to parasites and disease (plump et. al., 1978) and also decrease the metabolic rate and spawning of the aquatic animals (Fry, 1971). John (1952) has observed severe dypsea in fishes at about 0.5 mg/l of oxygen in less than 5 seconds at 20 ^{0}C. Similarly, Nammatawar (1984) considered that oxygen is the unknown factor, which is responsible for fish mortality.
   It is important to note that low dissolved oxygen valued were noted only during summer 2015 (4.1 mg/l) suggesting heavy organic matter laden waste. Such low levels of DO greatly threaten and survival of aquatic organisms as a minimum of 5mg/l oxygen is required for fish fauna.

5. **Biological Oxygen Demand (BOD) and Chemical Oxygen demand (COD):** The measurement of BOD and COD is good index for the assessment of pollution load (Gupta and Sharma, 2000). Comparatively higher valued of BOD and COD are encountered in the ponds as compared to standard limits (0 mg/l BOD and 10 mg/l COD WHO 1993). The BOD variations during winter form station No. 1 to 9 were 43.3 to 50.3 mg/l, and during summer rainy autumn seasons the values ranged from 87.2 to 88.7 mg/l, 21.0 to 25.0 mg/l and 25.5 to 31.5 mg/l respectively. The observed value of COD during winter, summer, rainy and autumn season at all the sampling stations ranged from 81.0 to 86.0 mg/l, 142.2 to 150.2 mg/l, 34.0 to 40.3 mg/l and 45.0 to 60.0 mg/l respectively. As expected BOD & COD valued showed opposite of DO results and indicated heavy discharge of wastes.

6. **Total Suspended Solids:** Total suspended solids considered to be pollution indicators as it shows an increasing affinity with the pollution condition (Pandey and Pandey 1980); David and Ray (1962) stated that solids may change the osmotic regulation and cause suffocation to fish even in the presence of high DO. During present investigations seasonal variations of suspended solids in all the nine ponds presented in the Table (1-4). The value varied from 134.3 to 144.4 mg/l during winter, 275.2 to 286.0 mg/l during summer, 291. 3 to 310. mg/l during rainy and 220.5 to 252.0 mg/l during autumn respectively. Comparatively higher values were recorded than standard limits (100 mg/l WHO 1993).

7. **Total Dissolved Solids:** The seasonal variations in total dissolved solids (TDS) in the aquatic environment under study are presented in Table 1 to 4. During present investigations, concentration of TDS found within tolerance limits (1000 mg/l WHO 1993) at all the sampling stations.

8. **Total solids:** The amount of total solids was low in winter (522.0 to 587.6 mg/l), in rainy (616.0 to 630.0 mg/l) season and high in summer (809.0 to 842.7 mg/l). The direct relationship between rainfall and total solids was attributed to an increased load of soluble salts from the catchments areas as a result of surface run-off.

9. **Chlorides:** Presence of chlorides above the desirable limits in a water source is used as an indicator of pollution by domestic wastes. Although chlorides are not harmful but its concentration beyond 50 mg/l imparts peculiar taste to the water rendering it unpalatable and increased degree of eutrophication (Sinha 1986). The chlorides content were within the permissible limits (250 mg/l WHO 1993) at all the nine samplings stations.

10. **Nitrates:** The valued ranged between 37 to 46.3 mg/l, 20.2 to 30.2 mg/l 1, 59.3 to 65.6 mg/l, 50.5 to 53.5 mg/l from station No. 1 to 9 winter, summer, rainy and autumn seasons respectively (Tables 1 to 4). The nitrates were found within permissible limit at all the nine sampling stations (50 mg/l WHO 1993).

11. **Chromium:** The maximum value of total chromium was recorded (4.1 mg/l) summer months while; minimum value was recorded (1.1 mg/l) in rainy season. A comparisons with no adverse effect level (0.5 mg/l) with drinking water standard (International standard for drinking water, WHO 1993) and with standards for discharge of chromium on inland surface water (tolerance limit for industrial effluents part-I New Delhi 1981), indicated that ponds water bear high level chromium. Sikher canal water which is a prime and ultimate source of water for fish farm received chromium through seepage from carpet industry waster and thereby creating serious health hazards to the aquatic flora and fauna.

    The role of water quality parameters is important for efficient production of a fish farm. The limitations of water quality parameters such as temperature, total alkalinity, pH, BOD, COD TDS, TSS, TS and heavy metal chromium are studied in fragments. It is obvious that hydro biological condition prevailing in all the nine ponds of fish farm can adversely affect the survival and growth of all the commercial fishes.

    It is well established that on the part of mature fish to store that compounds more easily within the body tissue than young ones, brood pond water contains high amount of suspended solids, which may block the gills (Metcalf and Eddy, 1996). It may be concluded, that ponds present in the fish farm have undergone considerable degradation. Therefore, it required an immediate need of its proper management to prevent the ecosystem of this area from further degradation.

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