

## **Limnological Features, Plankton Diversity and Fishery Status of Three Fresh Water Perennial Tanks of Kolhapur District (M.S.) India**

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### **ABSTRACT**

Fresh water habitats such as ponds, tanks and reservoirs hold great promise primarily as source of drinking water, irrigation and secondarily for fish production. However, in recent years, these habitats are increasing throughout the length and breadth of the country. Management and sustainable utilization of such water bodies is a greater challenge. Ecological information of such fresh water habitats proves significant for their conservation and sustained utilization for the welfare of mankind. Fishery development in such water bodies will assist to fulfill the additional requirement of fish as proteinacious food and generation of employment opportunities for the economically weaker sections of the areas concerned. Present paper is based on the evaluation of limnological features, plankton diversity and fishery status of three fresh water perennial tanks at Kagal, Kaneriwadi and Kandalgoan of Kolhapur district. Present study revealed 67 species of phytoplankton 35 species of zooplankton. Moreover, fishery activities are observed as an extensive type and tanks under investigation are categorized under natural fertility.

The limnological and biological parameters studied are observed within favourable range to execute the cultivation practices and ultimately, subjection of such water bodies for their sustainable utility.

### **INTRODUCTION**

Fresh water habitats are located in different parts of the country especially in rural areas, and are mainly used as a source of drinking water, irrigation and for fish production by the local fishermen communities. However, tropical climate of the region create an environment conducive for fast growth of fish. Fish is most important bio-product of fresh, marine and brackish water ecosystems contributing as an essential and beneficial food item to mankind since ancient time. India's total potential for fish culture is about 3.6 million hectares of which fresh water ponds cover 1 million hectares (Shrivastava 1988). The Maharashtra is endowed with an area of about 1,79,930 ha under reservoirs. The total area under ponds and tanks are estimated to be about 2.2 million hectares and the resources are widely spreading through the length and breadth of the country. There are about 380 tanks and reservoirs in Kolhapur district of which 239 are village tanks, 88 are Zila parishad tanks, 33 minor irrigation tanks and 20 private tanks. Among these, 86 are perennial tanks having maximum water spread area of 3,362 ha favourable for fish production.

Scientific management of such water bodies will assist to enhance the concept of sustainable utilization. Besides, the evaluation of ecological status, present fishery status and potential for fish production will help in implementation of developmental activities and improvement of fish production in such water habitats.

Area under ponds and tanks, at the production rate of about 2.0 tones per hectare holding potential to about 2.0 million tones of additional fish production worth of Rs 4000 crore would provide employment opportunities to about two million people (Dwivedi, 2000). In present study, an attempt has been made to evaluate the important physicochemical characters, organism diversity at different trophic levels and present fishery status of three fresh water perennial tanks from Kolhapur district.

### **MATERIALS AND METHODS**

For physicochemical characters, surface water samples from four stations of each tank were collected in sterilized plastic containers brought in the laboratory and analyzed immediately to obtain accurate results. Plankton samples were collected by filtering known quantity of water (72 lit) from single suitable station, it was concentrated to (90ml.), one ml. of this concentrate was placed on a Sedgwick Rafter cell and phytoplankton and zooplankton species were identified from the water samples of these tanks. Fish fauna and fishery status is evaluated by attending the commercial catches, species composition, their minimum and maximum length and weight and total weight of the catches of these tanks. Based on the commercial catches, mean weight per catch was estimated for each tank and these figures were used to estimate the approximate annual fish production considering 300 hundred operations excluding closed period and off season.

Economic status per acre of each tank was estimated considering capital and operational cost and cost of annual fish production.

## STUDY AREA

Kagal tank was constructed by His Highness Chattrapati Jaysingh, Maharaja of Kolhapur State during the stage period of 1892 to 1894, hence, popularly known as Jaysingh tank. It is situated about 2 km. North to Kagal town covering maximum water spread area about 32.66 ha, with an average water spread area 18.64 ha, having maximum length about 503 meters, and characterised by presence of littoral and submerged vegetation with coarse nature of bottom. Kaneriwadi tank was constructed in the year 1974 by the State Irrigation Department of Maharashtra state. It is situated in the vicinity of Kaneriwadi village of Karvir Tahsil of Kolhapur district covering water spread area about 63.05 ha, with an average water spread area about 35.2 ha, having maximum length about 765 meters.

Kandalgaon tank was constructed in 1984 by the State Irrigation Department. It is situated 2 km. south to Kandalgaon village. It is earthen type covering maximum water spread area about 32.08 ha, with an average water spread area about 17.58 ha, having maximum length 616 meters. All these tanks are auctioned on lease for the period of 3 to 5 years for fishery purpose. Kaneriwadi and Kandalgaon tanks are characterized by absence of littoral and submerged vegetation with silty nature of bottom.

## RESULTS AND DISCUSSION

Table 2, 3 & 4 shows physico-chemical and biological parameter of Kagal Kaneriwadi and Karololgam tanks. Average temperature was recorded within the range from 28.11 to 29.1 °C without much marked variations in these tanks.

Turbidity was recorded higher at Kandalgaon tank, moderate at Kaneriwadi and low at Kagal tank and it is correlated with the nature of bottom, wave action and anthropogenic activities in these tanks.

Maximum transparency was noticed at Kagal, moderate at Kaneriwadi and minimum at Kandalgaon tanks showing inverse relationship between turbidity and transparency.

pH was recorded always towards alkaline side without much marked fluctuations in these tanks. According to Venkateshwarlu's classification the tanks under study are categorized as alkaliphilous (i.e. pH range from 7.5 to 9.00).

Comparatively, high dissolved oxygen at Kagal tank is correlated with the presence of littoral and submerged vegetation and high plankton density might be responsible for accelerated rate of photosynthesis in this tank. Banarjee et. al. (1990) stated that, pond water with 5.0 to 10.0 ppm is considered ideal for fish production.

Free carbon dioxide was recorded in negligible proportion at Kagal tank, high at Kaneriwadi and moderate at Kandalgaon tank. Its negligible concentration is attributed to its utilization for photosynthetic activity, whereas, its presence is correlated with the absence of littoral vegetation, low plankton density and photosynthesis and respiratory rates in these water bodies. Hynes (1970) stated that, in order to safeguard the fisheries interest 25 mg/l of free carbon dioxide has been recommended as upper limit. Moreover, Sharma et al (1978) have pointed that, the absence of free carbon dioxide is usual in unpolluted water bodies.

Total alkalinity was recorded lower at Kagal tank, moderate at Kandalgaon tank and higher at Kaneriwadi tank. It was noticed always above 100 mg/l during all the months of study period in these tanks. Moyle (1946) stated that, water bodies having total alkalinity more than 200.0 mg/l were highly productive. Similarly Alikuhni (1957) noticed that, highly productive waters have to be more than 100.0 ppm alkalinity.

Hardness was observed higher at Kaneriwadi tank, moderate at Kandalgaon tank and lower at Kagal tank. Based on Venkateshwarlu's classification, Kagal tank is categorized as moderately hard, while Kaneriwadi and Kandalgaon tanks under hard waters. Jhingran (1985) found direct relationship between hardness and plankton production and stated that, hard waters enhance the productivity than soft waters.

Phosphate concentration was observed slightly lower at Kagal tank and within close range at Kaneriwadi and Kandalgaon tanks. Moyle (1946) opined that optimum concentration of phosphorus for sustainable and a moderate production was found to be between 0.1 to 0.2 ppm. Banarjee et. al. (1990) stated that, about 0.2 to 0.5 ppm of phosphate in water column is a good indication of pond productivity. However, its slight lower concentration in Kagal tank is compared with the presence of littoral and submerged vegetation and high plankton density in this tank.

Nitrate concentration was observed as minimum at Kagal, moderate at Kandalgaon and maximum at Kaneriwadi tank. Banerjee et al (1990) mentioned that, pond water containing more than 1.0-ppm nitrate nitrogen is considered to be good for optimum production of fishes. Dykyjova et. al. (1978) have stated that, when intense macrophyte growth is taking place the nitrate contents are very low or nil, supporting for the record of low values of nitrate in Kagal tank.

Phytoplankton density (units/l) was recorded maximum in Kagal tank, moderate in Kandalgaon and minimum at Kaneriwadi tank. Meshram (2003) stated that, macrophytes stimulate the growth of phytoplankton and help in recycling of organic matter; this can be positively correlated with high phytoplankton density at Kagal tank. The moderate

and low status of phytoplanktons in other tanks is attributed to factors like water level, biomass, temperature and nutrient level.

Zooplankton density was observed as maximum in Kandalgaon tank, moderate in Kagal and minimum in Kaneriwadi tank. Important physicochemical parameters such as temperature, pH, dissolved oxygen, alkalinity and certain others along with diverse producer population indicating their favourable range to execute the fish cultivation practices in these tanks.

Phytoplankton diversity represented by 67 species belonging to class Chlorophyceae, Bascillariophyceae, Myxophyceae and Euglenophyceae were identified and recorded from these tanks. Of these, 32 species belonging to 09 orders and 16 families are from class Chlorophyceae, 20 species belong to 02 orders and 09 families from Bascillariophyceae, 13 species from 02 orders and 04 families of Myxophyceae and 02 species from single order and two families of Dianophyceae and single species from order Eugnales was recorded from these

tanks. The phytoplankton population exhibits bimodal peak one in winter and other in summer season with infrequent occurrence of Dianophyceae and Euglenophyceae members in all these tanks.

About 35 species of zooplankton belonging to five major groups viz. Copepod, Cladocera, Rotifera, Ostracoda and Protozoa were identified and recorded table 1 during the study period in these tanks. Among the zooplankton Rotifera was observed as dominant group in the plankton samples of Kaneriwadi and Kandalgaon tanks and Copepod dominance at Kagal tank.

Species diversity of phytoplankton and Zooplankton were recorded mostly similar without marked variations however, presence of diverse planktonic forms indicate good ecological condition of these tanks. Moreover, such water bodies could be considered as good stocking grounds for the conservation of the fresh water biodiversity, as the riverine systems in the country are under the stress of pollution.

Table 1. Checklist of Phytoplankton diversity of three fresh water perennial tanks at Kagal, Kaneriwadi and Kandalgaon

<b>A. Class- Chlorophyceae</b>	
<i>I. Order- Volvocales</i>	
Family- chlamydomonadaceae	Chlamydomonas sp.
Family- Spharellaceae	Gonium sp.
Family- Volvocaceae	Volvox sp.
<i>II Order- Chlorococcales</i>	
Family- Chlorellaceae	Chlorella sp.
Family- Oocystaceae	Ankistrodesmus sp. Pediastrum sp. Selanastrum sp
Family- Hydrodictyceae	Hydrodictyon sp
Family- Characiaceae	Characium sp.
Family- Scenedesmaceae	Tetrastrum sp. Scenedesmus sp S. bijugatus
<i>III. Order- Heterococcales</i>	
Family- Characiopsidaceae	Characiopsis sp.
<i>IV. Order- Ulotrichales</i>	
Family- Ulotrichaceae	Ulothrix sp.
Family- Microsporaceae	Microspora sp.
<i>V. Order- Cladophorales</i>	
Family- Cladophoraceae	Cladophora sp.
<i>VI. Order- Oedogoniales</i>	
Family- Oedoginaceae	Oedogonium, Bulbochateae sp.
<i>VII. Order- Zygnematales</i>	
Family- Zygnemataceae	Spirogyra, Zygnema sp Mougeotia sp.
Family- Mesotinaeae	Mesotaenium sp. Netricum sp.
Family- Desmidiaceae	Closterium sp. C. reniformae. Cosmarium sp. Desmidium sp. Triplloceras sp. Staurastrum sp.
<i>VIII. Order- Charales</i>	
	Chara, Nitella sp.

Fishery activities of Kagal tank is controlled by private party while, it was under control of Kalamba Devi and Kandalgaon fishery CO-Op societies in case of Kaneriwadi and Kandalgaon tanks. Fish seedlings of major and exotic carps are released as per availability at least once in a year in monsoon and fishing activities are conducted from these tanks.

Commercial catches of Kagal tank revealed, predominance of naturally occurring fish species accompanied with infrequent occurrence of medium and large sized common carps. Kaneriwadi tank represented as an admixture of carps and naturally occurring fish species, while, Kandalgaon tank represented predominance of carps.

During the period of investigation all these tanks were auctioned on lease for the period of 3-5 years for fish production. The fishing activities were conducted mainly through gillnet supplemented with cast net along the shallow marginal areas and are harvested and marketed to the local or nearby market either directly or through the intermediaries. However, based on the available observations and commercial catch analysis, the average mean weights were estimated to be about 24.45 kg/catch with approximate annual production 7.3 tones at Kagal tank. It was recorded as 41.21 kg/catch and 30.20 kg/catch, with approximate annual production to about 12.3 tones and 9.6 tones at Kaneriwadi and Kandalgaon tanks respectively (table-5).

Belsare (1986) has mentioned that, production of perennial tanks might be expected to range from 1000 to 3000 kg/ha/year. Considering the average water spread area, the present fish productions were observed as lagging behind than the expected range.

In present investigation the tanks studied were observed to be passing through the following constraints.

The available leasing policy is not uniform therefore, the productivity in present investigation was observed to be running behind the potential productivity due to indefinite and concrete concepts regarding the significance of the production and

utilization of the available production, Probably, vesting the interest of fish farmers.

Unavailability of the seedling at right season and right time might be another factor responsible for lowered rate of the production in these tanks.

In present investigation, these tanks were leased for the period of three years for fish production to private party in case of Kagal tank and to co-operative societies, in case of Kaneriwadi and Kandalgaon tanks. In this situation, the fish farmers are mainly concentrated towards the release of the seedlings and exploit the maximum possible output in a due course of time, rather than concentrating towards the maintainance of such water bodies for steady and long lasting fish production centers.

Lack of complete knowledge regarding fish farming, managerial gap and application of scientific management practices might be the factors which need to be considered in future in order to enhance the fish production from such water bodies.

The tropical water bodies are shallow in nature, besides tropical climate endowed them high production potential and most of them are located in the rural areas such water bodies serve as an ideal location for fish production as well as for the maintainance of the biodiversity of the fresh water habitat. If such water bodies are subjected along with the scientific management practices including, maintenance of proper stocking density of the fish seedlings of indigenous and exotic carps, supplement of organic and inorganic fertilizers for plankton growth and supplementary feeding will prove significant in achieving the expected target of production range i.e. 1000 to 3000 kg/ha from perennial ponds and ultimately, utilization of such water bodies for economical, ecological and aesthetic benefits for mankind. This will set an ideal model before the rural population to obtain maximum possible output from fish production and in maintaining the socio-economic pulse of the fishermen communities related with such perennial water bodies.

Table: 2. showing annual average of physicochemical and biological parameters at stations A, B, C and D at Kagal tank.

Parameter	Station A	S.D.	Station B	S.D.	Station C	S.D.	Station D	S.D.
Temperature ( $^{\circ}$ C)	29.01	$\pm 0.23$	28.93	$\pm 0.23$	28.96	$\pm 0.24$	29.11	$\pm 0.25$
Turbidity (NTU)	8.55	$\pm 0.93$	9.84	$\pm 1.04$	8.05	$\pm 0.68$	13.23	$\pm 0.8$
Transparency (cm)	166.54	$\pm 1.47$	-	-	-	-	-	-
pH	8.8	$\pm 1.48$	8.9	$\pm 1.62$	8.9	$\pm 1.92$	8.9	$\pm 1.95$
D. O. (mg/l)	7.58	$\pm 0.11$	8.18	$\pm 0.11$	7.63	$\pm 0.1$	8.00	$\pm 0.12$
Free CO <sub>2</sub> (mg/l)	0.44	$\pm 0.07$	0.41	$\pm 0.07$	0.38	$\pm 0.07$	0.41	$\pm 0.07$
Alkalinity (mg/l)	132.47	$\pm 3.68$	130.66	$\pm 3.97$	131.27	$\pm 3.68$	130.16	$\pm 3.65$
Hardness (mg/l)	103.33	1.09	101.33	1.00	104.67	1.09	101.11	1.04
Phosphate (mg/l)	0.09	$\pm 0.01$	0.09	$\pm 0.01$	0.1	$\pm 0.02$	0.1	$\pm 0.01$
Nitrate (mg/l)	0.71	$\pm 0.07$	0.66	$\pm 0.07$	0.46	$\pm 0.05$	0.5	$\pm 0.08$
Phytoplanktons u/l	1476.00	-	-	-	-	-	-	-

Zooplanktons orga/l	71.00	-	-	-	-	-	-	-
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Table3: Showing annual average range of some important physico-chemical parameters at stations A, B, C and D at Kaneriwadi tank.

parameters	A	SD	B	SD	C	SD	D	SD
Temperature °C	28.5	± 0.26	28.31	± 0.25	28.33	± 0.24	28.33	± 0.24
Turbidity NTU)	29.5	± 1.39	25.36	± 1.36	23.20	± 1.27	28.44	± 1.38
Transparency cm.	54.65	± 1.23						
pH	8.51	± 0.08	8.54	± 0.08	8.54	± 0.08	8.56	± 0.08
D.O. mg/l	6.11	± 0.14	6.55	± 0.11	6.50	± 0.11	6.26	± 0.12
Free CO <sub>2</sub> mg/l	2.83	± 0.55	3.41	± 0.55	2.83	± 0.55	2.92	± 0.55

Table4: Showing annual average range of some important physico-chemical parameters at stations A, B, C and D at Kandagaon tank.

parameters	A	SD	B	SD	C	SD	D	SD
Temperature °C	28.52	± 0.27	28.5	± 0.26	28.49	± 0.27	28.5	± 0.31
Turbidity NTU)	21.72	± 0.98	18.91	±1.05	14.86	± 1.27	26.33	± 1.11
Transparency cm.	67.54	± 1.66						
pH	8.39	± 0.08	8.41	±0.08	8.34	± 0.08	8.43	± 0.08
D.O. mg/l	5.77	± 0.11	5.99	±0.09	5.66	± 0.11	6.05	± 0.1
Free CO <sub>2</sub> mg/l	5.72	± 0.81	5.91	±0.82	5.52	± 0.7	5.5	± 0.74
Total alkalinity mg/l	195.8	± 3.6	195.48	±3.3	196.16	± 3.42	196.11	± 3.48
Hardness mg/l	154.13	± 1.6	153.91	±1.27	153.44	± 1.37	157.2	± 1.34
Phosphate mg/l	0.11	± 0.008	0.12	±0.01	0.1	±0.008	0.12	± 0.01
Nitrate mg/l	1.13	± 0.11	1.29	±0.13	1.36	± 0.09	1.57	± 0.12
Phytoplankton u/l	378.00							
Zooplankton O/l	34.00							

Table: 5. Showing average minimum and maximum length (cm) and weight (gm) and approximate annual fish production at Kagal, Kaneriwadi and Kandagaon tanks.

Sr. No.	Name of tank	No. of Obs.	Species	No.	Min. Avg. Length	Max. Avg. Length	Min. Avg. Wt.	Max. Avg. Wt.	Mean Wt./ Catch Kg.	Apporox. annual production kg.
1.	Kagal	10	Naturally Occurring	860	19.12	32.15	103.19	323.17	25.49	7647.00
			Carps	09	44.45	44.45	316.66	316.66		
2	Kaneri-wadi	10	Naturally Occurring	464	26.46	39.87	189.98	718.52	41.21	12363.00
			Carps	443	31.57	43.71	382.67	1003.80		
3	Kanda-lgaon	05	Naturally Occurring	05	16.2	20.2	380.00	750.00	15.10	4530.00
			Carps	105	18.00	27.1	580.00	1620.00		

Table: 6 Economic Status in terms of expenditure, fish production and net income per acre at Kagal tank.

<b>A. Capital cost</b>	<b>Amount (Rs)</b>
1. Lease amount	20,000
2. Expenditure on fish seed including transportation	22,000
<b>B. Operational Cost</b>	
3. Expenditure on nets and gears	10,000

4. Cost of harvesting	35,000
5. Expenditure on transportation	3000
6. Miscellaneous	1500
<b>Total (A+B)</b>	<b>91, 500</b>

### C. Production

7. Fish production with an average catch 25.49kg/ operation	7.64 tons.
8. Total income from the sale of fish with the Wholesale rate (Rs. 35/ kg)	2, 67,645
9. Net profit from fish production	1, 76,145
10. Net income per acre Rs.	5,743.45

Table: 7 Economic status in terms of expenditure, fish production and net income per acre at Kaneriwadi tank.

<b>A. Capital cost</b>	<b>Amount (Rs)</b>
1. Lease amount	38,000
2. Expenditure on fish seed include	
2. Expenditure on fish seed including transportation	30,000
<b>B. Operational cost</b>	
3. Expenditure on nets and gears	10,000
4. Cost of harvesting	70,000
5. Expenditure on transportation	4000
6. Miscellaneous	2000
<b>Total (A+B)</b>	<b>1, 54,000</b>

### C. Production

7. Fish production with average catch (41.0kg) per operation	12.36 t.
8. Approximate income from fish sale with Wholesale rate (Rs. 35/kg)	4, 32,705
9. Net profit from fish production	2, 78,705
10. Net income per acre Rs.	4, 917.10

Table: 8 Economic status in terms of expenditure, fish production and net income per acre at Kandalgaon tank.

<b>A. Capital cost</b>	<b>Amount (Rs)</b>
1. Lease amount	25,000
2. Expenditure on fish seed in	
2. Fish seed and transportation	23,000
<b>B. Operational cost</b>	
3. Nets and gears	10,000
4. Cost of harvesting	50,000
5. Transportation of fish	3000
6. Miscellaneous	1500
<b>Total (A+B)</b>	<b>1, 12, 500</b>
<b>C. Production</b>	
7. Fish production with an average catch (15.1kg) per operation	4.53 tons
8. Total income from the sale of fish with the wholesale rate (Rs. 35/ kg)	1, 58,550
9. Net profit from fish production	46,050
10. Net income per acre Rs.	3,607.50

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