Impact of cow-dung and poultry manure on physico-chemical parameters of water in fish rearing ponds

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Abstract

An experiment was conducted in cement cisterns to determine the effect of different organic manures i. e., cow-dung and poultry manure on physico-chemical parameters of water in carps (*Catla catla, Labeo rohita and Cyprinus carpio*) rearing ponds during fry to fingerling stage when they are reared together. Ponds were applied with organic manures *viz.*, cowdung (T_1: CD), poultry manure (T_2: PM) and cowdung + poultry manure (T_3: CD+PM) @ 10,000 kg/ha, 5000 kg/ha and 5,000+5,000 kg/ha respectively. Fry were stocked @ 30/m^2 in the ratio of 4:3:3 (Catla: Rohu: Common Carp) to all treatment and replication tanks. Periodically physico-chemical water quality parameters were recorded. The result revealed that, physico-chemical parameters were found within the productive range for all the treatments. The mean dissolved oxygen level for the period of study was highest in PM treatments followed by CD and CD+ PM treatments. The mean carbon dioxide level was highest in CD treatment (8.33 ppm). Average concentration of carbonate alkalinity varied from 0.00 to 12.00 ppm in PM treatment. The maximum bicarbonate alkalinity of 56.33 ppm was recorded in PM treatment. The maximum nitrate concentration observed was 7.78 mg/L in PM treatment on the 1st week after fertilization. . However, the difference in pH between treatments was non-significant. The pH of water remained slightly alkaline throughout the period of experiment.

Key words: Organic Manures, dissolved oxygen, cow dung, poultry manure, nitrites

1. Introduction

Inland fisheries water bodies including rivers, tanks streams, flood plain lakes, wetlands, estuaries, estuarine wet lands brackish water, backwater and mangroves are major resources. These are being used for irrigation purpose and utilized for fish culture to some extent by creating awareness among the fish growers. Fertilizers used in aquaculture are the same ones which used in traditional agriculture. Scientific studies on fish culture by using different organic and inorganic fertilizers were started only since the beginning of this century. These studies conducted in various parts of the world have given useful information on fertilization practices and proved that fertilization of fish ponds either by organic manures or inorganic fertilizers or by both can increase fish yields considerably (Hepher, 1967). Judicious organic fertilization of fish ponds can eliminate the need for supplementary feeding. The use of manures such as poultry manure, dung from cow, sheep, goat or pig is well established (Priyadarshini, 2011). Plankton perform other important functions in pond aquaculture - a net producer of dissolved oxygen, which is indispensable for fish growth and the most important sink of ammonia-nitrogen, which is excreted by fish (Gangadhar, 2017).

The low-cost fish production needs use of organic fertilizers and better utilization of naturally available food through composite fish culture. The use of organic manure to increase production of fish was known to Chinese as far back as 4thand 5thcenturies. The wide variety of organic manures such as leaf litters, sewage water, livestock manure, industrial waste and night soil have been used to improve fish production. The purpose of pond manuring is primarily to provide adequate amount of nutrients for the phytoplankton. A shorter cycle of plankton production can be possible through the use of organic manure in comparison to the application of inorganic fertilizer. In this respect, a mixture of organic manures and inorganic fertilizers is likely to give better results than any one of them is used separately. However, indiscriminate use of this manure in fish ponds may deteriorate the water quality of the pond. Therefore, it is necessary to know the standard doses of the manures which would keep the physico-chemical parameters of pond water in favorable ranges for survival and growth of fishes. Therefore, the present study was undertaken to understand the effect of different organic manures on physico-chemical parameters of water in fish rearing ponds.

2. Materials and methods:

The experiment was under taken in cement ponds of the Zonal Agricultural and Horticultural Research Station Brahmavara, Udupi District, Karnataka. The size of ponds was equal having 8.57 m^2 each. The average depths of the ponds were 2.5ft. Three types of fertilizer, like cow- dung, poultry manure and cowdung + poultry manure **(**10,000 kg, 5000 kg and 5,000+ 5,000 kg/ha were tried in treatments T_1, T_2 and T_3 respectively. Treatments with three replicates were maintained.

The ponds were prepared by cleaning them properly and added one inch thickness of red soil was added each pond., lime ($CaCO_3$) was applied at a dose of 0.170 g. per m^2 and then after 3 days, the ponds were fertilized properly by organic fertilizers using proper dose in the respective three treatment groups. After 7 days of fertilization, the ponds were stocked with carp fry (Catla:Rohu:Common Carp) at a density of 30 No/m^2 in the ratio of 4:3:3 to the ponds of all the treatments and replications. From the second day of stocking, fry were fed twice daily with a mixture of finely powdered dried groundnut oil cake and rice bran at the ratio of 1:1.

Fertilization

Fresh poultry manure were collected and dried in shade to reduce the moisture content and collected the fermented cow dung. In the first trial all the cisterns were applied with fertilization at the fixed rate of 5000 kg / ha of cow-dung, 2500 kg of poultry manure and cow dung and poultry manure at the rate of 50% +50% on dry weight basis. The initial dose of manure was applied in dry (solid) form in all the cisterns. After Seven days of initial fertilization, the water level in the cisterns was raised to 2.5ft and maintained at that level till the termination of the experiment. Applied 50% of the manures initially to all the cement cisterns.

Refertilization with split doses

The second trial of fertilization was done after 20 days of the first application, the dosage of organic manures applied was in split doses according to the treatments. Refertilization of the manures was applied in liquid form *i.e.*, the dry manure required for an application was made into slurry by addition of water for easy

broadcast and uniformly spread all-overs the surface of the pond. The application of manures was always done in the morning hours as suggested by Woynarovich (1980a).

Water physico-chemical parameters such as dissolved oxygen, pH, carbon dioxide, carbonates, bi-carbonates, nitrites, nitrates and phosphates were recorded at an interval of 7 days throughout the experimental period.

Water analysis

Water inside the cement cisterns is directly used for the estimation of air and water temperature, dissolved oxygen, free carbon dioxide, carbonate and bicarbonate alkalinity, pH, total ammonia, nitrite, nitrate by using HATCH electronic recording machine (APHA 1995). The water except dissolved organic matter and orthophosphate were estimated separately by adopting standard methods. Dissolved organic matter was determined by the procedure recommended by Jhingran *et al*. (1969) and total orthophosphate was determined by the ascorbic acid method given in (APHA, 1976).

3. Results and Discussion:

Organic manures stimulate the growth of fish food organisms both phytoplankton and zooplankton. The conventional practice of use of organic manures is to apply a single large dose at the beginning of the culture period. Whenever refertilization is done, the time gap between two consecutive applications is often too long. The optimum time interval between refertilization is not known. Moreover, the application of large doses of organic manures results in deterioration of water quality. Also the nutrients can be retained in the water only for a short period as they are quickly lost from the water body (Hepher, 1967). Therefore, the plankton production is not sustained for a longer period. This fact leads to wastage of fertilizer resulting in economic constraints to the farmer. Therefore, an ideal pond fertilization practice should involve such manures or fertilizers, which supply all the nutrients and gases in required quantities so as to achieve the maximum biological productivity, which in turn will result in maximum yield of fish.

In present investigation, effect of organic manures viz., cow dung, poultry manure and cow dung+poultry manure on physical, chemical and biological parameters were studied. The data on the dissolved oxygen concentration observed in the different treatments over the period of study are presented in Table 1. After initial fertilization, mean dissolved oxygen concentrations slightly decreased in cow dung (CD) treatments up to the 2^{nd} week (5.00 ppm) and after that, gradually increased and become higher at 5^{th} week (6.43 ppm) and gradually deceases up to 9^{th} week (5.87 ppm). In poultry manure (PM) treatment, dissolved oxygen concentrations was gradually increased up to 4^{th} week (8.03 ppm) but thereafter it was gradually decreased up to 9^{th} week (5.50 ppm). In cow dung + poultry manure (CD + PM) treatment, dissolved oxygen concentrations was gradually increased up to 3^{rd} week (6.57 ppm) but thereafter concentration was fluctuated and maximum at 6^{th} week (7.23 ppm).

After the 3^{rd} week, the dissolved oxygen levels in PM and CD +PM treatments were generally higher than in CD treatment. The fluctuations in oxygen concentrations were lower in CD when compared to PM and

CD+PM treatments. The mean dissolved oxygen concentrations ranged between 4.73 and 6.43 ppm in CD treatments, 3.36 and 8.26 ppm in PM treatments, 4.73 and 7.23 ppm in CD + PM treatment during the experimental period. The minimum dissolved oxygen concentration was 3.36 ppm recorded in PM cistern on the initial day, while the maximum observed was 8.26 ppm in PM cistern on 6th week. The pre-fertilization levels of dissolved oxygen (first sampling day) were generally the lowest values for the treatment period in many cisterns. The mean dissolved oxygen level for the period of study was highest in PM treatments followed by CD and CD+ PM treatments (Table 1). Gogoi *et al*. (2015) opined that variation in DO concentration in aquatic bodies might be caused due to seasonal variation in temperature and fluctuations of photosynthetic and respiratory activities of the aquatic biomass. The low level of dissolved oxygen was in integrated with poultry birds ponds, especially in winter months, reflects the richness of organic matter, which consumes large amount of dissolved oxygen in the process of decomposition reported by Singh *et al*., (2013).

Table 1. Fluctuations of dissolved oxygen (ppm) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	5.23	4.73	5.00	6.13	4.63	6.43	6.20	6.27	5.97	5.87
	S.D.	0.25	0.80	0.66	0.40	0.21	0.72	0.44	1.22	1.82	0.90
Poultry manure	Mean	3.37	4.80	5.70	6.93	8.03	6.70	8.27	6.07	5.83	5.50
	S.D	0.15	0.20	0.70	0.84	0.76	1.05	0.90	1.60	0.15	0.89
Cow dung + Poultry manure	Mean	4.70	4.73	5.33	6.57	6.30	6.53	7.23	6.17	5.93	5.67
	S.D	0.78	0.47	0.47	0.31	0.26	0.29	0.32	0.21	0.83	0.86

In present investigation, after initial fertilization, mean free carbon dioxide concentrations markedly increased in cow-dung treatments, reached maximum on the 3rd week (8.33 ppm). Thereafter, especially during the later period of the experiments, free carbon dioxide was present in all the cisterns on almost all sampling days but lowest concentration was observed in poultry manure cisterns at 9th week (0.07 ppm). The average free carbon dioxide concentrations ranged from nil to 0.77 ppm in PM treatments, 4.57 to 8.33 ppm in CD treatments, 0.00 to 2.64 ppm in CD+PM treatments during the period of study. The maximum free carbon dioxide concentration was 8.33 ppm recorded in CD treatment on the 3rd week. In CD, and PM treatments, the high values of free carbon dioxide were observed on the first sampling day, prior to initial fertilization. The mean carbon dioxide level for the period of experiment was highest in CD treatments, followed by PM and CD+PM treatments in that order (Table 2). Concentration of free CO_2 increases from upstream to downstream. The free carbon dioxide in water supporting good fish population should be less than 5 mg/l (Santhosh and Singh, 2007). Bhatnagar *et al*., (2004) suggested 5-8 ppm is essential for photosynthetic activity; 12-15 ppm is sub lethal to fishes and 50-60 ppm is lethal to fishes. According to Ekubo and Abowei (2011) tropical fishes can tolerate CO_2 levels over 100 mg/g , but the ideal level of CO_2 in fishponds is less than 10 mg/l.

Table 2. Fluctuations of free carbon dioxide (ppm) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	4.57	6.03	7.40	8.33	8.00	8.07	6.67	7.33	6.40	6.93
	S.D	0.91	0.15	1.22	0.58	1.00	0.12	1.15	1.15	1.44	1.85
Poultry manure	Mean	2.16	0.31	0.00	0.00	0.18	0.00	0.77	0.11	0.52	0.07
	S.D	0.38	0.35	0.00	0.00	0.21	0.00	0.15	0.10	0.35	0.12
Cow dung + Poultry manure	Mean	2.64	0.23	0.00	0.00	0.07	1.00	1.57	0.00	0.09	0.84
	S.D	1.52	0.21	0.00	0.00	0.12	0.35	0.41	0.00	0.16	0.17

In present investigation, carbonate alkalinity was absent from 1st to 9th week in CD treatment. In poultry manure treatment, carbonate concentration was gradually increased and maximum at 3rd week (12.00 ppm). After each application of split dose of manure, carbonates alkalinity increased noticeably only in PM and CD+PM treatments. From the 6th to 8th week, carbonate alkalinity was absent in all the treatments. Average concentration of carbonate alkalinity varied from 0.00 to 12.00 ppm in PM treatment, 0.00 to 6.00 ppm in CD+PM treatment and completely nil in CD treatment, during the period of study (Table 3).

Table 3. Fluctuations of carbonates (ppm of CO_3) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	S.D	2.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poultry manure	Mean	0.00	0.67	8.67	12.00	0.67	10.67	0.00	0.00	0.00	4.00
	S.D	0.00	1.15	3.06	4.00	1.15	6.11	0.00	0.00	0.00	6.93
Cow dung + Poultry manure	Mean	0.67	0.33	4.33	6.00	0.33	5.33	0.00	0.00	0.00	2.00
	S.D	1.15	0.58	1.53	2.00	0.58	3.06	0.00	0.00	0.00	3.46

After initial fertilization, mean bicarbonate alkalinity increased up to 3rd week (56.33 ppm) in CD treatment. In PM treatment, mean bicarbonate alkalinity increased up to 9th week (56.33 ppm). The average bicarbonate alkalinity concentrations varied from 27.67 to 56.33 ppm in CD treatment, 27.66 to 56.33 ppm in PM treatment, 28.00 to 52.00 ppm in CD+PM treatment during the experimental period. The minimum bicarbonate alkalinity was observed on the first sampling day in all the cisterns and the maximum bicarbonate alkalinity of 56.33 ppm was recorded in PM treatment. The mean concentration of bicarbonate alkalinity over the period of study was the highest in PM treatments, followed by other treatments (Table 4).

Table 4. Fluctuations of bicarbonates [ppm of (HCO_3)] in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	29.00	43.67	50.67	56.33	44.33	51.00	46.33	40.33	39.00	39.33
	S.D	1.00	1.53	2.08	7.51	7.51	5.57	6.51	3.06	5.20	3.06
Poultry manure	Mean	27.67	34.00	39.67	41.33	45.67	48.33	47.67	51.33	46.33	56.33
	S.D	2.52	5.29	4.51	2.89	1.53	2.52	4.73	15.89	16.26	5.13
Cow dung + Poultry manure	Mean	28.00	38.67	46.00	48.33	44.67	49.00	48.00	45.67	43.00	52.00
	S.D	1.00	3.21	26.63	2.31	3.51	7.94	6.56	11.59	8.54	5.57

In present investigation, after initial fertilization, the pH increased in PM and CD+PM treatments up to the 3rd week. But after refertilization, pH declined in PM and CD+PM at 4th week. After subsequent application of each split dose of manure, pH increased slightly in PM and CD+PM treatments, whereas in CD treatment, the pH values remained more or less constant. The average water pH ranged from 7.67 to 8.27 in CD treatment, 7.40 to 8.77 in PM treatment, 7.73 to 8.40 in CD+PM treatment during the experimental period. However, the difference in pH between treatments was non-significant. In general, the pH of water remained slightly alkaline throughout the period of experiment (Table 5). Comparatively lower p^H values were observed in cattle dung treated pond, with low dissolved oxygen content. This may be due to the utilization of dissolved oxygen by the algal bloom and zooplankton swarms as well as due to the decomposition of organic matter. The hydrogen ion activity is often used as an index (p^H) of water quality indicating fertility or potential productivity of water as reported by Nandeesha (1982). Gangadhar et al. (2017) evaluate the three manures viz. cattle dung, poultry manure and press mud on water qualities. They reported that, tanks applied with cattle dung recorded lower (P>0.05) pH.

Table 5. Fluctuations of pH in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	8.13	7.67	7.70	8.03	8.03	8.27	8.07	8.07	8.00	8.00
	S.D	0.31	0.12	0.10	0.06	0.06	0.46	0.12	0.12	0.00	0.00
Poultry manure	Mean	7.40	8.13	8.53	8.77	8.20	8.53	8.03	8.23	8.07	8.30
	S.D	0.10	0.23	0.15	0.06	0.20	0.06	0.06	0.06	0.12	0.10
Cow dung + Poultry manure	Mean	7.73	7.90	8.10	8.40	8.10	8.37	8.03	8.13	8.03	8.13
	S.D	0.15	0.10	0.10	0.10	0.10	0.29	0.06	0.06	0.06	0.06

After initial fertilization, mean dissolved organic matter concentration increased in CD, PM and CD+PM treatments up to 3rd week. While it declined slightly in all the treatment on the 4th week. The dissolved organic

matter was more in CD treatment compared to other two treatments up to the 3rd week and thereafter, it was higher in PM treatment. The amplitude of fluctuation was more or less similar and gradual in PM and CD+PM treatments, whereas the same were sharp and more prominent in CD and PM treatments. The average dissolved organic matter concentration fluctuated from 3.47 to 11.07 ppm in CD treatment, 4.40 to 10.33 ppm in PM treatment, 4.37 to 10.60 ppm in CD+PM treatment during the period of observation (Table 6). Decomposition of organic manure in fish pond is carried out by bacteria, fungi and actinomycetes. Periphytic biota, including these organisms would have contributed to higher nutrient release for periphytic growth as stated by Gangadhar *et al*., (2017). Split manuring has therefore brought about differences in treatments with respect to DOM, the lower manuring frequencies (CD and CD+PM) showing lesser DOM levels with smaller fluctuations

Table 6. Fluctuations of dissolved organic matter (ppm) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	5.53	11.07	8.60	9.93	7.27	5.13	8.67	7.43	5.33	3.47
	S.D	1.14	1.10	0.60	0.64	1.17	0.95	0.61	0.49	0.61	1.01
Poultry manure	Mean	4.40	10.13	8.33	9.33	7.30	6.77	10.33	7.77	6.07	5.27
	S.D	0.53	1.50	0.93	0.83	1.05	0.35	0.61	0.85	0.90	0.99
Cow dung + Poultry manure	Mean	4.97	10.60	8.43	9.63	7.27	5.93	9.50	7.57	5.70	4.37
	S.D	0.75	0.72	0.61	0.49	0.23	0.32	0.53	0.59	0.36	0.78

In present study, after initial fertilization, mean nitrite levels increased slightly in PM and PM+CD treatments up to 3rd week while it was decreased on 4th week. Where as in PM and CD+PM treatments irregular fluctuations occurred. However nitrite concentrations were generally very low in CD treatment in many occasions, it was recorded only in traces. The average nitrite-nitrogen concentrations ranged from 0.00 to 0.12 mg/L in CD treatment, 0.00 to 1.08 mg/L in PM treatment, 0.06 to 0.57 mg/L in CD+PM treatment during the period of study (Table 7). The ammonia and nitrite were toxic to the fish, nitrate is harmless and is produced by the autotrophic *Nitrobacter* bacteria combining oxygen and nitrite. Nitrate levels are normally stabilized in the 50-100 ppm range. Nitrate ranges were 80 mg/ l in poultry droppings, 25.0mg/ l in cow dung and 12.5 mg/ l in the control (Lyiola *et al*., 2015).

Table 7. Fluctuations of nitrite - nitrogen (mg / L) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	0.18	0.06	0.12	0.00	0.00	0.00	0.00	0.00	0.07	0.00
	S.D	0.00	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.13	0.00
Poultry manure	Mean	0.00	1.08	0.27	0.57	0.30	0.70	0.12	0.53	0.22	0.40

	S.D	0.00	0.26	0.10	0.25	0.32	0.66	0.11	0.16	0.39	0.70
Cow dung + Poultry manure	Mean	0.09	0.57	0.21	0.29	0.15	0.35	0.06	0.27	0.15	0.20
	S.D	0.00	0.07	0.07	0.12	0.16	0.33	0.06	0.08	0.26	0.35

The fluctuation in nitrate content was relatively less and also gradual in CD and CD +PM treatments, whereas the fluctuations were sharp in PM treatments being more pronounced in the later treatment. The average nitrate concentrations ranged from 0.26 to 2.43 mg/L in CD treatment, 2.21 to 7.78 mg/L in PM treatment, and 2.00 to 4.22 mg/L in CD + PM treatment during the period of investigation. The maximum nitrate concentration observed was 7.78 mg/L in PM treatment on the 1st week after fertilization. The mean nitrate concentration for the duration of the study was the highest in PM treatment, followed by CD+PM, and CD treatments (Table 8).

Table 8. Fluctuations of nitrate-nitrogen (mg / L) in different treatments

Treatments	**Cisterns**	**Initial**	**1st week**	**2nd week**	**3rd week**	**4th week**	**5th week**	**6th week**	**7th week**	**8th week**	**9th week**
Cow dung	Mean	2.43	0.66	0.58	0.35	0.59	0.45	0.26	0.43	0.53	0.38
	S.D	1.27	0.29	0.34	0.15	0.04	0.05	0.06	0.14	0.04	0.05
Poultry manure	Mean	2.21	7.78	5.14	5.72	7.29	6.52	3.74	4.23	3.77	2.45
	S.D	0.93	1.61	3.00	0.52	0.30	1.31	1.09	0.64	0.50	0.61
Cow dung + Poultry manure	Mean	2.32	4.22	2.40	3.04	3.93	3.48	2.00	2.33	2.15	1.42
	S.D	0.19	0.95	0.91	0.24	0.18	0.67	0.58	0.25	0.23	0.33

Mean total orthophosphate levels increased markedly in PM and PM+CD treatments up to the 3rd week. Thereafter, total orthophosphate content was fluctuated in PM and PM+CD treatments up to the 6th week. Subsequent to the addition of every split dose of manure, there was a slight increase in total orthophosphate in PM treatment in the following week especially towards the later part of the experiment. The mean concentration of total orthophosphate varied from 0.00 to 0.30 mg /L in CD treatment, 94.33 and 468.33 mg /L in PM treatment, 46.33 to 206.67 mg /L in CD+PM treatment during the experimental period. The maximum total orthophosphate concentration of 468.33 mg /L was recorded in PM treatment on 3rd week after fertilization. The mean total orthophosphate concentration was higher PM treatment when compared to the CD and PM+CD treatments (Table 9). Phosphates are known to be readily and quickly removed from water by plankton, macrophytes and due to fixation in the soil. The total orthophosphate concentration varied from traces to 820 micro grams at P/L indicating the productive nature of the water. The productive pond waters contain 0.2-0.5 ppm of phosphate (Sinha *et al.*,1985).

Table 9. Fluctuations of phosphate (mg / L) in different treatments

Treatments	Cisterns	Initial	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
Cow dung	Mean	0.00	0.30	0.02	0.01	0.01	0.00	0.01	0.05	0.00	0.00
	S.D	0.00	0.11	0.01	0.01	0.01	0.00	0.01	0.07	0.01	0.00
Poultry manure	Mean	94.33	186.00	270.00	468.33	315.00	306.00	81.67	216.67	104.00	322.33
	S.D	22.37	26.51	45.83	76.54	31.22	70.87	20.82	84.01	28.51	82.71
Cow dung + Poultry manure	Mean	46.33	92.92	135.00	206.67	157.33	152.67	40.33	108.00	51.67	161.00
	S.D	11.85	12.92	22.91	42.52	15.70	35.23	10.41	42.23	14.50	41.07

Pratap Chandra *et al.*, (2015) reported that, in organic input, presence of soil substrate caused significantly lower value of pH, dissolved oxygen, dissolved organic matter and phosphate-phosphorus and significantly higher free CO_2, alkalinity, hardness, ammonia, nitrite and nitrate contents, compared with those in the absence of soil, revealing enhanced microbial mineralization in the presence of soil.

4. Conclusion:

In aquaculture, the productivity of water depends primarily on the physico-chemical and biological characteristics of water. The optimum range of physico-chemical parameters of water enhances the fish productivity. In this study, all the parameters are in permissible range and organic fertilization was supported the production of phyto and zooplanktons through optimum physico-chemical parameters of water. Poultry manure and cow dung + poultry manure was found to be superior in maintaining the physico-chemical parameters in fish rearing ponds.

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