



Physico-Chemical Parameters of the Fish Farming Paddy Field at Moyna Block of Purba Medinipur District of West Bengal, India

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Abstract

The research work was conducted to measure the water quality parameters during the period of July 2013 to December, 2013 at Moyna. Physico-chemical characteristics of water & soil very significant in paddy cum fish culture field which in general controls the productivity of the water bodies. Bottom soil plays an important role in the fertility of the water body. It provides shelter and food to the bottom micro-biota which help in the mineralization of organic bottom deposits and governs the storage and release of nutrients in the water phase. In general, therefore, the physical & chemical properties of water in a water body are more or less a reflection of the properties of its bottom soil. Chemical factors such as pH, DO, alkalinity, free Carbon dioxide, total Hardness, Ca, Mg, specific Conductivity etc. are also play a vital role in the biological process in water bodies. Sediment characteristics values depict productive range for better rice as well as fish production. The physico-chemical parameters of the water of the impoundment reveal that water level supported a conductive caring capacity resulting in better fish growth.

Keywords: Physicochemical, sediment character, productivity, rice and fish production.

Introduction

Both rice and fish are immensely important to the livelihoods of the rural poor in India as both a source of nutrition and as a source of income. Rice and fish are considered to be the main sources of food in this region. It has been estimated that rice constitutes as much as 60% of the daily food intake of the majority of Asians. Rice consumption in West Bengal, India is reported to be 139.68 kg/head/year and 127.56 kg/head/year (1993-1994) in rural and urban areas of India respectively¹. Production of fish in rice fields is almost as old as the practice of rice or paddy culture itself (combined culture of rice and fish is also known as Paddy-cum-fish culture^{2,3}. Whenever, water is stagnated within bunds as for rice culture, fish which naturally occur in the irrigation water and nearby tanks and pools enter the paddy-fields and grow there until harvest, along with the paddy^{4,5}. Thus fish production in rice fields dates from very early days, even though it was based on capture rather than culture⁶.

The research work was conducted to measure the water quality parameters during the Period of July 2013 to December 2013 at Moyna. Total area of the block 147 sq. Kms. Total population for the block 1, 96,503 (37 thousand families) approx. Paddy field utilized as pisciculture field 47 Mouza, area – 5282 hector. Approximate 10000 families (approx) engaged in fish and fisheries in moyna development block. Only 8500 fish farmers families (approx.) engaged in fish culture. Species culture mainly Indian Major Carp (IMC), exotic carp (EC), fresh water prawn, tiger prawn. Fish market i. Annapurna market, ii. Moyna market, iii. Balaiponda Market shows nearly production in the

per Block 20,000 – 25,000 Ton, Value in Rupees 170 cores (Rate Rs. 80/kg) (approx.). Average fish Production 4000 kg to 4500 kg/hectar within 6 months culture. Source of fund, maximum paddy cum fish culture farmers are tagged with mahajani loan, otherwise take Dadan from local Aratdar.

Material and Methods

Four paddy field were selected at Moyna block, Purba Medinipur for this research. Six sites are different mouza of this block. These sites are Site-I (Paramananda Pur), Site-II (Dakshin Changra Chak), Site-III (Dakshin Anukha), Site-IV (Bhandar Chak), Area of each site is approximate 50-100 Hecter, 1.3 meter in depth. From these six water bodies; water was collected and studied the physico-chemical parameters once in a month. The study in this context was conducted from July 2011 to December 2011 at Moyna. These water bodies are used as rearing site where fingerlings are left for 6 months for growing as market fish. After harvesting of fish, paddy cultivation are started. During this 6 months fisher man controlled physico-chemical condition and maintain all type culture method i.e. they applied different nutritional supplemental fish feed, anti fungal and anti bacterial medicine for better growth. This culture technique totally commercial process and rate of growth are high than other natural fish culture. The fishes were caught from the study areas using dip nets and different mesh sized cast nets. Water quality data viz. temperature (⁰C), pH, alkalinity (ppm.), dissolved oxygen (ppm.), free Carbon-dioxide (ppm.) and total hardness (ppm.) were recorded on the day using APHA method. Most samplings of water were done between 7 A.M. to 11 A.M. from the surface

layer near the shore. The temperature was collected, at the time of sampling, on the spot, using centigrade thermometer. pH was measured with standard pH meter. The other parameters were estimated by the procedures^{7,8,9}.

Results and Discussion

Water Quality Parameter: The monthly variations of physicochemical parameters of water of the four sampling sites recorded during the period of investigations are shown in table 1. Water temperature showed variations in different months of the study period in four water bodies. The present communication is an attempt to analyse the water quality of the paddy cum fish culture field at Moyna Block with respect to water depth, water temperature, pH, alkalinity, free CO₂, dissolve oxygen, Calcium as CaCO₃ equivalents, Magnesium as CaCO₃ equivalents, total hardness, specific conductivity, turbidity.

Water Temperature: The water temperature was ranged from 22.8°C - 31.7°C. The high temperature (31.7°C) in hot and wet summer (July) was recorded at site-I (Paramananda pur) and lowest temperature (22.8 °C) was recorded during cold winter (December) at Site-II (Dakshin Changra Chak) and Site-III (Dahshin Anukha). The all over mean temperature ranged from 27.63°C - 27.95°C. It was noticed that the temperature was highest in hot and wet summer and lowest in cold winter. It observed that during summer, the water temperature was high due to the low water level and clear atmosphere, which is quite similar to the results obtained in the present study of the paddy cum fisheries field¹⁰.⁸Research may observed that 25°C -31°C temperature is suitable for fish culture and below 14°C is harmful for fish culture.

Water Depth: The water depth was ranged from 1.4 meter – 1.7 meter. The highest depth (1.7meter) in rainy season (September) was recorded at site-IV. The all over mean water depth ranged from 1.55 meter -1.60 meter. The paddy field is filled with rainy water, some time by artificial irrigation technique. It is a commercial culture process, so some time the farmer takes artificial irrigation technique.

pH: The p^H values ranged from 6.8-7.9. The mean value ranged from 7.25 - 7.37. It also stated that the pH values varied from 7.4 – 8.5 suitable for aquatic organisms¹¹. The maximum pH was 7.9 in winter (December) at site-II and minimum was 6.8 in hot and wet summer (July) at site-II.¹⁷ Result observed that pH value 6.5- 9 is suitable for fresh water fish culture and p^H value below 4 and above 11 is harmful.

Free CO₂: The value of free carbon dioxide ranged from 2.6ppm - 10ppm. The mean values are 6.5±1.475ppm, 6.08±2.353ppm, 4.52±0.699ppm, 4.6±1.560ppm. at sites- I, II, III, and IV respectively. The highest free carbon dioxide value is 6.5±1.475 ppm at site -I and minimum is 4.52±0.699ppm at site

-III. It also stated that below 12ppm free carbon dioxide is suitable and above 12ppm is harmful for fish culture¹².

Total Alkalinity: The total alkalinity ranged from 34 ppm – 160 ppm. The highest alkalinity is 160 ppm at site- I and site-II in the month of August and minimum alkalinity is 34 ppm at site-II in the month of October. The mean values are 116±53.755 ppm, 114.83±57.39 ppm, 115±58.11 ppm and 107.5±49.52 ppm, at sites -I, II, III and IV respectively. Stated that 40-200 ppm alkalinity is suitable for fish culture and below 15 and above 300 is harmful fish culture¹².

Dissolved Oxygen: Dissolved oxygen is an essential water parameter which maintains the level of Oxygen to aquatic organisms. The Dissolve Oxygen content (DOC) of a fishery sector to subject to physical, chemical and biological controls. The ultimate source of oxygen in water body is the atmosphere, although its solubility in water body depends heavily on temperature and pressure. The DO values ranged from 4.4 – 10.4 ppm with the mean value range of 6.53-8.08ppm. The DO value is maximum (10.4±1.281ppm) in hot and wet summer (August) at site-IV and minimum (4.4±2.077 ppm) in cold winter (November) at site-I. It is observed that DO value was high during the rainy season. It also observed that DO value 5-7 is suitable fish culture and below 1.0 is harmful for fish culture¹³.

Calcium (Ca) as CaCO₃ equivalents: The calcium value ranged from 59.5 - 149.41 ppm. The maximum value is 149.41 ± 21.592 ppm at Site- III in month of August and minimum value 59.5 ± 38.368 ppm at site-IV in the month of October. The mean value ranged from 107.9 - 124.5 ppm. The calcium level is slightly high than natural water body because it is a commercial technique for fish culture¹³. They are applied lime for better treatment.

Magnesium (Mg) as CaCO₃ equivalents: The Magnesium value ranged from 49.32-118.36 ppm. The maximum value is 118.36±24.49 ppm at Site- I in month of September and minimum value 49.32±24.49 ppm at site-I in the month of December. The mean value ranged from 80.55-93.71 ppm.

Total Hardness (TH): Total hardness ranged from 138.4 - 257.9 ppm. The maximum value of TH is 257.9±28.55 ppm at site-III in the month of August and the minimum is 138.4±37.64 ppm at site-IV in the month of October. The mean value ranged from 193.43 – 214.92 ppm. However that total hardness value 40-200 ppm is suitable for fish culture and below 15 ppm and above 300 ppm is harmful for fish culture¹⁴. Here TH value is high than other natural water bodies, due to the farmers are applied lime for better treatment.

Specific Conductivity: Specific conductivity ranged from 180.5 – 215.4 m.mohs/cm. The maximum value of specific conductivity is 215.4±12.890 m.mohs/cm at site-II in the month of July and the minimum is 180.5±12.890 m.mohs/cm at site-II

in the month of December. The mean value ranged from 199.17 - 201.57 m.mohs/cm. The specific conductivity ranged in all water bodies was observed to be optimum for better fish production.

Turbidity: Turbidity ranged from 16 - 48 NTU. The maximum value of specific conductivity is 48±10.074 m.mohs/cm at Site-I in the month of August and the minimum is 16 ± 13.706 NTU at Site-II in the month of November. The mean value ranged from 31.83 – 36.0 NTU. The turbidity ranged in all water bodies was observed that it fluctuated due to rain water⁹.

Sediments Characteristics of the Soil: The sediment characteristics of the soil of Moyna indicate that soil texture of the impoundments was water retentive and conductive for rice cultivation. The pH ranged between 6.30 and 7.0. The total nitrogen (mg/100mg) ranged from 0.07-0.21, available nitrogen (mg/100g) ranged from 41.10 - 49.08 phosphorus (mg/100mg) ranged from 0.46-1.10, organic carbon (%) ranged from 1.0-2.35, free CaCO₃ (%) ranged from 4.15-5.20. The C/N ratio ranging from 10.10 to 12.10 definitely catalyzed boosting of fish production.

Table-1
Water Parameters of paddy cum fish culture field at different site

Parameters	Sites	Month						Range/mean	SD
		July 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013	Dec 2013		
Water Depth (Meter)	Site-I	1.4	1.5	1.6	1.6	1.6	1.6	1.4-1.6 1.55	0.083
	Site-II	1.5	1.5	1.5	1.6	1.5	1.5	1.5-1.6 1.52	0.040
	Site-III	1.4	1.5	1.6	1.6	1.6	1.6	1.4-1.6 1.55	0.083
	Site-IV	1.4	1.6	1.7	1.7	1.6	1.6	1.4-1.7 1.6	0.109
Temperature (°C)	Site-I	31.7	31.4	29.4	27.9	24.2	23.1	23.1-31.7 27.95	3.6232
	Site-II	31.5	31.5	29.6	27.7	24.6	22.8	22.8-31.5 27.95	3.625
	Site-III	31.5	31.2	29.3	27.5	24.4	22.8	22.8-31.5 27.78	3.585
	Site-IV	31.0	31.0	29.1	27.8	23.9	23.0	23-31 27.63	3.471
pH	Site-I	7.5	7.2	7.1	7.6	7.4	7.4	7.1-7.6 7.37	0.186
	Site-II	6.8	7.4	7.5	6.9	7.0	7.9	6.8-7.9 7.25	0.423
	Site-III	7.4	7.5	7.2	7.5	7.3	7.1	7.1-7.5 7.33	0.163
	Site-IV	7.2	7.1	7.4	7.1	7.1	7.6	7.1-7.6 7.25	0.207
DO (ppm)	Site-I	7.0	6.4	7.0	4.4	10	4.4	4.4-10 6.53	2.077
	Site-II	7.4	10	8.2	4.8	8.0	8.8	4.8-10 7.87	1.742
	Site-III	7.2	9	9.1	6	8.8	7.8	6-12 7.48	2.034
	Site-IV	6.8	10.4	7.0	8	8.1	8.2	6.8-10.4 8.08	1.281
Free CO ₂ (ppm)	Site-I	4.8	5.0	7.2	7.5	8.5	6.0	4.8-8.5 6.5	1.475
	Site-II	3.8	4.0	6.0	10	7.5	5.2	3.8-10 6.08	2.353

	Site-III	3.8	3.6	4.8	4.5	5.0	5.4	3.6-5.4 4.52	0.699
	Site-IV	2.6	2.8	5.2	5.5	6.5	5.0	2.6-6.5 4.6	1.560
Alkalinity (ppm)	Site-I	160	158	152	46	50	130	50-160 116	53.755
	Site-II	150	152	155	34	48	150	34-155 114.83	57.391
	Site-III	160	160	154	40	42	134	40-160 115	58.113
	Site-IV	140	142	150	44	45	124	44-150 107.5	49.524
Calcium As CaCO ₃ equivalents (ppm)	Site-I	109.56	79.68	119.52	109.56	139.44	119.52	79.6-139.4 112.88	19.585
	Site-II	99.60	99.60	99.60	139.44	119.52	89.64	89.6-139.4 107.9	18.275
	Site-III	119.52	149.41	139.44	99.60	139.44	99.60	99.6-149.41 124.5	21.592
	Site-IV	109.56	149.40	69.72	59.56	149.40	119.52	59.5-149.4 109.53	38.368
Magnesium As CaCO ₃ equivalents (ppm)	Site-I	59.18	88.77	49.32	88.77	78.91	118.36	49.3-118.36 80.55	24.492
	Site-II	78.91	98.64	78.91	108.50	88.77	108.56	78.9-108.5 93.71	13.609
	Site-III	78.91	108.50	78.91	88.77	98.64	88.77	78.9-108.5 90.42	11.531
	Site-IV	98.64	59.18	88.77	78.91	78.91	108.50	59.18-108.5 85.485	17.273
Total Hardness (ppm)	Site-I	168.74	168.45	168.84	198.33	218.35	237.88	168.4-237.8 193.43	29.863
	Site-II	178.51	198.34	178.51	247.94	208.29	198.20	178.5-247.9 201.63	25.614
	Site-III	198.43	257.90	218.35	188.37	238.08	188.37	188.3-257.9 214.92	28.555
	Site-IV	208.20	208.58	158.49	138.47	228.31	228.02	138.4-228.31 195.01	37.648
Specific Conducti vity m.mohs/cm	Site-I	213.5	210.2	205.1	204.7	187.5	185.2	185.2-213.5 201.03	11.859
	Site-II	203.7	215.4	205.9	202.3	187.2	180.5	180.5-215.4 199.17	12.890
	Site-III	211.3	213.9	212.2	192.5	198.5	181.0	181-213.9 201.57	13.225
	Site-IV	210.2	202.1	209.5	202.2	187.5	184.0	184-210.2 199.25	11.067
Turbidity (ntu)	Site-I	38	48	40	22	25	28	22-48 33.5	10.074
	Site-II	47	45	38	17	16	32	16-47 32.64	13.706
	Site-III	38	47	39	35	30	27	27-47 36	7.099
	Site-IV	45	44	32	25	24	21	21-45 31.83	10.457

Table-2
Sediment Parameter of Soil

Site	p ^H	Total Nitrogen mg/100g	Available Nitrogen mg/100g	Available P ₂ O ₅ mg/100g	Organic carbon (%)	Free CaCO ₃ (%)	C/N Ratio
Site-I	7.00	0.07	42.12	0.46	1.0	5.20	10.5
Site-II	6.50	0.18	46.08	1.10	2.12	4.15	9.80
Site-III	6.30	0.09	43.21	0.54	1.10	5.20	12.10
Site-IV	6.60	0.21	41.10	0.89	2.35	4.50	10.10

Conclusion

The fish yield from four water body of Moyna portrayed an encouraging venture. The fish yield varied between 4000 to 4500 kg/ha./6 month. The growth of carps were observed to be moderate ranging from 250gm- 900gm. A large number of varieties of wild fishes were also recorded which also good price in the market. The physico-chemical parameters of the water of the impoundment reveal that water level supported a conducive caring capacity resulting in better fish growth¹⁵. The sediment characteristics of the soil of Moyna indicate that soil texture of the impoundments were water retentive and conducive for rice cultivation. Sediments parameter depicts productive range for better rice as well as fish production. The C/N ratio definitely catalyzed boosting of fish production. This type of paddy cum fish culture is a commercial culture technique, so some parameters differ from other natural process¹⁶.

References

- Saha N.K. and Bardhan Roy S.K., Rice-fish cultivation in seasonally flooded deep water ecosystem in West Bengal, India. Workshop on sustaining and increasing the productivity of fish and rice in seasonally flooded ecosystem in South and South East Asia, Dhaka: June 12-16 (2001)
- Kutty M.N., Pisciculture in a farm complex, Seminar on role of sugar factories in rural development, Sugar Technologists Association of India, Bombay, Oct. 1976 (1976)
- Jhingran A.G., Integrated fish-livestock-crop farming and Its role In developing rural economy, *Bull. Cent. Inland Fish. Res. Inst., Barrackpore.* (48), 1.1-4 (1986)
- Nguyen S.H., Bui A.T., Le L.T., Nguyen T.T.T. and De Silva S.S., The culture based fisheries in small, farmer-managed reservoirs in two Provinces of northern Vietnam: an evaluation based on three production cycles, *Aquaculture Research*, 32, 975-990 (2001)
- Datta S.K., Konar S.K., De D., Banerjee S.K. and Pandit P.K., Deep water rice-fish culture, *IRRI News letter*, 10(2), 30-31 (1985)
- Anon, Hand book on fishing statistics of West Bengal, Department of Fisheries, Government of West Bengal; 104 (2004)
- APHA, Standard Methods for the examination of water and waste water, 22nd Edition, Washington D.C. (2012)
- NERI, Manual on water and waste water analysis, National Environmental Research Institute, Nagpur M.S., India (1986)
- WHO, Guideline for drinking water quality recommendation, World Health Organization, (1984)
- Salve B.S. and Hiware C.J., Studies on water quality of Wanparakalpa reservoir, Nagpur, near Parli Vaijnath district Beed, Marathwada region, *J Aqua Biol*, 21(2), 113-117 (2006)
- Subbamma D.V. and Rama D.V., Plankton of temple pond near Machaliptanum, *J. Aqua. Boil.*, 7, 17-21 (1992)
- Jhingran V.G., Fish and Fisheries of India – Second ed. Hindustan Publishing Corporation, New Delhi, 666 (1988)
- Rao A.P. and Singh R., Rice-fish farming system, In: S.H. Ahmed (ed.) Advance in fisheries and fish production. Hindustan Publishing Corporation, New Delhi, India, 309 (1998)
- Anon, Final report on Increasing and sustaining the productivity of fish and rice in the flood prone ecosystems in South and Southeast Asia, World Fish Centre, penang; Malaysia (2002)
- Ali A.B., Rice? Fish farming in Malaysia: A resource optimization, *AMBIO*, 19(8), 404-408 (1990)
- Shyam R., Status of fisheris in India. In: S.H. Ahmed (ed.) Advances in fisheries and fish production, Hindustan Publishing corporation, New Delhi, India, 309, (1998)