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Limnological characteristics of ponds for improvement of livelihood of fishermen through aquaculture

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Abstract: Water quality analysis was carried out in 3 ponds in three separate villages in Khurda district in order to prepare the ponds for aquaculture. The physico-chemical parameters chosen for study were, Rain fall, Relative humidity, Atmospheric temperature, Total alkalinity, Specific conductivity, dissolved organic matter, Calcium, Magnesium, Potassium, Ammonia nitrogen, of water as shown in tables & Figs I to VIII. After analysis, the villagers have been trained to prepare the ponds for aquaculture following standard guidelines empowering the local population with the techniques to enable them to earn their livelihood.

Key words: Aquaculture; chemical; physical; parameters; ponds; villagers.

INTRODUCTION

That water quality of a water body is determined by studying its physical, chemical, biological characteristics is known Boyd, (1998); Panda *et al.,* (2015); Adeniji and Ovie (1982). Any change in any of these parameters alters culture growth and development of aquatic organism Gupta, (2006); Jhingram, (1985). It was also observed that in a polluted aquatic medium, the quantity of fish flesh also differs Zweig *et al.,* (1999). Temperature, turbidity, suspended solids, dissolved oxygen conc. are among other factors that determine the quality of a water body Adeniji and Ovie, (1982); Nikolosky, (1963). Limnological characters of ponds lakes and rivers have been studied Panda, *et al.,* (2015); Olopade, (2013); Shivasharanappa, and Prakash (2013); Baliarshingh *et al.,* (2013); Parida *et al.,* (2013).

The inland fresh water ecosystems suffer from increased irresponsible human activities Wood and Gibson, (1974); Hemasundaram (2003); causing eutrophication from domestic sewage, industrial effluents and runoffs is known. The present study aims at estimating the physical and chemical characteristics of three selected community ponds which were not used for fish cultivation earlier.

MATERIALS AND METHODS

Three community ponds of three villages Khudupur, Podopada, Barapada were chosen for analysis of water quantity. For convenience of study these were designed as P1, P2 and P3 respectively. The parameters chosen for study were Rain fall, Relative humidity, Atmospheric temperature, Total alkalinity, Specific conductivity, Dissolved organic matter, calcium, magnesium, sodium, potassium, and ammonia nitrogen.

The Rain fall, Relative humidity and Atmospheric temperature were recorded from meteorological department, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. Other parameters of pond water were estimated following the methods of APHA, (1989) using water testing kits (NICE).

RESULTS

The results obtained from water quality analysis during the period of study from Nov. 2011 to Nov. 2012 were as follows: Tables and figures I to VIII. The rain fall recorded was minimum in March 2012 (5.3mm) and maximum 348.9 mm in October of the same year. The relative humidity was minimum 74% in April and 89% in August. Atmospheric temperature was minimum 17°C in Dec. and maximum 33°C in Feb. (Table I, Fig.I). The specific conductivity of water Table II, Fig. II varied from 284 in Nov. to 484 in P1, from 364 in Oct. to 660 in April in P2 and from 394 in Oct. to 672 in March in P3.

Table I: Variations in average rainfall (mm) relative humidity (%) atmospheric temperature (^{0}C) in the study area.

Year	Month	Rainfall	Relative Humidity	Atm. Min.	Temp. Max.
2011	Nov	108,2	80	22	29
2011	Dec		80	17	28
2012	Jan	5,9	86	19	29
2012	Feb	12,9	76	20	33
2012	Mar	5,3	76	23	32
2012	Apr	28,2	74	25	32
2012	May	20,7	78	27	34
2012	Jun	216,1	84	26	32
2012	July	116,5	80	26	32
2012	Aug	344,3	89	26	33
2012	Sept	162,2	84	26	32
2012	Oct	348,9	88	24	31

Dissolved organic variation Table III, Fig. III in P1 was 0.4> in Feb. and 1.3 in Nov., in P2 it was 1.0 in May and 3.45 in Dec. and in P3, the variation was 1.2 in June and 4.62 in Dec.

Calcium content analysis revealed Table IV, Fig. IV 38.12 in August and 120.24 in May in P1, 54.20 in Sept. and 132.50 in May in P2 and 64.18 in Sept. and 134.40 in May in P3.

Magnesium values Table V Fig. V varied from 6.10 to 22.08 in P1, from 8.35 to 28.03 in P2 and from 9.35 to 31.84 in P3.

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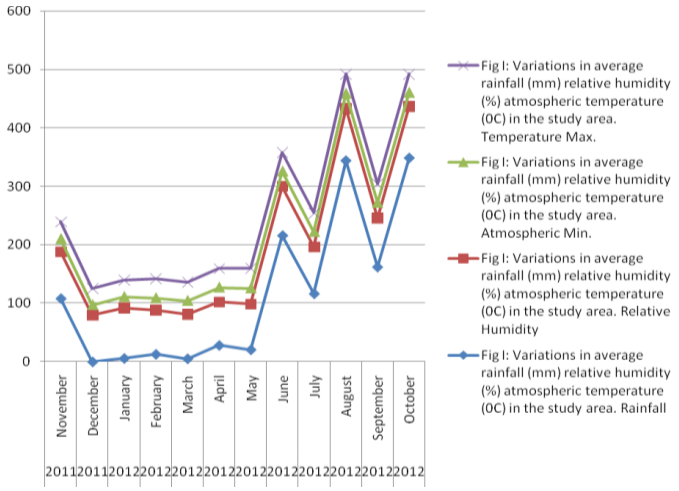
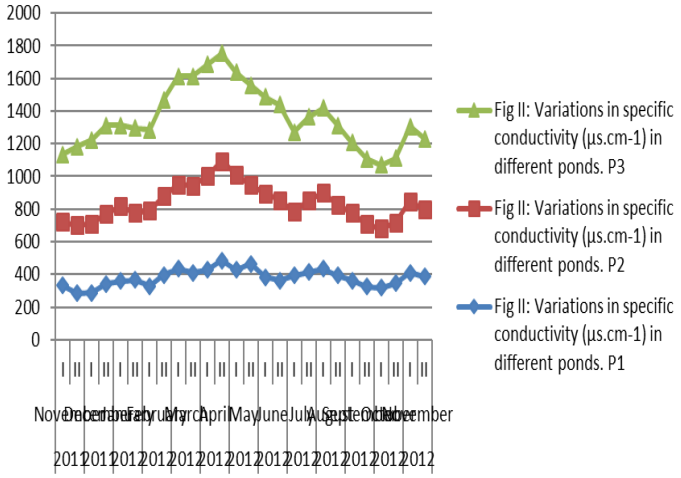




Sodium value analysis Table VI, Fig. VI showed variation from 8.35 to 25.32 in P1, from 10.18 to 28.86 in P2 and from 15.98 to 34.10 in P3. Potassium content Table VII Fig.VII varied from 1.12 to 6.38 in P1, from 1.97 to 7.2 in P2 and from 2.12 to 8.32 in P3.

Ammonia nitrogen Table VIII, Fig. VIII exhibited variation between 1.2 and 4.12 in P1, between 1.98 and 7.82 in P2 and from 2.97 to 12.65 in P3.

Table II: Variations in specific conductivity (µs.cm-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	331	389	416
		II	284	418	482
2011	December	I	286	426	513
		II	341	432	540
2012	January	I	358	459	496
		II	365	410	520
2012	February	I	328	466	492
		II	397	483	589
2012	March	I	436	515	663
		II	410	532	672
2012	April	I	429	572	685
		II	484	610	660
2012	May	I	428	584	624
		II	466	482	610
2012	June	I	384	510	594
		II	362	492	586
2012	July	I	394	389	488
		II	415	438	510
2012	August	I	436	464	518
		II	394	435	482
2012	September	I	364	412	432
		II	326	382	399
2012	October	I	318	364	387
		II	345	372	394
2012	November	I	410	438	459
		II	386	412	432

Table III: Variations in dissolved organic matter (mg.l-1) in different ponds.

	Month	Phase	P1	P2	P3
2011	November	I	1,10	3,10	3,15
		II	1,00	3,00	4,28
2011	December	I	1,08	3,26	4,62
		II	0,98	3,45	3,28
2012	January	I	0,86	2,80	3,00
		II	0,74	2,10	2,20
2012	February	I	0,51	1,98	2,41
		II	0,47	1,96	2,35
2012	March	I	0,52	2,32	2,54
		II	0,50	2,15	2,12
2012	April	I	0,48	1,92	1,98
		II	0,62	1,46	2,00
2012	May	I	0,56	1,00	2,20
		II	0,60	1,38	1,85
2012	June	I	0,66	1,12	1,20
		II	0,58	1,10	1,45
2012	July	I	0,75	1,26	2,41
		II	0,98	1,32	2,10
2012	August	I	0,84	1,20	1,85
		II	0,72	1,05	2,35
2012	September	I	0,88	2,58	2,86
		II	0,95	2,16	3,36
2012	October	I	0,88	2,85	3,10
		II	0,98	2,34	3,54
2012	November	I	1,20	2,40	4,10
		II	1,30	2,52	3,98

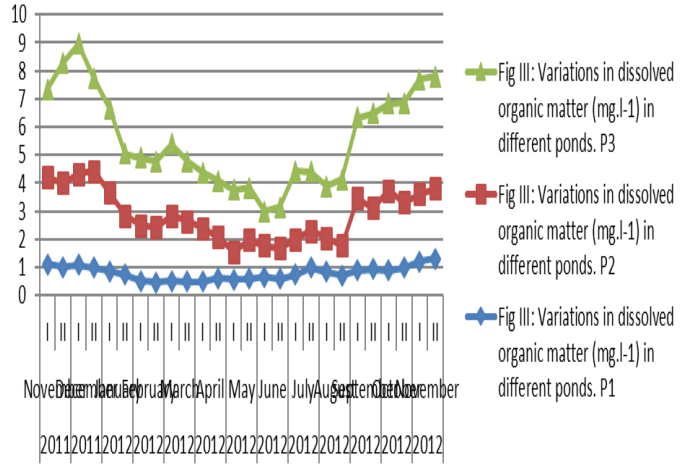
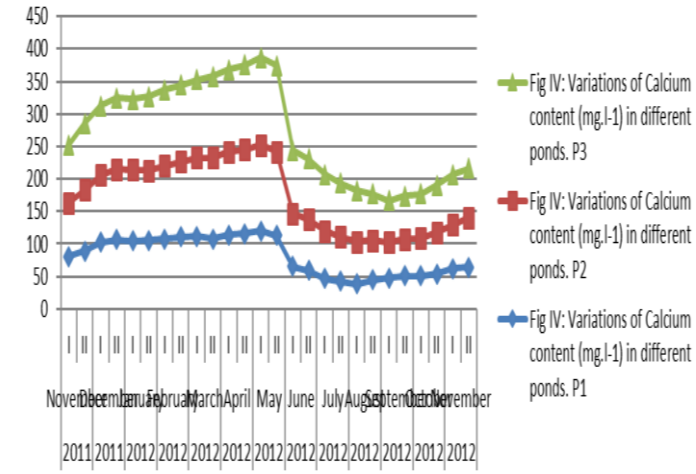


Table IV: Variations of Calcium content (mg.l-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	80,36	82,64	89,10
		II	89,10	94,10	102,15
2011	December	I	102,38	103,56	106,30
		II	106,54	108,12	110,05
2012	January	I	104,20	110,16	108,12
		II	105,38	107,30	114,35
2012	February	I	108,05	112,52	116,50
		II	110,24	116,10	118,25
2012	March	I	112,20	120,30	120,10
		II	108,10	125,10	124,30
2012	April	I	114,09	127,50	126,80
		II	116,18	128,65	130,20
2012	May	I	120,24	132,50	134,40
		II	112,60	129,30	132,64
2012	June	I	64,79	82,45	96,52
		II	58,62	79,32	92,80
2012	July	I	47,14	72,50	87,24
		II	42,76	68,20	82,00
2012	August	I	38,12	65,20	78,60
		II	44,36	61,15	71,52
2012	September	I	48,12	54,20	64,18
		II	51,10	56,15	66,20
2012	October	I	50,58	58,45	68,15
		II	54,30	64,10	72,30
2012	November	I	62,50	66,50	78,10
		II	64,10	76,30	75,80



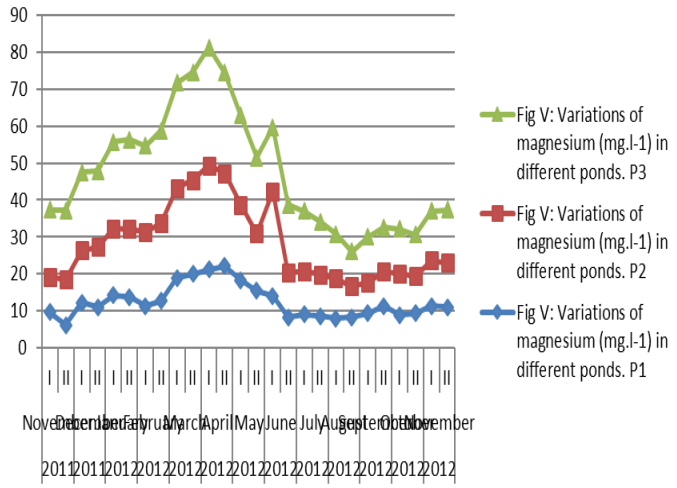


Table V: Variations of magnesium (mg.l-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	9,58	9,58	18,20
		II	6,10	12,35	18,75
2011	December	I	12,25	14,20	21,10
		II	11,00	16,25	20,58
2012	January	I	14,25	18,10	23,33
		II	13,82	18,36	24,18
2012	February	I	11,30	20,15	23,25
		II	12,65	21,00	25,18
2012	March	I	18,94	24,38	28,34
		II	19,92	25,40	29,25
2012	April	I	21,27	28,15	31,84
		II	22,08	25,12	27,20
2012	May	I	18,34	20,39	24,18
		II	15,36	15,55	20,56
2012	June	I	14,10	28,30	17,25
		II	8,24	12,10	18,30
2012	July	I	9,10	11,60	16,25
		II	8,60	11,20	14,30
2012	August	I	7,98	10,75	12,10
		II	8,34	8,35	9,35
2012	September	I	9,34	8,35	12,30
		II	11,25	9,40	11,98
2012	October	I	8,87	11,25	12,10
		II	9,30	10,10	11,25
2012	November	I	11,25	12,45	13,34
		II	11,00	12,10	14,20

Table VI: Variations in sodium (mg.l-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	14,36	15,36	24,32
		II	15,42	17,42	25,54
2011	December	I	18,10	21,15	26,51
		II	19,53	20,20	27,88
2012	January	I	20,40	27,05	29,12
		II	21,55	26,82	27,35
2012	February	I	23,78	27,45	25,20
		II	23,56	25,86	23,48
2012	March	I	23,92	26,34	25,42
		II	24,81	27,24	34,10
2012	April	I	25,10	26,98	30,28
		II	25,32	27,52	33,55
2012	May	I	24,76	28,86	38,20
		II	19,35	20,32	25,10
2012	June	I	17,62	18,76	22,35
		II	12,35	15,34	21,42
2012	July	I	10,05	14,25	20,14
		II	9,22	12,10	19,56
2012	August	I	8,58	10,18	18,32
		II	9,36	15,65	17,60
2012	September	I	10,12	12,62	16,45
		II	9,05	11,84	15,98
2012	October	I	8,35	12,51	18,75
		II	12,45	14,10	17,96
2012	November	I	13,32	16,09	20,32
		II	12,85	14,25	21,56

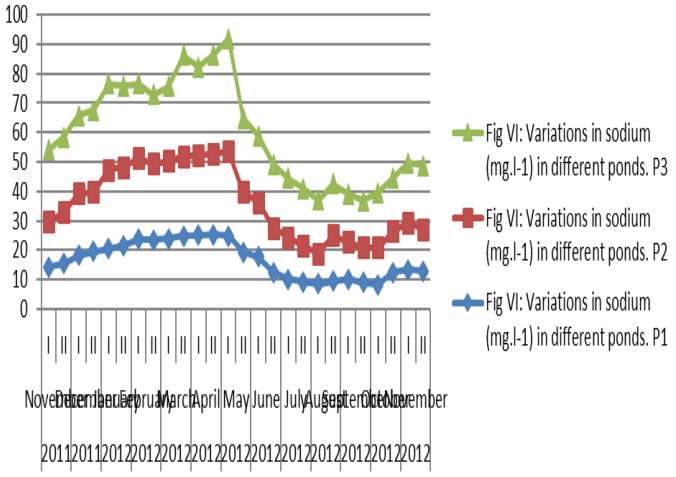


Table VII: Variations in potassium (mg.l-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	2,30	3,08	3,75
		II	2,10	2,98	3,08
2011	December	I	1,95	3,62	4,12
		II	2,84	4,10	3,80
2012	January	I	4,38	5,15	6,15
		II	3,92	4,92	5,94
2012	February	I	4,53	5,09	6,57
		II	3,76	3,98	6,25
2012	March	I	5,32	5,12	5,38
		II	4,90	5,98	6,05
2012	April	I	5,06	6,38	8,32
		II	5,84	7,20	7,95
2012	May	I	6,38	5,32	6,49
		II	2,37	3,15	6,01
2012	June	I	2,60	2,42	3,52
		II	1,76	3,10	3,25
2012	July	I	2,00	2,95	3,40
		II	2,17	3,05	3,24
2012	August	I	3,07	2,02	2,94
		II	2,59	1,98	2,75
2012	September	I	1,12	2,05	2,62
		II	2,08	1,97	2,24
2012	October	I	2,14	2,10	2,12
		II	1,95	2,35	2,38
2012	November	I	2,12	3,10	2,56
		II	2,08	3,25	3,42

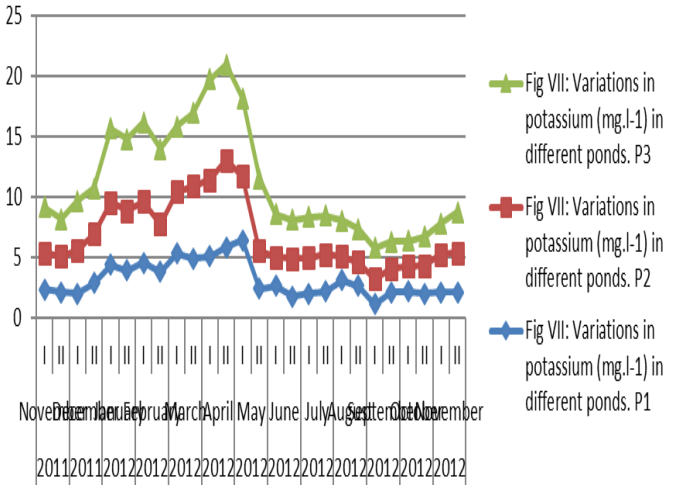
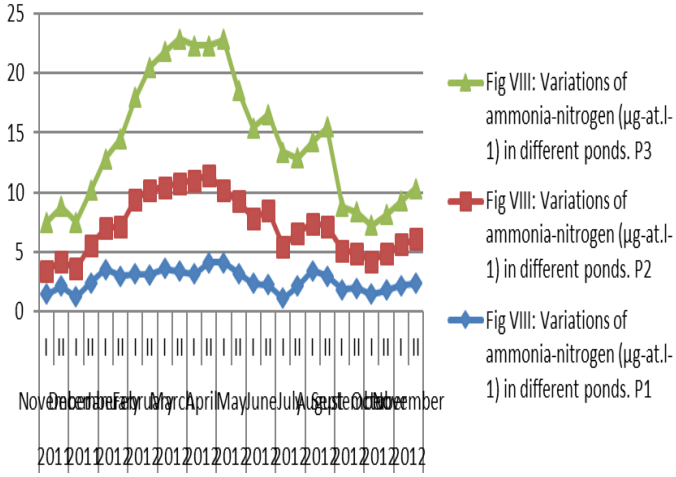


Table VIII: Variations of ammonia-nitrogen (µg-at.l-1) in different ponds.

Year	Month	Phase	P1	P2	P3
2011	November	I	1,44	1,98	4,10
		II	2,10	2,10	4,58
2011	December	I	1,20	2,39	3,92
		II	2,40	3,15	4,62
2012	January	I	3,52	3,48	5,84
		II	2,96	4,22	7,35
2012	February	I	3,12	6,28	8,56
		II	3,09	7,10	10,34
2012	March	I	3,60	6,84	11,38
		II	3,36	7,41	12,15
2012	April	I	3,16	7,82	11,35
		II	4,12	7,34	10,86
2012	May	I	4,08	6,10	12,65
		II	3,18	6,06	9,32
2012	June	I	2,36	5,48	7,58
		II	2,24	6,21	8,10
2012	July	I	1,09	4,38	7,94
		II	2,10	4,50	6,25
2012	August	I	3,42	3,95	6,87
		II	2,96	4,18	8,32
2012	September	I	1,86	3,28	3,65
		II	1,94	2,94	3,49
2012	October	I	1,42	2,80	2,97
		II	1,78	3,10	3,24
2012	November	I	2,18	3,46	3,61
		II	2,34	3,72	4,28



DISCUSSION

The Rain fall, relative humidity, atmospheric temperature recorded varied during different periods of the year. The rain fall was least in March and highest in Oct. Relative humidity was low in April and high in August. The atmospheric temperature was minimum during Dec. and maximum during February Table I, Fig. I. The factors studied were almost in normal range without affecting the growth and development of the fish community.

The specific conductivity results revealed Table II, Fig. II variation in three different ponds during different periods of the year. The specific conductivity in P1 P2 P3 were less during Nov-Oct but more during April-March respectively "ranging between 284 µs to 672µs/cm against the recommended value of typical unpolluted fresh water of 350 µs/cm Koning and Ross, (1999).

The dissolved organic matter values Table III, Fig. III ranged from 0.47 in P1 to 4.62 mg/l in Dec in P3. The total dissolved organic matter (mg/l) Table III, Fig.III in P1 was 0.47 in Feb and 1.3 in Nov, in P2 the value was 1.0 in May and 3.45 in Dec. In P3 it was 1.2 in June and 4.82 in Dec. It showed variability during different seasons of the year. It was less during dry season and more during wet season; influencing the water quality of the ponds under study.

The hardness of water was studied (mg/l) by determining the calcium content Table IV, Fig. IV, Mg content Table V, Fig. V, Sodium content Table VI, Fig. VI, Potassium content Table VII Fig. VII and Ammonia nitrogen Table VIII Fig. VIII.

The variation of calcium content (mg/l) was between 38.12 during August, September and 134.40 during May in all the three ponds studied. Magnesium content (mg/l) varied from 6.10 in P1 during Nov to 31.84 in P3 during April. Sodium value mg/l ranged from 8.35 in P1 during Oct to 31.84 in P3 during March. Potassium content was low i.e. 1.2 in P1 during Sept to 8.32 during April in P3. Ammonia nitrogen content was as lower 1.12 during Dec in P1 and high i.e. 12.65 during May in P3.

The range of variations of parameters in all the three ponds studied were almost in conformity with standard levels prescribed for aquaculture Swingle, (1967); Boyd and Walley, (1975). The parameters like temperature, P^H, nitrate nitrogen, total alkalinity and dissolved oxygen have also been studied Panda et al., (2015). Thus after determining the quality of water of the three ponds the ponds understudy the prepared for aquaculture imparting technical knowhow to the villagers for gainful employment.

CONCLUSION

After determination of different parameters, the local people were trained to stabilize the ponds for composite fish culture by cleaning, liming, fertilizing, pre-stoking, post stoking and harvesting methods. Outcome of the efforts in the first year (2013-14) was quite satisfactory. The net gain from fishing were Rs 18, 300 from P1, Rs 16,300 from P2 and Rs 18,500 from P3. It was believed, if such awareness is created among villagers, people will be interested in aquaculture thereby can be able to boost the economy by utilizing available water bodies of their locality.

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