Austin Journal of Environmental Toxicology

Open Access

Austin Publishing Group

Research Article

Carbon Storage in Sediments of Freshwater Fishponds of Odisha, Andhra Pradesh, and West Bengal, India

Adhikari S[1]*, Mahanty D[1], Ikmail S[2], Sarkar S[2], Rathod R[3] and Pillai BR[2]

[1]Regional Research Centre (RRC) of ICAR-Central Institute of Freshwater Aquaculture, West Bengal, India

[2]ICAR-Central Institute of Freshwater Aquaculture, India

[3]Regional Research Centre (RRC) of ICAR-CIFA, Penamaluru Fish Seed Farm, India

***Corresponding author:** Subhendu Adhikari, Regional Research Centre (RRC) of ICAR-Central Institute of Freshwater Aquaculture, Rahara, Kolkata, West Bengal, India

Received: September 27, 2019; **Accepted:** October 29, 2019; **Published:** November 05, 2019

Abstract

Considering the impact of climate change on aquaculture practices, carbon storage by fish pond sediment could mitigate some emission of greenhouse gases form the fish ponds. The potentials of carbon storage by the sediments of fish ponds of Ganjam, Keonjhargarh, and Puri districts of Odisha, Krishna district of Andhra Pradesh, Moyna and Tamluk of East Medinipur, Purulia, Bankura, Murshidabad, South and North 24 Parganas districts of West Bengal, India were estimated. It is evident from the results that with an increase in fish production, the C storage decreased. The production per crop in the present study increased from 1815±376 kg/ha to 8351±1882 kg/ha and accordingly, the C storage/kg fish decreased from 1.44±0.73 to 0.62±0.21. The three types of combined humus carbon (loosely, stably and tightly combined humus carbon) were also analyzed for some sediment in the present study. The loosely combined humus varied from 36 to 43 per cent, stably combined humus varied from 4 to 6 per cent, and tightly combined humus varied from 53 to 58 per cent, respectively. Among the three combined humus, loosely combined form constitute about 40 percent of the total soil organic carbon, and thus, carbon sequestration could be 60 percent of the total soil carbon storage.

Keywords: Carbon storage; Sequestration; Sediments; Aquaculture ponds

Introduction

Increase in greenhouse gases (GHGs) concentration in the atmosphere is the main reason for climate change as accumulated GHGs in the atmosphere intercepts outgoing infra-red radiation which traps heat and raises the temperature in the atmosphere. The carbon dioxide (CO_2) level has increased by 31 per cent, from 280 ppmv in 1850 to 380 ppmv in 2005, and is now increasing at 1.7 ppmv/ yr [1]. With this increase, there is a growing public and scientific concern about the carbon sequestration potential of various terrestrial ecosystems especially wetlands [2]. It has been suggested that the sequestration of atmospheric CO_2 into soil organic carbon (SOC) could contribute significantly to adhere with the Kyoto Protocol to reduce emissions of greenhouse gases [3,4]. In stabilizing the atmospheric abundance of CO_2 and other greenhouse gases to mitigate the risks of global warming [5]. [6] suggested that there are three strategies of lowering CO_2 emissions: (i) reducing the global energy use, (ii) developing low or no-carbon fuel, and (iii) sequestering CO_2 from point sources or atmosphere through natural and engineering techniques. Fifteen options of stabilizing the atmospheric concentration of CO_2 by 2050 at approximately 550 ppm have been outlined by [7]. Three of these 15 options were based on carbon sequestration in terrestrial ecosystems [8]. In this respect, aquaculture ponds can play potential role in carbon sequestration.

During the last three decades world food fish production of aquaculture has expanded by almost 12 times, with an average annual rate of 8.8 per cent. Presently 600 aquatic species are raised in captivity in about 190 countries for production in farming systems of varying input intensities and technological sophistication (FAO, 2016). Thus, there is immense scope to store and capture carbon by the fishponds to reduce and offset the chance of emitting different GHGs from the different aquaculture systems. Thus the objectives of the present study are: (i) to assess the potentials of carbon storage in different aquaculture ponds of three different states in India; (ii) to determine the extent of carbon sequestration of pond sediments.

Materials and Methods

Aquaculture ponds were chosen for the carbon storage study from the Ganjam (19.5860° N, 84.6897° E), Keonjhargarh (21.6289° N, 85.5817° E) and Puri (19.8134° N, 85.8315° E) districts of Odisha, Kaikaluru Mandal (16.5527° N, 81.2129° E) of Krishna district of Andhra Pradesh, and Moyna (22.2738° N, 87.7697° E), Tamluk block (22.2788° N, 87.9188° E) of East Medinipur, Purulia (23.3321° N, 86.3652° E), Bankura (23.1645° N, 87.0624° E), Murshidabad (24.2290° N, 88.2461° E), south 24 Parganas (22.1352° N, 88.4016° E) and North 24 Parganas (22.6168° N, 88.4029° E) districts of West Bengal, India. Overall, the culture period in these areas varied from 180 to 300 days. The culture practices in these ponds are shown in Table 1.

Calculation of carbon storage

Soil carbon storage was measured by CORE Method. In this method, sediment samples from the pond was collected by a soil sampler (Corer) in such a way that only the sediment core was collected, no bottom soil below the sediment was collected. The sediment dry bulk density was measured and the sediment organic carbon was determined by CHN Analyzer. The carbon storage (Mg C/ha, mega gram C/ha) was calculated as per [9] as follows = [C (%)*dry bulk density (Mg/m^3)*depth (m)*10^4 m^2]/100.

Adhikari et al. © All rights reserved

Citation: Adhikari S, Mahanty D, Ikmail S, Sarkar S, Rathod R and Pillai BR. Carbon Storage in Sediments of Freshwater Fishponds of Odisha, Andhra Pradesh, and West Bengal, India. Austin J Environ Toxicol. 2019; 5(1): 1026.

Table 1: Culture practices in the ponds under different places under study.

Area/Location	Culture of Species with Stocking size (g)	Stocking density (10^3/ha)	Harvesting size (g)	Management practices
Ganjam, Puri, Keonjhargarh, Puri, Odisha	Rohu (5.0-8.0) Catla (5.0-8.0) Mrigal (5.0-8.0)	5.0	Rohu 700 Catla 900 Mrigal 500	Organic manure (cow dung), Inorganic fertilizers (Urea,Single Super Phosphate), lime. Supplementary feeding with ground nut oil cake and rice bran in a ratio of 1:1.
Kaikaloru, Krishna, Andhra Pradesh	Rohu- 50 Catla 150 Mrigal 100	5.0	Rohu 1100 Catla 2200 Mrigal 1300	Mainly pelleted feed along with organic manure (cow dung), inorganic fertilizers, lime.
Moyna , West Bengal	Rohu- 90 Catla 110 Mrigal 70	5.0-14.0 (av. 10.0)	Rohu 800 Catla 1200 Mrigal 600	Mainly pelleted feed along with inorganic fertilizers, lime.
Tamluk, West Bengal	Rohu- 50-100 (av.70) Catla 75-200 (av.120) Mrigal 25-150 (av.70)	5.0-14.0 (av.9.0)	Rohu 770 Catla 1170 Mrigal 600	Mainly pelleted feed along with organic manure (cow dung), inorganic fertilizers, lime.
Bankura, West Bengal	Rohu- 20 Catla 25 Mrigal 18	5.0- 7.0 (av.6.0)	Rohu 460 Catla 1000 Mrigal 425	Mainly pelleted feed along with organic manure (cow dung), inorganic fertilizers, lime.
Murshidabad, West Bengal	Rohu- 80 Catla 130 Mrigal 60	2.5-7.5 (av.5.8)	Rohu 775 Catla 1600 Mrigal 650	Mainly pelleted feed along with organic manure (cow dung), inorganic fertilizers, lime.
North and South 24 Parganas, West Bengal	Rohu- 100 Catla 500 Mrigal 50	6.6-11.2 (av.9.0)	Rohu 900 Catla 2800 Mrigal 600	Mainly pelleted feed along with organic manure (cow dung), inorganic fertilizers, lime.

Table 2: Sediment carbon storage in fish ponds of Ganjam district of Odisha.

Sample no.	Sediment depth (cm)	Dry bulk density (Mg/m^3)	Organic carbon (%)	Carbon storage/ crop(kg C/ha)	Production/ crop (kg/ha)	C storage/ kg fish(kg)
1	3.0	1.33	0.240	960	1850	0.51
2	2.6	1.27	0.456	1550	1500	1.03
3	3.0	1.19	2.016	7220	2000	3.61
4	2.6	1.27	0.600	2020	1800	1.12
5	3.2	1.24	0.366	1480	1250	1.18
6	3.0	1.41	0.192	810	1700	0.47
7	3.3	1.20	0.264	1060	1680	0.63
8	3.0	1.13	0.600	2040	1800	1.13
9	3.0	1.11	1.056	3520	1680	2.09
10	3.3	1.10	0.600	2200	1950	1.12
11	3.4	1.21	0.648	2720	3000	0.90
12	2.0	1.04	0.696	1450	1200	1.20
13	3.0	0.78	1.440	3390	1780	1.90
14	3.4	1.27	0.864	3800	2150	1.76
15	3.5	1.78	0.552	3450	2000	1.72
16	2.9	1.25	0.432	1560	1600	0.97
17	3.3	1.49	0.480	2380	1780	1.33
18	3.2	1.43	0.840	3930	1200	3.27
19	3.3	1.15	0.672	2590	1600	1.61
20	3.3	1.57	0.600	3170	1800	1.76
21	3.2	1.19	0.648	2480	1760	1.40
22	5.2	1.18	0.648	2650	1810	1.46
23	3.4	1.41	0.600	3100	1920	1.61
24	3.4	1.31	0.600	2670	2230	1.19
25	3.0	1.40	0.600	2520	2350	1.07
Mean±SD	**3.18±0.53**	**1.22±0.19**	**0.65±0.38**	**2590±1310**	**1815±376**	**1.44±0.73**

Table 3: Sediment carbon storage in fish ponds of Keonjhargarh district of Odisha**.**

Sample no.	Sediment dept (cm)	Dry bulk density (Mg/m³)	Organic carbon(%)	Carbon storage/ crop(kg C/ha)	Production/ crop(kg/ha)	C storage/kg fish (kg)
1	3.05	0.79	0.721	1730	1800	0.961
2	3.00	0.92	0.837	2310	1120	2.06
3	2.75	0.49	2.023	2740	3000	0.913
4	3.36	1.07	0.534	1920	1800	1.066
5	3.00	0.74	0.976	2160	1975	1.093
6	3.20	0.52	1.418	2390	2114	1.130
7	2.80	0.45	2.209	2850	1750	1.628
8	3.10	0.48	1.232	1840	1410	1.304
9	4.20	0.63	0.624	1690	2250	0.751
10	3.40	0.56	0.888	1690	1037	1.629
11	2.93	0.99	1.128	3290	1650	1.993
12	3.80	0.76	1.584	4570	2000	2.285
13	3.20	0.49	1.584	2560	4500	0.568
14	3.84	0.81	0.168	0520	2750	0.189
15	3.37	0.94	0.720	2290	1300	1.761
16	3.00	0.56	1.224	2080	1310	1.587
17	3.00	0.44	0.912	1200	1687	0.711
18	3.00	0.29	2.184	1940	1900	1.021
19	3.30	0.48	0.960	1520	1200	1.266
20	3.10	0.55	0.480	0840	1750	0.48
Mean S.D.	**3.22±0.36**	**0.648±0.21**	**1.12±0.56**	**2120±890**	**1915±789**	**1.21±0.56**

Analysis of combined humus forms

The combined humus forms are classified into three types by using three different extractants and were extracted as: (i) the loosely combined humus was extracted using 0.1 M NaOH; (ii) the stably combined humus was extracted using 0.1 M $N_a4P_2O_7$ + 0.1 M NaOH mixed liquid (pH 13); and (iii) the residue was considered as the tightly combined humus. Both of the loosely and stably combined humus solution was measured at 465 and 665 nm using the ultraviolet spectrophotometer, respectively [10]. The E465/E665 ratio was calculated by dividing the absorbance of the sample at 465nm by that at 665nm. The loosely and stably combined humus C contents were measured by a liquid C/N analyzer, whereas the tightly combined humus C content was calculated by subtracting the sum of the loosely and stably combined humus C contents from the total humus C content [10].

All the data were presented as average with standard deviation (SD).

Results and Discussion

The sediment carbon storage in fish ponds of Ganjam district of Odisha is presented in Table 2. The organic carbon and carbon storage in the sediments of the fish ponds were 0.65±0.38 per cent and 2590±1310 kg C/ha/crop, respectively. The fish production was 1815±376 kg/ha/crop. The C storage was 1.44±0.73 kg/kg fish.

The sediment carbon storage in fish ponds of Keionjhargarh district of Odisha is presented in Table 3. The organic carbon and carbon storage in the sediments of the fish ponds were 1.12±0.56 per cent and 2120±890 kg C/ha/crop, respectively. The fish production was 1915±789 kg/ha/crop. The C storage was 1.21±0.56 kg/kg fish.

The sediment carbon storage in fish ponds of Puri district of Odisha is presented in Table 4. The organic carbon and carbon storage in the sediments of the fish ponds were 0.66±0.37 per cent and 2340±1470 kg C/ha/crop, respectively. The fish production was 2044±1118 kg/ha/crop. The C storage was 1.64±1.24 kg/kg fish.

The sediment carbon storage in fish ponds of Kaikaluru, Krishna district of Andhra Pradesh is shown in Table 5. The organic carbon content in the sediments was 1.5±0.68 per cent, and the carbon storage was 5486±2980 kg C/ha/crop. The fish production was 8351±1882 kg/ha/crop. The C storage was 0.62±0.21 kg/kg fish.

The sediment carbon storage in fish ponds of Moyna, East Medinipur district of West Bengal is shown in Table 6. The organic carbon content in the sediments was 1.35±0.65 per cent, and the carbon storage was 5682±1591 kg C/ha/crop. The fish production was 7475±1156 kg/ha/crop. The C storage was 0.76±0.19 kg/kg fish.

The sediment carbon storage in fish ponds of Tamluk, East Medinipur district of West Bengal is presented in Table 7. The organic carbon and carbon storage in the sediments of the fish ponds were 1.42±0.63 per cent and 5490±2336 kg C/ha/crop, respectively. The fish production was 7169±3065 kg/ha/crop. The C storage was 1.80±0.30 kg/kg fish.

The sediment carbon storage in fish ponds of Purulia district of West Bengal is presented in Table 8. The organic carbon and carbon storage in the sediments of the fish ponds were 1.08±0.33 per cent

Table 4: Sediment carbon storage in fish ponds of Puri district of Odisha.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage /crop (kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	2.3	2.84	0.227	1480	1250	1.184
2	3.7	0.84	0.954	3030	2500	1.212
3	2.45	1.25	0.500	1530	1500	1.02
4	1.95	2.67	0.410	2130	1000	2.13
5	2.33	1.10	0.250	0640	1000	0.64
6	3.3	1.02	0.886	3000	880	3.40
7	2.0	2.07	1.364	5670	3800	1.49
8	3.2	1.60	0.250	1280	1154	1.109
9	2.75	0.55	0.636	0960	2130	0.450
10	3.5	1.12	1.023	4040	875	4.617
11	3.64	1.53	0.727	4040	3000	1.346
12	3.5	1.18	0.515	2130	3500	0.608
13	5.2	0.47	0.425	1040	3750	0.277
14	3.24	0.80	0.672	1760	1375	1.28
15	2.99	2.23	1.454	9730	3800	2.56
16	3.33	1.3	1.068	4730	1250	3.78
17	3.25	1.10	0.492	1770	2000	0.885
Mean±SD	**3.07±0.83**	**1.523±0.80**	**0.660±0.37**	**2340±1470**	**2044±1118**	**1.64±1.24**

Table 5: Sediment carbon storage in fish ponds of Kaikaluru, Krishna district of Andhra Pradesh.

Sample no.	Sediment dept (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ crop (kg/ha)	Production/ Crop (kg/ha)	C storage/ kg fish (kg)
1	6.85	0.88	0.92	5550	8500	0.65
2	6.92	0.60	2.53	10500	10,666	0.98
3	6.92	0.30	2.07	4290	8000	0.53
4	6.66	0.39	1.01	2680	5500	0.48
5	6.15	0.74	0.97	4410	9090	0.48
Mean±S.D	**6.7±0.32**	**0.582±0.24**	**1.5±0.68**	**5486±2980**	**8351±1882**	**0.62±0.21**

Table 6: Sediment carbon storage in fish ponds of Moyna, East Medinipur district of West Bengal.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ Crop (kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	5.0	0.59	1.38	4071	8000	0.50
2	7.9	1.01	0.66	5266	6500	0.81
3	6.3	0.56	1.41	4974	5800	0.85
4	4.8	1.07	1.51	7755	9000	0.86
5	5.2	0.59	2.47	7577	7500	1.01
6	6.4	0.98	0.71	4453	8050	0.55
Mean±S.D	**5.93±1.17**	**0.80±0.24**	**1.35±0.65**	**5682±1591**	**7475±1156**	**0.76±0.19**

and 3217±818 kg C/ha/crop, respectively. The fish production was 2363±813 kg/ha/crop. The C storage was 1.43±0.39 kg/kg fish.

The sediment carbon storage in fish ponds of Bankura district of West Bengal is shown in Table 9. The organic carbon content in the sediments was 1.52±0.81 per cent, and the carbon storage was 4708±3248 kg C/ha/crop. The fish production was 4326±1441 kg/ha/crop. The C storage was 1.15±0.67 kg/kg fish.

The sediment carbon storage in fish ponds of Murshidabad districts of West Bengal is shown in Table 10. The organic carbon content in the sediments of fish ponds was 1.18±0.40 per cent, and the carbon storage was 5210±910 kg C/ha/crop. The fish production was 6375±1932 kg/ha/crop, and the C storage was 0.87±0.30 kg/kg fish in the fish ponds of Murshidabad district.

The sediment carbon storage in fish ponds of South and North 24

Table 7: Sediment carbon storage in fish ponds of Tamluk, East Medinipur district of West Bengal.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ crop(kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	5	0.78	0.66	2574	6633	0.38
2	5	0.73	1.02	3723	4300	0.86
3	5	0.55	1.38	3795	6600	0.57
4	6	1.01	1.65	9999	6795	1.47
5	5	0.61	2.35	7167	10,000	0.71
6	5	0.58	2.47	7163	14,400	0.49
7	6	0.76	0.91	4149	4100	1.01
8	6	0.88	0.83	4382	5750	0.76
9	6	0.65	1.12	4368	5313	0.82
10	5	0.82	1.85	7585	7800	0.97
Mean±S.D	**5.4±0.51**	**0.73±0.14**	**1.42±0.63**	**5490±2336**	**7169±3065**	**0.80±0.30**

Table 8: Sediment carbon storage in fish ponds of Purulia district of West Bengal.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ crop (kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	4.2	0.99	0.68	2827	1687	1.67
2	2.7	1.17	1.39	4391	3376	1.30
3	3.0	1.23	0.97	3579	1700	2.10
4	2.7	0.77	1.47	3056	1880	1.62
5	5.0	0.62	0.71	2201	1716	1.28
6	5.5	0.45	0.98	2425	2683	0.90
7	3.7	0.78	1.4	4040	3500	1.15
Mean±S.D	**3.82±1.12**	**0.85±0.28**	**1.08±0.33**	**3217±818**	**2363±813**	**1.43±0.39**

Table 9: Sediment carbon storage in fish ponds of Bankura district of West Bengal.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ crop (kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	3.0	0.93	2.4	6696	3800	1.76
2	5.0	0.78	1.4	5460	3500	1.56
3	2.0	1.46	0.7	2044	3247	0.62
4	2.6	1.04	1.3	3515	2536	1.38
5	6.0	0.18	1.7	1836	6600	0.28
6	3.2	0.31	2.6	2579	5100	0.50
7	10	0.57	1.9	10830	5500	1.96
Mean±S.D	**4.54±2.78**	**0.86±0.51**	**1.52±0.81**	**4708±3248**	**4326±1441**	**1.15±0.67**

Table 10: Sediment carbon storage in fish ponds of Murshidabad district of West Bengal.

District	Sample no.	Sediment level (cm)	Dry bulk density(Mg/ m³)	Organic carbon (%)	Carbonstorage/crop (kg/ha)	Production/ Crop(kg/ha)	C storage/ kg fish (kg)
Murshidabad	1	6.0	0.74	1.32	5860	4320	1.35
	2	7.5	0.64	1.18	5664	7051	0.80
	3	7.5	0.68	0.84	4284	7500	0.57
	4	7.5	0.45	1.80	6075	8620	0.70
	5	8.0	0.66	0.79	4171	4388	0.95
	Mean±SD	**7.3±0.75**	**0.63±0.10**	**1.18±0.40**	**5210±910**	**6375±1932**	**0.87±0.30**

Parganas districts of West Bengal is shown in 11. The organic carbon content in the sediments of fish ponds was 1.38±0.59 per cent, and the carbon storage was 5376±1597 kg C/ha/crop. The fish production was 4270±1008 kg/ha/crop, and the C storage was 1.31±0.45 kg/kg fish in

Table 11: Sediment carbon storage in fish ponds of South and North 24 Paraganas districts of West Bengal.

Sample no.	Sediment level (cm)	Dry bulk density (Mg/m³)	Organic carbon (%)	Carbon storage/ crop (kg/ha)	Production/ crop (kg/ha)	C storage/ kg fish (kg)
1	3.7	0.81	1.49	4465	4200	1.06
2	4.2	0.95	1.08	4309	4800	0.89
3	4.5	1.01	0.59	2681	5000	0.53
4	5	1.01	0.68	3434	5550	0.61
5	5	1.01	1.55	7827	4800	1.63
6	4.7	0.64	2.42	7279	4366	1.66
7	4.2	0.72	1.92	5806	5625	1.03
8	4.5	0.51	2.45	5622	4742	1.18
9	2.7	1.53	1.87	7724	5050	1.52
10	4	1.56	1.07	6676	3375	1.97
11	4.7	0.73	1.37	4700	2656	1.76
12	4.2	0.8	1.12	3763	2656	1.41
13	4	1.56	0.87	5428	4000	1.35
14	3.8	1.59	0.92	5558	2960	1.87
Mean±S.D	**4.22±0.60**	**1.03±0.37**	**1.38±0.59**	**5376±1597**	**4270±1008**	**1.31±0.45**

Table 12: Proportions of combined humus C at some selected locations (% soil organic carbon).

Location	Loosely combined humus	Stably combined Humus	Tightly combined Humus
Habra I, North 24 Parganas	39	4	57
Habra II, North 24 Parganas	40	4	56
Barasat, North 24 Parganas	40	5	55
Kharibari, North 24 Parganas	36	6	58
Canning, South 24 Parganas	38	6	56
Moyna I, East Medinipur	41	5	54
Moyna II, East Medinipur	43	4	53

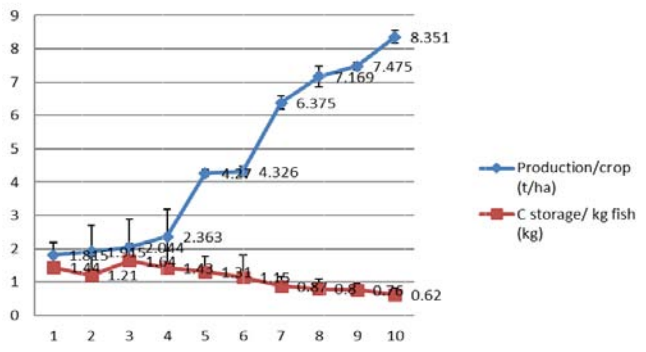

Figure 1: C storage in relation with total production.

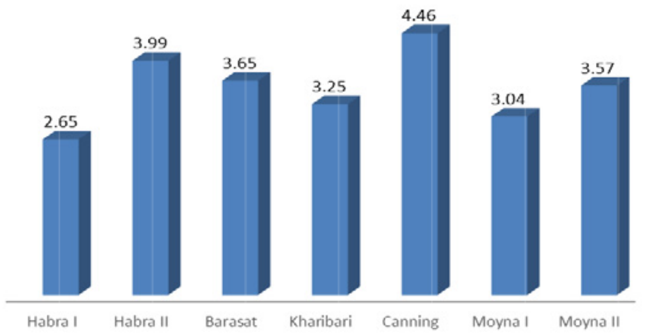

Figure 2A: E_{465}/E_{665} of loosely combined humas.

the fish ponds of these districts.

The carbon storage with the fish production has presented in Figure 1. From the figure, it is evident that with an increase in fish production, the C storage decreased. The production per crop in the present study increased from 1815±376 kg/ha to 8351±1882 kg/ha and accordingly, the C storage/kg fish decreased from 1.44±0.73 to 0.62±0.21. This could be due to the fact that higher production utilized the C at a maximum level for their growth than that the same at lower production level.

In earlier study, [11] reported that the carbon sequestration capacity ranged from 442 to 1882 kg C/ha with an average value of 1018±447 kg C/ha for 9 aquaculture ponds of one place. The present study conducted for different places under different management systems for 116 numbers of ponds.

The three types of combined humus carbon (loosely, stably and tightly combined humus carbon) are shown in Figure 2A, 2B, 2C and Table 12. The carbon contents of the loosely, stably and tightly combined humus ranged from 2.40 to 7.87 g/kg (Figure 2A), 0.27 to 0.96 g/kg (Figure 2B), and 3.30 to 11.02g/kg (Figure 2C) respectively. The combined humus forms were arranged on the basis of C content in the following order: tightly> loosely> stably combined humus C. However, the proportion of the three combined humus C showed no significant differences among the different soils (Table 12). The loosely combined humus varied from 36 to 43 per cent, stably combined humus varied from 4 to 6 per cent, and tightly combined

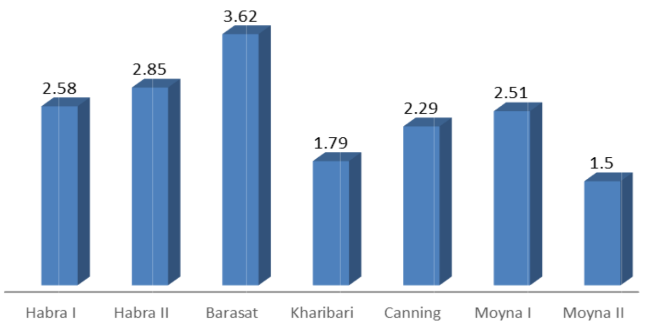

Figure 2B: E_{465}/E_{665} of stably combined humus.

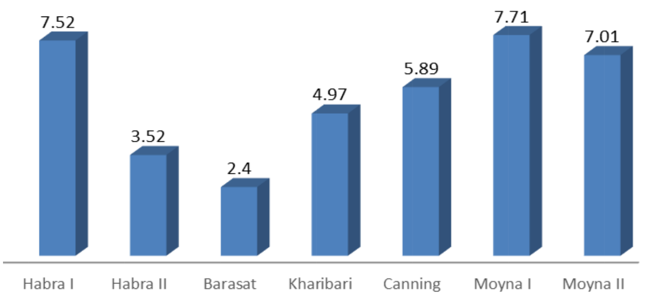

Figure 3A: Comparison of the C contents of loosely combined humus C (g kg^{-1}).

humus varied from 53 to 58 per cent, respectively. Among the three combined humus (loosely, stably and tightly combined humus C), loosely combined form constitute about 40 percent of the total soil organic carbon, and thus, carbon sequestration could be 60 percent of the total soil carbon storage.

The E465/E665 values of the loosely combined humus (2.60 to 4.46) were higher than that of the stably combined humus (1.50 to 3.62) (Figures 3A and 3B). Thus, the E465/E665 of loosely combined humus can be considered a more suitable index rather than that of the stably combined humus for identifying the aromaticity and humification degree of soil organic carbon. The E465/E665 ratio is related to the aromaticity and to the degree of condensation of the chain of aromatic carbons of the humic acids, and could be used as a humification index [12,13]. Low E465/E665 ratio reflects a high degree of condensation of these structures while high ratio means presence of large quantities of aliphatic structures and low quantities of condensed aromatic structures [14]. This ratio also is inversely related to the degree of aromaticity, particle size, molecular weight, and acidity [15].

Conclusion

From the present study it is evident that aquaculture ponds could play a vital role to counteract the emission of green house gases from the aquaculture practices by sequestering carbon in the sediments. Even if sometimes, the bottom sediments could remove from the pond to enhance the productivity, at least 60 per cent carbon storage will act as carbon sequester and it will not be able to come out in the atmosphere. Thus, more study is needed in this respect to generate more data so that carbon neutral aquaculture practices can be achieved.

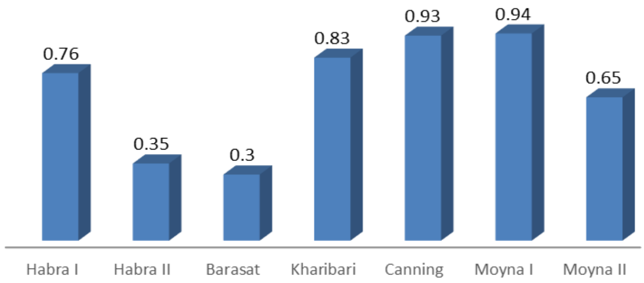

Figure 3B: Comparison of the C contents of stably combined humus C (g kg^{-1}).

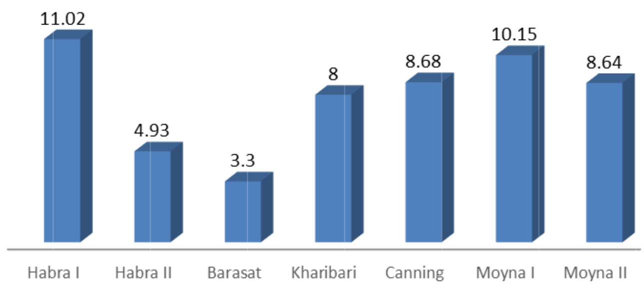

Figure 3C: Comparison of the C contents of tightly combined humus C (g kg^{-1}).

Acknowledgement

The funding of NICRA (National Innovation on Climate Resilient Agriculture) for conducting of the present investigation is gratefully acknowledged. We are also highly grateful to all the farmers for their immense help during our investigation.

References

1. IPCC (Intergovernmental Panel on Climate Change). Climate Change: Climate Change Impacts, Adaptation and Vulnerability. Working Group II, Geneva. 2007.
2. Xiaonan D, Xiaoke W, Lu F, Zhiyun O. Primary evaluation of carbon sequestration potential of wetlands in China. Acta Ecol Sin. 2008; 28: 463–469.
3. Schlesinger WH. Carbon sequestration in soils. Science. 1999; 284: 2095.
4. Akselsson C, Berg B, Meentemeyer V, Westling O. Carbon sequestration rates in organic layers of boreal and temperate forest soils – Sweden as a case study. Global Ecol Biogeogr. 2015; 14: 77–84.
5. Walsh B. Greenhouse airlines: traveling by jet is a dirty business. As passenger load increases, enviros look for ways to cut back the carbon. Time Magazine. 2007; 169.
6. Schrag DP. Preparing to capture carbon. Science. 2007; 315: 812–813.
7. Pacala S, Socolow R. Stabilization wedges: solving the climate problem for the next 50 years with current technologies. Science. 2004; 305: 968–972.
8. Eid EM, Shaltout KH. Evaluation of carbon sequestration potentiality of Lake Burullus, Egypt to mitigate climate change. Egyptian Journal of Aquatic Research. 2013; 39: 31–38.
9. Lal R, Kimble JM, Follet RF, Cole CV. The potential of US cropland to sequester carbon and mitigate the greenhouse effect. Chelsea: Ann Arbor Press. 1998; 1: 128.
10. Ji H, Zhuang S, Zhu Z, Zhong Z. Soil Organic Carbon Pool and Its Chemical composition in Phyllostachy pubescens Forests at Two Altitudes in Jian-ou City, China. PLOS ONE. 2015; 10.

11. Anikuttan KK, Adhikari S, Kavitha M, Jayasankar M. Carbon sequestration capacity of sediments, algae, and zooplankton from fresh water aquaculture ponds. Environ Monit Assess. 2016; 188: 422.

12. Kononova MM. Soil organic matter: Its nature, its role in soil formation and in soil fertility. Oxford: Pergamon. 1966.

13. Stevenson IL, Schnitzer M.Transmission. electron microscopy of extracted fulvic and humic acids. Soil Science. 1982; 133:179–185.

14. Chin YP, Aiken GR, Danielsen KM. Binding of pyrene to aquatic and commercial humic substances: the role of molecular weight and aromaticity. Environmental Science & Technology. 1997; 31:1630–1635.

15. Uyguner CS, Hellriegel C, Otto W, Larive CK. Characterization of humic substances: Implications for trihalomethane formation. Analytical and bioanalytical chemistry. 2004; 378:1579–1586.

Austin J Environ Toxicol - Volume 5 Issue 1 - 2019
ISSN: 2472-372X | www.austinpublishinggroup.com
Adhikari et al. © All rights reserved

Citation: Adhikari S, Mahanty D, Ikmail S, Sarkar S, Rathod R and Pillai BR. Carbon Storage in Sediments of Freshwater Fishponds of Odisha, Andhra Pradesh, and West Bengal, India. Austin J Environ Toxicol. 2019; 5(1): 1026.