J. Indian Soc. Coastal agric. Res. 32(1): 70-72 (2014) **Short communication**

Impact of Brackishwater Shrimp Culture on Natural Resources – a Case Study in Coastal Odisha

Received : 14.11.2013 Accepted : 22.02.2014

Brackishwater shrimp aquaculture is a favorable and lucrative livelihood option for farmers in coastal area. The practice is reported to produce unfavorable impact on the coastal environment. Discharge of shrimp wastes degrade the quality of local water bodies, seepage loss of saline water from shrimp farm ponds increases salt level of soil and water resulting to low yield of rice as reported by several rice farmers in coastal area. Nonetheless, by exporting brackishwater shrimp India earned handsome amount of foreign exchange @ 16.67% growth rate from 1997 to 2000. It is an emerging export driven production system, generating income, creating employment opportunities and thereby provides a livelihood security for rural communities. The practice is therefore expanding exponentially and encroaching the rice cultivated land in coastal areas. Some of the issues pose concerns are location specific, as in Odisha the coastal flat land serves the 'rice basket' of the state, it is the gift of three rivers. Impact of the practice is not friendly with soil and water qualities in rice field area. It is a remunerative farming option. Regulating the farming to produce minimum possible impact on soil and water qualities is thus required to restore the quality of coastal ecosystem. The purpose of the investigation was take a stock of soil and water qualities appraisal and study the extent of impact of brackishwater shrimp farming in coastal area

The coastal plains of Odisha stretch on the eastern coast of India from the Subarnarekha in the north-east to the Rushikulya in the south-west. This fertile region is known as the 'rice bowl' of Odisha. This is narrow in the north, widest in the middle, narrowest in the Chilika coast and wide in the south. For establishing information on soil and water qualities, both the soil and water samples were collected from shrimp farming practice area all along the coastal tract while to study the extent of shrimp farming practice on soil and water, the study area was selected at Erasama, and at Astaranga, on the basis of type of shrimp farming practice in coastal Odisha. Soil samples were collected from the area in and around the brackishwater shrimp farming pond, and water samples from shrimp pond (brackishwater), rain water harvesting ponds, open well tube well as per the recommendation made by APHA (1995). All the samples were collected during pre-monsoon, monsoon and post-monsoon periods from 2008 to 2010, and analyzed.

Coastal area is characterized by soil and water salinities, which vary with seasons and also over space. Magnitude of salt stress occurred in soil and water depends on soil type, lithology, relief and local climate, fluctuates with seasons and the amount of rainfall received during the period of study. Owing to that distinguish between salinity build up through brackishwater aquaculture practice and seasonal influence is difficult in coastal area. However, for proper utilization of soil and water sources the coastal regulatory authority has established the norm for practicing aquaculture along with the optimum stocking density in various shrimp farming practices, listed below:

Stocking Density	**Type of practice**
40000 – 60000 ha^{-1}	Traditional/ Improved traditional
60000 – 1000000 ha^{-1}	Scientific extensive system

Applying this to coastal shrimp farming practicing area in Odisha, Astarang and Erasama blocks representing "Traditional/Improved traditional" and "Scientific extensive system" were selected for this study.

Appraisal of soil and water qualities across the shrimp farming area

Soil properties relevant to soil fertility have been observed to vary across the different shrimp farming area. Data pertaining to relevant soil characteristics (Table 1) reveal that soil was invariably acidic in reaction with different salt stresses. Preponderance of Na over Mg and Ca in soil exchange complex was also maintained as obtained in water sources contained different amount of organic carbon, phosphorous, and other nutrient cations but the

Table 1. *Important soil properties (SEm)*

Soil parameters	Kendrapada / Mahakalpada	Ersama	Bhadrak / Baleswar
pH	4.49 + 0.58	5.33 + 0.41	5.17 + 0.41
EC_2 (dS m^{-1})	2.2 + 0.6	3.9 + 0.6	2.6 + 0.7
Organic carbon (%)	0.77 + 0.27	0.54 + 0.12	0.43 + 0.06
Bray's - P (mg kg^{-1})	0.95 + 0.11	1.13 + 0.08	0.97 + 0.1
Exchangeable K (mg kg^{-1})	575.73 + 191.16	595.4 + 180.56	447.07 + 81.54
Exchangeable Ca (mg kg^{-1})	911.97 + 166.45	496.94 + 163.07	975.66 + 112.46
Exchangeable Mg (mg kg^{-1})	1373.4 + 337.26	1180.47 + 306.63	1325.44 + 140.46
Exchangeable Na (mg kg^{-1})	2529.75 + 844.35	4617.0 + 1383.7	2720.83 + 640.82

Table 2. *Relevant water quality characteristics at pre – farming period in brackish water shrimp farm area in coastal Odisha (SEm)*

Water quality attributes	Dhamra	Kendrapada	Baleswar	Ersama	Overall
pH	6.8 + 0.35	6.57 + 0.19	6.6 + 0.22	6.34 + 0.67	6.57 + 0.22
EC (dS m^{-1})	3.38 + 1.12	4.32 + 0.79	5.9 + 0.21	5.25 + 1.07	5.59 + 0.3
Na (mg l^{-1})	1919.91 + 725.8	1961.77 + 596.51	2467.83 + 332.26	2485.28 + 894.17	2209.57 + 341.87
K (mg l^{-1})	96.6 + 35.76	115.14 + 22.26	122.72 + 19.85	136.8 + 46.43	118.52 + 16.97
Ca (mg l^{-1})	138.88 + 30.1	148.17 + 22.98	216.28 + 34.09	238.78 + 69.26	186.65 + 24.34
Mg (mg l^{-1})	333.96 + 137.51	314.14 + 88.34	469.41 + 132.4	482.86 + 113.28	400.76 + 57.33

estimates varied across the places. Water at pre farming (shrimp) stage was found to vary from strongly acidic (pH 3.66) to alkaline (pH 8.45) in reaction, and highly saline (Table 2). It was Na – Mg – Ca type where Na preceded by 5 – 6 times over Mg and 11 – 13 times over Ca while Mg was headed by 2 to 2.5 times over Ca.

Water quality across the sources

The water quality changes with type of water sources, fluctuates with seasons and varies over space in coastal Odisha. Data pertaining to relevant water quality parameters in Fig. 1 reflect an increasing trend of salinity across the sources from monsoon to summer periods. It was almost at par in river/canal/drain water with brackishwater shrimp pond followed by paddy field – water, rainwater harvesting pond and groundwater. The groundwater was not much constrained by the rising of salt stress while it was 11 to 188 and 55 to 92% in paddy field and pond water. The Na, Ca and Mg stress was also intensified over time with a highest value registered as. 1.11 to 2.45 times for Na, 0.39 to 3.78 for Ca and 0.33 to 2.32 times for Mg in shrimp pond water. Frequent water exchange during the practice in the pond may result in high salt load and its constituents in the water. This consequently indicates about high salt load on soil and water resources in paddy growing area in coastal Orissa

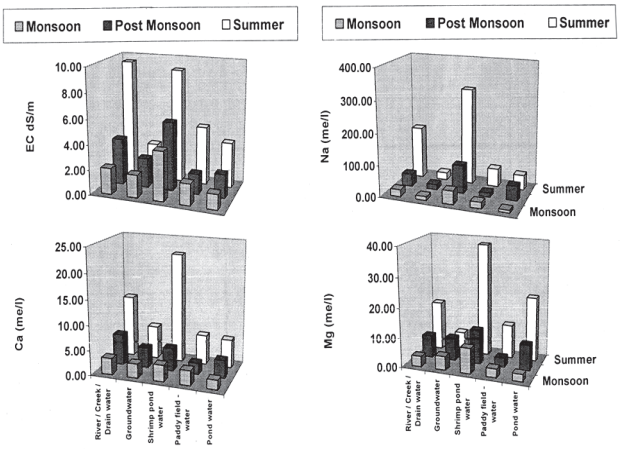

Fig. 1. Distribution of salt stress and major cations across the water sources and with time-periods in brackish water shrimp farming area

Soil Properties

Soil texture plays key role to control salinity development in soil profile, therefore to know the salt stress retained from brackishwater inundation was studied in the laboratory. The soil texture varied from sandy loam (sl) to clay (c) with percentage content of 21.46 to 85% sand, 2.5 to 28.62% silt and 5 to 57% clay while the "(Silt+clay)/sand" ratio ranged 0.18 to 0.84.This account for developing 0.18 to 6.33 times more salinity in soil, Linear or near linear increment of salinity can be easily controlled by draining the excess salt through leaching by low-

saline water, as observed in the light textured soil (sl to scl) having high sand content (54.4 to 85%). Under sub-humid climatic condition, this can be naturally controlled by the monsoon-rainfall. But quadratic rise of salinity can not be controlled by leaching with low-saline water and thus probability of persistent salt build up in brackishwater shrimp farming in paddy cultivated area can not be ruled out.

Extent of salt load due to brackish water shrimp farming in cultivated pasture

The shrimp farming season varies from March/ April to June in Astrang and Ersama area while throughout the year in Balasore and Bhadrak district of coastal area. It has also been practiced from August to November in some places at Astarang and Erasama. On an average 7 to 8 dS m^{-1} of EC is used to maintain in this standing water of the shrimp pond of 4000 m^2 size. That equivalent to to17922 to 20480 ton salt per brackishwater shrimp pond area. On the basis of amount of soil this practice exerts a pressure of salt grows to the tune of 22.4 to 25.6 ton salt per Kg soil for 120 days.

Inferences

Brackishwater shrimp culture is a promising livelihood option for small and marginal farmers in coastal Odisha. The practice is not incompatible with the environment in the locations which are persistently saline and usually not used for agricultural crops. Coastal salinity fluctuates with seasons and creates a harmony with nature, but the practice induces an unusual salt stress to the tune of 2.3 to 7 times more salinity (ECe) than the salinity observed in low lying paddy growing area, which is strikingly varied with soil texture, specifically relative presence of soil mechanical separates. It has been found that continuous stagnation of saline water of 7 – 8 dS m^{-1} magnified the salt stress in soil and didn't discharge the excess salt content even after prolonged rainfall. A sustained salt build up e.g. 6.1 dS m^{-1} (ECe) was observed in the soil, which was initially non saline. Rise of salt concentration slowly enriches Na concentration in soil exchange complex, raised exchangeable sodium percentage and deteriorate soil structure. This has been marked by loss of saturated hydraulic conductivity of soil. Increase of soil salinity also poses potential threat to raise salt stress in underground aquifer and making them unusable in farming. Without proper measures of soil and water conservation the study thus reflects that brackishwater shrimp farming slowly degrade soil and water qualities in coastal paddy growing area in Orissa.

Directorate of Water Management
Chandrasekharpur, Bhubaneswar - 751 023
Odisha
*E-mail: mdas6yahoo.com

MADHUMITA DAS*, P. SWAIN, O. P. VERMA
and D. P. SINHABABU

REFERENCES

APHA (1995). American Public Health Association. *Standard methods for the examination of water and wastewater* (19th ed.). Washington, D.C., American Public Health Association.

Minhas, P. S and Samra, J. S. (2003). *Quality Assessment of water Resources in the Indo-Gangetic Basin part in India.* Technical Bulletin No. 1/2003, Central Soil Salinity Research Institute, Karnal-132 001, India. 51 p.

Oldeman, L. R., Hakkeling, R. T. A., and Sombroek,W.G. (1991). *World map of the status of human-inducedsoil degradation—an explanatory note.* Wageningen, ISRIC.

Sugimori, Y., Funakawa, S., Pachikin, Ishidan; Ishidan; K. M., Khski, T. (2008). Soil salinity dynamics in irrigation fields and its effects on paddy-based rotion systems in southern Kazakhstan. *Land degradation and development* **19**(3): 305-320.