



## IMPACT OF SHRIMP PROCESSING INDUSTRIES ON THE CHEMICAL PROPERTIES OF SOILS OF RUPSHA UPAZILA, KHULNA, BANGLADESH

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**Abstract:** A Comparative study was carried out in different shrimp processing industries at Rupsha Upazila under Khulna district during 2010. In the experiment, some soils which are collected from nearby fields of the industries and the agricultural field that approximately 100 meters away from the industries were determined to sketch out the nutrient dynamics of the experimental area. The nutrient contents of water were analyzed for measuring pH, EC, Salt percentage and some major ionic concentrations. The pH was more than 8.0 in the polluted soil which reflected alkaline in nature. The EC values was also higher ( $7.7 \text{ dSm}^{-1}$ ) in polluted soil than in controlled soil ( $5.54 \text{ dSm}^{-1}$ ). Other values of major ionic concentrations were differing from controlled soils to polluted soils except Ca, Mg. Among the five industries, Lockpur fish processing industry showed the most effectively increased the values and concentrations of different chemical parameters. High sodium (alkali) content with medium salinity hazard is the major problem in the investigated area. So, appropriate sustainable management technologies need to be incorporated to control pH and salinity hazard.

**Keywords:** Soil quality, effluents, shrimp processing industries, crop growth, salinity

### Introduction

A shrimp farm is an aquaculture business that cultivates marine shrimp or prawns for human consumption. Commercial shrimp farming began in the 1970s, and production grew steeply, particularly to service the U.S., Japan and Western Europe. Shrimp farming has become one of the Asia's fastest growing industries. The world cultured shrimp production increased steadily and reached 600,000 mt. by 1990. The Asia-Pacific region continued to dominate the world's cultured shrimp production with its 80.6 % contribution in 1991 (Csavas, 1992). More than 85% of world's farmed shrimp is produced in coastal areas of the Asia-Pacific region and Bangladesh was the fifth largest producers in the world (DOF, 2006).

In Bangladesh, there are about sixty shrimp processing industries where about thirty one industries are running at current moment. This project becomes very much profitable and makes satisfactory result for the indigent people in the southeast and southwest part of the country. These industries produce about 10,000 tons wastes per day at the peak time. The authority follows local waste treatment process. They separate cartons, polythene from the waste and sell them to another party. Remaining wastes are gone through the nearby 'Rupsha River'. Various chemicals are used during shrimp processing such as STP (Sodium tri phosphate), Sodium-meta-bi-sulfate etc. The dyes are also responsible for both water and soil pollution (Saha, 2010).

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Bangladesh is a tropical country which is suited for the production of fish. Now a day shrimp industries are becoming popular and already 11.2 million people depends on shrimp processing industry. But in shrimp processing industries various chemicals are used which are harmful for soil quality and crop production.

Investigation has been conducted to assess the intensity of soil pollution and the potential impacts of effluents & wastes on soil surrounding some Shrimp processing industries (Modern sea food, Sabuj fish., Khulna fish, Lockpur fish processing Ltd. and Bright sea food) of Rupsa Upazila under Khulna district. Consequently, a research work has been made at the Discipline of Soil Science, Khulna University, Khulna with the following objective: To estimate the level of pollution in terms of soil chemical parameters of the study area as compared with unpolluted (control) soil.

### Materials and Methods

**Study Area:** An investigation has been conducted to assess the quality of water where effluents discharged from shrimp processing industries for irrigation use at Rupsha Upazilla under Khulna district with 22°45' and 22°52' north latitude and 89°33' and 89°41' east longitudes (Map-01). 'Rupsha' River flows beside the Upazilla which is evolved 5.5 sq km (Thana Nirdeshika, SRDT, 1989). In Rupsha Upazilla the soil type is flood plain to little bit non-flood plain. It consists of organic soil and tidal plain. In spite of having a lot of rivers and canals it depends on monsoon rainfall for crop production. So, further investigation and research work should be essential for proper use of nutrients in soils and sustainable agriculture (Thana Nirdeshika, SRDI, 1989).

**Sampling and Analysis:** The soil sampling sites consisted of Rupsa Upazila under the district of Khulna. Fifteen soil samples were randomly collected to cover most of the investigated area during 11 October, 2009. Composite method has been applied during sampling soil samples. Samples were collected at optimum time associated with favorable environmental condition. Three soil samples collected from five of each selected industries. Among these three soil samples, two were collected from areas where the washing materials were discharged from the industry and another one is collected from nearby cultivated field which was approximately 100 meters away from the industries. Samples were contained in polythin bags tied, labeled and preserved for laboratory analysis. The sites were near Modern Sea Food, Sabuj Fish, Khulna Fish, Lockpur Fish Processing Ltd, Bright Sea Food where the effluents of shrimp processing industries were being discharged.

The major chemical constituents of water and its quality factors were considered for analyses by following methodology. The methods and procedure followed for the determination are as follows: The pH value of soil samples were measured by using pH meter (Jenway pH meter) as described by Tan (1996). Electrical conductivity (EC) of soil was estimated by EC meter (Jenway EC meter) as described by Ghosh, *et al.* (1983). Salt (%) =  $0.064 \times \text{EC (dS m}^{-1} \text{ or mS cm}^{-1} \text{ or mmhos cm}^{-1})$  (Jackson, 1973). Calcium and calcium plus Magnesium were determined by titri-metric method as described by Jackson (1973). Potassium and sodium contents in soil samples were determined separately by flame emission spectrophotometer (Jenway, Model: PEP-7) using potassium and sodium filters, respectively as outlined by Jackson (1973). Chloride (CT) was determined by the titri-metric method as described by Jackson (1973). Carbonate and bicarbonate contents of the soil samples were determined by titrimetric method as described by Jackson (1973). The data were statistically analyzed by using MINITAB 13.0 and The statistical analyses of the analytical results obtained from soil samples were performed as described by Zaman, *et al.* (1982).

### Results and Discussion

A research was conducted to determine the different chemical properties of collected soil samples. The chemical Properties of the collected water samples are presented in Table 1

Table 1: Chemical compositions of collected soil samples

INDUSTRY NAME	CHEMICAL PARAMETERS									
	PH	EC	N	K	Ca	Mg	cr	CO <sub>3</sub> <sup>-2</sup>	HCO <sub>3</sub> <sup>-1</sup>	Salt
Modern food sea	8.4*	6.45*	19.35*	0.89*	32.71**	4.73**	177.5*	45*	0.25**	0.41
Sabuj fish	8.35*	6.65*	16.12*	0.81*	35.37**	5.58**	159.75*	60*	0.2**	0.43
Khulna fish	8.62*	4.75*	15.06*	0.84*	35.25**	5.66**	142*	75*	0.3**	0.30
Lockpur fish	8.57*	6.80*	18.01*	0.90*	34.36**	5.53**	188.5*	60*	0.4**	0.33
Bride sea food	8.5*	7.07*	16.49*	0.83*	33.56**	5.08**	178*	45*	0.4**	0.45
Modern food sea	7.31*	5.48*	12.26*	0.51*	30.09**	3.69**	106.5*	30*	0.1**	0.35
Sabuj fish	7.12*	5.54*	11.56*	0.50*	31.25**	3.88**	106.5*	30*	0.15**	0.35
Khulna fish	7.35*	3.96*	11.31*	0.48*	30.51**	3.76**	105.5*	30*	0.1**	0.25
Lockpur fish	7.31*	4.48*	13.12*	0.45*	30.49**	3.78**	112.5*	30*	0.15**	0.29
Bride sea food	7.12*	4.81*	12.48*	0.41*	29.59**	3.81**	98.97*	30*	0.4**	0.45

Note: All parameters are in meq/100g except EC (dS/m) and Salt (%). \*significant at 95% level of (0.05) and \*\*non significant at 95% level of (0.05)

The soil samples were analyzed to determine the value of pH of the soils collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on soil pH. The pH of soil samples of the disturbed soil were varying from 8.35 to 8.62 and pH values of controlled soil were found to be less than 8 according to Table 1. So, there was a significant difference in pH values between disturbed soils and controlled soils at 95% level. Soil pH determines the microbial community at rhizosphere and vegetation above soil surface. Soils with a pH between 7 and 8.3 are in a range that will promote microbial activity, but may limit P, iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) availability at toxic level and help to increase availability of these nutrients under alkaline conditions (Rosen *et al.*, 2005). Little variation in pH value can make available form of nutrients to unavailable non soluble form.

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Phosphorus availability is highly affected by pH along with other nutrient as Ca (Bennett, 1993). So, continuous rising in pH is really harmful for better crop production. The soil samples were analyzed to determine the value of EC of the soils collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on soil EC. The EC of soil samples of the disturbed soil were varying from 4.75 to 7.07 dSm<sup>-1</sup> and EC values of controlled soil were found to be less than 5.54 (Table 1). So, there was a significant difference on EC values between disturbed soils and controlled soils at 95% level. Higher EC values of compared to control soils were observed due to the high NaCl, STP and various kinds of dyes content of the discharged wastes and effluents from the industries. EC is an indirect measurement of soil salinity. Sample collected from near shrimp industries show higher EC value than the far distance soil samples. So salinity increases into the contaminated sites. The soil samples were analyzed to determine the value of potassium of the soil collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on soil potassium. The K of soil samples of the disturbed soils were varying from 0.81 meq/100g to 0.90 meq/100g and K values of controlled soil were found to be 0.41 meq/100g to 0.51 meq/100g (Table 1). So, there was a significant difference on K values between disturbed soils and controlled soils at 95% level. The range 0.271 to 0.36 meq/100g and 0.181 to 0.27 meq/100g indicated optimum and medium potassium respectively (Muslem *et al.*, 2005). Excess potassium may cause deficiencies in magnesium and possibly calcium in plant body. Thus cause reducing growth or death of growing tips, blossom-end rot of tomato, poor fruit development and appearance for Ca deficiency and initial yellowing of older leaves between leaf veins spreading to younger leaves; poor fruit development and production due to the deficiency of Mg (Bennett, 1993). The soil samples were analyzed to determine the value of Na of the soils, collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on Na value of soil. The Na of soil samples of the disturbed soil were varying from 15.06 meq/100g to 19.35 meq/100g and Na values of controlled soil were found to be 11.31 meq/100g to 12.48meq/100g (Table 1). So, there was a significant difference on Na values between disturbed soil and controlled soil at 95% level. Higher Na values of compared to control soils were observed due to the high NaCl, STP and various kinds of dyes content of the discharged wastes and effluents from the industries. Excess amount of Na is worst for optimum crop production. It may reduce growth or death of growing tips by causing delay in nutrient supply through the growing plants (Bennett, 1993). The soil samples were analyzed to determine the value of Ca of the soils, collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on Ca value of soil. The Ca of soil samples of the disturbed soil were varying from 32.71 meq/100g to 35.37 meq/100g and Ca values of controlled soil were found to be 29.59 meq/100g to 31.25 meq/100g (Table 1). So, there was no significant difference on Ca values between disturbed soil and controlled soil at 95% level. Higher Ca values of compared to control soils were observed due to the high Ca content of the discharged wastes and effluents from the industries. The range >7.5 meq/100g of soil Ca indicated very high level of calcium (Muslem *et al.*,2005). Excess calcium may cause deficiency in either magnesium or potassium in plants. So that older leaves turn yellow initially around margins and die; irregular fruit development for Ca deficiency and initial yellowing of older leaves between leaf veins spreading to younger leaves; poor fruit development and production for deficiency of Mg (Black, 1957). The soil samples were analyzed to determine the value of Mg of the soils, collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on Mg value of soil. The Mg of soil samples of the disturbed soil were varying from 4.73 meq/100g to 5.66 meq/100g and Ca values of controlled soil were found to be 3.69 meq/100g to 3.88 meq/100g (Table 1). So, there was no significant difference on Mg values between disturbed soil and controlled soil at 95% level. The range > 1.875 meq/100g.soil magnesium indicates very high level of magnesium (Muslem *et al.*,

2005). High concentration tolerated in plant; however, imbalance with calcium and potassium may reduce growth (Bennett, 1993). The soil samples were analyzed to determine the value of  $\text{Cl}^{-1}$  of the soils, collected from nearby and distant fields of the industries to observe the effect of different types of waste and effluents on  $\text{Cl}^{-1}$  value of soil. The  $\text{Cl}^{-1}$  of soil samples of the disturbed soil were varying from 142 meq/100g to 178.0 meq/100g and  $\text{Cl}^{-1}$  values of controlled soil was found to be 98.97 meq/100g to 112.5 meq/100g (Table 1). So, there was a significant difference on CT values between disturbed soil and controlled soil at 95% level. Excess amount of chlorine is not reported yet. But  $\text{Cl}^{-1}$  works on the photosynthesis reactions in plants. So there is a possibility to enhance photosynthesis (Bennett, 1993). In this experiment, the CCV of soil samples of the disturbed soil were varying from 45.0 meq/100g to 75.0 meq/100g and CCV values of controlled soil were found to be 30 meq/100g (Table 1) and the HCCV of soil samples of the disturbed soil were varying from 0.2 meq/100g to 0.4 meq/100g and HCCV values of controlled soil were found to be 0.1 to 0.4 meq/100g (Table 1). So, there was a significant difference on CCV but no significant difference was found in HCCV values between disturbed soils and controlled soils at 95% level. Soils with CCV greater than 25 to 30 meq/100g are harmful for soils. Presence of excess carbonate and bicarbonate makes the soil color whitish and thus may have some effects on soil temperature. Carbonates and bicarbonates both are responsible for soil buffering system. Those soils are contaminated with effluents may show poor buffering capacity (Bennett, 1993). The results of salt% on the disturbed soils were varying from 0.30 % to 0.45 % and of controlled soils were found to be 0.25% to 0.45% (Table 1). This experiment has proved that the value of salt% is increased from shrimp processing industries to its surrounding soil through effluents of shrimp processing industries because NaCl and STP (Sodium tri phosphate) are used in shrimp industries which may add salt in soils that enhance salt concentration and induce soil quality.

### Conclusion

An investigation was carried out to test the impact of shrimp industries of Rupsha Upazilla under Khulana district on chemical properties of nearby soils that are subject to be affected by the discharged effluents from these industries. The findings of the investigation are showed that Soil sample analyses showed that affected soils contains higher pH and EC values, and higher concentrations of Na, K, Ca, Mg,  $\text{CO}_3$ , Cl and HCCV than those values and concentrations of unaffected soils. Results were statistically significant except for Ca, Mg and HCCV. It was showed from the result of the study that Lockpur fish processing unit most effectively increased the values and concentrations of different chemical parameters. However excess Na in affected soils may render dispersion and disrupt structure development and hence affect many other qualitative values of these soils if the conditions prevail for a long time. So, immediate appropriate sustainable technology should be adopted for the treatment of these soils in the study area.

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