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Effect of Shrimp Culture on Livestock Feeds and Fodder

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Abstract: The mean yield of rice, rice straw, rice bran, till oil seed, mango tree and jack fruit tree number and other feeds decreased significantly ($p< 0.01$) after shrimp culture compared with before shrimp culture. The salinity and pH of water under shrimp culture area (saline area) are significantly ($p< 0.01$) higher than that of non-shrimp culture area (non-saline area). In case of soil, the average EC value and pH under shrimp culture area are significantly ($p< 0.01$) higher compared with non-shrimp culture area. The chemical composition of green grass, rice straw and rice bran is similar for both of shrimp culture and non-shrimp culture areas. So the production of livestock feeds have been affected following the shrimp farming practices but it do not affect the feed quality.

Key words: Shrimp culture, gher, saline water, pH, EC value, feeds, fodder

Introduction

In recent years, the issue of environmental degradation has caused great concern both nationally and internationally. Agriculture and environment interact in such a way that agricultural growth depends on the proper functioning of the environmental process, the same way that environmental soundness depends upon agriculture (Conway, 1990). Wadleigh and Dyal (1970) defined environmental degradation as "the unfavourable alteration of our surroundings, wholly or largely as a by product of man's action through direct or indirect effects of changes in energy patterns. These changes may affect man directly, or through his supplies of water and of agricultural and other biological products, his physical objectives or possessions, or his opportunities for recreation and appreciation of nature."

The livestock production and survival capacity mainly depends on natural environment. In Bangladesh, shrimp farming started in some coastal areas at the later part of the sixties called brackish water aquaculture of shrimp in the coastal districts. Marine (marine water) shrimp farming over the coastal areas has been expanded and spread during the decades of seventies and eighties as a result of high demand in the international markets and its high prices in the world. However, the fast growing shrimp industry has also been accompanied by concerns over social, economic and environmental impacts (Flaherty *et al.*, 2000, De Silva, 2000). The introduction of marine and brackish water shrimp farming near shore and inland has created ecological and social problems by changing the quality of agricultural land, natural vegetation, poultry and livestock production and daily life of the area. Water use in the shrimp culture affects the surrounding environment through extraction of ground water and discharge of pond water. Heavy water use drives away fresh water, and reduces supply of domestic and agricultural water, aside from causing seawater contamination.

All soils and natural sources of water contain more or less amounts of soluble salts, which may affect the normal growth, and yield of livestock feeds. Salinity may be defined for soils and water which contains sufficient soluble salts that impair its productivity. Feeds and fodder management under saline condition is difficult by the fact that an excessive salt concentration in soil is detrimental to plant growth. Due to the presence of excessive concentration of salts in the soil high osmotic pressure is created which obstructs the absorption of nutrient elements.

The impact of shrimp farming on the socio-ecological condition of the coastal regions of Bangladesh has been interpreted by different groups in different ways. The local marginal farmers and crop cultivators are of the opinion that shrimp farming is destroying the soil and making it unsuitable for crop cultivation and also livestock feeds and fodder. On the other hand gher owners do not support this opinion. This calls for more concerted efforts to assess the impact of shrimp farming on the socio-ecological conditions of the coastal regions.

Most of the studies so far conducted on the effects of shrimp farming are, however, superficial and fragmentary. Information on the effects of shrimp farming on the feeds and fodder of livestock is however, scarce. Therefore, the present study has been aimed to provide information on the impact of shrimp farming on livestock feeds and fodder in some selected villages of Paikgacha upazila under Khulna district.

Materials and Methods

The experiment was divided into two parts, Field study and Laboratory analysis. Duration of the experiment was 1st February to 30th April 2001.

Field study: In field study survey method was used to collect data. The study area is located in the south-western part of Bangladesh in the tidal flood plain near the large mangrove forest, the Sundarbans. For the collection of data and samples (water, soil and feeds) villages of Paikgacha upazila under Khulna district were selected. In this study, a total of 100 respondents (sampling units) were selected. Classification of respondents was done on the basis of landownership. The interview schedule was carefully designed keeping the objective of the study in view.

The data were collected from both primary and secondary sources. Primary data were collected by researcher himself through personal interviews with the selected responding farmers in the Paikgacha upazila and secondary data were available from, various sources viz., books, journals, reports, thesis, official records and statistical year books of Bangladesh. Data were collected during the period from 1st February to 30th April 2001. Information received from the respondents about the condition of variables before and after shrimp culture is described below:

Rice yield: Rice yield was measured in terms of kg ha^{-1} of land.

Rice straw: Rice straw yield was calculated from total rice yield. (Rice:Straw = 1:1.6; Karim *et al.*, 1987)

Rice bran: Rice bran yield was calculated from rice yield.

Til oil seed yield: Til oil seed yield were measured in terms of kg ha^{-1} of land.

Grass availability (durba, baju, chechu, nal, and roadside grasses): A score of one (1) was assigned for availability of grass and score two (2) was assigned for unavailability of grass.

Tree number: Tree number was determined on the basis of number of trees in homestead area. Trees, directly related to livestock, like mango and jackfruit, were considered.

The collected data were then edited to summarize them

meaningfully and were processed by tabulation sheets. Collected data were coded, compiled, tabulated and analyzed in accordance with the objectives of study. Data were analyzed using paired t-test with the help of computer package SPSS.

Laboratory analysis: Five soils and water samples were collected from different places of shrimp culture area and five from non-shrimp culture area. Feed samples were also collected from shrimp culture area and non-shrimp culture area.

Water pH and salinity was determined just after collection at the spot. The soil sample collected from the field was carried to the laboratory for analyses. Soils were air dried, processed and passed through 2 mm (10 mesh) sieve and stored in plastic jars. For bulk density the samples were collected using core samplers from each depth interval. EC value and pH of soil were determined in the Agrivarsity Humboldt Soil Testing Laboratory under the Department of Soil Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. Salinity and pH of water was determined with the help of instruments of the laboratory of Water Quality and Pond Dynamic, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, Bangladesh. The feed samples were sun dried and then ground. The dry matter, crude protein, crude fibre, ether extract and ash content of feed ingredients were analyzed in the Animal Nutrition laboratory, following the procedure of AOAC (1980). Data for water and soil were analyzed using paired 't' test with the help of computer package SPSS.

Results and Discussion

Field study: Mean value of rice yield, rice straw yield, rice bran yield, til oil seed yield and number of mango trees, jack fruit trees before and after shrimp culture are shown (Table 1). After shrimp culture yearly production (kg ha^{-1}) of rice (1137.69), rice straw (1820.30), rice bran (226.53) and til oil seed (566.45) has been decreased significantly ($p< 0.01$) compared with the yield before shrimp culture. Similarly, number of trees per family has reduced significantly ($p< 0.01$) which for mango trees and jackfruit trees were 6.46, 4.15 and 2.12, 1.47 number respectively in before and after shrimp culture.

Farmers were pressurized by Gher owners to lease their land for shrimp culture. The shrimp culture continued from March to September and in these seven months field contained saline water. After completion of shrimp culture gher (shrimp culture area/field) owners do not flush saline water from fields. So there was a limited scope for cultivation of any crop or other feeds. Na-Sae-B (1989), stated that paddy farmers suffer from salt water of prawn farms. In the course of shrimp field management a lot of chemicals were used e.g., pesticides and molluscides (tea seed cake, rotenone, tobacco dust, thiodan, lime etc.), antibiotics (oxytetracycline, streptomycin, tetracycline etc.), disinfectants and many other known and unknown chemicals. Agricultural land became barren by wide use of these chemicals. Chanratchakool *et al.* (1998) reported that widely abused chemicals decreased the soil fertility.

The interviewees mentioned the several grasses like Durba (*Cynodon dactylon)*, Baju (*Tarmarix troupii),* Chechu (*Bauhinia vahlii)* and Nal (*Fhragmites karka)* have become completely extinct now because of shrimp farming. The grass named 'Kaju Ghas', once popular as a fodder crop and as feed for ducks and birds has become completely extinct since the advent of shrimp farming. It is reported that shrimp culture destroyed the grasses. Deb (1998) also reported that salt intrusion has caused the loss of crop production and grasses. A severe inundation of shrimp field and abused chemicals decreased the availability of grasses and other crops yield. These reports are in agreement with the present findings. Al-Tahir and Al-Abdulsalam (1997) reported that water salinity decreased grain yield and grain number significantly. Iyengar and Kuria (1971) reported that sea water decreased grain yields of bajra and wheat crops. Jabber *et al.* (1993) indicated that modern rice varieties were threatened in greater Khulna district, where salinity problems exist. Reddy *et al.* (1995) reported that

Table 1: One year production of crops, feeds and trees before and after shrimp culture

	Mean ± SE		
Parameters◊	Before shrimp culture	After shrimp culture	Level of significance
Rice yield (kg ha^{-1} $year^{-1}$)	3692.77± 74.75	1137.69± 29.13	**
Rice straw yield (kg ha^{-1} $year^{-1}$)	5908.84± 41.00	1820.30± 30.00	**
Rice bran yield (kg ha^{-1} $year^{-1}$)	626.64± 10.95	226.53± 8.08	**
Til oil seed yield (kg ha^{-1} $year^{-1}$)	1515.20± 110.21	566.45± 78.80	**
Mango tree (per farmer)	6.46± 0.23	2.12± 0.19	**
Jack fruit tree(per farmer)	4.15± 0.25	1.47± 0.23	**

** = Significant at 1% levels ◊ Each parameter represents mean of 100 respondents

Table 2: Water quality under shrimp culture area and non shrimp culture area

	Mean ± SE		
Parameters◊	Shrimp culture area	Non shrimp culture area	Level of significance
Water			
Salinity (PPT)	17.00± 0.71	1.10± 0.33	**
pH	8.67± 0.06	7.06± 0.16	**
Soil			
EC (dS/m)	8.79± 0.18	1.58± 0.18	**
pH	8.24± 0.08	6.64± 0.08	**

** = Significant at 1% levels ◊ Each parameter represents mean of 5 samples

Table 3: Chemical composition of different feed ingredients under shrimp culture area and non shrimp culture area

	Green grass		Rice straw		Rice bran	
Parameters	Shrimp culture area	Non shrimp culture area	Shrimp culture area	Non shrimp culture area	Shrimp culture area	Non shrimp culture area
DM g/100g	17.00	16.80	89.92	89.20	89.90	89.60
CP (%)	9.90	9.70	3.40	3.20	14.50	14.43
CF (%)	31.50	32.40	32.00	35.00	16.40	15.70
EE (%)	2.00	2.17	1.30	1.50	18.95	19.00
NFE (%)	45.40	43.73	47.80	45.30	35.17	36.09
Ash (%)	11.20	12.00	15.50	15.00	14.98	14.78

shrimp farming causes pollution of the environment. So the main cause of reduction of crops and other livestock feed is the shrimp culture or salinization.

Laboratory analysis: It is revealed that water salinity (17.00 ppt) and pH (8.67) under shrimp culture area are significantly ($p< 0.01$) higher compared with water salinity (1.10 ppt) and water pH (7.06) respectively of non shrimp culture area (Table 2). Crops, feeds, fodder and trees require normal water or low saline water. So the water of shrimp farming area is not suitable for crops, grass, feeds, fodder and trees. This water is harmful for any productive purpose except shrimp. Rahman (1990) reported that water salinity and pH ranged 10-25 ppt and 7.8-8.7 respectively was favourable for shrimp growth and production. Crops, feeds, fodder and other trees cannot tolerate such high salinity and pH. It is reported that the destruction of crops, shrubs, trees etc due to high salinity of water. Nasae (1989) also supports this result and stated that salt water spoils crop fields and grazing land.

The mean value EC (8.79 dS/m) value is significantly ($p< 0.01$) higher in shrimp culture area compared with of non shrimp culture area (1.58 dS/m) (Table 2). Richards (1968) reported that EC value of saline soil was 2 to 4 dS/m. The use of saline soil for any productive purpose is a universal problem because the soil salinity inhibits the release of soil nutrients for unitization by agricultural crops, feeds, fodder, grasses and trees. Such soil is generally termed as 'dry soil'. Stagnation of saline water in the field increases EC value of soil. Sankov (1976) reported that concentrated salt solutions disrupt the absorbing activity of roots. The results indicate that the mean EC (dS/m) value of shrimp culture area was 8.79, which was totally harmful for crops or livestock feeds. It is reported that germination of crops (maize, sorghum, wheat etc.) was greatly reduced where soil EC value exceeded 3.00 dS/m. Suchato *et al.* (1995) reported that germination percentage gradually decreased as salinity increased. Popay and Sanders (1982) reported that perennial pasture species were adversely affected by increase in soil salinity.

The results reveal that pH (8.24) is significantly ($p< 0.01$) higher in shrimp culture area compared with pH (6.64) in non-shrimp culture area. High salinity increased pH level of shrimp culture area. These soils had adverse effect on crops and grasses. This result is supported by Dubey and Sharma (1987) and stated that pH was 8.2 to 8.3 and 8.0 to 8.5 at two highly saline areas of India where shrimp culture was practiced. Tamhave *et al.* (1970) reported that pH from 6.5 to 7.5 was the range in which most soil nutrients were available to plants. Plants or grasses of shrimp culture area do not get sufficient soil nutrients for their proper growth and survivability. So there was drastic reduction of crops, grasses and other livestock feeds in shrimp culture area.

The chemical composition of different feed ingredients (green grass, rice straw and rice bran) in shrimp culture area and non-shrimp culture area showed no significant differences in DM (g/100), CP, CF, EE, NFE and Ash % (Table 3).

Salinity has no effects on chemical composition of feed ingredients but had adverse effects on yield. Al-Tahir and Al-Abdulsalam (1997) reported that water salinity decreased grain yield and grain number but not affect on grain quality. Aksoy *et al.* (1997) also supported this result and stated that salinity did not affect the feed quality.

There is a great difference in table values (2 and 3) of shrimp and non-shrimp culture area because shrimp culture area contains high saline water which increases EC (dS/m) and pH of soil, salinity (PPT) and pH of water.

The study has revealed that the production of crops, trees, grasses and other livestock feeds have been affected following the shrimp farming practices in study areas. Shrimp farming interacts with the environment and its expansion destroyed the whole ground in coastal region.

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