PERFORMANCE OF GRASSCUTTTER (*Thryonomy swinderianus*) FED VARYING LEVEL OF DIETARY PROTEIN

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ABSTRACT

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A farm study was conducted at the grasscutter unit of the Forestry research institute of Nigeria during June to August, 2007 to determine the effect of feeding varying levels of dietary protein on growth performance and cost of feeding growing grasscutter. Thirty-two grower grasscutters between the ages of 5-6 months were equalized by weight and used in a completely randomized design of four treatments with each treatment having four replicates of two animals. The results showed that elephant grass (*Pennisetum puperium*) is low in protein therefore necessitating the use of formulated concentrate. The final live weight, total weight gain and daily weight gain were significantly influenced by the dietary treatment ($P<0.05$). The final live weight and total weight gain significantly increased ($P<0.05$) with increasing levels of protein in the diet. The average concentrate intake increased from 178.02g in diet 1 to 262.05g in diet 4 ($P<0.05$). The findings also showed that the cost of feed was higher for diet 4 (₦34.48/kg) and decreased with decreasing level of protein in the diet (diet 1=₦23.00/kg).

Key words: Grasscutter, crude protein level, growth performance

INTRODUCTION

The level of meat and animal protein consumed by Nigerians is estimated at 6g per caput per day which is about 29g less than the minimum of 35g daily requirement recommended by the Food and Agriculture Organisation (FAO, 2004). It is well documented that the developing countries of the world do not produce enough food and the right nutritional quality to meet daily needs (Alstchul and Wilche, 1998).

The importance of adequate protein intake (in term of quality and quantity) in the nutrition of man cannot be over emphasized. Thus there is need to increase the level of animal production in Nigeria and also make animal protein source affordable to the populace. An area where effort may be rewarded in terms of meeting the animal protein requirement of Nigeria is the contribution of wild animals. Mbah, 1989 suggested that the shortage of animal protein in the third world countries can be ameliorated by improving the existing conservation programme of wildlife particularly the domestication of rodents that are tractable, prolific and widely accepted to the public for consumption. Again, captive rearing of rodents and other species of manageable sizes in cages and enclosures might augment the bush meat supply from the wild (extensive management) with attendant reduction of hunting pressure on the wild game.

Grasscutter production provides an opportunity of supplementing animal protein and income to Nigerian. The grasscutter can be reared with minimal capital outlay and land. It is less affected by disease, devoid of noise and its food requirement are low in captivity. It can therefore serve as a considerable income earner for the small scale urban and rural mini-livestock producers.

Grasscutter is desirable for domestication because of its excellent taste, acceptability, comparatively high nutritional value and meat yield than most species of livestock. It also contributes to both local and export earning of countries like Kenya, Benin republic and Nigeria (Ntiamoa-Baidu, 1998). Asibey (1974) earlier reported that grasscutter meat has a protein content of 24.7%, and a low fat content of 1.2% which makes it better than beef with a protein content of 19.6% and fat content of 6.6% and pork with a protein content of 19.4% and fat content of 13.4%.

The objective of this paper is to evaluate the performance and cost benefit of grasscuttter fed varying levels of dietary protein.

MATERIALS AND METHODS

Experimental site

The feeding trial was conducted at the grasscutter research unit of the wildlife section of forestry research institute of Nigeria (FRIN), Jericho Ibadan between June and August 2007.

Experimental layout

A total of thirty two (32) grower grasscutter between the age of 5-6 months were equalized by weight and used for the feeding trial. There were two animals per replicate and 4 replicates per each of the four dietary treatments. The animals were given elephant grass and formulated concentrate *ad libitum* throughout the period of the experiment. The formulated diets presented in Table 1 contained varying protein levels of (15%, 17%, 19% and 21%) for diets 1, 2, 3 and 4 respectively; and metabolisable energy level of 2800kcal/kg. The economic of production was calculated using the prevailing market price of feed ingredient as at the time of the experiment.

Housing

The grasscutters were housed in well ventilated concrete hutches with individual cells shaving a size of (0.2m long x 0.75m wide x 0.30m high). There were two animals per cell and a total of sixteen cells were used for the experiment.

Data collection

Records of average feed intake were taken by weighing the leftover every morning before giving fresh feed. The animals were weighed weekly to calculate the weight gain and feed conversion ratio were also calculated.

Chemical and statistical analysis

The proximate analysis of the elephant grass was carried out using the method of AOAC (1995). Data on feed intake, weight gain and feed conversion ratio were subjected to one-way analysis of variance.

RESULTS AND DISCUSSION

The gross composition of the formulated concentrate and the proximate composition of the elephant grass used for the study are presented in Tables 1and 2 respectively.

Table 1. Grass composition of experimental diets (%)

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Maize	40	39.1	63.1	32.5
Fish meal	0.5	2	3	5
Soya bean	5	6	7	10.1
Groundnut cake	1.6	5	5.5	7.5
Wheat bran	20	21	21.5	21
Bone meal	3.9	3.9	3.9	3.9
Palm kernel cake	28.36	22.36	22.36	19.36
Salt	0.24	0.24	0.24	0.24
Methionine	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1
Grower premix	0.2	0.2	0.2	0.2
Total	100.00	100.00	100.00	100.00
Calculated composition				
ME (kcal/kg)	2800	2800	2800	2800
Crude protein (%)	15	17	19	21

Table 2. Proximate composition of elephant grass

Parameters	Percentage (%)
Moisture	15.65
Crude protein	7.38
Crude fibre	29.35
Ether extract	0.42
Ash	6.45
Nitrogen free extract	40.75

Elephant grass has low protein content of 7.38%, high fibre content of 29.35% and ether extract content of 0.42%, thus necessitating the use of formulated concentrate. Onyeanusi *et al.*, 2007 reported that formulated balanced feed as supplements improve grasscutter performance. Table 3 shows the growth performance of grasscutter fed the experimental diets

Table 3. Growth performance of grasscutter fed diets containing varying levels of dietary protein

Diet	1	2	3	4	S.E.M
% Dietary protein.	15	17	19	21	
Initial live weight (g)	1500.00	1400.00	1400.00	1400.00	28.85
Final live weight (g) (g/animal/day)	2150.00^{bc}	2100.00^{c}	2180.00^{b}	2250.00^{a}	20.46
Total weight gain (g/animal/day)	650.00^{c}	700.00b^{c}	750.00^{b}	850.00^{a}	45.29
Daily weight gain	13.27^{c}	14.28b^{c}	15.00^{b}	17.35^{a}	0.97
Average daily feed intake forage (g)	400.40	370.20	371.14	374.20	20.05
Ave daily feed intake concentrate (g)	178.02^{c}	202.97^{b}	244.01^{a}	262.05^{a}	5.46
Feed conversion ratio forage	0.96	0.96	0.82	0.80	0.012
Feed conversion ratio concentrate	3.65	3.44	3.07	3.24	0.01

SEM= standard error of mean, Values with different superscript in the same row are significantly different ($p<0.05$)

Final live weight, total weight gain and daily weight gain were significantly influenced ($p< 0.05$) by the dietary treatment. The final live weight and total weight gain significantly increased ($p<0.05$) with increasing levels of protein in the diet. The daily weight gains of 13.27g, 14.28g, 15.00g and 17.35g for 15%, 17%, 19% and 21% dietary protein levels were higher than between 9.408g and 10.88g reported by Woger *et al* 2007. The average concentrate intake also increased from 178.02 in diet 1 to 262.05 in diet 4 ($p<0.05$). The increase in concentrate feed intake with increasing protein level in the diets may be as a result of improvement in taste or palatability in the diet.

The average forage intake, feed conversion ratio (forage) and fed conversion ratio (concentrate) were not significantly influenced ($p<0.05$) by the dietary treatments.

The economics of production (Table 4) shows that the cost of feed was highest for diet 4 (₦34.48/kg) and decreased with decreasing level of protein in the diet (diet 1= ₦23.00/kg). The cost of feed ₦/kg of between ₦23.00 for diet 1 and ₦34.48) in diet 4 were lower than between (₦48.47 and ₦75.64) reported by Woger *et al.,* 2007.

Table 4. Cost analysis of grasscuttter fed diets containing protein

Diets	% Dietary protein	Cost of feed (₦/kg)	Av. Total feed intake.	Ave total feed cost (₦).
1	15	₦23.00	14.95	339.25
2	17	₦26.36	16.97	447.33
3	19	₦ 29.55	20.49	605.48
4	21	₦ 34.48	22.01	758.56

CONCLUSION

Supplementing forage with formulated concentrate at up to 21% dietary protein significantly improves the growth performance of grasscutter in captivity. Although the cost of production increased with increasing levels of dietary protein, cost of production at 21% dietary protein inclusion (₦34.48) is lower than between (₦48.49-₦75.64) reported by Woger *et al.,* 2007.

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ASSESSMENT OF FIELD MAINTENANCE PRACTICES OF *Coffea arabica* AMONG COFFEE FARMERS IN TARABA STATE, NIGERIA

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ABSTRACT

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This study was conducted to assess field maintenance practices on production of *Coffea arabica* among farmers in Sardauna Local Government Area of Taraba State, Nigeria during 2007. Data for the study were obtained from a systematic random sampling of eighty-eight coffee farmers through the use of well structured questionnaire. Data were analyzed using descriptive statistics and chi-square. Most (44.3%) of the respondents were 50-69 years old while 56.8 % of them belonged to 3-12 range of family size. Majority (98.9%) of the respondents claimed to be engaged in clearing of coffee farms, 97.7% coppiced old unproductive plot and the same figure harvested coffee berries. Extension workers' contact with farmers (36.4%) was low. The very serious constraints to *Coffea arabica* production were poor marketing (97.7%) and pricing (95.5%), inadequate market information (89.8%), high labour cost (84.1%) and weak extension services 67.1%. The significant socio-economic variables that influence field maintenance practices of *Coffea arabica* include family size, farming experience, coffee beans price, and number of coffee farms maintained ($p< 0.05$). Good marketing strategies via farmers' group and improved extension contact would sustain *Coffea arabica* farming among farmers.

Key words: Production, socio-economic variables, constraints and respondents

INTRODUCTION

Coffee plant is native to Africa. The Harrrar tribe was the first to cultivate *Coffea arabica* in Ethiopia, which is centre of origin of the species (Opeke, 2005 and Ngussie and Dererse, 2007). Another species, *Robusta coffee* is believed to come from Central to West Africa. It is mainly spread throughout the Equatorial zone of Africa from Guinea through Zaire into Uganda (Opeke, 2005). The preparation and cultivation of coffee as we know it today was first done by the Arabs. Williams (1998) pointed out that the Europeans introduced Coffee cultivation to most parts of Africa during the colonial era. Thus, the *arabica* variety was cultivated in well suited highland areas, whereas *robusta* in favourable lowland areas. In the context of world production, and markets, African coffee production fluctuated annually in the last 10 years between 14 and 19 million (60kg) bags, with an average of about 16 million bags. However, this situation has fallen considerably due to varied factors (Surendra, 2002). Coffee is grown and exploited by more than 50 developing countries, but the consumers are all industrialized countries namely United States of America, Finland, Sweden, Belgium and Japan among others. Coffee is the second major traded commodity to oil and thus plays a vital role in the balance of trade between developed and developing countries.

In Nigeria, cultivation on a large scale started as far back as the 1940s, but gained momentum in the early to mid 1950s. *C. arabica* is grown mainly by the small scale farmers in the highland area of Mambilla plateau in Taraba State (Williams, 1998). In the world trade, *Arabica* coffee is of greatest economic importance which account for 4% of export in Nigeria. Although, Nigeria supplies less than 2% of world coffee, yet in terms of the national economy, its contribution in the non-oil sector is significant (Williams, 1989).

Economic Uses of Coffee

Coffee is an important foreign exchange earner, contributing in varying degrees to the national income of the producing countries. It guarantees a solid basis for the promotion of economic development (Cambrony, 1992). About 33 million people in 25 African countries as put by Surendra (2002) derived their livelihoods by growing coffee on their subsistence farms on about 4.5 million square kilometers of land. *Arabica coffee* for instance has become a major global commodity. Its cultivation, processing, trading, transportation, marketing provide employment for a lot of people in all producing countries (Muleta, 2007).

Pochet (+) and Flemal (2001), reported that coffee is consumed as an instant drink with its stimulating properties in an infusion of the roasted and grounded beans in boiling water. In Ethiopia, and Kenya, the Galla consume a sort of porridge prepared in the form of an intimate mixture of roasted and grounded coffee beans with butter and salt (Daviron and Ponte, 2005). When coffee is subjected to appropriate roasting, the beans yield a product which when reduced to powder makes it possible by infusion to prepare liquor well known by the name of coffee. It is used on a large scale by nearly all nations. The annual consumption per inhabitant ranges from 0.5-7.5kg (Pochet (+) and Flemal (2001).

Maintenance of coffee Farm

The management of coffee farms is well documented in literature. According to Obatolu and Famaye (1997), Pochet (+) and Flemal (2001) and Opeke (2005), it was reported that coffee farms could be maintained by farmers in a number of ways depending on the resources available to the farmer, price and the type of coffee. Some of these maintenance practices include weeding, mulching pruning, coppicing old coffee trees, fertilization, pest and disease control, timely harvesting among others.

Weeding: Weeds constitute serious problems to coffee after planting operation especially in early years of establishment. Weeding could be done manually and through the use of herbicides. Clean weeding in 18-24 months would eradicate all weeds problems in later years and facilitate good establishment. Three to four times a year is adequate using hoes. The use of herbicides such as primextra, paraquat at 2litre/ha in 33 litres of water reduces the frequency of weeding.

Mulching: It is an excellent practice particularly for young coffee seedlings. This is very effective in soil moisture preservation, increase vegetative growth and yield of coffee berries. Also, it provides organic matter. Mulching is a costly operation and only possible if sufficient quantity of vegetation is available. Leguminous plants, grasses (*Pennisetum purpureum and Tripsacum laxum*) and plantain trash are good organic mulches.

Pruning: This is carried out to promote vigorous plant growth, remove unwanted growth, and maintain regular shape trees. There are many types of pruning which include capping, single stem, multiple stem and so on.

Coppicing of old trees: It is the most common method of rehabilitating coffee trees. It involves the cutting off of the whole branches from the upright stem at 30cm above ground level using chain saw or cutlass. Red paint is applied to prevent infection. The essence is to 'reborn' many coffee trees that had been abandoned either by old age or disease attack back to good production.

Problem Statement

Agronomic practices are poor in most coffee growing countries in Africa. Over 80% of coffee from these countries is produced by small scale farmers who lack adequate education on proper agronomic practices for coffee farming (Mutua, 2000). Coffee yield in Nigeria has been on the decline as a result of the dearth of technical knowledge among farmers. Besides technical knowledge, low bean price resulting from the collapse in world market price has led to poor farm management, abandoned farms and improper harvesting. Consequently, this neglect has led to low productivity as well as disease and pest attack (Williams, 1989 and Agbongiarhuoyi *et al*, 2006).

From the foregoing, it is pertinent to investigate critical issues of some routine field practices that would improve the productivity and sustainability of existing coffee farms and plantations in Nigeria.

Objective

The broad objective of this study is to assess farmers' field maintenance practices in the cultivation of *Arabica coffee* in Sardauna Local Government Area of Taraba State, Nigeria. Specifically, the study addressed the following objectives:

i determined the socio-economic characteristics of coffee farmers,
ii examined the maintenance practices carried out by farmers,
iii ascertain the level of extension workers' contact with farmers cultivating coffee and
iv. determine the constraints encountered by farmers in producing coffee in the study area.

Hypothesis

Ho= There is no significant relationship between coffee farmers' socio-economic characteristics and maintenance practices on coffee farms.

METHODOLOGY

Study area

The study was conducted in the Mambilla Plateau in Sardauna Local Government Area (L.G.A) of Taraba State located in the Northern part of Nigeria. Mambilla has an altitude of 1,800m above sea level. Taraba State is bounded in the West by Nassarawa and Benue States and on the East by the Cameroon. The major occupation of the people of Taraba State is agriculture. Cash crops produced in the state include *Coffea arabica*, tea, groundnuts and maize. Crops such as rice, sorghum, millet, cassava, and yam are also produced in commercial quantity (E-Nigeria,

2004 and Wikipedia, 2008). *C. arabica* is cultivated successfully only at altitudes from 1,200 to 1,500m. It requires a mean annual temperature of about 18^0-22^0c and annual rainfall of 1500-1800mm (Obatolu, 1991 and Pochet (+) and Flemal, 2001).

Sampling Design and Data Analysis

A set of primary data for the study was obtained from well structured questionnaire from ninety coffee respondents but eighty-eight of the questionnaires were found useful for analysis. Six communities namely Kakara, Lekitaba, Mbaso, Furmi, Tapare-yahya and Kusuku in Sardauna L.G.A. were covered during data collection for the study. The selection of this area was purposive, predicated on the fact that the area is where *C. arabica* is extensively produced in Nigeria (Williams, 1998). *C. arabica* strives well in that part of the country due to its highland nature and temperate climate that favours the growth and development of the crop. Systematic random sampling technique was employed to select the respondents.

Data Analysis

Descriptive statistics (frequency, percentage, modal group) and chi-square were used to analyze data for the study. A statistically significant association for analysis was tested at 0.05 probability level.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Table 1 shows the distribution of respondents according to their socio-economic profile. All (100%) of the respondents were male while 44.3% were 50-69 years old. It means that men in their less productive age dominate coffee production in the study area. Furthermore, 42 percent of respondents had no formal education while all the respondents (100%) were married with majority having a family size of 3-12 persons, representing 56.8%. It means that the different forms of formal education attained by respondents will assist in management of Coffea *arabica* farms. The respondents with large household size are likely to be engaged more in coffee field maintenance. The modal category of the respondents' farming experience in coffee was 12-25 years indicating that most respondents had long years of growing *Coffea Arabica* which might likely assist in better handling of the crop.

Table 1. Socio-economic characteristics of respondents

Characteristics	Frequency	Percentage	Modal Group
Sex			
Male	88	100	Male
Female	-	-	
Age (Years)			
30-49	35	39.8	
50-69	39	44.3	50-69 years
70-89	14	15.9	
Marital status			
Married	88	100	Married
Single	-	-	
Educational level			
No formal Education	37	42	No formal education
Primary	24	27.3	
Secondary	17	19.3	
Standard six	6	6.8	
Tertiary	4	4.6	
Family size			
3-12	50	56.8	3-12 persons
13-22	28	31.8	
23-32	10	11.4	
Farming experience (Years)			
Below 12	11	12.5	
12-25	37	42	12-25 years
26-39	23	26.1	
40 and above	17	19.3	

Source: Field survey, 2007.

Coffee field maintenance practices by respondents.

In Table 2, majority (98.9%) of respondents engage in clearing of coffee farms using a mean cost of ₦1,739. Also, 68.2% pruned coffee trees using an average of ₦920 per acre/season. None of the respondents used chemical to spray coffee trees and only 9.1% practiced fertilizer application. This confirms to some extent the organic status of Nigerian coffee as put by Sanusi, *et al* (2006). In terms of rehabilitation, 97.7% coppiced old coffee trees at a mean cost of ₦2,040 per acre. It means that more farmers are adopting coppicing method of rehabilitating coffee. This would ensure the sustainability of *Coffea arabica* in Nigeria. Harvesting of coffee berries are practiced by 97.7% of the respondents at a mean cost of ₦1,674 per acre. This indicates that coffee berries are usually harvested from the trees irrespective of the disincentive being faced by farmers.

Table 2. Distribution of coffee field maintenance practices by respondents

Coffee practices	Yes	No	Mean cost/Acre/ Season (₦)
Clearing weeds	87(98.9)	1(1.1)	1739.88
Pruning	60(68.2)	28(31.8)	920
Spraying of chemical	-	88(100)	-
Fertilizer application	8(9.1)	80(90.9)	-
Coppicing old trees	86(97.7)	2(2.3)	2040.98
Harvesting berries	86(97.7)	2(2.3)	1674.39

Source: Field survey, 2007. Figures in parentheses are percentages.

Visit of extension workers

Table 3 showed that 63.6% of the respondents were not visited by extension agents for information about coffee cultivation. Furthermore, 28.4% was visited by extension workers on quarterly basis while 36.4% of the respondents were contacted at home and on the farm. It means that coffee farmers' linkages with extension agents are not regular in the study area.

Table 3. Distribution of extension workers' visit by respondents

Extension workers' visit	Frequency	Percentage
Yes	32	36.4
No	56	63.6
Frequency of visit		
Bi- monthly	2	2.3
Once a year	5	5.7
Quarterly	25	28.4
Type of visit		
Farm visit	30	34.1
Home visit	2	2.3

Source: Field survey, 2007

Current constraints to Coffea arabica production

In Table 4, poor marketing and pricing were scored high (97.7% and 95.5%). This means farmers find it difficult to market their coffee beans. It could have serious implication on their income. This situation corroborates the finding of Sanusi *et al* (2004), those most coffee producers in Nigeria experience low sales and sometimes no market of their produce after processing. Inadequate market information was scored high also (89.8%), which could be an indication of poor knowledge about information on coffee commodity market among growers. Lack of farm inputs and high labuor cost were scored high 86.4% and 84.1% respectively. It means that inputs and cost of labour are among the very serious constraints of coffee production in Taraba State. Another variable, weak extension services was scored 67.1%. These findings confirm the result in Table 3 that there is a gap between extension workers and coffee farmers. There is need for information providers to always relate with coffee growers to reduce any form of problems militating against coffee production.

Table 4. Distribution of current constraints to *Coffee arabica* production in Taraba State

Constraints	Not Serious	Serious	Very Serious
Poor marketing	1(1.1)	1(1.1)	86(97.7)
Weak extension	7(8)	22(25)	59(67.1)
High labour cost	12(13.6)	2(2.3)	74(84.1)
Poor farm access road network	59(67.1)	12(13.6)	17(19.3)
Inadequate market information	2(2.3)	7(8)	79(89.8)
Lack of farm inputs	9(10.2)	3(3.4)	76(86.4)
Poor pricing	2(2.3)	2(2.3)	84(95.5)
Pest and disease problem	34(38.6)	30(34.1)	24(27.3)

Source: Field survey, 2007. Figures in parentheses are percentages

Test of Chi-Square Analysis

The result of the chi-square analysis in Table 5 shows that there is no significant relationship between farmers' educational level, age, farm size and field maintenance practices of coffee. However, there is a significant relationship ($P<0.05$) between other farmers' socio-economic characteristics (family size, farming experience, coffee beans price, number of coffee farms maintained) and coffee maintenance practices. It implies that these significant variables are important factors that could have influence on the management of *Coffea arabica* farms.

Table 5. Chi square analysis of the association between socio-economic characteristics and coffee field maintenance practices

Variables	df	χ^2 Value	P Value
Educational level	4	2.9906	0.5594
Age (Years)	4	7.5152	0.1110
Family size	3	9.3384	0.0251*
Farming experience (Years)	5	12.1207	0.0332*
Farm size (acres)	2	0.2244	0.8939
Coffee beans price	1	4.6338	0.0313*
No. of Coffee farms maintained	1	10.7611	0.0010**

Source: Field survey, 2007. df Degree of freedom. χ^2 is Chi-square. * Significant at 5% P Probability

CONCLUSION

The findings in the study revealed that most coffee respondents carried out different field operations that would enhance good production of *Coffea arabica*. Some of these practices were clearing of weeds, pruning, coppicing old trees in coffee farms and harvesting of berries. Information gap exists between the respondents and extension agents about coffee cultivation. Poor marketing and pricing of coffee beans, inadequate market information, lack of farm inputs, high labour cost and weak extension linkage were scored as very serious constraints to *Coffea arabica* production. Statistical analysis indicated that there were significant relationships between farmers' socio-economic characteristics (family size, farming experience, coffee beans price, number of coffee farms maintained) and coffee maintenance practices. They constitute important variables that could have influence on the management of coffee plots.

It is recommended that good marketing strategies via farmers groups be created to increase income and livelihood of *Coffea arabica* farmers in order to encourage them to continue to sustain their field maintenance practices. Extension contact with coffee farmers should be improved through all relevant bodies in the agricultural sector.

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SOCIO-ECONOMIC STUDY OF TOSSA JUTE SEED GROWERS IN SOME SELECTED AREAS OF BANGLADESH

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ABSTRACT

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Study on socio-economic performance of Tosa Jute seed growers was conducted during February to March, 2005 in Rangpur and Natore district. Farmers of Rangpur area used animal power for both land preparation and carrying jute. But in Natore areas farmers used animal power for land preparation. Farmers used recommended seed rate in both the areas. They purchased jute seed from BADC and local market. The farmers in the study areas used traditional practices of using inputs. The farmers of Rangpur received higher yield than the farmers of Natore. It might be due to Rangpur farmers use manure and fertilizer in previous crop potato. So residual effect of fertilizer, incentive land preparation and better management practices followed by Rangpur farmers. The total variable cost per hectare was higher in Natore (Tk. 24604/ha) than that of Rangpur (Tk. 22118/ha). The major cost items was human lobour (56%) followed by animal and mechanical power (31%). About 50% of total cost was spent in cash for jute cultivation which indicated the credit need for poor farmers. However, Tossa jute seed production appeared promising at farm level but there is a member of constraints which greatly influenced the jute seed production. Hence, a concerted effort is needed to solve the problem and motivate farmers to follow improved management practices in the production process to achieve to desired yield and substantial return to the investment.

Key words: Socio-economic, quality seed, fibre crop

INTRODUCTION

Jute (*corchorus* sp) is considered as the main cash crop of Bangladesh. It covers about 4.14% of total cropped area and accounts for about 16% of total foreign exchange through export of row jute and jute product (BBS, 2004). Besides, jute fibre and jute sticks are largely used for different domestic purposes. In addition, jute plants improved soil productivity because of its massive leaf fall and root proliferation in the field.

Jute is predominately grown for fibre and thus little attention is given to its seed production. Conventionally, farmers grow jute seed along with the fibre crop. Jute crop requires few months more to produce seeds and farmers keep some plants at the corner of the field during harvesting of fibre crop. After harvesting fibre crop, the seed crop remains almost uncared for a long period. Due to long stay in the field, the seed crop is affected by diseased and insects and produces poor quality seed. Quality jute seeds improved variety itself provides about 20% additional yields although there is and acute shortage of quality seed in every year (Hossain *et al*., 1994). It requires about 4000 metric tons of jute seeds of which only 12% to 15% is produced and distributed by the Bangladesh Agricultural Development Corporation (Salim *et al*., 1998). Rest jute seed is solely produced and utilized by the farmers themselves. The quality of these farmers` seed is not controlled carefully during production, processing or storing period. Due to unawareness of seed quality, farmers sow jute seed whatever they store in their houses or purchase from the local market. From these seeds, farmers sometimes get good germination and a good crop, sometimes poor germination and a poor crop, and occasionally the germination is almost nil which results in total crop failure(Hossain *et al*, 1994)

Jute seed quality however does not vary only from farmer to farmer but also from source to source, species to species and even from variety to variety of each species. Information relating such variability of jute seed quality is very scanty under Bangladesh condition. Moreover, the category and extent of jute seed quality of different sources, species and varieties are yet to be elucidated. With this view, the present study therefore, was undertaken to assess the production performance, as well as, economic return of the farmers under their own production environments at Rangpur and Natore area. The specific objectives of the study were as follows:

i) To know the agronomic management practices and resource use pattern in jute seed production systems under farmers environment and

ii) To estimate the cost and return aspects of the technology at farm level.

MATERIALS AND METHODS

Information of the study were collected through field survey of farmers plot of Rangpur and Natore region representing *olitorius* growing areas of Bangladesh. Twenty farmers from each location were selected randomly for data collection. Plot wise information of all pre and post harvest operations have been collected by personal interview through a structured questionnaire prepared for this purpose. The data collection was conducted during February to March 2005. The collected data were then compiled, tabulated and analyzed in accordance with the objectives of the study. Simple descriptive statistics was followed in analysis data. Variable cost was worked out from the collected data and gross margin and benefit cost ratio were estimated (Perrin *et. al*. 1976).

RESULTS AND DISCUSSION

The average land holding and utilization pattern of different resources is shown in Table 1. On an average, about 85 percent of the total cultivated land of the farmers was brought under Deshi jute cultivation. In total, 181 man days per hectare were required for Deshi Jute cultivation out of which 61 percent was farmers own labour and the rest was hired casual labour. Major part of the total labour was required for land preparation, weeding, harvesting and carrying of jute. Animal and mechanical power was mainly used for land preparation but some farmers also used it for carrying of jute in the study area. On an average, 19 animal pair days per hectare and 6 days per hectare were required for Jute cultivation. Farmers of Rangpur area used animal power for both land preparation and carrying jute. So, they required higher (20 days/ha) animal power in this area (pair days). In Natore, farmers used animal power for land preparation and they mostly used mechanical power for carrying Jute. The average seed rate in the study area was 5.22 kg per hectare with 4.94 kg per hectare in Rangpur and 5.5 kg per hectare in Natore. Farmers used recommended seed rate (5-5.5kg/ha) in both the areas. The farmers in both areas purchased jute seed from BADC and local market. The farmers in Rangpur area used cow dung 2500 kg/ha in their jute plots in addition to commercial fertilizer which were 60-50-30 kg/ha Urea, TSP and MP, respectively. On the other hand, the farmers in Natore area used cow dung 2200 kg/ha in addition to 70-50-30 kg/ha of Urea, TSP and MP, respectively. The farmers in the study areas used traditional practices of using inputs. This was mainly due to lack of available technology of jute in the farmers fields and also farmers had problem of managing cash money for purchasing inputs like fertilizers, seeds etc.

Table1. Land holding and use of inputs in jute seed cultivation

Parameter	Rangpur (Tosa jute growing area)	Natore (Tosa jute growing area)	Average
Land holding (ha/farm)			
Total area	2.55	3.50	3.03
Cultivated area	1.75	3.00	2.38
Jute area	0.15	0.25	0.20
Human labour (days/ha)			
Family	128	116	122
Hired	74	84	79
Total	202	200	201
Animal power (days/ha)			
Own	25	19	22
Hired	15	15	15
Total	20	17	19
Mechanical power (days/ha)			
Own power tiller	2.50	2.60	2.55
Hired power tiller	3.00	3.20	3.10
Total	5.50	5.80	5.65
Purchased seed (kg/ha)	4.94	5.50	5.22
Manure (kg/ha)			
Cowdung	2500	2200	2350
Fertilizer (kg/ha)			
Urea	60	70	65
TSP	50	50	50
MP	30	30	30

The source of jute seed was mostly self-grown by the farmers or purchased from the local market (Table 2). The use of market jute seed at Rangpur and Natore area was (39%) which was higher than self grown and Government seed. The quality of Government seed was better than the quality of self-grown or market purchased jute seeds.

Table 2. Seed sources of jute growers over the location

Locations	Jute crop area (ha)		Type of seed crop		Source of seed (%)		
	Fibre crop	Seed crop	Capsularis	Olitorius	Self grown	Market seed	Govt. seed
Rangpur	0.39	0.15	-	O-9897	27	38	35
Natore	0.28	0.25	-	O-4	25	40	35
Average	0.34	0.20	-	-	26	39	35

Sowing time of seed crop varied widely depending on the agro climatic condition of the area (Table 3). Rangpur region is consisted of high land and most of the farmers adopted the late seeding techniques of jute seed production. Jute research regional station, Rangpur organized a massive programme to train up the farmers for late sown technology of jute seed production. Under late sown condition, *olitorius* jute seed was sown from 11-19 September at Rangpur region. At Natore area, *olitorius* jute seed was sown from 15-30 May which served as both fibre and seed crop. The farmers grew jute seeds along with fibre crop, a part of which is kept for seed at the corner of the field. None of the farmers tested their seeds before sowing in the field.

Jute seed growers were interviewed whether they had taken any special care those were not normally taken for fibre crops. Farmers of the different region responded differently about special management practices of seed crop. Most of the farmers did not rogue out the off type plants from the seed crop (Table 3). However, the farmers (50 %) of Natore area were more aware of rouging than those of Rangpur area. Number of weeding ranged from 1 to 3 by the farmers of different tested areas. Fertilizers were applied only during the fibre crop production and no additional fertilizers were applied for seed crop. Any farmer of different jute growing area did not do applications of irrigation or plant protection measures. Harvesting time did not vary widely among the farmers of different location. Table 3 reveals that most of the farmers of all the locations harvested their seed crop when about 67% fruit turned brown colour. However, good quality of jute seed may also be obtained by harvesting crop even at green mature stage of fruits when some black tings appear on the fruit surface (Hossain *et al.*, 1982; Wahab and Talukdar, 1978). In this context, Khandakar (1985) reported that 60% browning for *capsularis* and 70% browning for *olitorius* indicates the physiological maturity of jute seeds.

Table 3. Agronomic practices followed by jute seed growers of different locality

Locations	Sowing date (range)	Farmers responded (%)							
		Use of non tested seeds	Rouging	Number of weeding			Plant protection	Harvesting brown fruit at	
				1	2	3		67%	50%
Rangpur	11-19 Sept.	100	30	30	50	20	-	100	-
Natore	15-30 May	100	50	21	68	11	-	100	-
Average	-	100	40	26	59	16	-	100	-

Drying of seed crop before threshing persuades for consistently better seed quality. Besides, it becomes easier to thresh seeds and need less sunning after threshing. Farmers of all the locations dried seed crops around 4 days, which seemed not to be enough for drying the crop (Table 4). Table 4 further shows that 100% farmers of Rangpur and 60% of Natore, areas threshed their seed crops by beating with sticks. This practice seems to be ideal for threshing of jute seeds. However, 40% farmers of Natore threshed their seeds by cattle threshing are generally discouraged, because enormous seeds are damaged due to heavy pressure of cattle feet.

Cent percent sampled farmers of Rangpur and Natore threshed their seeds in earthen floor. Cemented floor is certainly conductive for processing of jute seeds. Damp earthen floor does not support proper drying of the seeds and different diseases are likely being associated and carried to the field in the following season. Earthen floor also aids in contamination to different inert materials with the seeds. Drying is important in seed processing. If seed is not dried properly, the viability declines very quickly with the pass of time. Generally, 8% moisture content in jute seed is safe for storing. Normally five full sunny days are required to bring moisture content near this level. Cent percent farmers of both location responded that they dried seeds by four full day sunning (Table 4).

Table 4. Seed processing procedures of jute seed growers of different locality

Locations	Seed top drying (days)	Farmers responded (%)				
		Threshing method		Threshing floor		Four sunning
		Sticks	Cattle	Earthen floor	Cemented floor	
Rangpur	5.6	90	10	100	-	100
Natore	6.7	60	40	100	-	100
Average	6.15	75	25	100	0	100

Seed viability and vigor highly depend on the type of strong container. Closed metal containers like tin, cans and polyethylene bags were found to be better for storage jute seeds at farmer level (Ali, 1963). Table 5 indicates that 50% and 60 % farmers of Rangpur and Natore used earthen pot, respectively. Other farmers of these areas stored their seeds in polyethylene bags or in gunny bag. Earthen pot and gunny bags are highly detrimental for preservation of quality seed.

Generally seeds need cool and dry storage in order to conserve its viability for longer period. Building and Katcha house are better than tin shed house for seed storing. In tin shed house, fluctuation of temperature is very rapid and fluctuation of temperature certainly affects viability of seed in the storage. Table 5 indicates that 40% farmers of Rangpur area stored their seeds in katcha house. In Natore area 40% farmers stored their seeds in tin shed house and 30% in katcha house.

Table 5. Storage container and storage condition of jute seed growers of different locality

Locations	Farmers responded (%)							
	Storage containers				Storage condition			
	Metal	Earthen	Polybag	Gunny bag	Building	Semi building	Tin shed	Katcha house
Rangpur	-	50	15	35	7	20	33	40
Natore	-	60	15	30	5	25	40	30
Average	-	55	15	32.5	6	22.5	36	35

The cost of production included only the variable cost items like human labour, animal power, mechanical power, seed, manure, fertilizers etc. Both cash expenses and imputed value of the family-supplied inputs were included in calculating the cost of production of jute. It was observed that the average cost of production of jute was Tk. 23361 and Tk. 11666 per hectare on full cost and cash cost basis, respectively (Table 6). It was found that the total variable cost per hectare was higher in Natore (Tk.24604/ha) than that in Rangpur (Tk. 22118/ha) mainly due to higher cost in human labour, animal & mechanical power and chemical fertilizers. In the study areas, the major cost item was human labour (56%) followed by animal & mechanical power (31%), manure (5%) and chemical fertilizers (5%). About 50% of the total cost was spent in cash for jute cultivation. It indicated the credit need for poor farmers to support the cash requirement for jute cultivation.

Table 6. Cost of production of jute seed

Parameter	Cost (Tk/ha)		
	Rangpur (Tosa jute growing area)	Natore (Tosa jute growing area)	Average
Human labour			
Family	7680	8120	7900
Hired	4440	5880	5160
Total	12120	14000	13060 (56)
Own draft animal power	2000	2400	2200
Hired draft animal power	2500	2600	2550
Hired tractor/power tiller	2400	2544	2472
Total	6900	7544	7222(31)
Seed (purchased)	248	220	234 (1)
Manure			
Cowdung (Own)	1236	1100	1168 (5)
Fertilizer (kg/ha)			
Urea	319	385	352
TSP	563	572	568
MP	336	324	330
Total	1218	1281	1250 (5)
Interest on cash cost*	396	459	428 (2)
Total cost			
Full cost basis	22118	22640	23361(100)
Cash cost basis	10806	12525	11666

Figures in the parentheses represent the percentages of the total cost
* Calculated @ 11% for 4 months

The average yield of jute fibre, stick and seed was 1740 kg, 3500 kg and 516 kg/ha, respectively. The sample farmers of Rangpur received higher yield than farmers of Natore (Table 7). The higher yields at Rangpur might be due to the use of manure & fertilizers in potato cultivation, incentive land preparation and better intercultural practices. The higher yield at Rangpur results in higher gross return as well as higher gross margin both on full cost and cash cost basis. The benefit cost ratio on full cost basis was higher at Rangpur mainly due to lower per unit cost of production. Another efficiency criterion was return to labour per day. It was also found higher at Rangpur (Tk. 225/days) than in Natore (Tk 216/day) against the wage rate of Tk. 60/days at Rangpur and Tk. 70/days at Natore areas.

Table 7. Returns from jute seed cultivation

Parameter	Rangpur	Natore	Average
Total cost (Tk/ha)			
Full cost basis	22118	24604	23361
Cash cost basis	10806	12525	11666
Yield (kg/ha)			
Fibre yield	1800	1680	1740
Stick yield	3600	3400	3500
Seed yield	478	553	516
Gross return (Tk/ha)	55510	53830	54670
Gross margin (Tk/ha)			
Full cost basis	33392	29226	31309
Cash cost basis	44704	41305	43005
Benefit-cost ratio			
Full cost basis	2.51	2.19	2.34
Cash cost basis	5.14	4.30	4.69
Return to labour (Tk/day)	225	216	221

Farmers in the study areas reported different problems of jute cultivation. At Rangpur, the first ranked was poor seed germination followed by the lack of quality seeds and high price of fertilizers. At Natore, the farmers faced acute problems of getting labour timely high price of fertilizers, lack of credit, fertilizer are also the major constraints to jute cultivation at Natore (Table 8). Good quality seeds of jute should be made locally available to the farmers at a reasonable price than will encourage them to bring move area under jute cultivation. Extension people can help

greatly in this matter. More high yielding verities of jute should be released for higher production of the crop. More research work is needed for this purpose.

Table 8. Problems confronted by the growers for jute seed cultivation

Problems	Location		
	Rangpur	Natore	Average
Problem of seed germination	11	04	7.5
Lack of quality seed	10	08	9.0
High price of fertilizer	09	12	10.5
High price of insecticide	05	07	6.0
Labour availability	05	06	5.5
Low price of jute	06	09	7.5
Lack of credit facility	08	11	9.5
Timely Availability of suitable land	01	03	2.0
Timely availability of quality seed	04	10	7.0
Selling problem of produced excess jute seed	02	01	1.5
Lack of training facilities	12	05	8.5
Knowledge gap of quality seed production & preservation	03	02	2.5

Farmers are mostly practicing traditional ways of using inputs in these areas. The farmers should be given knowledge about the use of balanced doses of inputs like seed, fertilizer and management of the crop. There should be strong extension services with the available technology. Many farmers still are not aware of the jute seed production and storage. So, there should be regular field days and demonstrations in the farmers' field encourage them for quality jute seed production. The farmers should be given credit facilities at the time of need to meet the cost of production. This will encourage them to bring more areas under jute seed production. There was variation of inputs use and other practices in the study areas. The specific reasons should be worked out from farm-to farm and area-to-area basis and the result should be communicated to the farmers.

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ENVIRONMENTAL AWARENESS OF THE FFS FARMERS IN PRACTICING IPM

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ABSTRACT

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The study was conducted at Bancharampur upazila under Brahmarbaria district to determine and describe the environmental awareness of the farmers' of Farmer Field School (FFS) in practicing integrated pest management (IPM) during September 15 to October 30, 2006. The study also explored the relationship between the selected characteristics of the FFS farmers' and their overall environmental awareness. The selected characteristics included in the structured questionnaire for study were age, literacy, family size, farm size, annual income, contact with change agent, organizational participation, cosmopoliteness, knowledge about IPM and agricultural knowledge. Data were collected from a sample of randomly selected 120 FFS farmers. In respect of environmental awareness, the findings revealed that the highest proportion (76.67 %) of the respondents had medium to high awareness while only 23.33 % of them had low awareness. The literacy and knowledge of the farmers about IPM and agricultural knowledge had significant positive correlation with their environmental awareness. Rest of the variables had no significant relationship with their environmental awareness.

Key words: Environmental awareness, FFS farmers, IPM practice

INTRODUCTION

Agro-chemicals played a vital role in increasing productivity, but its use is now considered hazardous for our eco-system. In fact, the scale and non-judicious use of agro-chemicals for a long period has been damaging for our natural resources such as land, fishes, beneficial insects, soil microbes, etc. The environment problems of developing countries are largely due to over exploitation of lands and now-days this is an issue of multidimensional and international nature. Increased use of pesticides and artificial fertilizers is also causing environmental problems. Farmers are the ultimate users of agro-chemicals to control their crop pests. Bangladesh is no exception of this general trend of environmental degradation. Agriculture and environment has a close relationship and interacts with each other in such a way that the health of agriculture depends on the proper functioning of environmental process (Conway, 1990). It has been found in different countries of the world that in addition to beneficial effect, the improved agricultural practices have tremendous influence on environmental population and Bangladesh is not exception to this (Sattar, 1994). So it is necessary to know the awareness and overall knowledge of the farmers about Integrated Pest Management (IPM) as well as environmental pollution.

Integrated Pest Management (IPM) is an appropriate package of technology for pest management, which is most economical and less hazardous to the environment. As most of the farmers of Bangladesh are poor, they could hardly spare the money for expensive toxic pesticides. IPM educates the farmers to utilize the ready available sources of biological control agents, tolerant genetic resources, modern cultivation practice and mechanical means of control. Above all, IPM has ample scope of making less reliant on chemical control. Through imparting practical IPM field training, the FFS farmers become aware of the harmful effect of pesticides used.

IPM was stared from 1981 through simple demonstration at field level and became popular during the second phase on the FAO's inter-country program in 1989. Farmers who were trained under this program were able to reduce their pesticide use substantially. However, in order to receive such benefits and to see a significant positive impact of IPM in Bangladesh, a large number of farmers need to be trained on IPM.

Already with the lunching of UNDP funded National IPM program, DANIDA's strengthening of plant protection services (SPPS), CARE's "NOPEST" and INTERFISH project, ADB's command area project, FAO's inter-country vegetable IPM program and the involvement of a number of other NGO's in IPM activities are running to ponder over this concept and give sufficient thought for its application. So, it is necessary to know about the environment awareness and problem concept of IPM, if applied properly, can reduce the quantity of pesticide of Bangladesh. This will save foreign exchange, reduce farmers production cost and above all, lessen threats on environment. In order to give proper direction to study the following objectives were formulated-

1) To determine and describe some selected characteristics of the FFS farmers.
2) To determine the environment awareness of the FFS farmers.

3) To explore the relationship between selected characteristics of the FFS farmers and their environmental awareness in practicing IPM.

MATERIALS AND METHODS

The study was conducted in Bancharampur upazila under Brahmarbaria district. Six Farmers Field School (FFS) were randomly selected in 6 respective village such as Bancharampur, kadamtali, Saifullkandi, khalla, Bancharampur, Ujanchar, A total of 120 FFS farmers were selected at random by taking 20 from each of the 6 Farmers Field School. Data were collected during September 15 to October 30, 2006. The independent variables of this study were age, literacy, family size, farm size, annual income, contract with change agent, cosmopoliteness, organizational participation, knowledge about 1PM and agricultural know ledge. All these variables were measured by computing appropriate score and variance statistical measures such as range, mean, percentage, standard deviation. Co-efficient of correlation was also computed to explore the relationship between selected characteristics and their environmental awareness in practicing IPM. Five percent (0.05) and one percent (0.01) level of probability were used to reject any null hypothesis.

RESULTS AND DISCUSSION

Selected characteristics of the FFS farmers

Table 1 indicates that the highest proportion 60.83 percent of the FFS farmers belonged to the young group, while 32.84 percent and 3.33 percent were middle and old aged category. However, the data also revealed that 96.67 percent of the farmers in the study area were young to middle aged category.

Various agricultural organizations those are involved in the transfer of new technology have given emphasis in choosing young to middle aged farmers. Because more or less of them were involved in cultivation and younger people are comparatively more energetic, prompt, enthusiastic and innovative than the older people in our country.

Data furnished in Table 1 indicate that the highest proportion (44.17%) of the farmers were primary education whereas 18.33 percent were secondary education, 5.00 percent above secondary, 16.67 percent can sign only and 15.83 percent illiterate. Majority (67.5 %) of the farmers was found literate from primary to above secondary level but only 9.17 percent respondents had large family. Data also indicate that the average family size (4.84) of the farmers in the study area was lower than the national average of 5.6 (BBS, 2005).

Table 1 show that the highest proportion (40.00 %) of the farmers belonged to large farm holding group compared to 38.33 and 21.67 percent with small and medium farm holders respectively. The average farm size of the farmers was 0.66 hectares, i.e., smaller than national average (0.81 hectares) (BBS, 2005). The highest proportion (48.33%) of the farmers had medium family income, while 19.17 percent and 32.50 percent had low and high income respectively. As a result, the majority proportion (80.83 percent) of the FFS farmers family in the study area constitute medium to high income categories (Table1).

Table 1. Salient features of the farmer's selected characteristics and their environmental awareness

Selected characteristics	Scoring method	Possible range of score	Observed range of score	Categories	Farmers (n=120)		Mean	SD
					No.	%		
Age	No. of years	-	15-54	Young (15-35)	73	60.83	32.06	10.28
				Meddle aged 36-50	43	5.84		
				Old above 50	4	3.33		
Literacy	Years of schooling	-	0-12	Illiterate 0	19	15.83	3.24	3.27
				Can sign only 0.5	20	16.67		
				Primary education 1 to 5	53	44.17		
				Secondary education 6 to 10	22	18.33		
				Above Secondary education >10	9	5.00		
Family size	No. of members	-	2-9	Small family 2-4	55	45.83	4.84	1.74
				medium family 5-7	54	45.00		
				large family above 10	11	9.17		
Farm size	Size in hectares	-	0.2-1.75	Small farm 0.20-0.49	46	38.33	0.66	0.32
				medium farm 0.50-0.79	26	21.67		
				large farm above 0.79	48	40.00		
Annual income	In Tk. (1000)	-	20-70	Low income up to 35	23	19.17	44.70	11.90
				medium income 36-50	58	48.33		
				high income above 50	39	32.50		
Contact with change agent	Scaling	0-57	17-40	low contact 17-24	47	39.17	27.29	6.62
				medium contact 25-30	31	25.83		
				high contact above 30	42	35.00		
Cosmopoliteness	Scaling	0-24	10-22	low cosmopoliteness 10-15	79	65.83	15.26	10.34
				medium cosmopoliteness 16-20	37	30.83		
				high cosmopoliteness > 20	4	3.34		
Organizational participation	Scaling	-	4-40	low participation 4-14 medium	58	48.33	16.59	9.95
				participation 15-25 high	41	36.67		
				participation above 25	18	15.00		
Knowledge about IPM	Scaling	0-50	19-40	low IPM knowledge below 20	2	1.67	24.87	5.68
				medium IPM knowledge 20-25	86	71.67		
				high knowledge above 25	32	26.66		
Agricultural knowledge	Scaling	0-50	24-43	low knowledge below 20	26	21.67	29.74	4.63
				medium knowledge 20-25	61	50.83		
				high knowledge above 25	33	27.50		
Environmental awareness	Scaling	0-15	8-15	low awareness up to 8	28	23.35	9.99	1.67
				medium awareness 9-10	57	47.50		
				high awareness above 10	35	29.17		

Data presented in Table 1 describe that 35 percent of the farmers had high contact with change agents while 25.83 % and 39.17% had medium and low contact with the change agents respectively. About 31 percent of the farmers had medium cosmopoliteness compared to 65.83 percent low cosmopoliteness and only 3.34 percent high cosmopoliteness. Data also reveal that majority (96.66 percent) of the farmers was under medium to low cosmopoliteness group. On the other hand 85 percent of the farmers had low to medium organizational participation and only 15 percent of the farmers had high participation in the organization. The highest proportion (98.33 percent) of the farmers were medium to high knowledge about IPM and only 1.67 percent of them low knowledge about IPM (Table 1). From the Table 1 it may be concluded that the highest proportion (78.33 percent) of the farmers had medium to high agricultural knowledge.

Environmental awareness of the FFS farmers

The environmental awareness scores on the basis of practicing IPM of FFS farmers ranged from 8 to 15 with and average 9.99. Figure 1 reveals that 47.50% of the respondents had medium environmental awareness while 29.17% and 23.33% of the respondents had high and low environmental awareness respectively.

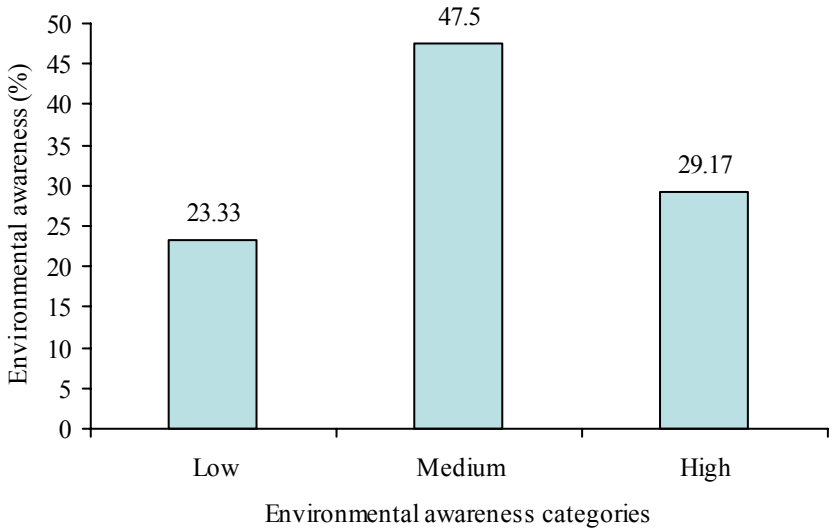

Figure 1. Distribution of the respondents according to environmental awareness of the FFS farmers in practicing IPM

Relationship between independent and dependent variables

The relationship of the selected characteristics of the FFS farmers with their environmental awareness is presented in Table 2.

Table 2. Relationship between the selected characteristics of the respondents with their environmental awareness

Dependent variable	Independent variable	Correlation coefficient (r)
Environmental awareness of FFS farmers	Age	-0.028NS
	Literacy	0.740***
	Family size	-0.047NS
	Farm size	-0.197*
	Annual income	-0.102NS
	Contact with change agent	0.133NS
	Cosmopoliteness	0.115NS
	Organizational participation	0.003NS
	Knowledge about IPM	0.861***
	Agricultural knowledge	0.720***

N= 120, Degrees of freedom= 118, NS= Not significant

Table value at 5 percent level = 0.176 * Significant at 0.05 level of probability
Table value at 1 percent level = 0.230 ** Significant at 0.01 level of probability
Table value at 0.1 percent level = 0.292 *** Significant at 0.001 level of probability

Relationship between the environmental awareness of the FFS farmers and their selected characteristics

Age of the respondents and their environmental awareness

The null hypothesis was "The age of the farmers is not related with their environmental awareness in practicing IPM.'' Table 2 shows that the relationship between the two variables was negatively insignificant which indicates that the age of FFS farmers had no significant effect on their environmental awareness in IPM practice.

Relationship of literacy with environmental awareness of the FFS farmers

The null hypothesis was "The literacy of the farmers is not related with their environmental awareness in practicing IPM''. The relationship between these two variables was highly significant at 0.001 level of probability (Table 2). In other words, literacy plays a key role on the environmental awareness of the FFS farmers. It indicates that literacy makes an individual wise, broadens one's outlook and extends the horizon of knowledge. The literate persons are

used to have frequent contact with printed materials and are exposed in various external sources which increase their power of understanding. So, the individual having more education was found to have high environmental awareness.

Knowledge about IPM and environmental awareness of the FFS farmers

The null hypothesis was "The knowledge about IPM of the FFS farmers is not related with their environmental awareness in practicing IPM''. The relationship between the two variables was highly significant (Table 2). The findings indicate that the FFM having more IPM knowledge had more environmental awareness. It fact, in the FFM, there were supposed to get sufficient information regarding the bad impact of pesticides on environment. Such information from the FFM played a significant role for the increase of their awareness about environmental.

Agricultural knowledge of the respondent and their environmental awareness

The null hypothesis was "The agricultural knowledge of the FFS farmers is not related with their environmental awareness in practicing IPM''. The relationship between the two variables was highly significant (Table 2).The findings indicate that the FFM farmer having more agricultural knowledge had more environmental awareness. It fact, in the FFM, the farmers were supposed to get sufficient information regarding the negative impact of pesticides used in their crop field. Agricultural knowledge helps the farmers to grow crops by using various cultivation practices in friendly environment.

CONCLUSION

The findings revealed that about three-fourths of the respondents had medium to high awareness while 23.33% of the respondents had poor environmental awareness in practicing IPM. It was found that the IPM and agricultural knowledge of the respondents had positive significant influence on their environmental awareness.

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PATHOGENICITY OF IBDV RELATED TO OUTBREAKS IN THE VACCINATED FLOCKS AND THE CAUSES OF VACCINATION FAILURE

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ABSTRACT

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Pathogenicity of infectious bursal disease virus (IBDV) related to the outbreaks in the vaccinated flocks and the probable causes of vaccination failure were field based investigated during March, 2007 to March, 2008 at Dinajpur district of Bangladesh. The virus was pathologically determined as very virulent infectious bursal disease virus (vvIBDV) and the probable causes of vaccination failure were identified. Among the 23 Gumboro incidences in the vaccinated flocks, 15 in broiler, 3 in layer and 5 in cockerel flocks were recorded during the course of observations. The number of the birds in the farms was variable ranging from 250-1250 and they were reared on litter. The flocks were divided into five groups basically based on the severity of the disease and the mortality patterns. A relationship between the mortality rate and bursal lesion scores was determined. One apparently normal and another one unvaccinated affected flocks were also included in this study for the comparison. The birds were vaccinated with commercially available Gumboro vaccines containing intermediate strains. The clinical signs of the affected birds of the vaccinated flocks were noted during the physical visit of the farms and the farmer's complaints were also emphasized. The birds were examined systematically at necropsy and the lesions of the muscles and bursa of Fabricius were recorded. Only the bursae were collected, preserved at 10% formalin solution and processed for the histopathological study giving emphasis on bursal lesion scores. The pathogenicity of the virus related to vaccination failure was evaluated groupwise. The clinical signs of the affected birds were more or less similar to the signs generally developed due to the infection with vvIBDV, and clinically characterized as anorexia, high fever, whitish diarrhoea, dehydration, ruffled feathers, drowsiness and death. The morbidity of the affected flocks was around 100%, and the mortality rate was variable ranging from 7–38%. Highest mortality rate was recorded in cockerel (38%) followed by layer (27%) and broiler (7-19%), respectively. At necropsy, the birds were severely dehydrated and varying degrees of haemorrhages were found in thigh and breast muscles. The bursa of Fabricius was swollen, oedematous, haemorrhagic and atrophied containing cheesy exudates. Histopathologically, varying degrees of lymphoid depletion, necrosis, and reactive cells infiltration, cystic formation of the follicles with or without fibroplasia were seen in the bursae. Highest bursal lesion scores were recorded in the vaccinated flocks was more commonly similar to that of unvaccinated affected group. There was a proportional relationship between the pattern of mortality and the bursal lesion score in the respective group. The suspected causes of vaccination failure were also identified during the farm visit and from the farm records. The clinical and pathological findings with significantly high scores in the bursal lesions would suggest that outbreaks in the vaccinated flocks were undoubtedly vaccination failure, closely associated with different factors.

Keywords: Gumboro disease, vaccination failure, pathogenicity

INTRODUCTION

IBDV is highly infectious and very resistant to inactivation. There is none alternative without vaccination to prevent IBD or Gumboro disease (Lukert and Saif, 1997), but the outbreaks in the vaccinated flocks are also reported (Muhammad *et al.,* 1996; Hafez *et al.,* 2002). In order to control IBD with live vaccines, it is critical to vaccinate commercial chickens that have maternal antibodies at the optimum time. Live vaccines have the ability to overcome the maternal antibody at a certain level. Vaccination during low maternal antibody titre shows better immune response than high maternal antibody titre (Giasuddin *et al.*, 2003). But it is very much difficult to field based determine when maternal antibodies in chicks will decline to levels that vaccine can overcome as well as the optimum time of vaccination.

The apparent inability to control IBDV infections through vaccination sometimes may be due to improper administration of vaccine virus, antigenic differences among the viruses (Rosenberger *et al*., 1987), insufficient potency of the live attenuated vaccine virus (Ismail and Saif, 1991), interference between the residual maternally derived antibodies and the vaccine virus (Eterradossi, 2001). The vaccine prepared from classical strain did not give protection against variant IBDV strains (Snyder, 1990). Again, the immunogenicity of the virus may differ between strain to strain (Rosales *et al.,* 1989a, b, c; Abdel-Alim and Saif, 2001). The invasive vaccine strains are able to break through higher maternally derived antibody level (Kouwenhoven and van den Bos, 1994). The intermediate vaccine strain produced moderate to severe bursal lesions reported by many reseachers (Franciosini and Coletti, 2001). The better protection with more virulent strain of IBDV is due to more antigenic stimulation based on higher and longer replication in lymphoid tissues (Rautenschlein *et al.,* 2001). There is no evidence of antigenic variation between classical and vvIBDV strains and they belong to classical serotype I (van der Marel *et al.,* 1991). The

genetically engineered tissue culture adapted vvIBDV was attempted to use as vaccine candidate, but the attempt was not yet successful for its reversion (Raue *et al.,* 2004). This study was conducted for the field based evaluation of the pathogenicity of the viruses responsible for the outbreak in the vaccinated flocks and to investigate the probable causes of vaccination failure.

MATERIALS AND METHODS

Experimental chickens/Clinical cases

Gumboro outbreaks in the vaccinated flocks and the probable causes of vaccination failure were investigated at Dinajpur district of Bangladesh and the laboratory examinations were conducted at the Department of Pathology and Parasitology of Dinajpur Government Veterinary College, Dinajpur, Bangladesh.

Table 1. Grouping of the different flocks and their relative clinical history

Experimental group	No. of incidences	Age of bird when reported	Morbidity (%)	Mortality (%)	Birds examined at necropsy	Bursae examined at histopathology
Apparently normal	0	0	0	0	3-5 birds/flock	3-5/group
Broiler 1	3	14-28	Around 100	7	As above	As above
Broiler 2	7	14-28	Around 100	13	As above	As above
Broiler 3	5	14-28	Around 100	19	As above	As above
Layer	3	19-35	Around 100	27	As above	As above
Cockerel	5	18-29	Around 100	36	As above	As above
Unvaccinated infected group	4	17-26	Around 100	47	As above	As above

A total of 23 outbreaks in the vaccinated flocks among which 15 in broiler, 3 in layer and 5 in cockerel flocks were recorded during the course of observation. The number of the birds in the farms was variable ranging from 250 to 1250 and they were reared on litter. The age and population of the birds per flock, biosecurity of the farms, previous history of Gumboro outbreaks, intervals between the batches, rearing of one more batches in the same farm at the same time, etc. were also recorded.

Grouping of the flocks

The flocks were categorized into five groups basically based on the severity of the disease and the mortality patterns. The mortality rate was determined from the farm records.

Vaccines and vaccination

The birds were vaccinated with the commercially available Gumboro vaccines containing intermediate plus strain of IBDV. The vaccines and vaccination schedule, transportation, preservation, preparation and administration of vaccines were thoroughly investigated specifically to find out the clue(s) of vaccination failure.

Clinical findings

The clinical signs were recorded during the physical visit of the affected flocks and the farmer's complaints about the affected birds were also considered. One apparently normal and another one unvaccinated affected flocks were also included in this study for the comparisons.

Necropsy

The necropsy examination of the birds was done systematically as per standard procedure (Charlton, 2000). The general appearances of the birds and the visible gross morbid lesions of the muscles and the bursa of Fabricius were noted. The concurrent infections, if any were also investigated. Only the representative bursae were collected at 10% formalin solution.

Histopathology and bursal lesion score

A part of the each sample of the formalin fixed bursa of Fabricius was processed for paraffin embedding, sectioned and stained with haematoxylin and eosin as per standard procedures (Luna, 1968) for the histopathological examination under light microscope with variable magnifications. On histopathological examination, a bursal lesion score was determined on the basis of the following criteria (Raue, *et al.,* 2004): score 0 = apparently normal lymphoid follicles; score 1 = mild lymphoid depletion indicated by just thinning of the lymphocyte population without any sign of focal necrosis or remarkable oedema; score 2 = moderate lymphoid depletion along with focal

necrosis and interfollicular oedema; score 3 = severe lymphoid depletion virtually leaving no lymphocyte but only reticular cells and proliferating fibrous tissue; and score 4 = atrophy of follicles usually with cystic spaces, infolding of epithelium and marked fibroplasia.

Relationship between mortality rate and bursal lesion score

The mortality rate was detected from the farm records (Table 3). A proportional relationship between the mortality rate and the bursal lesion score was determined within the respective group.

RESULTS AND DISCUSSION

Experimental chickens/Clinical cases

The morbidity rate of the affected flocks was around 100%, and the mortality rate was variable ranging from 7-38%. Highest mortality rate was recorded in cockerel (38%) followed by layer (27%) and broiler (7 – 19%), respectively.

Grouping of the flocks

The flocks were categorized into five groups basically based on the severity of the disease and the mortality patterns. The mortality rate was determined from the farm records.

Vaccines and vaccination

The birds were vaccinated with the commercially available Gumboro vaccines containing intermediate strains of IBDV and the vaccines were administered as per instructions. The faults in the transportation, preservation, preparation and administration of vaccines and other probable managemental errors closely associated with the vaccination failure were identified and the tentative interpretation(s) of vaccination failure in connection with each suspected factor was summarized (Table 4). The level of maternally derived antibody during the administration, cold chain maintenance by the distributors, the residual pathogenicity of the vaccine virus, and failure due to variation in the antigenicity or immunogenicity, if any were not determined.

Clinical findings

The clinical signs of the affected birds of the vaccinated flocks varied from farm to farm and breed to breed. The signs were clinically characterized as anorexia, high fever, variable degrees of whitish diarrhea, depression, ruffled feathers, huddling together, and death.

Necropsy, histopathology and bursal lesion score

The gross morbid lesions of the muscles and the bursa of Fabricius as well as the histopathological lesions of the bursa of Fabricius with bursal lesion scores of the affected birds of different groups were mentioned (Table 2).

Table 2. Gross and histopathological lesions with bursal lesion scores of the different groups

Experimental group	Gross morbid lesions	Histopathological lesions	Bursal lesion score
Apparently normal	0	0	0,0,0
Broiler 1	• Swollen oedematous bursa • Absence of muscular haemorrhage	• Moderate to severe lymphoid depletion • Focal necrosis • Follicular atrophy and interfollicular oedema • Some degrees of fibroplasia	2, 4, 3, 1
Broiler 2	• Swollen oedematous bursa • Muscular haemorrhages	• Moderate to severe lymphoid depletion • Follicular atrophy and interfollicular oedema with thickened serosa • Infolding of epithelium	2, 4, 4
Broiler 3	• As above	• Moderate to severe lymphoid depletion • Follicular atrophy and interfollicular oedema with thickened serosa • Infolding of epithelium	4, 4, 4
Layer	• As above	• Moderate to severe lymphoid depletion • Follicular atrophy and interfollicular oedema with thickened serosa • Infolding of epithelium	4, 4, 4, 4
Cockerel	• As above	• Moderate to severe lymphoid depletion • Follicular atrophy and interfollicular oedema with thickened serosa • Infolding of epithelium	4, 4, 4, 4
Unvaccinated infected group	• Swollen, haemorrhagic and atrophied bursa containing caseous exudate • Severe haemorrhages in breast and thigh muscles	• Follicular atrophy • Cystic formation • Infolding of epithelium • No fibroblastic proliferation • Erythrocytes extravascularly	4, 4, 4

Table 3. Comparative study between the mortality rate and the bursal lesion score of the respective group

Experimental group	Mortality rate (%)	Average bursal lesion score
Normal	0	0
Broiler 1	7	2.50
Broiler 2	13	3.33
Broiler 3	19	4.00
Layer	27	4.00
Cockerel	38	4.00
Unvaccinated infected group	47	4.00

Relationship between mortality rate and bursal lesion score

The mortality rate and the bursal lesion scores of the different groups were different (Table 3). There was an around proportional relationship between the mortality rate and the bursal lesion score within the respective group.

The pathogenicity of IBDV virus related to outbreaks in the vaccinated flocks and the probable causes of vaccination failure, especially in connection with defective farm managements were investigated. A number of 23 such outbreaks were recorded, the pathogenicity of the virus was determined as highly virulent strain of IBDV, and the probable causes of vaccination failure were suspected (Table 4).

Gumboro is the threat of poultry farming in Bangladesh and there is none alternative to prevent IBD without vaccination (Lukert and Saif, 1997). But Gumboro outbreaks in the vaccinated flocks were recorded elsewhere (Lukert and Saif, 1997; Hafez *et al.,* 2002). Various vaccines against IBD are commercially available. Some vaccines were tested their protection level experimentally giving challenge with vvIBDV and both significant and insignificant increase of antibody titre were reported (Islam *et al.,* 2005). Some commercially available vaccines became fail to give protection against IBD in a number of commercial poultry farms. Different factors related to

Gumboro vaccine failure were suspected in the present study (Table 4). However, vaccination failure in connection to variation in the antigenicity among the IBD viruses (Rosenberger *et al*., 1987), interference between the residual maternally derived antibodies and the vaccine virus (Eterradossi, 2001) and the appropriate time of vaccination were not determined in this study. It is critical to vaccinate commercial chickens that have maternally antibodies at the optimum time (Tsukamoto *et al*., 1995). Vaccination during low maternally derived antibody titre shows better immune response than high maternal antibody titre (Giasuddin *et al*., 2003). Again, the immunogenicity of the virus may differ between strain to strain (Rosales *et al.,* 1989a, b, c; Abdel-Alim and Saif, 2001) and the invasive vaccine strains are able to break through higher maternally derived antibody level (Kouwenhoven and van den Bos, 1994). The genetically engineered tissue culture adapted vvIBDV was attempted to use as vaccine candidate, but the attempt was not yet successful for its reversion (Raue *et al.,* 2004).

The mortality rate determined in this study was upto 36% in the vaccinated flocks. Highest mortality recorded in layer followed by cockerel and broiler, respectively. This picture of mortality principally found in the flocks infected by vvIBDV. IBDV strains isolated from the affected chickens induce severe clinical signs with high mortality in specific pathogen free (SPF) chickens (Nunoya *et al.,* 1992; Tsukamoto *et al.,* 1992). However, the mortality rate in the unvaccinated affected flocks in this study was 47%. The clinical signs of the affected birds of the vaccinated flocks were variable (mild to the signs generally developed due to the infection with vvIBDV). The data clearly indicated the vaccination failure in the flocks. Almost a proportional relationship between the mortality rate and the bursal lesion scores of the respective group was observed in the study (Table 3). The scores of the different experimental groups clearly indicated the degree of severity of the disease which was closely associated with the pathogenicity of the IBD virus.

The gross and histopathological lesions of the bursa of Fabricius were variable in different experimental groups in the present study (Table 2).

Swollen: Normal: Swollen (5.7 gram : 5.5 gram : 5.8 gram)

Atrophied: Normal: Atrophied (1.2 gram : 5.5 gram : 1.3 gram)

Atrophied: Normal: Atrophied (0.7 gram : 5.5 gram : 0.4 gram)

Mild Haemorrhagic: Normal: Dark haemorrhagic (2.9 gram : 5.5 gram: 2.3 gram)

Mild Haemorrhagic bursa with exudate

Swollen oedematous bursa

Figure 1. Different pathological levels of bursa of Fabricius collected from the affected broilers with previously vaccinated

Bursal lesion scores were surprisingly high in most cases except few, where moderate bursal lesions were recorded. Depending on the residual virulence of the live attenuated viruses, some vaccine strains can cause bursal damage (Mazariegos *et al.,* 1990) and lead to immunosuppression in the vaccinated birds (Edward *et al*., 1982; Reece *et al.,* 1982). Although highest bursal lesion scores with cyst formation (Tsukamoto *et al.,* 1995), lymphocytic depletion

with inflammation (Mazariegos *et al.,* 1990), acute necrosis (Rautenschlein *et al.,* 2001), follicular atrophy (Franciosini and Coletti, 2001), extensive bursal damage with follicular repopulation (Rautenschlein *et al.,* 2001) and increased interstitial connective tissue proliferation (Franciosini and Coletti, 2001) produced by intermediate vaccine strain of IBDV were reported. The high scores of bursal lesions especially found in the outbreaks with vvIBDV (Raue *et al.,* 2004).

The histopathological features and remarkably high score of bursal lesions in this study would evaluate the virus as undoubtedly highly pathogenic virus which could either be vvIBDV or vaccine virus. However, the pathogenicity of vaccine viruses were not yet determined in a separate experiment and further experiment to evaluate it can be conducted. Several suspected factors in connection to managemental errors in this study might be closely related to vaccination failure and outbreaks in the vaccinated flocks.

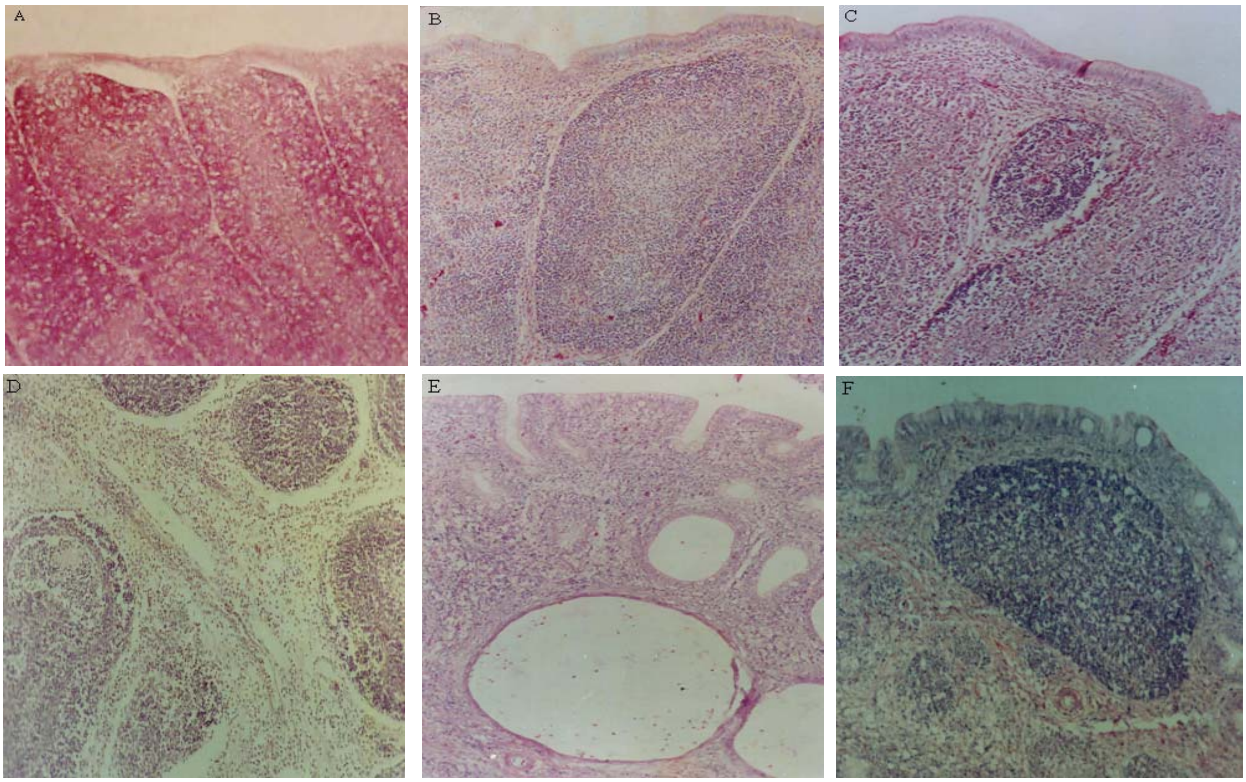

Figure 2. Histopathology of bursa of Fabricius affected by IBDV and scoring of bursal lesions; A. apparently normal lymphoid follicles (score 0), B. mild lymphoid depletion (score 1), C. moderate lymphoid depletion along with focal necrosis (score 2), D. severe lymphoid depletion with reactive cells infiltration and fibroplasia (score 3), E. atrophy of bursal follicles along with cystic development (score 4), and F. variable degree of follicular regeneration

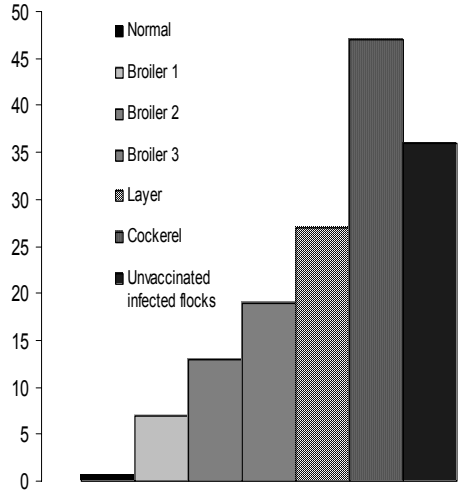

Figure 3. Mortality rate of the birds of the different groups

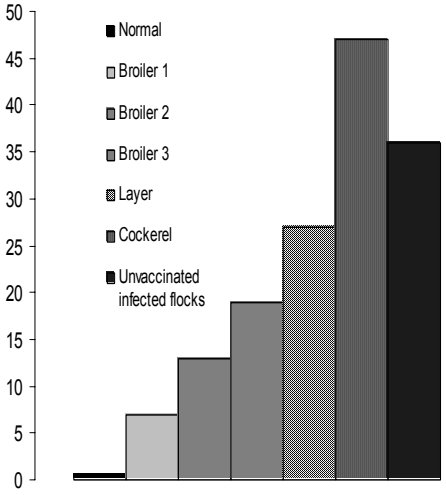

Figure 4. Bursal lesion scores of the different groups

Vaccines were most repeatedly failed in those flocks where the batches of birds reared giving at least an interval to destroy the persistent IBDV and single dosing without boosting was followed. IBDV is highly infectious and very resistant to inactivation. The viruses could survive outside the host for at least for months (Allan *et al*., 1982). Houses that contained infected birds are infective for inmate birds after 54 and 122 days (Benton *et al.,* 1967). According to Godwin (2001), the factors causing vaccine breaks are either vaccine types, storage and handling; or condition of the birds including the level of maternally derived antibodies; or administration of vaccine. In this study, vaccination failure exclusively due to defective managements were thoroughly investigated and the suspected factors were listed (Table 4).

Table 4. Suspected factors of vaccination failure with their tentative interpretations

Suspected factors causing vaccination failure	Tentative interpretations on vaccination failure	No. of incidences
Previous history of Gumboro outbreaks	Virus loads in the farms and the birds of the newly batch(es) became exposed	3
Vaccination at early age (Between 7 to 10 days of age limit)	Inactivation of vaccine viruses by maternally derived antibodies	2
Vaccination beyond the optimal age limit	Vaccination after exposure	1
Intervals between the succeeding batches not more than 10-20 days	The shaded virus could be viable and the birds of the succeeding batch(es) might be infected	3
Single dosing without boosting	Insufficient immune response	4
Cold chain break during transportation, preservation and processing	Inactivation of the vaccine viruses	1
Completion of dosing taking prolonged time	The vaccine viruses might be inactivated and subsequent infection	1
Lower dosing	Insufficient immune responses	1
Rearing of one more batches of different ages in the same farms	Continuous exposure by different sources of IBDV infection	2
Vaccination and disinfection simultaneously as spray or in drinking water	Inactivation of the vaccine virus	2
Vaccination at stressful condition	Inadequate immune response	1
Vaccination through inappropriate drinking water	Inactivation of the vaccine virus	2

However, the inactivation of vaccine virus may be due to careless transportation, preservation, preparation and administration of vaccines, and the vaccination and disinfection simultaneously by the farmers were noticed. All of these clues might be strongly associated with the vaccination failure, although the exact causes of vaccine breaks in

connection with the antigenicity, immunogenicity and pathogenicity of vaccine viruses to protect the birds from this devastating malady are still obscure.

CONCLUSION

The pathogenicity of the infectious bursal disease virus related to the outbreaks in the vaccinated flocks was observed as highly pathogenic IBDV. Mostly lacking of farmer's awareness about the vaccines and vaccination might be closely related in the vaccination failure.

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ENVIRONMENTAL IMPACT OF SUGAR INDUSTRY - A CASE STUDY ON KUSHTIA SUGAR MILLS IN BANGLADESH

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Abstract

Salequzzaman M., Tariqul Islam S. M., Tasnuva A., Kashem M. A. and Mahedi Al Masud M. 2008. *Environmental Impact of Sugar Industry - A Case Study on Kushtia Sugar Mills in Bangladesh.* **j. innov.dev.strategy 2(3): 31-35**

The study was conducted at the adjacent area of Kushtia Sugar Mill to determine the physico-chemical properties of effluent of Kushtia sugar Mills and Gorai Khal water to know the pollution load on environment. For the present study, sampling of water effluents was conducted before and after starting the sugar mill at different stations. The samples were then analyzed and it is found that the effluent of Kushtia Sugar Mills does not maintain the Department of Environment (DoE) Standard and Surface Water Quality Standard. A wide variation is found in the water quality of before and after starting the mill. The EC and TDS values of the effluent and the neighboring water vary from 612 to 1306 µS/cm and 430 to 927ppm respectively. High TDS, low DO content, high BOD, COD and conductivity values with high Cl^-, K^+, Ca^+, Mg^+, SO_4^{2-}, PO_4^{3-}, NO_3^- content indicates a highly polluted condition of water. It is true that sugar mill plays an important role but adversely affect the environment simultaneously. Proper way of operation and imposing laws and regulations and maintaining those strictly, can reduce pollution level. Improving technology may be the best strategy in the context of reducing pollution level and environmental damage.

Key word: Sugar industry, effluent and environmental impact, pollution

INTRODUCTION

Sugar industry plays an important role in the economy of Bangladesh by way of farming and creation of employment. The by-products of sugar mills are also used as raw materials in different industry. However sugar mill have a great environmental impact upon the surrounding environment. The change of water chemistry is the main associated environmental impact of discharging sugar mill's effluent on an open water body. The effluents are causing odor nuisance during decomposition. Wastewater from sugar mills with its high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) rapidly deplete available oxygen supply when discharged into water bodies endangering fish and other aquatic life and also creates septic conditions, generating foul-smelling hydrogen sulfide, which in turn can precipitate iron and any dissolved salts, turning the water black and highly toxic for aquatic life. Suspended solids reduce light penetration capability and, as a result, plant production in the receiving water body is diminishing through increasing turbidity that also clog fish gills. Discharge of water with a high Total Dissolved Solids (TDS) level would have an adverse impact on aquatic life, render the receiving water unfit for drinking and domestic purposes, reduce crop yields if used for irrigation, and exacerbate corrosion in water systems and pipe (ETPI, 2001).

Highly colored water, besides being aesthetically unpleasing, limits light penetration, reducing production of phytoplankton and, by association, zooplankton, and fish and dissolved oxygen supply. Effluents with a high temperature can be of concern because high temperatures deplete dissolved oxygen levels in the water body. Effluents also change the natural pH level of the receiving water body to some extent. Such changes can tip the ecological balance of the aquatic system, excessive acidity particularly; can result in the release of hydrogen sulfide. Dermatitis, skin disease or other water born diseases is a major health complaint resulting from domestic uses of eutrophied water (Nadia and Mahmood, 2006).

The study was done in Kushtia Sugar Mill, which is situated at Jogoti in Kushtia district in Bangladesh in 2006-2007.

Objectives of the Study

- To determine the physico-chemical characteristics of the effluents of the sugar mill;
- To develop a management system regarding effluents of the sugar mill.

MATERIALS AND METHODS

The study was done by a comprehensive study through primary data collection and secondary literature survey for secondary data collection. First of all the study area was selected and a reconnaissance survey took place. Then to obtain basic ideas of the quality, characteristics and chemical composition of the effluent of sugar mill,

five samples were collected before and after starting the production activity of the mill. This sampling method involves purposive or deliberate selection of particular units of the sampling area for constituting a sample, which represent the universe. The samples were collected along the flow path of the effluent i.e., the drain and Gorai Khal. A questionnaire survey was also held to assess the health condition and collect opinions of the inhabitants of the surrounding.

For physical and chemical analysis of those effluent samples a number of sophisticated instruments were used and standards methods were followed. To measure the effluent quality of the collected sample the following analysis were performed in the laboratory of Environmental Science Discipline of Khulna University. The analyzed parameters are given in the Table 1.

Table 1. The analyzed parameters for the study

Physical Parameters	Chemical Parameters	Physico-chemical Parameters
pH, EC, TDS, Temperature	Sodium (Na^+), Potassium (K^+), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Chloride (Cl^-), Carbonate (CO_3), Bicarbonate (HCO_3^-), Dissolve silica ($H_4SiO_4^{2-}$), Ortho-Phosphate ($H\text{-}PO_4^{3-}$), Sulphate (SO_4^{2-}), Nitrate-Nitrogen (NO_3-N)	DO, COD, BOD

RESULTS AND DISCUSSION

The impact of pollution on the environment can be estimated through checking out the pollution level in the affected environment. In this study the physico-chemical characteristics of sugar mill's effluent was determined and compared with the Department of Environment (DoE) standard and surface water standard. The concentrations of different parameters are given in Table 2.

Table 2. The Physico-chemical Characteristics of the effluent of Kushtia Sugar Mill and Gorai Khal water before and after operation

Parameters	Station 1		Station 2		Station 3		Station 4		Station 5	
	Before	After	Before	After	Before	After	Before	After	Before	After
Temperature(ºC)	31	39	29.3	38.66	30	36	29.9	38.1	30.5	38
pH	7.11	7.7	7.05	6.95	7.18	5.42	7.9	5.59	7.7	5.73
TDS	383	927	374.4	789	301	430	365	540.4	350	529
EC (µs/cm)	819	1306	803	1306	712	1212	777	1298	761	1279
DO (mg/l)	-	-	-	-	1.2	1.2	1.4	-	1.9	-
BOD (mg/l)	73	88	67	79	33	59	42	64	39	61
COD (mg/l)	943.2	1631.2	727.2	1291	631.2	612	823.2	1198	712.7	1179
Na^{2+} (mg/l)	17.80	22.5	15.40	23	14.80	17	15.80	24	15	18.3
K^+ (mg/l)	15.2	96	8.4	91	7.3	38	7.4	77	7	63
Ca^+ (mg/l)	90	160	96	147	90	123	94	134	92	129
Mg^+ (mg/l)	24	55	19.2	51	25.2	32	21.6	46	23.1	40
Cl^- (mg/l)	8.4	440	7.7	425	8.2	565	7.7	585	7.9	575
HCO_3^- (mg/l)	437	16.2	401	15	419	13	408.5	14.46	403	14.03
SO_4^{2-} (mg/l)	8.2	23.75	6.7	22.70	5.8	7.2	6.7	21.7	6.5	20
PO_4^{3-} (mg/l)	13.65	50	11.8	56	10.6	60	11.5	59	9.5	52
NO_3^- (mg/l)	0.65	23	0.60	21.5	0.50	18.3	0.55	17	0.53	13.7

Source: Laboratory analysis, 2006-2007.

Discussion of the Parameters

pH: According to the DoE standard the pH of the effluent should be in range of 6-9 at discharge point. Before starting the mill the pH at the discharge point was 7.11 and after starting the mill the pH range is 5.42 to 7.07 which do not maintain the standard.

Total dissolved solid: According to the DoE standard the TDS of the effluent should be in range of 2,100 mg/L. Before starting the mill the effluent contains 383 ppm total dissolved solid. After starting the operation the effluent at station 1 and 2 contains total dissolved solid of 927 and 789 ppm respectively.

***Electrical conductivity*:** According to the DoE standard the EC of the effluent should be 1200 μs/cm. The effluent from Kushtia Sugar Mills before starting the mill contains 819 μs/cm and after starting the mill at station 1 and 2 contains EC 1526 and 1306 μs/cm. All of the values are greater than the standard value.

Dissolved oxygen: Dissolved oxygen (DO) in water body is very good indicator of water quality. According to the DoE standard the Dissolved Oxygen of the effluent should be within the range of 4.5 to 8. Before starting the mill the DO is absent in the waste discharge point. After starting the mill the station 1, 2,4and 5 contains 0mg/l dissolved oxygen. Only station 3 contains 1.2 mg/l DO. This result shows that the lake water is highly loaded with organic pollutants.

***Biological oxygen demand (BOD)*:** According to the DoE standard the BOD of the effluent should be 50 mg/L. Before starting the mill the BOD is 21.65mg/L in the effluent. After starting the mill the effluent of sugar mill contains 73.2 and 67.7 mg/L BOD in station 1 and 2 respectively. This high level of BOD refers that large amount of organic matter present in water at the station 1 and 2. Here the effluent BOD level doesn't maintain the DoE standard.

Chemical oxygen demand (COD): COD indicates the toxic condition and the presence of biologically resistant organic substances. According to the DoE standard the COD of the effluent should be 200mg/L. Before starting the mill the industrial effluent contains 943.2 mg/L COD. After starting the mill the effluent contains 1631.2 mg/L and 1146.4 mg/L in station 1 and 2 respectively. This result shows that the effluent from sugar industry releasing large amount of oxygen demanding chemicals. As the effluent mix with lake water the COD level reduces to 1079.6 mg/L and 975.2 mg/L at station 4 and 5 respectively. All of the values are greater than the standard value.

Sodium (Na^+): According to surface water standard the Na^+ in fresh water should be 6.3 mg/L (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains Na^+ 17.80.mg/L at the discharge point and after starting the mill the effluent of sugar mill contains 22.5, 23, 21, 17 and 18.3 mg/L at station 1, 2, 3, 4 and 5 respectively.

Potassium (K^+): According to surface water standard the K^+ in fresh water should be 2.3 mg/L. (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains 15.2 mg/L K^+ and after starting the mill the effluent of sugar mill contains 96 and 91 mg/L in station 1 and 2 respectively. As the effluent mix with lake water the K^+ concentration reduce to 77 and 63 mg/L at station 4 and 5 respectively.

Calcium (Ca^{++}): According to surface water standard the Ca^{2+} in fresh water should be 15 mg/L (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains 90 mg/L Ca^{2+} and after starting the mill the effluent contains 160 and 147mg/L in station 1 and 2 respectively. As the effluent mix with lake water the Na^+ concentration reduces to 134 and 129 mg/L at station 4 and 5 respectively.

Magnesium (Mg^{2+}): According to surface water standard the Mg^{2+} in fresh water should be 4.1mg/L (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains 24mg/L Mg^{2+} and after starting the mill the effluent of sugar mill contains 55 and 51 mg/L in station 1 and 2 respectively.

Chloride (Cl^-): According to surface water standard the Cl^- in fresh water should be 7.8 mg/L (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains Cl^- 8.4 mg/L and after starting the mill the effluent of sugar mill contains 23 and 21.5 mg/L in station 1 and 2 respectively.

Bicarbonate (HCO_3^-): According to surface water standard the HCO_3^- in fresh water should be 58.4 mg/L (Garrels and MacKenzie, 1971). But the sugar mill effluent before starting the mill contains 437 mg/L HCO_3^- and after starting the mill the effluent of sugar mill contains 440 and 425 mg/L in station 1 and 2 respectively. As the effluent mix with lake water the HCO_3^- concentration increase to 585 and 575 mg/L at station 4 and 5 respectively.

Sulphate (SO_4^{2-}): According to surface water standard the SO_4^{2-} in fresh water should be 11.2 mg/L (Garrels and MacKenzie, 1971). The sugar mill effluent before starting the mill contains 8.2 mg/L SO_4^{2-} and after starting the mill the effluent contains highest concentration of SO_4^{2-} 16.2 and 15 mg/L in station 1 and 2 respectively.

Ortho-Phosphate (PO_4^{3-}): The sugar mill effluent before starting the mill contains 13.65 mg/L PO_4^{3-} at the discharge point and after starting the mill the effluent of sugar mill contains PO_4^{3-} 23.75 and 22.70 mg/L in station 1 and 2 respectively. Other sampling points become less in concentration.

Nitrate (NO_3^-): The DoE standard mentions 10mg/L as a standard of NO_3^- the effluent should contain. The sugar mill effluent before starting the mill contains 0.65mg/L NO_3^-. After starting the mill the effluent of sugar mill contains NO_3^- 5.3 and 4.85mg/L in station 1 and 2 respectively. As the effluent mix with lake water the NO_3^- concentration reduced to 4.9 and 4 mg/L at station 4 and 5 respectively. The NO_3^- concentration in lake water at station 3 is 3.65mg/L.

Table 3. Comparison the Kushtia Sugar Mill's Effluents with Waste Discharge Quality Standards

Parameter	Unit	Standard	Kushtia Sugar Mill's Effluents	Remark
pH	-	6-9	7.7	Within the standard
TDS	mg/L	2,100	927	Maintain the standard
EC	µs/cm	1,200	1306	Doesn't maintain the standard
BOD	mg/L	50	73	Doesn't maintain the standard
COD	mg/L	200	1631	Much grater than the standard
NO_3^-	mg/L	10	5.3	Within the standard

(Source: DoE, 2002)

Table 4. Comparison the Kushtia Sugar Mill's Effluents with Surface Water Standards

Parameter	Unit	Standard	Kushtia Sugar Mill's Effluents	Remarks
Na^+	mg/L	6.3	22.5	Does not maintain the standard
K^+	mg/L	2.3	96	Much grater than the standard
Mg^{2+}	mg/L	4.1	55	Much grater than the standard
Ca^{2+}	mg/L	15	160	Much grater than the standard
Cl^-	mg/L	7.8	23	Does not maintain the standard
SO_4^{2-}	mg/L	11.2	16.2	Does not maintain the standard
HCO_3^-	mg/L	58.4	440	Much grater than the standard

(Source: Garrels and MacKenzia, 1971), Lab analysis, 2006-2007

Recommendations for Water Pollution Minimization Option

Monitoring and Maintenance

- Prevention or minimization of spills and leaks through regularly inspecting and repairing various units (pumps, conveyors, pipes, and etc) and handling and storing molasses properly.
- Monitoring of quantity and quality of incoming and outgoing water at the mill with flow meters by measuring the flow.

Process Modifications

Minor changes in the sugar production and waste handling process can produce substantial reductions in wastewater volume and pollutant load:

- Mills should be operated at optimum capacity and with minimum stoppages because raw water consumption per ton of cane crushed increases when crushing lower than the optimum capacity and when hot water production is suspended during halts in operations (cleaning, restocking, and breakdowns).
- For maximum sugar sucrose recovery, condensate hot water should be used for imbibitions. For optimum recovery, imbibitions water should be maintained around 25-30% of cane used.
- The TSS level of the wastewater is much less when the sugar cane is manually harvested.
- Water conservation and sugar recovery can be improved by avoidance of overloading evaporators and vacuum pans, boiling at excessive rates, or operating at incorrect liquid levels

- Dirt and large particles in effluents can be minimized by allowing suspended particles in filter cloth washings to settle in a holding tank before being mixed with other effluents and screening wastewater before emitting to remove refuse, dirt, and remnants of the cane
- Caustic wastes from the cleaning equipment should be separated from the rest of the wastewater and gradually released into furrows and blended with the other effluents.
- The recycling of water is the primary factor in reducing wastewater volume.
- Effluents from sugar mills are often used for irrigation and this is considered an apt measure if the wastes are first treated to remove oil and suspended particles and to correct the pH value.

Policy Recommendation

- It is necessary to strengthen research and development activities in the Kushtia Sugar Mill. The aim should be to develop an idea to use nutrient rich effluent in the form of fertilizer to the agriculture field.
- Kushtia Sugar Mill should have the pretreatment process within the plant boundary and thus waste generated from the plant can treat to reduce the level of BOD, COD, TDS, K^+, Ca^{2+}, Mg^{2+}, PO_4^{3-} etc.
- Kushtia Sugar Mill should also analyze the physico-chemical properties of Gorai Lake to know its assimilation power and to control the environmental contamination of the lake water and vicinity.
- Regular monitoring of air quality should be performed and disclosed to the people and setting a limit on the total amount of pollution produced by sugar mill.
- Making existing laws more stringent
- The awareness program is to be initiated by the NGO's and the DOE to discourage the investors to invest in polluting technology.

CONCLUSIONS

Kushtia Sugar Mill is one of the largest industries among all operating industries in Kushtia region. Though this industry is seeking to increase government revenue and employment opportunities the rampant discharge of untreated effluents causing severe environmental degradation. The present investigation has been carried out to assess the physico-chemical characteristics of effluent from Kushtia Sugar Mill. From the result of physico-chemical analysis of effluent of Kushtia Sugar Mill it has been concluded that it does not always maintain DoE standard for industrial effluent as well as the surface water quality standard. It is to be concluded that it maintains DoE standard for pH, BOD, TDS while discharging its effluent. The standard of BOD and COD are also very low in comparison to the discharged effluent. Discharges of such nutrient containing effluent directly affect the water quality of lake and the stream that should be prevented.

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FARMERS CHARACTERISTICS ASSOCIATED WITH THE PARTICIPATION IN COTTAGE INDUSTRY ACTIVITIES OF BAUEC

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ABSTRACT

Alam M.A., Nur F., Mosaddeque H.Q.M., Rhaman M. L. and Rashid M. H. 2008. *Farmers Characteristics Associated with the Participation in Cottage Industry Activities of BAUEC*. **j. innov.dev.strategy 2(3): 36-41**

The study was undertaken to assess the influence of the farmer's characteristics on their participation in cottage industry activities of BAUEC. Random sampling method was used to collect data through personal interview method from 120 farmers of nine villages of Mymensingh district. Significant positive relationship was found between age, family size, attitude towards BAUEC and agricultural knowledge of the respondents and their participation in cottage industry program. About one seventh (16.70%) of the respondents had low participation, one third (32.5%) had medium and more than half (50.80%) of the respondents had high participation in cottage industry activities of BAUEC.

Key words: Farmers, participation, cottage industry, BAUEC

INTRODUCTION

Cottage industry once formerly applied to manufacturing that took place in people's homes, prior to the industrial revolution. For example farmers might take in extra sewing or make cloth, which was then sold to a larger retailer, in order to earn a few extra dollars during the slow month of winter. Today, the manufacturing of goods is largely done in big manufacturing plants, thus eliminating the individual textiles or sewing worker at home. A few of cottage industry business still exist, like home assembly or stuffing envelopes. Most often today's cottage industry involves using advanced technology to work from home, via fax, internet and telephone. At all stages of such an endeavor, as in most human activities these days, good, timely information is absolutely essential (Aina *et al.*, 1995). In this regard Bangladesh Agricultural University Extension Center (BAUEC) village development society programmes can be considered as playing a crucial role in generating income and self-employment opportunities for the rural area.

BAUEC have to motivate, educate and help farmers to make all-round development by their local and own resources through six development components such as crop development, livestock development, fish development, adult education, health and family planning and cottage industries (BAUEC, 2001). Participation is an essential component of successful and lasting development. Success in rural development can be achieved only if all groups are fully integrated into, and actively support, the developmental process (Ullrich, 1981). Successful BAUEC village development programme depend crucially on the degree of rural farmers participation in different development activities.

The main focus of this paper is to examine the role of rural farmers participating in BAUEC cottage industry activities in improving their socio-economic status.

METHODOLOGY

Sources and collection of data: Field level data were collected from nine villages of BAUEC farmers' societies under Mymensingh sadar upazila. From this Upazilla nine villages Daribhabokhali, Bhabokhali, Suhila, Char Raghurampur, Char Kalibari, Sutiakhali, Boyra, Mirzapur and Char Ishwardia were selected using random sampling technique (Table 1).

A list of the farmers of nine villages was made and found to be 481. Twenty five percent of the farmers were selected from each of the nine villages by using a table of random number as per and Blalock (1960). A total of 120 farmers out of 481 were selected as shown in Table 1. These 120 farmers constituted the sample for this study.

Table 1. Distribution of population and sample of farmers in nine purposively selected BAUEC villages

Sl. No.	Selected villages	Total number of farmers	Sample	Reserve
1	Daribhabokhali	51	13	1
2	Bhabokhali	76	19	2
3	Suhila	30	8	1
4	Char Raghurampur	25	6	1
5	Char Kalibari	60	15	1
6	Sutiakhali	84	21	2
7	Boyra	105	26	2
8	Mirzapur	25	6	1
9	Char Ishwardia	25	6	1
	Total	481	120	12

A reserve list of farmers was also prepared so that the farmers of this list could be used for interview if any farmers included in the original sample were not available during the collection of data.

Interview schedule was used for data collection. The content validity of the interview schedule was established by a panel of experts and its reliability and suitability were also determined for pertinent data.

Measurement of the variables

Age**:** Age of respondent referred to the period of time from his birth to the time of interview.

Education: Education was measured on the basis of the level of formal schooling. If a respondent passed the final examination of class five, his education score was taken as 5. If some one can not write, or can not sign, his education score was taken as 0.

Family size: Family size was measured by the number of the members in the family of a respondent including himself, his wife, children and other dependents.

Farm size: Farm size was operationalized in terms of area cultivated land owned or occupied by individual in hectare. The farm size was measured in terms of hectares by using the following formula.

Farm size = a+b+c-d+1/2(e+f)+g

Where,

a = Homestead area including vegetable plots.
b = Cropped area (owned)
c = Cropped area leased in.
d = Cropped area leased out.
e = Cropped area shared in (borga).
f = Cropped area shared out (borga)
g = Own pond.

Annual income**:** Annual income of a respondent was determined on the basis of his total earnings from agriculture, service, business and other sources.

Organizational participation**:** Organizational participation was measured on the basis of the nature of one's participation in different organization. The respondents were asked to mention the nature of participation i.e. no participation, ordinary member, executive committee member, officer of the executive committee. Score assigned to these responses were 0, 1, 2 and 3, respectively. And also asked the duration of participation i.e. nil period, upto 5 years, 6-10 years and 11 years or above. Score assigned to these responses were 0, 1, 2 and 3, respectively.

Organizational participation score of the respondents were measured by the following formula.

Organizational participation score = Position score (P) X Duration score (D)

Extension service contact: Extension service contact score of a respondent was calculated on the basis of his extent of contact with four sources of information. The respondents were asked to mention the number of contact made with different individuals, media and activities on daily, weekly, monthly, yearly or not at all basis. Weights assigned to these responses were 4, 3, 2, 1 and 0, respectively. Score obtained for use of 16 selected extension media by a respondent farmer were summed together to compute his extension exposure score.

***Cosmopoliteness*:** Cosmopoliteness scores of the respondents were determined on the basis of visit by them to eight different places. Farmers indicated whether they visited those places frequently, occasionally, rarely or not at all. Weights assigned to these responses were 3, 2, 1 and 0, respectively. The cosmopoliteness score of an individual was determined by adding the weights for his responses to all eight places as shown in interview schedule.

***Agricultural knowledge*:** Agricultural knowledge of scores of respondents was determined on the basis of their responses to 10 questions related to agricultural. A weight of 2 was assigned for each question. The agricultural knowledge scores could range from 0 to 20; 0 indicate no agricultural knowledge and 20 indicated very high level of agricultural knowledge.

***Attitude towards BAUEC*:** An attitude may be defined as predisposition to act towards an object in a certain manner. Attitude of a farmer towards BAUEC was used to refer to his belief, feeling and action tendency towards the various aspects of BAUEC. It was measured by constituting of 12 statement was considered positive if it is possessed an idea favourable towards the BAUEC. On the other hand, a statement was considered negative if it was unfavourable towards the BAUEC. The respondent were asked to express their opinion i, e fully agree, agree, no comments, disagree, fully disagree. Scores assigned to these responses were 4, 3, 2, 1 and 0 respectively if the statement was positive. A reverse scoring method was followed in case of statements considered negative. Attitude score of a respondent was determined by summing the scores obtained by him self for all the items in the scale.

Descriptive statistics such as number, frequency distribution, range, average and standard deviation were calculated to explore the relationship between selected farmer's characteristics and the cottage industry related activities of BAUEC.

RESULTS AND DISCUSSION

Characteristics of the farmers

Analysis of the data furnished in Table 2. Age of the farmers ranged from 18-50 years with an average of 33.58 indicating that the study group was moderately heterogeneous. More than 50% respondents had young aged group, this leads to understanding that the phenomena with regard to the health and family planning program of BAUEC would be reflected more in the present study by the young aged group. A major proportion 48.30 farmers had secondary education and one third i,e 34.30% of the farmers had primary education. As regard to farm size it ranged from 2 to 8 with an average 4.34. Majority of them (43.40%) had medium family. The farm size of the respondents of the study area ranged from 0.10 – 2.0 hectare with an average 0.98 hectare. Highest proportion (50 %) of the respondent family had medium farm, while marginal and small farm were 6.70% and 43.70% respectively. No large farm family was found but average farm size (0.98 ha) of the respondents is greater than national average (0.514 ha).

Analysis of the respondent characteristics also revealed that a large proportion (51.70%) of the farmers was in medium income group and only 15.80 % were in high income group. The average income of the respondents is higher (69.74 thousand taka) than the average per capita income of the country i, e 400 US dollar which is approximately 24 thousand taka. This might be due to the fact that the respondents of the study area were not engaged in agriculture only. They also earned from other sources such as service, business etc. which facilitate them for higher income.

Majority of the respondent (35.80%) had low organizational participation followed by medium organizational participation (31.50%) and high organizational participation (32.70%). More than two-third of the respondent had high and medium extension contact with different activities, agents and media. Highest proportion (43.50%) of the respondent had high cosmopoliteness compared to 35.70% having medium and 20.80% low cosmopoliteness. About half of the respondent (45.90%) had low knowledge while 38.30% had medium and only 15.80 % had high level of agricultural knowledge.

Attitude of the respondent towards BAUEC activities was found to range from 18-50 with a mean attitude score was 32.84. Majority (40.80%) of the respondents had moderately positive attitude towards BAUEC crop development activities and 26.60 % respondents respondent showed highly positive response towards BAUEC activities. Existence of highly positive attitude among the farmers indicates that they were well benefited by participation in BAUEC activities.

Table 2. Selected characteristics of the farmers of BAUEC

Characteristics	Scoring rank	Range	Mean	Categories	Farmers	
					Number	Percent
Age	Number of Year	18-50	33.58	Young 18-32 yrs	61	50.80
				Middle age 33-49	51	42.50
				Old >50	8	6.70
				Total	120	100
Education	Years of schooling	0-11	5.16	Illiterate (0)	10	8.30
				Sign literate (0.5)	8	6.60
				Primary edu. (1-5)	41	34.30
				Secondry edu. (6-10)	58	48.30
				Higher secondry and above (>10)	3	2.50
				Total	120	100
Family size	Number of members	2-8	4.34	Small (<4)	46	38.30
				Medium (4-6)	52	43.40
				Large (>6)	22	18.30
				Total	120	100
Farm size	Area in hectares	0.1-2.0	0.98	Marginal (<0.5)	8	6.70
				Small (o.51-1.0)	52	43.30
				Medium (1.01-3.0)	60	50.0
				Total	120	100
Annual income	Total earnings (taka in thousand)	20-120	69.74	Low (<53)	39	32.50
				Medium (53.01-98)	62	51.70
				High (>98)	19	15.80
				Total	120	100
Organizational participation	Nature of participation in different organization	1-50	25.18	Low (<17)	43	35.80
				Medium (18-34)	38	31.50
				High (>34)	39	32.70
				Total	120	100
Extension service contact	Number of contacts	2-43	24.76	Low (2-15)	29	24.30
				Medium (16-29)	45	37.50
				High (>29)	46	38.20
				Total	120	100
Cosmopoliteness	Number of visits to eight places	1-20	12.27	Low (1-7)	25	20.80
				Medium (8-14)	43	35.70
				High (15-20)	52	43.50
				Total	120	100
Agricultural knowledge	Number of response to question	12-17	14.69	Low (12-14)	55	45.90
				Medium (15-17)	46	38.30
				High (>17)	19	15.80
				Total	120	100
Attitude towards BAUEC activities	Number of response to positive or negative	18-50	32.84	Slightly positive (18-28)	29	32.60
				Moderately positive (29-39)	49	40.80
				Highly positive (>39)	32	26.60
				Total	120	100

Participation of farmers in cottage industry activities of BAUEC

The participation scores on the basis of cottage industries activities of the farmers ranged from 10 to 19 with an average 15.43. From the Figure 1 revealed that 16.7% of the respondents had lower participation in cottage industries activities of BAUEC. 32.5% of the respondent had medium participation in cottage industries activities of BAUEC as compared to 50.8% had high participation. Finding indicates that more than half of the respondents had high participation in cottage industries activities of BAUEC.

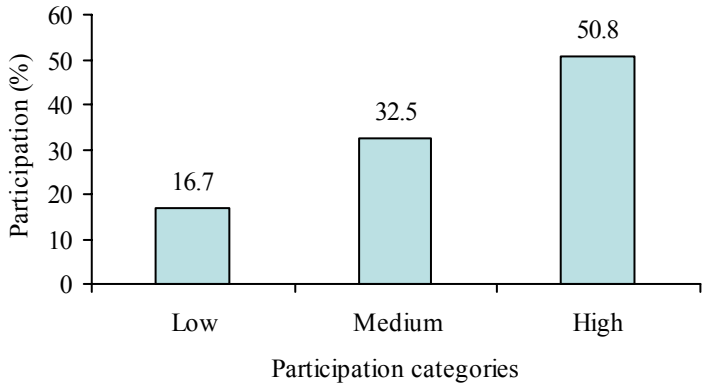

Figure1. Distribution of respondents according to their participation in cottage industry activities of BAUEC

Relationship between selected characteristics of the respondents with the participation of health and family planning activities

Both dependent and independent variables were analyzed in ordinal scales. Spearman rank order correlation co-efficient were computed to determine the strength of association between the respondents characteristics and their participation in health and family planning activities of BAUEC.

Table 3. Relationship between the characteristics of farmers and their participation in health and family planning activities

Dependent variable	Independent variable	Correlation co-efficient (r values)
Participation in cottage industries activities of BAUEC	Age	0.623***
	Education	-0.285**
	Family size	0.548***
	Farm size	0.099 NS
	Annual income	0.148 NS
	Organization participation	0.111 NS
	Extension service contact	0.015 NS
	Cosmopoliteness	0.159 NS
	Agricultural knowledge	0.653***
	Attitude towards BAUEC	0.608***

NS = Not significant, * = Significant at 0.05 level, ** = Significant at 0.01 level, *** = Significant at 0.001 level

From the Table 3 revealed that there was a significant positive relationship between age of the respondents and their participation in cottage industry activities. That is level of farmer age had great influence in accepting the cottage industry related technology. A negative significant relationship was found between education of the farmers and their participation in cottage industry programme. This means that the farmers with lower levels of education had more participation in cottage industry activities of BAUEC. Family size had significant and positive relationship with the participation in cottage industry programme of BAUEC. It indicates that the farmers with higher family member had higher tendency to adopt or participation in cottage industry activities. Participation or adoption of cottage industry activities had no statistically significant relationship with the farm size, annual income, organizational participation, extension service contact and cosmopoliteness of the

respondent. Higher level of agricultural knowledge, greater could be the adoption of cottage industry technology. Positive and significant relationship was found between attitude towards BAUEC of the respondents and the adoption of cottage industry technology (r = 0.608).

CONCLUSION

Disseminate an innovation or a new technology among the farmers the characteristics of them should be considered by the introducer of the technology. If the introducer, are aware about the influence of characteristics of farmers will help them to motivate farmers to adopt improved cottage industry technology. Knowing this information about the farmers on their adoption behavior would result in easy access to them by the introducer. Based on the findings of this study following conclusions are drawn.

1. Higher proportion (50.8%) of the respondents had high participation in cottage industry activities of BAUEC.
2. Majority of the respondents of BAUEC was young to middle aged group and young aged members were more involved in cottage industry activities. Significant positive relationship were found between age of the respondents and their participation in cottage industry programme indicating that it may be necessary for the extension to work more with the younger farmer.
3. Significant negative relationship was found between the education of the farmers and their participation in cottage industry programme. It indicates that the participation become more with the lower levels of education rather than higher.
4. Positive significant relationship was existed between the family size, agricultural knowledge and attitude towards BAUEC of the respondents and their participation in cottage industry programme of BAUEC.

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EFFECT OF DIFFERENT TRAP CROPS AGAINST ROOT KNOT NEMATODE DISEASE OF JUTE

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ABSTRACT

Haque S. M. A., Mosaddeque H. Q. M., Sultana K., Islam M. N. and Rahman M.L. 2008. *Effect of Different Trap Crops against Root Knot Nematode Disease of Jut*e. **j. innov.dev.strategy 2(3): 42-47**

An experiment was conducted at JAES, Manikganj and Monirampur, Jessore of Bangladesh Jute Research Institute during 2005-2007 to study the effectiveness of growing of sunhemp, sesbania, safflower and marigold as a trap crop. Seeds of *olitorius* variety O-9897 and Sesbania (*Sesbania rostata*), Safflower (*Carthamus tinctorius*), Sunhemp (*Crotalaria juncea*), Marigold (*Tagetes patula*) were sown in line as trap crop in nematode infested soil. Finding revealed that the highest gall formation was found in control and the lowest gall formation when sunhemp used. Plant height, fibre and stick yield found higher under the treatment with sunhemp + jute. Among four treatments sunhemp showed suitable trap crop for reducing gall formation.

Keyword: Trap crop, gall, fibre and stick weight, root knot nematode

INTRODUCTION

Jute (*Corchorus capsularis* L. and *Corchorus olitorius* L.) is the most important cash crop and one of the major foreign currency earners of Bangladesh. Jute fibre is extensively used all over the world for its versatility, durability and fineness. It is used for the production of newsprint paper, carpet, hessians, gunny bags, ropes, juton etc. Now a days, jute sticks are used in making partex.

Jute is mostly grown in the Indo-Bangladesh region and in some countries of Southeast Asia. It has been reported that about 90% of world's jute is produced in Bangladesh and India (Atwal 1976). In respect to the production, Bangladesh ranks second among the jute growing countries of the world. In Bangladesh, about 4.72 lac hectares of land are under jute cultivation and the total yield is 821000 m.ton (BBS, 2006). It is worthy to note that 100 thousand traders and 250 thousand industrial labours earn their livelihood from the jute business (Khandaker 1987). Jute ranks second only to cotton among all the natural fibre in case of production (Talukder *et al.* 1989).

Root-knot of jute caused by *Meloidogyne* spp. is one of the most important diseases of jute in Bangladesh and affected at various stages of growth (Talukder, 1974 and Ahmed, 1977). Hot and humid climate of Bangladesh makes it a suitable bed for the predominantly occurring *Meloidogyne javanica* and *Meloidogyne incognita* along with other 14 genera of plant parasitic nematodes (Timm and Ameen, 1960). Chattopadhary and Sengupta (1955) reported that stunting, wilting, defoliation and death to the attack of root knot nematode, *Meloidogyne javanica* (Kofoid and White) Chitwood. Ahmed and Timm (1961) found that *M. incognita* and *M javanica* were responsible for root knot disease of jute. Plant parasitic nematodes are obligate parasite. They can not survive in absence of their host. Trap crop enhance root knot nematode eggs to hatch. The larvae enter the roots but fail to develop. Sunhemp is a common green manuring crop in Bangladesh. It is susceptible to invasion by the root knot nematodes but resistant to the development of their larvae thus reduced the nematode population in soil (Quader, 1995). Nematodes are tiny, worm like, multicellular animals adapted to living in water. The number of nematode species is estimated at half a million, many of which are "free living" types found in the oceans, in freshwater habitats and in soils. Plant parasitic species form a smaller group. Nematodes are common in soils all over the world (Dropkin, 1980; Yepsen, 1984).

No specific control measure of root knot has been yet suggested in Bangladesh to save jute crop from the disease, safely. Besides, this chemical control is very expensive for controlling root knot disease. Moreover, their harmful effect is responsible for air, soil and water pollution (Alam, 1987). Various botanicals have recently been reported to have nematicidal properties (Mahmood *et al.,* 1982, Sartaj *et al.,* 1985, Ahmed *et al.,* 1990).

MATERIALS AND METHODS

The experiment was conducted at JAES, Manikganj and Monirampur, Jessore of Bangladesh Jute Research Institute during 2006-2007 crop seasons.

Seeds of olitorius variety O-9897 and Sesbania (*Sesbania rostata*I, Safflower (*Carthamus tinctorius*), Sunhemp (*Crotalaria juncea*), Marigold (*Tagetes patula*) were sown in line as trap crop in nematode infested soil at JAES and Monirampur. Land was prepared by deep ploughing and applied recommendation fertilizer doses (Urea- 200 kg/ha, TSP- 50 kg/ha, MP- 60 kg/ha, Gypsum- 95 kg/ha and Zinc Sulphate- 11 kg/ha). Urea was applied two times half amount of urea applied on sowing time and half 45 days after sowing. TSP, MP, Gypsum and Zinc Sulphate were applied on sowing time. Each line was 3 meters long and with 3 replications. Stand data was recorded after 40 days of sowing. Ten plants from each line were uprooted carefully and washed with water without disturbing the roots at the age of 90 days of the plants. The roots of each accession were examined for gall formation.

RESULTS AND DISCUSSION

Gall index

Sesbania, safflower, marigold and sunhemp cultivated to soil and gave considerable reduction in gall number in roots of jute. The ranges decrease gall numbers over control were 44.29, 70, 60 and 91.43% under the treatments with sesbania + jute, safflower + jute, marigold + jute, sunhemp + jute, respectively (Table 1).

Highest gall number of gall formation was found in control, safflower, marigold showed near similar results and reduction of gall formation highly reduced with sunhemp (Figure 1). Ahmed *et al.* (1988) reported that galling incidence was higher both non treated and less fertilized plants. Certain Prairie species have been found to provide excellent nematode control when used trap crop (Anon. 1996, Ploe, 2000).

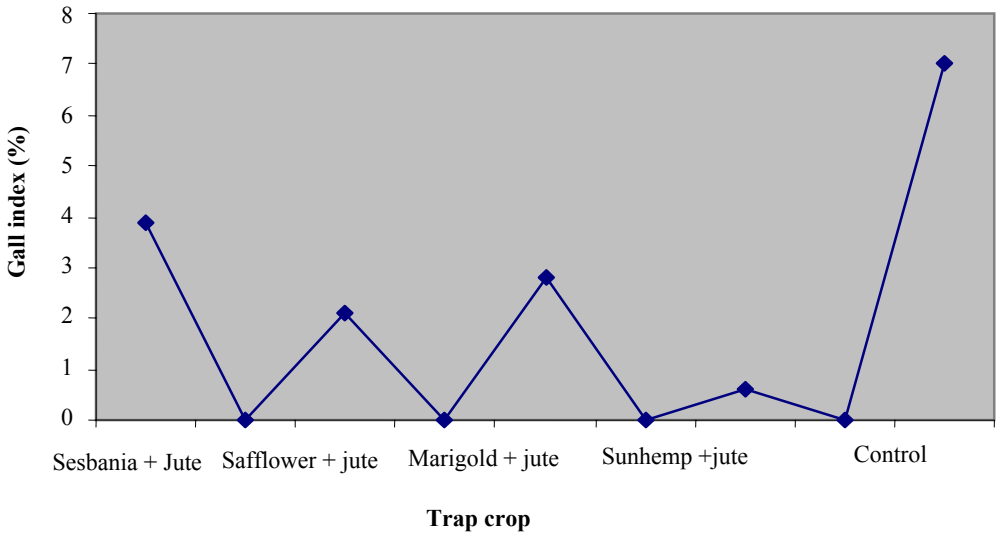

Figure 1. Effect of different trap crops on jute root gall formation

Table 1. Effect of different trap crop on jute root gall formation

Treatment	% Decrease gall formation of gall number over control
Control	-
Sesbania + Jute	44.29
Safflower + Jute	70
Marigold + Jute	60
Sunhemp + Jute	91.43

Plant height

Increase of plant height over control was achieved with all treatment applied to soil infested with *Meloidogyne* spp. However appreciable improvement of plant height was recorded under the treatments with sunhemp + jute and safflower + jute (Figure 2).

Depending on the treatment the ranges of increase in plant height over control were 3.81, 9.29, 2.38 and 14.76 % under the treatments with sesbania + jute, safflower + jute, marigold + jute, sunhemp + jute, respectively (Table 2).

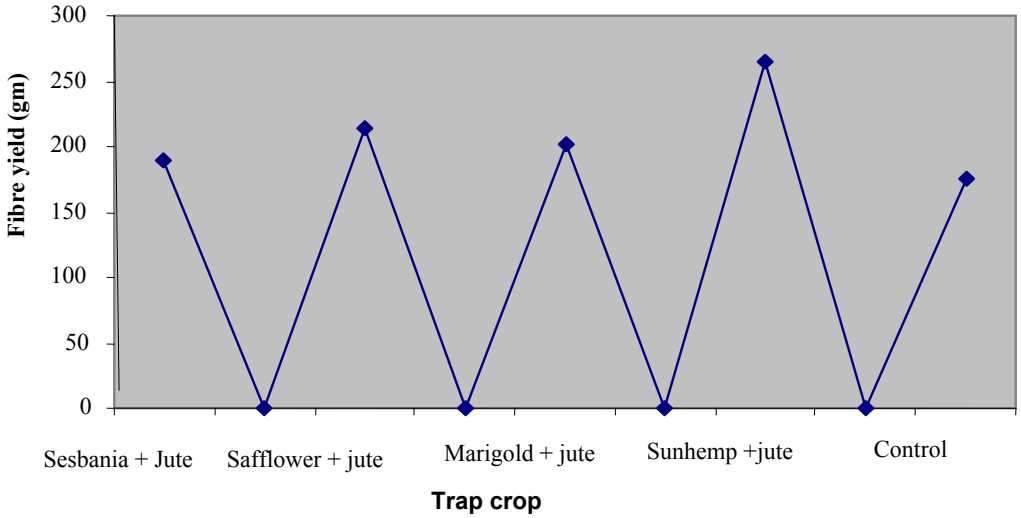

Figure 2. Effect of different trap crops on jute fibre yield

Table 2. Effect of different trap crop on jute plant height

Treatment	% increase jute plant height over control
Control	-
Sesbania + Jute	3.81
Safflower + Jute	9.29
Marigold + Jute	2.38
Sunhemp + Jute	14.76

Fibre and stick yield

Appreciable fibre and stick yield was recorded due to cultivation of sunhemp with jute. Identically same fibre and stick yield found with sesbania + jute, safflower + jute and marigold + jute and lowest yield found in control treatment.

Fibre and stick yield found higher with sunhemp + jute and it was 265 and 576 gm, respectively (Figure 3 & 4).

The fibre and stick yield increased over control were 8.57, 22.29, 15.43 and 51.43% and 19.1, 19.53, 18.12 and 35.53% under the treatments with sesbania + jute, safflower + jute, marigold + jute, sunhemp + jute, respectively (Table 3 & 4).

This finding agreed with Phukan and Roy, 1983. They reported that yield loss of jute fibre weight be up to 50% due to attack of root knot nematode.

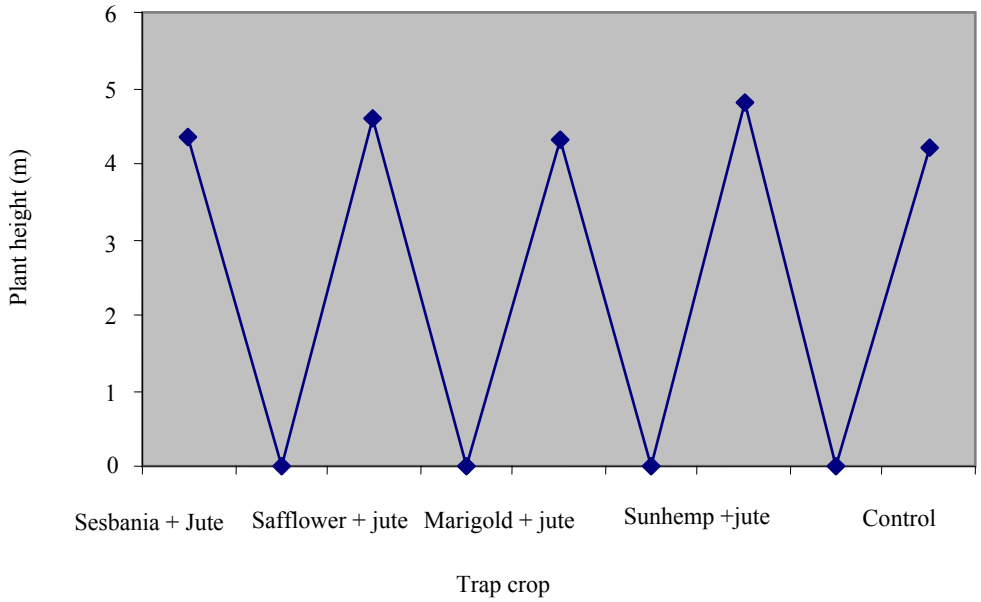

Figure 3. Effect of different trap crops on jute plant height

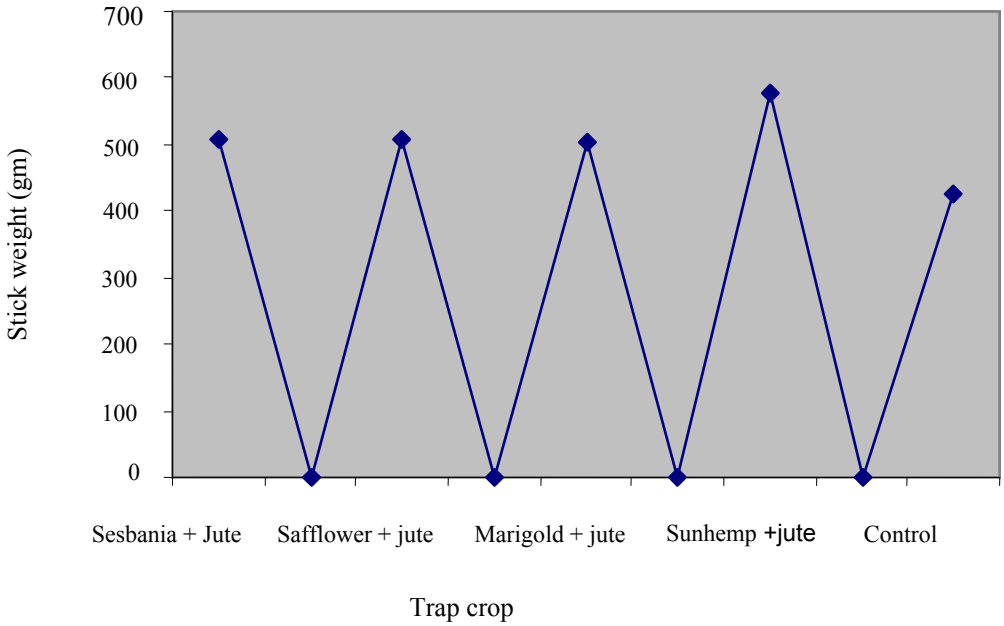

Figure 4. Effect of different trap crops on jute stick yield

Table 3. Effect of different trap crop on jute fibre weight

Treatment	% increase jute fibre weight over control
Control	-
Sesbania + Jute	8.57
Safflower + Jute	22.29
Marigold + Jute	15.43
Sunhemp + Jute	51.43

Table 4. Effect of different trap crop on jute stick weight

Treatment	% increase jute stick weight over control
Control	-
Sesbania + Jute	19.06
Safflower + Jute	19.53
Marigold + Jute	18.12
Sunhemp + Jute	35.53

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MANAGEMENT PRACTICES IN SOME SELECTED COLD STORAGE IN BANGLADESH

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ABSTRACT

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An attempt was made to study the management practice of some selected cold storage in Rangpur district where the main objective was to assess the management practices, to identify the major problems encountered during operations, to compare the economic assessment of private cold storage and BADC cold storage. Data were collected through interview schedule from four private cold storages and one BADC cold storages of Rangpur districts. It was found that the visited five cold storages were found to be operated within the temperature range of 1.67 to 2.8^{0}C and relative humidity was maintained within the range of 80 to 95 percent. Operating hours of the cold storage unit range from 10 to 18 hrs. The control system was either manual or automatic. Average capacity utilization ranged from 74.42 to 100 percent. The weight losses due to evaporation of moisture from potatoes in different cold storages range from 1.2 to 2.38 percent. The storage was period in between 8.5 to 9.5 month. The cold storage facilities and their management were conforming to the requirements laid down by national codes of practices, insurance companies, banks, international and national standard or recommendations. It is also found that none of the cold storage suffered losses, but the profit (Tk/ton) is comparatively less in BADC cold storage than the privately owned cold storages. The present study indicates that there are no special problems on the technological side regarding the cold storage in Bangladesh. Therefore, cold storage facilities can be effectively used for storage of potato in Bangladesh.

Keywords: Economic assessment, management practice, cold storage

INTRODUCTION

In Bangladesh, potato is one of the major food items which are preserved in cold stores for commercial storage purpose. Among the major staple foods of the world the status of potato is third. It is rich in calories, carbohydrates and proteins as well as substantial amount of vitamins. Potato is a cold climate vegetable crop which is grown in the winter season. The cultivation of potato increased considerably over the past years because of it's various uses as food. The area under potato cultivation constitutes 30% of total area for vegetable crop and 1.11% of the gross cropped area. In 1996-97 about 1,34,000 ha(0.87% of total cultivated land) was under potato cultivation in Bangladesh (Razzaque, 2000). In 2003-04 potato production was about 3907 thousand metric tons (BBS, 2004). Potato is a very important item of food for human consumption. It is used in culinary preparation in a variety of products made from its fresh and processed forms. Potato tuber contains about 75 to 80 percent water, 16 to 20 percent carbohydrates, 2.5 to 3.2 percent crude protein, 1.2 to 2.2 percent true protein, 0.8 to 1.2 percent mineral matter, 0.1 to 0.2 percent crude fat, 0.6 percent crude fibre and some vitamins (Schoenemann, 1977). The common potato (*Solanum tuberosum*) is one of around 150 tuber-bearing species of the genus solanum (Family: Solanaceae).

Freshly harvested potatoes like other tuber crops contain more than 70 percent moisture and are perishable in nature. These crops can not be saved from spoilage unless properly preserved. Farmers usually keep their potato spread on the elevated platforms created in their dwelling houses. Some other crude methods are also used. But these methods are only partially effective for storing potatoes for one or two months depending on the varieties. Due to improper handling and storage a huge amount of potato perishes every year due to spoilage and sprouting.

For large scale commercial preservation of potatoes cold storages are used in Bangladesh. But the total number of cold storages in the country is much lower than that actually needed. There are altogether 283 cold storages of which some are out of operation due to various reasons. Average capacities of these cold storages are 2500 metric tons. (Directorate of Agricultural Marketing, 1998). To preserve the produced potatoes in Bangladesh, the number of cold storages should be increased by about 5 times the present number. Potatoes have to be stored after harvest for a shorter or longer period in order to maintain even supply to the market throughout the year for direct human consumption as well as for the processing industry. Seed potatoes have to be stored after harvest till the next planting time.

There is a popular slogan "take more potato and save rice" in our country. So, it is important to preserve the potatoes, to maintain the potato supply throughout the year. As the country is situated in the tropical zone and is hot and humid during summer, so, it is necessary to preserve the potatoes by maintaining controlled storage environment. To evaluate the process of cold storage management practices in Bangladesh a project was undertaken

in 2003. The project was aimed at achieving the following objectives: (i) to assess the management practices in the studied cold storages. (ii) to identify the major problems encountered during operations of cold storages. (iii) to compare the economic assessment of private cold storage and BADC cold storage.

METHODOLOGY

An attempt was made to study the management practice of some selected cold storages. Since it was not possible to visit all the cold storages in the country, some selected cold storages of Rangpur districts (greater districts) were visited in March 2004 to study the practical situations existing in the selected cold storages and to collect other relevant information. The list of all the studied cold storages is shown in Table 1.

Table1. Cold storages which were studied

Name of the cold storage	Location	Ownership pattern	Year, when started functioning
BADC cold storage	Kellabond, BSCIC area Rangpur	Government	1979
Mrs. Chowdhary Ice & cold storage limited	Kellabond, BSCIC area Rangpur	Private (A group of individual)	1969
Kisan Himagar limited	R.K. Road Binodpur, Rangpur	Private (A group of individual)	1999
Northan cold storages limited	Kundol, Dinajpur Road, Saidpur	Private (Partnership)	1970
Himaddri cold storage limited	Kellabond, BSCIC area Rangpur	Private	1976

Collection of Data

A questionnaire was prepared for collection of information from the cold storages. Data were collected by personal contact at the relevant cold storages site through direct interview method. Manager and other operating staffs of the cold storages were interviewed for obtaining information regarding general management practices of the cold storages. The data were placed in tabular form for comparison and analysis, in order to understand the management practice of cold storages in Bangladesh.

Methods of cost calculation

Estimated costs are composed of expenses that occur independent of use, termed fixed costs and those that occur because use, termed variable costs.

Fixed cost

Fixed cost included: Depreciation (D), Interest (I), Taxes (T) and Insurance (In).

Depreciation

Depreciation is the reduction in value of the cold storage machinery and building with the passage of time. In calculation of fixed cost a straight line depreciation method is assumed and the following equation was used.

$$\text{Annual Depreciation } D = \frac{P - S}{L}$$

Where, P = Purchase price of the machine, Tk.
S = Salvage value of the machine, Tk.
L = Useful life of machine in years

Interest

The suggested interest rate considered in this study was 10 percent of purchase price

$$\text{Interest } I = 0.1 \times P$$

Where, P = purchase price in Tk.

Taxes

The annual cost of taxes is estimated at about 2 percent of the remaining value when spread over a 10 year life. Tax for a particular year on a cold storage can be estimated by the following way.

$$\text{Tax} = 0.02 \times P$$

Insurance

Estimated insurance cost was 0.2 percent remaining cold storage value in the beginning of the particular year and can determine by the following equation.

Insurance = 0.002 X P

Fixed cost (FC) = Depreciation + Interest + Tax + Insurance.

Variable cost

Variable costs include the cost of electricity, labour, fuel energy, ammonia gas, repair and maintenance costs and lubrication

Repair and maintenance cost

Repair costs are difficult to estimate because of wide variation, resulting from difference in operating conditions, management, maintenance programs etc. Repair costs include maintenance as well as the cost of all parts and the skilled labour cost to install the parts. It was considered 3.5 % of purchase price.

Labour cost

The labour cost was calculated by the following equation.

Lc = LC X CC

Where,
Lc = Labour cost (Tk/yr)
LC = Labour Charge (Tk./bag)
CC = Capacity of cold storage (ton)

Energy cost

The cost of energy was calculated as follows.

EC = RE X C X AU

Where,
EC = Electrical cost in (Tk./yr)
R.E = Rate of electrical energy in Tk./kw-hr
C = Capacity of motor in kw
AU = Annual use in hrs.

Fuel and oil cost

Yearly fuel and oil costs were collected from the record data of cold storage managers.
Variable cost. (VC) = Electricity cost (E) + Labour cost (L) + Repair and maintenance cost + Fuel & oil cost.

Total cost,

$T_{cost} = FC + VC$

Where,
T_{cost} = Total cost in Tk./yr.
FC = Fixed cost Tk./yr.
VC = Variable cost Tk./yr
Gross profit = storage rent (Tk./ton) X actual amount of product stored (ton).
Net profit = (gross profit – total storing cost)
Profit (Tk./ton) = Net profit ÷ Actual amount of product stored

RESULTS AND DISCUSSIONS

Identification of the cold storage under study

Five cold storages were included in this study. Out of five cold storages only one belonged to government and others were private belonging to either an individual or a group of individuals.

Installed capacity and actually stored

Actual stored amounts were found to vary from year to year. Variations of actual stored were within the range of 74.42 to 100 percent of the installed capacities based on 5 yrs data from 1999 to 2003.

Table 2. Installed capacities and amounts actually stored in different cold storages during the operational period

Name of the cold storage	Installed capacity (ton)	Amount actually stored		Based on
		Actually stored (5 years average) (ton)	Percent of installed capacity	
BADC cold storage	500	508	101.64	5 year data from 1999 to 2003.
Mrs. Chowdhary Ice & cold storage limited	6300	4675.6	74.42	
Kisan Himagar limited	10,000	9642.4	96.42	
Northan cold storages limited	2,000	2000	100	
Himaddri cold storage limited	3000	2770	92.33	

Table 3. Operating condition of the cold storage (inside the storage during operation)

Name of the cold storage	Relative humidity %	Temperature (^{0}C)	Operating hrs/day	Actual use of month/year	Control system
BADC cold storage	90-95	2.2-2.8	14-16	9	Manual
Mrs. Chowdhary Ice & cold storage limited	90-92	1.67-2.2	15-18	8.5	Manual & automatic
Kisan Himagar limited	85-90	2.2-2.8	18	9.5	Manual & automatic
Northan cold storages limited	90	2.0	10-12	9	Manual
Himaddri cold storage limited	80-90	1.67-2.2	12-15	9	Manual

Operating condition of the cold storage

Weight loss during cold storages

Weight losses due to evaporation of moisture from potatoes in different cold storages range from 1.2 to 2.38 percent per season (8.5 to 9.5 months). These are shown in Table 4. The rates with which weight losses took place were dependent upon the following factors:

i. Immatured potatoes stored
ii. Variety
iii. Injury during harvesting and storing
iv. Storage temperature and relative humidity during a short time after harvest.
v. Temperature, humidity and amount of ventilation during storage.
vi. Period of storage

Table 4. Weight loss (%) due to evaporation of moisture in different cold storages

Name of the cold storage	Weight loss (%)
BADC cold storage	2.6
Mrs. Chowdhary Ice & cold storage limited	1.2-2.38
Kisan Himagar limited	1.2-1.78
Northan cold storages limited	2.35
Himaddri cold storage limited	2.38

Pre-storage conditions

Before filling, the storage chambers were thoroughly cleaned and disinfected with copper-sulphate. The storing process involves three stages such as:

i. The receiving potatoes and their washing, sorting grading and packing

ii. Pre-cooling of potatoes

iii. Placing the potatoes under the cold storage temperature.

Washing, sorting, grading and packing of potatoes

The potatoes, which are procured and brought from different places, are washed, sorted, graded and packed in bags before storage. At this stage fanning helps remove excess moisture and heat from tubers.

Pre-cooling of potatoes

Potatoes should not be stored directly in the cold storage; these are to be pre-cooled at an intermediate pre-cooling temperature of about 14 to16^{0}C for 48 to72 hours. Pre-cooling prepares the tubers for the cold storage temperature.

Cold storage conditions

Temperature, humidity and air movements (ventilation) are the main factors which determine the storage life of potatoes in cold storage. The requirements of these parameters differ with the use of potatoes after storage. The requirements that are to be full-filled for storing table potatoes are different from those meant for seed.

Pre-heating of seed potatoes before taking out from storage

At the time of taking out seed potatoes from the cold storage seed should never be exposed to high temperature that exists out side the storage. Seeds must pass through chambers where pre-heating takes place at 14 to16^{0}C for 48 to72 hours.

Spoilage

Spoilage does not generally occur in the cold storage if the recommended operating conditions were maintained and handled carefully. Each cold storage under study had stand by generators, so the spoilage of potatoes due to power failure and load shading was not a factor for spoilage.

Spoilage of potatoes took place due to the following reasons:
i. If temperature is comparatively high.
ii. Excessive pressure of bag
iii. Diseases
iv. Mishandling

Capital Investment and bank loans for the cold storage

Amount of money invested for each of the cold storages under study area were found to vary widely depending on the individual situations- size or storage capacity, year of investment, prices of the land, building materials and machineries and also the cost of building construction.

In comparison to storage capacities of other cold storages, the capital investment for a 500 tons capacity BADC cold storage was high. This was due to additional costs for extra buildings, which were constructed for accommodation of the BADC staffs working with the cold storage. Capital investment for each cold storage was very high and it is difficult for an individual, to invest such a large amount. For this reason bank loan was essential for establishing such a big enterprise. Bank loan were given to all of the private cold storages. The banks allowed a loan of 20 to 80 percent of the total investment. Amount of money invested for different cold storage are shown in table 5.

Table 5. Total amount of investment for different cold storage in Rangpur Districts

Name of the cold storage	Amount invested (Tk. In crore)					
	Land	Building	Machineries	Total	Own investment (%)	Bank loan (%)
BADC cold storage	0.60	0.54		1.14	Government	
Mrs. Chowdhary Ice & cold storage limited	1.5	2.5	3	7	40	60
Kisan Himagar limited	1.0	2.8	2.5	6.3	40	60
Northan cold storages limited	0.02	0.05	0.03	0.1	40	60
Himaddri cold storage limited	0.40	2	0.05	2.9	31	69

Physical facilities and their management

The cold storage facilities and their management were conformed to the requirements laid down by national codes of practices, insurance companies, banks, international and national standard or recommendations. There were no

reports of troubles or inconvenience due to general layout of the cold storage surveyed. Some problems relating to the equipments as reported are e.g. lack of availability of spare parts, repair and service facilities.

Overall problem of cold storage business

The problem encountered by the cold storage management as understood from interviewing the manger and other staff of the five cold storage could be summarized as follows:

i. Potato growers do not get enough bank loans specially for growing potatoes.
ii. Procurement policies of the cold storages are not fair:
a) Carrying cost is not given to the grower or traders.
b) Fair price is not given
c) Payment is delayed.
iii. There are acute power problem arising out of frequent disruption of supply, prolonged power failure, low voltage and electrical load shading.
iv. Cost of electrical energy is being increased quite regularly.
v. Most of the cold storages do not have adequate transport facilities of their own for carrying potatoes.
Vii. The cold storage are not uniformly distributed over the entire are a where the potatoes are grown. This situation results in low utilization of installed capacities.
Vii. Repair and service facilities for the foreign made equipments are not available

Cost-benefit analysis

Total storing cost and net profit are tabulated in the Table 6 and 7

Table 6. Storing cost and net profit of different cold storages

Name of the cold storage	Storage rent (Tk/ton)	Actual amount of product stored (ton)	Gross profit (Tk)X 1000	Fixed cost (Tk.)X 1000	Variable cost (Tk.) X 1000	Total storing cost (Tk.) X 1000	Net profit (Tk.) X 1000	Profit (Tk./ton)
Mrs. Chowdhary Ice & cold storage limited	2238.09	4675.6	10464.41	4435.4	2397.14	6832.54	3631.87	776.77
Kisan Himagar limited	2226.19	9642.4	21465.81	5248.75	3203	8451.75	13014.06	1349.67
Northan cold storages limited	2238.09	2000	4476.18	1250.35	620.04	1870.39	2605.79	1302.89
Himaddri cold storage limited	2095.24	2770	5803.82	2640.5	2126.19	4766.69	1037.13	374.42

Table 7. Storing cost & net profit for BADC cold storage

Name of Cold storages	Buying rate (Tk/ ton)	Actual amount of stored (ton)	Total cost of product (Tk.)X 1000	Selling rate (Tk./ ton)	Valuation of the stored product (Tk.)X 1000	Gross profit (Tk)X 1000	Fixed cost (Tk.)X 1000	Variable cost (Tk.) X 1000	Total storing cost (Tk.) X 1000	Net profit (Tk.) X 1000	Profit (Tk./ ton)
BADC cold storage	8100	508.2	4116.42	14700	7470.54	3354.12	2280	1042.76	3322.76	31.36	61.71

The cost analysis of private cold storage and BADC cold storage are presented in Table 6 and 7. It is found that none of the cold storages suffered losses, but the profit (Tk/ton) is comparatively less in Chowdhary cold storage Ltd. and Himaddri cold storage Ltd. than the Kisan Himagar Ltd. and Northan cold storage Ltd. The main reason for this situation was high over head cost and operating cost. It is also found that the profit (Tk/ton) in BADC cold storage in very less than the private cold storage. The main reason for that the storing cost of BADC cold storage is higher than the private cold storage. Many of the post harvest handling such as grading, sorting, cleaning and transporting are not done in privately owned cold storages.

CONCLUSION

The present study indicates that there are no special problems on the technological side regarding the cold storage in Bangladesh. But for smooth trouble free operation they need uniform and regular supply of electricity and

transportation facilities. Comprehensive plan to mitigate these problems will not only help growth of cold storage business but will also help the growth of production of potatoes. Therefore, cold storage facilities can be effectively used for storage of potato in Bangladesh.

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SOCIO- ECONOMIC IMPACT OF SUBSIDY IN SUGARCANE AND BENEFICIARIES APPRAISAL: A CASE STUDY OF A SUGAR MILLS OF BANGLADESH

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ABSTRACT

Rashid M. A., Kamal M. M., Mia M. S., Zitu R. A. and Oan M. N. 2008. S*ocio- Economic Impact of Subsidy in Sugarcane and Beneficiaries appraisal: A Case Study of a Sugar mills of Bangladesh*. **j. innov.dev.strategy 2(3): 55-58**

The economy of North Bengal revolves round the sugar mills. The crux attempt of the study was to dig out the socio-economic impact of subsidy for the beneficiaries as well as sugar mills and to assess the beneficiaries' appraisal about the subsidy in sugarcane. Data were collected from both primary and secondary sources. Due to subsidy cane yield was increased by 18.47 t/ha and found that due to subsidy additional 978.91 ton sugarcane were produced. Thus additional return from those were taka about 1.3 million among the respondents and total extra money flow was taka 1.7 million. Data also expressed that the sugar mills received a total benefit of Tk. 2.84 million, 125.37 million, 205.10 million and 188.55 million during 2003-04, 2004-05, 2005-06 and 2006-07 cropping year respectively. Beneficiaries' appraisal were evaluated and ranked as per weight. Top three responses were as 'it should be continued '; 'subsidy is a motivation tool for STP' and 'it should be distributed during Sept-Oct'.

Key words: Subsidy, sugarcane, Beneficiaries appraisal

INTRODUCTION

Sugar industry lays an immense importance in agro-based economy of Bangladesh. Sugar cane, the only raw material of this industry is the main cash-crop of north Bengal of our country. Sugar cane industry is contributing importantly in building roads and developing physical infrastructure in rural areas, generating employments along with developing socio- economic conditions. Many industries can be formed by using various by -products of Sugar industry like as molasses, bagasse etc. Molasses are used to produce alcohols in distilleries, spirits, vinegar, citric acid, lactic acid, yeast, bio- ethanol etc. At the same time, it is a quality fodder also. Another by – product of this industry is press- mud.

Thakurgaon sugar mill was established in 1958 at the underprivileged Thakurgaon by the former EPIDC considering the urgency of Sugar industry.

The sugar mills had daily crushing capacity of 1000 tons and annual sugar production capacity of 10,000 tons at the time of installation. From 1966- 67 seasons, the daily crushing capacity was increased to 1524 metric tons and yearly sugar production capacity to 15240 metric tons. Nearly 1017-man power is directly engaged here. In this mills zone, about 30,000 families cultivate sugar cane where as a huge number of farm laborers are involved in cane culture, harvesting and transportation. The economy of such locality revolves round the sugar mills indeed.

Paying subsidy to the farmers is a great social welfare activity of the Government. Almost all the developed countries including USA, EU and developing countries pay subsidy on agriculture either directly as cash incentive or on agricultural production inputs. Subsidy on agricultural input is now treated as social investment as it can boost agricultural production. However, developing countries are assured to pay subsidy upto 10% of its GDP and LDCs have no such obligations as per WTO rules of business.

Economy of Bangladesh depends mainly on its agriculture. About 66.18 percent farm families of the country depend on farming businesses which influences their lives each year (BBS, 2003). Agriculture sector is contributing 23.5 percent GDP to the national economy (BBS, 2003). Among this 5.52 percent GDP is coming from crop sub-sector of which 0.74% is from sugarcane (Pal *et al*, 2003). Sugarcane is an industrial crop which is contributing more than 15 billion taka to the national economy. It is the most important cash-cum industrial crop of northern and north-western part of the country. About 0.17 million hectare land is utilized for the crop of which 0.086 million hectare in sugar mill zone and 0.084 million hectare in non-mill zone. About 0.6 million farmers depend directly on sugarcane (Pal, *et al.* 2005). But the Socio-economic conditions of these farm families are not satisfactory. Because sugarcane is a long durational (12-18 month) crop and its production cost is much higher than many other crops. Per hectare cost of production of sugarcane is taka 55 thousand (Rahman *et al.* 2005). The major cost involved in inputs like seed (11.44%), fertilizer (10.58%), pesticide (3.40%),

irrigation (1.90%) and transport for cane supply to the mills 8.79% for sugarcane production (Alam and Pal, 2006; Alam *et al*, 2007). Under the present socio-economic condition sugarcane farmers can not pay all these inputs correctly which results ultimate decreasing in sugarcane production. Thus decreasing yield makes the crop unprofitable which ultimately hampers the production of sugar and gur. Hence, it is necessary to subsidize the production cost of sugarcane for its survival.

Government of Bangladesh decided to pay subsidy to the sugarcane farmers since 2003-04 considering the poor conditions of the farmers and vulnerability of frequent natural disaster. With the increasing rate of production cost of sugarcane, authorities has increased the payable amount of subsidy per hectare and also extended the area of payments. Earlier, the farmers received only Tk. 1740.00 per acre if he/she produced any one of six selected varieties and followed the plantation method of Spaced Transplanting Technology (STP). From the year (2005-06) the amount and the number of selected varieties were increased from Tk. 1740.00 to 2500.00 and from six varieties to ten varieties. Moreover, it has included intercrop, seed plot and ratoon technologies within the subsidy program. From the year 2006-07, the amount and the number of selected varieties were further increased from Tk. 2500.00 to 3000.00 and they have included intercrop, seed plot and methodological ratoon technologies within the subsidy programme. Thus this study was undertaken to ascertain the farmers' response on subsidy and its impact on their socio-economic conditions.

Table 1. The land area cultivated and no. of farmers in mills zones during the last five years

Year of plantation	Land area(hectres)	Number of farmer
2003-04	10005	9800
2004-05	9685	8775
2005-06	12538	10500
2006-07	13000	9700
2007-08	9320	8500

Table 2. Five Years Production Statement

Serial No.	Description	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
a)	Duration of Crushing (days)	89	62	89	132	118	74
b)	Sugarcane Crushing (M. ton)						
	Target	175000	150000	95000	135000	155000	100000
	Achieved	109000	77595	111746	164160	153260	
c)	Sugar Production (M. ton)						
	Target	12688	11700	7078	9990	11238	7250
	Achieved	7681	5523	7904	10957	10040	
D)	Recovery %						
	Target	7.25	7.80	7.45	7.40	7.25	7.25
	Achieved	7.03	7.116	7.076	6.676	6.55	-

METHODOLOGY

For this study, Thakurgaon Sugar Mills area was purposively selected to ascertain the impact of subsidy on socio-economic condition of farmers during April 2008. Data were collected from both primary and secondary sources. A pre structured questionnaire was used to collect information regarding beneficiaries' appraisal about subsidy. Other data were collected from sugar mills record and analyzed after that. Descriptive statistics were employed to analyze the data of the study.

RESULTS AND DISCUSSION

It was found that subsidy was paid to the all kind of farmers from illiterate to highly educated; marginal land holder to big farmers and poor farmers to rich farmers including all the sub zones of the sugar mills. It helped to increase the yield of sugarcane by 18.47 t ha^{-1} among the 143 respondents (Table 3). Average yield of sugarcane with and without subsidy were 60.46 t ha^{-1} and 41.99 t ha^{-1} respectively. The additional production of sugarcane due to subsidy was 978.91 ton from the subsidized 44.0 ha of land. Although the total land areas of the respondents were 344.90 ha but they received subsidy only on 53.0 ha, because of its condition. Additional

return from additional production was Tk. 13, 99841.30 and total amount of money received as subsidy was Tk. 377155.0. Thus the total extra flow of money was taka 1776996.30. This additional money flow helped them positively in their farming business as well as to sustain their livelihood.

Table 3. Effect of subsidy on beneficiaries' economy

No. of respondents	Total area of land (ha)	Land occupied in subsidy (ha)	Total amount of money received as subsidy (Tk)	Yield sugarcane in subsidy plot (t ha^{1})	Yield of sugarcane in other plot (t ha^{1})	Yield increased (t ha^{1})	Additional cane production from subsidy plot (Ton)	Additional return from subsidy plot (Tk)	Total extra money flow (Tk) (column 4+9)
1	2	3	4	5	6	7	8	9	10
143	555.70	53	377155.00	60.46	41.99	18.47	978.91	1399841.30	1776996.30

Benefit accrued by the sugar mills was also identified and presented in Table 4. It is clear that Thakurgaon Sugar mills was able to produce additional sugar on an average of taka 17,884823 by distributing average amount of taka 3530609 during the cropping year 2003-04, 2004-05, 2005-06 and 2006-07. Thus the average national benefit of those 4 years was taka 13686234. This was due to an average extra production of 13.39 t ha^{-1} of those 4 years. Thus an average of 9883.09 ton cane was produced as extra which worth Taka 13570382 (as the price of cane Tk. 1328.35 per ton). All the canes of subsidy plots were supplied to the mills. Thus from the mean additional 9883.09 ton sugarcane a mean additional 663.04 ton sugar were produced. The market price of 663.04 ton sugar was taka 17884823. The achievements of subsidy were 174.61, 413.94, 932.65 and 1302.59 hectare during 2003-04, 2004-05, 2005-06 and 2006-07 respectively. Thus the trends of total benefits were also very positive which were Tk. 28,41,293, Tk. 1,25,37,491.0, 2,05,10,191.0 and Tk. 1,88,55,960.0 respectively.

Table 4. Total Benefits of Thakurgaon Sugar mills due to subsidy in sugarcane

Production Season	2003-04	2004-05	2005-06	2006-07	Mean
Sugarcane yield in subsidized plot (t ha^{1})	44.46	62.94	62.49	60.46	57.5875
Sugarcane yield in non-subsidized plot (t ha^{1})	35.70	46.64	46.60	47.86	44.2
Additional yield (t ha^{1})	8.76	16.30	15.89	12.62	13.39
Land area where subsidy was given (Hectare)	174.61	413.94	932.65	1302.59	705.9475
Total additional sugarcane production (ton)	1529.58	6744.28	14819.80	16438.68	9883.09
Mill price of sugarcane (ton)	1254.70	1254.70	1355.10	1448.90	1328.35
Price of additional sugarcane (Tk.)	1919164.02	8462048.11	20082310.98	2,38,18,003.45	13570382
Recovery (%)	7.116	7.076	6.676	6.55	6.8545
Additional sugar yield from additional sugarcane (ton)	108.84	477.22	989.36	1076.73	663.04
Price of sugar (ton\ Tk)	33,000	30,000	27,000	25,000	28750
Market price of additional sugar (Tk.)	35,91,720	1,43,16,600	2,67,12,720	2,69,18,250	17884823
Amount of subsidy given (Tk.)	7,50,427	17,79,109	62,02,529	80,62,290	3530609
Total National benefit (Tk.)	28,41,293	1,25,37,491	2,05,10,191	1,88,55,960	13686234

Source: Department of Agriculture, Thakurgaon sugar mills

Recording beneficiaries' appraisals were also the major scope of the study and were collected through an open questionnaire. Beneficiaries' appraisal were arranged and ranked as per total weight, which were presented in Table 5.

Table 5. Beneficiaries' appraisal

	Topic	Total weight	Rank
1.	Subsidy helps to purchase production inputs	14	13
2.	Subsidy enhances intercropping	32	9
3.	Subsidy is a motivation tool for STP	54	2
4.	Subsidy helps to increase production per hectare	47	4
5.	Net benefit helps to sustain livelihood	45	5
6.	It should be continued	70	1
7.	It should be distributed during Sept-Oct.	48	3
8.	Training program should be arranged regularly	40	6
9.	Maximum STP cultivating farmers should be selected and awarded with subsidy	20	10
10.	Best plots of conventional plantation should be included in subsidy	35	8
11.	Amount of subsidy is inadequate	39	7
12.	Irrigation, early plantation etc. should be included as different items in subsidy	18	11
13.	Authorities should be alert for selecting the farmers for subsidy	8	14
14.	All the farmers should be included in this program	15	12
15.	Subsidy can be treated as a big-business of the Govt.	7	15

It was found from the Table 5 that 'it should be continued' ranked top of the list with a total weight of 70. 'Subsidy is a motivation tool for STP' and 'it should be distributed during Sept-Oct' ranked 2nd and 3rd with the total score weight of 54 and 48 respectively. Weight of 47 was received by 'subsidy helps to increase production per hectare' was ranked 4. Other responses were as follows: net benefit helps to sustain livelihood (weight 45, rank 5); training program should be arranged regularly (weight 40, rank6); amount of subsidy is inadequate (weight 39, rank 7); best plots of conventional plantation should be included in subsidy (weight 35, rank 8); subsidy enhances intercropping (weight 32, rank 9); maximum STP cultivating farmers should be selected and awarded with subsidy (weight 20, rank 10); irrigation, early plantation etc. should be included as different items in subsidy (weight 18, rank 11); all the farmers should be included in this program (weight 15, rank 12); subsidy helps to purchase production inputs (weight 8, rank 13); authorities should be alert for selecting the farmers for subsidy (weight 8, rank 14); subsidy can be treated as a big-business of the Govt. (weight 7, rank 15).

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CHARACTERIZATION AND SENSITIVITY PATTERN OF BACTERIAL PATHOGENS ISOLATED FROM PNEUMONIA PATIENTS UNDER 5 YEARS OF AGE: A HOSPITAL-BASED STUDY

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ABSTRACT

Das S., Khan M. S., Neogi P. K., Akhter N. and Islam M. J. 2008. *Characterization and Sensitivity Pattern of Bacterial Pathogens Isolated from Pneumonia Patients Under 5 Years of Age: A Hospital-Based Study.* **j. innov.dev.strategy 2(3): 59-64**

A surveillance study on pneumonia was undertaken at Chittagong Maa-Shishu-O-General Hospital, Bangladesh during February 2007 to June 2007. It was conducted in order to isolate, identify and determine the sensitivity pattern of this disease causing agents from blood and cerebrospinal fluid (CSF) of hospitalized children less than 5 years of age to document the burden of these agents in Chittagong; Bangladesh. A no. of tests including cytological, biochemical, cultural and antimicrobial susceptibility test by Kirby-Bauer disc diffusion method was performed for their confirmative identification and for concerning their sensitivity pattern. Out of 547 blood samples, 52 (9.51%) yielded bacterial growth of which *K. pneumoniae,* 29 (55.77%) was the most frequent offender. It was followed by *Serratia spp.,* 07 (13.46%); *Acinetobacter spp.,* 5 (9.62%); *Staphylococcus aureus,* 4 (7.69%) etc. Only 01 (1.92%) *Haemophilus influenzae* was isolated from blood. From 53 CSF samples, number of bacterial isolates were 3 (5.66%) of which *Streptococcus pneumoniae* were 02 (66.67%) and the rest was *pseudomonas aeruginosa* (33.33%). Studies on age-dependent variation of bacterial isolates revealed that neonates (13.56%) are particularly vulnerable to infections because of weak immune barrier. Imipenem was found to be more active against *Klebsiella, Serratia,* and *Proteus spp.* than other antibiotics. Again *Acinetobacter spp*. was found to be more sensitive against imipenem and ciprofloxacin. Other Enterobacteriaceae family such as *E. coli* and *Pseudomonas spp.* offered sensitivity towards extended spectrum ciprofloxacin, imipenem as well as co-trimoxazole. The fluorinated quinolones, in particular ciprofloxacin and β-lactams, in particular ceftriaxone are still active against *Streptococcus Pneumoniae*. Pneumococcal isolation rate was very low both from blood and CSF. This study will provide local information on the common serotypes so that the future formulation of pneumococcal and other vaccines based on the local prevalent serotypes causing disease could be suggested.

Keywords: Multidrug resistant, *Klebsiella pneumoniae*, neonatal age, sensitivity pattern

INTRODUCTION

Pneumonia is defined as inflammation and consolidation of the lung tissue due to an infectious agent. World Health Organization (WHO) statistically showed pneumonia as the leading cause of death in children (under 5 years of age) worldwide and the most of them in developing countries like Bangladesh. While it is difficult to know which pathogen is responsible for a specific child's death from pneumonia, infections caused by *Streptococcus pneumoniae* (pneumococcus) are believed to be a major cause of fatal childhood pneumonia and meningitis worldwide. Even in ideal situation pneumococci are difficult to isolate, and so the vast majority of pneumococcal infections are unrecognized. Among 90 serotypes of *S. pneumoniae,* 4 strains are actually responsible for most disease and drug-resistant *S. pneumoniae* (DRSP). These are strains 6B, 14, 19 and 23F. Most strains are resistant to co-trimoxazole. Penicillin resistant strains are also recognized which are resistant to other drugs such as chloramphenicol, erythromycin, tetracycline etc. In Bangladesh, the most common serotypes of pneumococcus isolated among hospitalized patients are different from the serotypes that are included in the available vaccines (Saha *et al.,* 2003). Besides pneumococcal pneumonia, reports from different studies reveal that G (-ve) pneumonia may also contribute to the higher percentage in nosocomial pneumonia. Newborn infants are particularly vulnerable to gram-negative bacteria including *Klebsiella pneumoniae, Serratia marcescens,* etc. Various extrinsic and intrinsic factors are the main cause of G (-ve) pneumonia. However, the incidence of *Staphylococcus aureus* lower ultimate fate of G (-ve) pneumonia continues to be a common causes of neonatal mortality in Bangladesh (Darmstadt *et al.,* 2005). Besides the risk factors identified both in the neonates and in the mother, neonatal age is particularly vulnerable to infections because of weak immune barrier. Moreover, the G (-ve) organisms isolated are often resistant to multiple antimicrobials which make the treatment difficult. Resistant may be acquired by the loss or deficiency of specific porins, emergence of extended spectrum β-lactamases (ESBLs) producing strains, presence of R-factors that carry one or more genes that encode resistance, mutation in chromosomally-encoded genes or by the horizontal gene transfer of antibiotic resistance determinants. So, this study was designed to isolate, identify and determine the sensitivity pattern of pneumococcus and other pneumonia causing agents from the suspected cases to document the burden of these agents in Chittagong; Bangladesh.respiratory tract infection is also increasingly common in the hospitalized patients and must now be considered a possible pathogen for nosocomial pneumonia. In spite of great advances in antimicrobial therapy, septicemia that is the

MATERIALS AND METHODS

Patient selection

Children of less than 5 years of age who were admitted in the Chittagong Maa-Shishu-O-General Hospital, Chittagong, Bangladesh either with the manifestations of pneumonia, severe pneumonia, meningitis/febrile convulsion or very severe disease were included in this study. On fulfilling the clinical criteria, blood and/or CSF were collected following standard operating procedure (SOP) with prior parental consent.

Subculture of blood culture bottle

About 1-3 ml blood was drawn and aseptically added to the blood culture bottle containing 10 ml of trypticase soya broth. After 14-17 hrs of incubation, the bottles were examined for the appearance of any turbidity or lysis of the erythrocytes and then everyday for up to 7 days. Subcultures from the positive growth had been performed ordinarily on Chocolate agar plates (Oxoid, UK), Blood agar plates (Oxoid, UK) and MacConkey agar plates (Oxoid, UK). Next day after proper incubation, media were examined for any bacterial growth and subsequently gram stain followed by different biochemical tests (e.g. KIA, Citrate, Catalase, Coagulase, Oxidase, Satellitism test etc) were performed (Cheesebrough, 2000).

CSF collection and analysis

CSF was collected by lumber puncture and was inoculated directly on to supplemented chocolate agar plates (CAP), blood agar plates (BAP) and MacConkey agar plates (MAP). In the laboratory, Blood agar (BA) and Chocolate agar (CA) plates were placed in the incubator with 5-10% carbon-dioxide (CO_2) containing environment. On the 2nd day, incubated media were examined for any bacterial growth and subsequently gram stain followed by different biochemical tests (KIA, Citrate, Optochin susceptibility test etc.) for their confirmative identification. Besides microbiological, cytological (to determine the number and types of cells) and biochemical tests (to measure protein and sugar content) of CSF had also been done.

Antibiogram by disc diffusion method

Antimicrobial susceptibility testing was performed by the Kirby-Bauer disc diffusion method (Bauer *et al.,* 1966) as per the NCCLS (presently CLSI) recommendations. In brief, the tests were performed on Mueller-Hinton agar supplemented with 5% sheep blood for all identified G (-ve) and G (+ve) pathogens except *Haemophilus influenzae* (antibiogram on Chocolate agar). There were the discs (Oxoid, UK) of ampicillin (10µg/disc), ceftriaxone (30µg/disc), co-trimoxazole (25µg/disc), ciprofloxacin (5µg/disc), gentamicin (10µg/disc), amikacin (30µg/disc), imipenem (10µg/disc), optochin (5µg/disc) and oxacillin (1µg/disc). Finally results were interpreted as susceptible (S), intermediate (I) or resistant (R) according to CLSI-defined breakpoints.

RESULTS AND DISCUSSIONS

In this study, among 600 cases (from few patients blood and CSF both were obtained) total 55 (9.17%) cases exhibited bacterial infection of which 52 (9.51%) were from blood samples and 03 (5.66 %) were from CSF samples (Table 1). Similarly Mamishi *et al.,* (2005) in Iran described 9.13% isolation rate from blood stream infection. But Dewanjee (2000) and Saha *et al.,* (1992) in Bangladesh reported that the rate of isolation were 20.5% and 23.5% respectively.

Table 1. Representation of total case definitions

Total cases	Numbers	Percentages
A. Disease cases:		
a) Total pneumonia cases	322	53.67 %
b) Total meningitis cases	50	8.33 %
c) Total severe cases	228	38.00 %
B. Total sample:	600	
a) Total blood sample	547	91.17 %
b) Total CSF sample	53	8.83 %
C. Total positive cases	55	9.17 %
a) Blood	52	9.51 %
b) CSF	3	5.66 %

In the present study, *K. pneumoniae* (55.77%) and *Serratia marcescens* (13.46%) were the most common isolates in blood (Table 2, Figure 1). Levy *et al.,* (1996) in Israel also found *K. pneumoniae*, *E. coli* and *P. aeruginosa* as the predominant isolates in blood. Study on septicaemic patients done by Dewanjee (2000) in Bangladesh found four common isolates as *E. coli*, *Staph. aureus*, *K. pneumoniae* and *Enterobacter* species.

Table 2. Rate of type specific bacterial Isolates from blood and CSF

Sample	Bacterial isolates	No. of isolates	Percentage
Blood	*K. pneumoniae*	29	55.77%
	S. marcescens	7	13.46%
	A. baumannii	5	9.62%
	Staph. aureus	4	7.69%
	E. coli	2	3.85%
	P. aeruginosa	2	3.85%
	Proteus spp.	2	3.85%
	H. influenzae	1	1.92%
CSF	*Strep. pneumoniae*	2	66.67%
	P. aeruginosa	1	33.33%

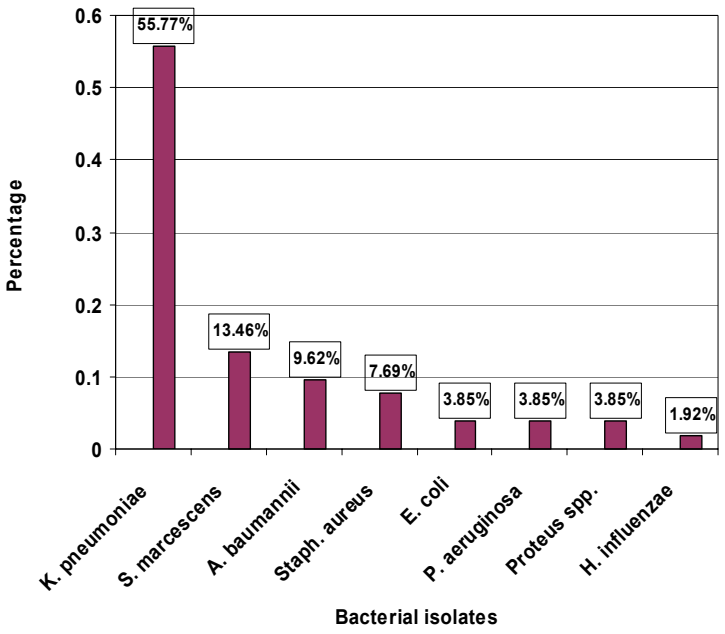


Figure 1. Rate of bacterial isolates from blood

In another study from Trinidad, Orrett and Changoor (2006) found *Staph. aureus* as the commonest isolates followed by *P. aeruginosa , K. pneumoniae* and *Enterobacter* species. Among five most common bacterial isolates in blood, Weinstein *et al.,* (1997) in the USA described coagulase negative *Staphylococci* (CoNS) as the third commonest organism. However, the etiological agents of septicaemia may vary from country to country, from hospital to hospital and from one community to another.

From the statistical representation of age-dependent distribution of bacterial pathogens, it is very much clear that neonate (13.56%) (Figure 2) are particularly vulnerable to infections because of weak immune barrier. Roy *et al.,* (2002) from India also isolated and depicted on the neonatal septicaemia in a tertiary care hospital of Northern India. Several risk factors have been identified both in the neonates and in the mother, which make them susceptible to infections. The varying microbiological pattern of neonatal septicaemia warrants the need for an ongoing review of the causative organisms and their antibiotic sensitivity pattern. Some reports from home and abroad also showed the incidence of neonatal septicaemia to vary from 36% to 55% (Ako-Nai *et.al.,* 1999 and Das *et.al.,* 1999).

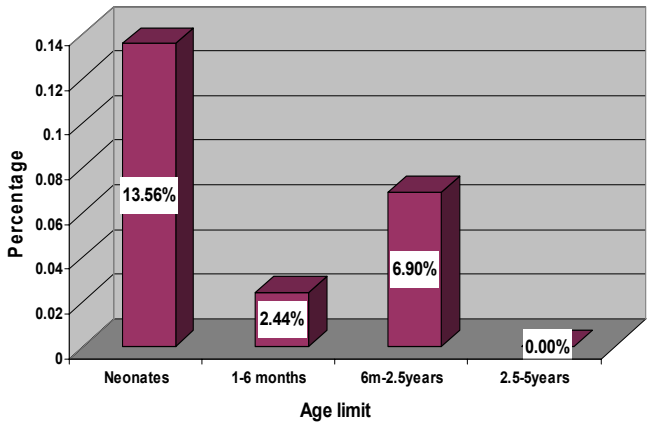


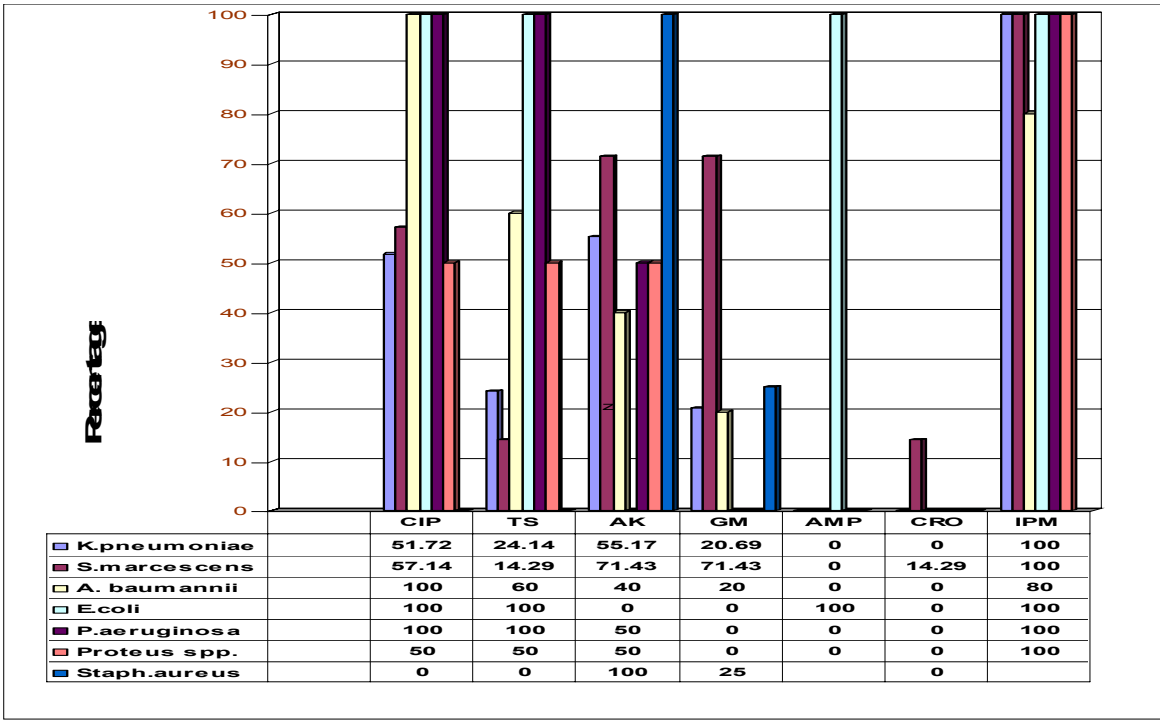
Figure 2. Prevalence of bacterial pathogens at neonatal age

Antibiogram of bacterial pathogens showed that maximum 100% *K. pneumoniae* were sensitive to imipenem followed by amikacin (55.17%), ciprofloxacin (51.72%) etc. In the study undertaken by Dewanjee (2000) in Bangladesh found 28.58% *K. pneumoniae* were sensitive towards chloramphenicol (Table 3, Figure 3). So, culture and antimicrobial susceptibility tests should always be sought before instituting any empirical antimicrobial therapy.

Table 3. Antimicrobial sensitivity (%) pattern among the bacterial isolates

Sample	Name of Isolate	Sensitivity pattern (%)	Name of antibiotics						
			CIP	TS	AK	GM	AMP	CRO	IPM
Blood	*K. pneumoniae*	S	51.7	24.1	55.2	20.7	0	0	100
	S. marcescens	s	57.1	14.3	71.4	71.4	0	14..3	100
	A. baumanii	S	100	60	40	20	0	0	80
	E. coli	S	100	100	0	0	100	0	100
	P. aeruginosa	S	100	100	50	0	0	0	100
	Proteus spp	S	50	50	50	0	0	0	100
	Stap aureus	S	0	0	100	25	X	0	X
CSF	*Strep. pneumoniae*		100	100	50	0	100	100	

An important striking feature found in this study was increased resistance to ampicillin by *Pseudomonas aeruginosa*. Alarming increase in resistance of *Pseudomonas spp*. to various antimicrobial agents has also been reported by many workers (Paul, *et al.*, 1992). Area based knowledge of the bacteriological spectrum is essential because the first antibiotic administered will not wait for the culture results and keeping in mind the high morbidity and mortality associated with neonatal sepsis, a right choice for such empiric therapy is of utmost importance. In western countries, antibiotics of choice are directed towards group B *Streptococcus* and *E. coli*. But in tropical areas, early onset neonatal infections may be caused by multi resistant hospital acquired bacteria, which are transmitted during delivery by lack of hygiene. During study, most causes of death displayed seasonal fluctuation, and sex differentials were marked with female deaths exceeding male deaths for all ages after the neonatal period. Malnourished children from low socioeconomic status families had higher mortality rates than their better nourished and weather counterparts. Overall, the data suggest that the delivery of a few basic health measures (oral hydration and immunization) could result in substantial reduction of less than 5 years age mortality.



	CIP	TS	AK	GM	AMP	CRO	IPM
K.pneumoniae	51.72	24.14	55.17	20.69	0	0	100
S.marcescens	57.14	14.29	71.43	71.43	0	14.29	100
A. baumannii	100	60	40	20	0	0	80
Ecoli	100	100	0	0	100	0	100
P.aeruginosa	100	100	50	0	0	0	100
Proteus spp.	50	50	50	0	0	0	100
Staph.aureus	0	0	100	25		0	

Figure 3. Sensitivity pattern of 7 isolates against 7 antibiotics

Finally, the important feature of this study is the resistance of bacterial pathogens to a variety of antimicrobial agents that is emerging in throughout the world at the present time. Therefore, to combat this problem, efforts should be made to isolate and characterize plasmids responsible for resistance in multi-drug resistant (MDR) organism from all over the country and a nation wide antibiotic policy should be defined after evaluating the effectiveness of the regime so that misuse of antibiotics is minimized and also the emergence of multi-drug resistant organism can be restricted. The present study will remain as a pioneering milestone for any future study to understand the burden of pneumococcal and other infections of pneumonia in Chittagong; Bangladesh.

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STUDY ON THE MANGROVE ECOSYSTEM IN MALDIVES

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ABSTRACT

Shazra A., Rasheed S. and Ansari A. A. 2008. *Study on the Mangrove Ecosystem in Maldives*. **j. innov.dev.strategy 2(3): 65-67**

This study was carried out in HA.Baarah, Maldives during 2004 to increase the understanding of ecological rich ecosystems like mangrove. Mangrove vegetation in HA.Baarah is mainly dominated by *Rhizophora mucronata Lam*, *Hibiscus tiliaceus L* and *Pemphis acidula* species. Site 1 studied is rich in soil fertility as result diversity is higher in this area compared to site 2. Site 1 is rich in organic matter, the soil is very dark, waterlogged, many organisms especially worms leeches, and other borrowing organisms are present. Site 2 is more of having stiff clay or sandy like soil. *Hibiscus tiliaceus L* and *Pemphis acidula* species are common in this area. *Ceritidea cingulata* is common to both the areas.

Key words: Mangrove ecosystem, mangroves, soil fertility, species diversity, dominance

INTRODUCTION

These forests are characterized by trees, shrubs and other vegetations that thrive in saline or brackish water. Mangroves support an ecosystem that is comprised of plants, animals and other microorganisms that have adapted to life in dynamic environment of the tropical intertidal zones. Mangrove ecosystems are important environmentally and economically (Primack, 1998).

Mangrove ecosystems are found all over the world in tropical and subtropical regions. In Maldives, Mangrove ecosystems occur towards both end of the country and no Mangroves are found in the central islands of the country. 14 Mangrove species are found in Maldives however all 14 species are not to be found together in one single region or island. As the islands of the Maldives are geographically isolated by large bodies of water as a result the environmental conditions of these islands also differ. This is the reason why different Mangrove species adapted to different environmental conditions are restricted to particular islands. In K. Hura only one Mangrove species is found, in Addu atoll 3 species are found and in HA. Baarah four Mangrove species are found (*Bruguiera cylindrical* Blume, *Excoecaria agallocha, Rhizophora mucronata* Lam, *Ceriops tagal* C.B.Rob) (Kitamura *et al.,* 1997).

These mangrove ecosystems are one of the most important coastal communities found in the islands of Maldives. However there has been little scientific work done to study these habitats. As a result their ecological, social and economic benefits have largely been unrecognized. Consequently, these ecosystems are under great pressure from the population and developmental activities threatening their existence. In this study, vegetation of the areas, other associated organisms, the soil analysis and other physical parameters of two different sites were analyzed. The main aim of this study was to explore the mangrove ecosystem in H A. Baarah, Maldives.

MATERIAL AND METHODS

The study was carried out to compare different Mangrove areas and to estimate the species diversity and density of different Mangrove species, using standard sampling techniques. It also involved the analysis of soil from the sites in the mangrove ecosystems for clear interpretation of the environmental conditions in which they are adapted. Two Mangrove sites were studied. Quadrate sampling and line transect methods were used to obtain data in order to estimate the species density and diversity of these species in both sites of the Mangrove. The species were identified using standard identification keys. Soil sample were collected and subjected to physical (soil moisture), chemical (pH, organic matter, organic carbon and nitrogen content).

The island Baarah is located in the Haa Alif Atoll, Latitude N 06° 49', 867'; E 073° 12', 793' with an area of 18324700 feet^2 and a population of 1652 having 800 males and 839 females. The mangrove ecosystem stretches over a large area of the island specifically on the two ends. 16% of the island area is covered by mangroves.

RESULTS AND DISCUSSION

Site 1 is dominated by *Rhizophora mucronata* Lam. Both quadrat and line transect reflect the highest importance value to the above species. In quadrat sampling, the importance value of *Rhizophora mucronata* Lam was found to be 108.38 and in line transect the value was 180.267. In contrast to site 1, site 2 was dominated by *Hibiscus tiliaceus* L (Table 1 and 2).

The result showed that the organic matter content in site 1(0.34%) was higher than site 2 (0.030%). Carbon content and nitrogen content was 0.196 % and 0.02% respectively in site 1. In site two carbon and nitrogen contents are 0.017 % and 0.002 % respectively. The pH was found to be lower in site 1 (pH 6) compared to site 2 (pH of 6.5) (Table 3).

This difference in vegetation and organisms presented in the two sites depends on many factors. Soil condition was one of the contributing factors. *Rhizophora mucronata* Lam copes better with soft humus – rich mud which can be found through the site 1. On the other hand *Hibiscus tiliaceus* L favors stiff clay containing little organic matter as a result the other species dominates in the site 2. Site 1 showed greater index of dominance of 0.84 compared to 0.41 at site 2.

At site 1 the topsoil was darker in colour containing higher quantity of organic matter, this made the soil in this area a little acidic than the site 2 where organic matter content was significantly low. Because of greater soil fertility, many organisms preferred to live at site 1. Organisms like earthworms, leeches, insects, fungi, woodlouse, microorganisms and many other types could be seen in the area, which was not very common in site 2. This indicates that soil fertility determines the species diversity (Brady and Weil, 2004). At site 2 subsurface soils was typically waterlogged, had little aeration, which decreased with depth, and contained high organic matter which decomposed at a very slow rate. This darker or black soil produced a strong odour when unearthed indicated the presence of hydrogen sulphide. This was the result of anaerobic bacteria and it could be *Desuifovibrio sp*. that thrives in anoxic condition (Peter and Sivasothi, 2001).

Human activities have always been one of the biggest threats to any ecosystem and in the same way mangroves are under pressure from the population. Activities such as dumping of wastes, cutting down trees, logging, and poor management practices stresses this ecosystem. Past studies indicate that it takes at least a century for mangroves to recover from severe damage, if they are able to recover at all. These pressures have already placed mangrove ecosystem around the world in danger of profound destabilization, the consequences which include loss of valuable mangrove resources and a reduction in mangrove ecosystem (Singh and Odaki, 2004).

Table 1. Species diversity by quadrate sampling

Site	Species	Density (number per m^2)	Importance value
1	*Excoecaria agallocha L*	0.0004	9.66
	Rhizophora mucronata Lam	0.0354	108.38
2	*Ceriops tagal C.B.Rob*	0.0025	51.94
	Pemphis acidula	0.0004	14.43
	Hibiscus tiliaceus L	0.0046	62.32
	Sceevola taccada Roxb	0.0021	18.27
	Dodder laurel	0.0004	7.18

Table 2. Species diversity by line transect

Site	Species	Density (number per m^2)	Importance Value
1	*Pandanus tectotius Parkinson*	0.11	7.75
	Cordia subcordata	0.037	3.097
	Clerodendum inerme Gaertn	0.75	35.943
	Sceevola taccada Roxb	0.32	16.38
	Excoecaria agallocha L	0.026	3.687
	Bruguiera Cylindrica	0.536	52.877
	Rhizophora mucronata Lam	3.32	180.267
2	*Rhizophora mucronata Lam*	0.08	13.715
	Karamana Ceriops tagal C.B.Rob	0.13	31.133
	Hibiscus tiliaceus L.	0.45	87.047
	Cerbera manghas L.	0.016	23.089
	Pandanus tectotius Parkinson	0.04	15.481

Table 3. Soil fertility status

Parameters	Site 1	Site 2
Soil Moisture %	3.600	0.402
Soil pH	6.000	6.500
Organic Matter %	0.340	0.030
Carbon content %	0.196	0.017
Nitrogen %	0.020	0.002

CONCLUSION

Mangrove ecosystems are one of the most important coastal ecosystems in the Maldives. It is a home for many plants, animals, fishes, crustaceans and many microorganisms. Not only that mangrove ecosystems render invaluable services to the ecology and hence to the environment. But unfortunately certain human activities put them under stress. So today we should take certain measures and conservation strategies in order to minimize human impact on this important coastal ecosystem especially to countries like Maldives where erosion is a major problem for most of the villagers. Otherwise, mangroves will vanish from our ecosystem.

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