

MECHANISMS AND SOURCES OF HYDROCHEMISTRY IN SOUTH-WEST COASTAL AQUIFER OF BANGLADESH

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Abstracts : In the study, the mechanisms and sources of hydrochemistry in groundwater of the south-west coastal area in Satkhira district of Bangladesh have been evaluated based on the major chemical compositions of the groundwater. In this context 55 groundwater samples have been analyzed in the study. Most of the water samples contain high Na⁺ and Cl⁻ concentration, while other chemical constituents such as Ca²⁺, Mg²⁺, K⁺, HCO₃²⁻, NO₃⁻ and SO₄²⁻ are within the permissible limit of WHO (2006) recommended values as a drinking water. Average TDS values are within the range of 243.70 to 5011.50 mg/l which is few above the WHO permissible limit. Ionic distribution of these constituents in groundwater of the area has a definite special trend, which constitute the significant parts of the total dissolved solids in groundwater of the area. The CEV values of groundwater samples are within the range of -0.003 to 0.7878, which represent the ground waters are mainly inland origin and sea water mixing low to medium salty waters in some well locations of the area. The representing chemical data in Gibb's diagram which indicates that 35 out of 55 samples are their chemical constituent under the influence of rock dominance and 20 samples are influenced by evaporation and crystallization processes. From the bivariate plot of Na⁺-Cl⁻ (meq/l) versus Ca²⁺+Mg²⁺-HCO₃²⁻-SO₄²⁻ (meq/l), the slope value of -0.17, which indicates that ion exchange was taking place in groundwater of the area.

Key words: Groundwater, aquifer system, mechanisms, sources, hydro chemical, coastal area, Bangladesh.

সারসংক্ষেপ: গবেষণা কর্মটিতে বাংলাদেশের দক্ষিণ পশ্চিম অঞ্চলের ভূগর্ভস্থ পানির রাসায়নিক উপাদানের উৎস এবং দূষণের প্রক্রিয়া নির্ধারণ করা হয়েছে ভূগর্ভস্থ পানির রাসায়নিক উপাদানের উপর ভিত্তি করে। গবেষণা অঞ্চলের বেশীরভাগ পানিতে সোডিয়াম এবং ক্লোরাইডের পরিমাণ বেশী এবং অন্যান্য রাসায়নিক উপাদান যেমন- ক্যালসিয়াম, ম্যাগনেসিয়াম, পটাশিয়াম, বাইকার্বনেট, নাইট্রেট এবং সালফেটের পরিমাণ খাওয়ার পানি হিসেবে নির্ধারিত বিশ্ব স্বাস্থ্য সংস্থা (২০০৬) সীমার মধ্যে প্রতীয়মান হয়। যদিও গড় টি ডি এস-এর পরিমাণ ২৪৩.৭০ থেকে ৫০১১.৫০ গ্রাম/লিটার, যা বিশ্ব স্বাস্থ্য সংস্থা (২০০৬) দ্বারা নির্ধারিত সীমার কিছুটা উপরে। পানিতে দ্রবীভূত এই সকল রাসায়নিক উপাদানগুলির আয়নিক বস্তু হিসেবে একটি নির্দিষ্ট বিশেষ দিক পরিলক্ষিত হয়। ভূগর্ভস্থ পানির ক্যাটায়ন এক্সচেঞ্জ মান -০.০০৩ থেকে ০.৭৮৭৮ এর মধ্যে হওয়ায় প্রতীয়মান হয় যে গবেষণা অঞ্চলের ভূগর্ভস্থ পানি প্রধানত: ভূমি অঞ্চল হইতে উৎপত্তি এবং কিছু কিছু জায়গার ভূগর্ভস্থ পানি কম থেকে মধ্যম মানের লবনাক্ততা বহন করে। গিবস ডায়াগ্রাম হইতে প্রমানিত হয় যে ৫৫ টি ভূগর্ভস্থ নমুনার মধ্যে ৩৫ টি নমুনার রাসায়নিক উপাদানে যথেষ্ট শিলার প্রভাব এবং ২০টি নমুনাতে রাসায়নিক উপাদান বাষ্পীভূত ও স্ফটিককরণ পদ্ধতিতে এসেছে। সোডিয়াম-ক্লোরাইড এবং ক্যালসিয়াম+ম্যাগনেসিয়াম-বাইকার্বনেট- সালফেট- এর বাইভেরিয়েট প্লট হইতে পাওয়া ঢাল -০.১৭ যা গবেষণা অঞ্চলের ভূগর্ভস্থ পানিতে আয়ন এক্সচেঞ্জ ঘটেছে নির্দেশ করে।

Introduction

The concentration of chemical constituents in groundwater originated from the aquifer mineral compositions when groundwater flows and saturated in the aquifer. The hydro geochemical processes depend on the geology and chemical characteristics of the aquifer (Nwankwoala and Udom, 2011). These hydro geochemical processes such as dissolution, precipitation, ion exchange processes and the residence time along the flow path control the chemical composition of groundwater (Apodaca et al. 2002; Martinez and Bocanegra 2002). In the present study in south-western costal adjoining area (Fig. 1), where groundwater chemistry may also be controlled by sea water intrusion. The field observation report in the area shows that groundwater quality is rapidly deteriorating which is increasing towards northern portion (Kalaroa Thana) from the southern coastal area, while salinity in groundwater varies from 0.2 to 3.9 ppt during pre-monsoon period (Shafiuzzaman and Haque, 2014). Groundwater is one of the vital resources which plays role in solving the drinking water crisis in the area, but it is seriously polluted by naturally and anthropogenic activities such as increasing population, urbanization and industrialization. It is possible to solve in easily the

anthropogenic causes by the visual effective steps of human awareness, but the natural causes that are difficult to solve the groundwater chemical pollution without any scientific evaluations. Hence it is important to understand the hydro geochemical processes which are mechanisms and sources of hydrochemistry in the aquifers of the area. Because the dissolved ionic constituents in groundwater derived from various sources which may be either natural or anthropogenic or both sources. These dissolved constituents and their relations with each other can reveal their origin and process that occurred during the interaction. Major ions constitute the most significant part of the total dissolved solids present in the groundwater and the concentration of these ions in groundwater depends mainly on the hydrochemical processes that place in the aquifer system (Lakshmanan et al., 2003). They have a special distribution in groundwater and present a definite spatial trend (Nwankwoala and Udom, 2011). To full fill the research objectives it is important to measure the chemical compositions especially major cations and anions of groundwater in the area. The achievement from the study will be helpful to adequate hydro geochemical knowledge of the area that will be established to find out the suitable groundwater

resources and also will be helpful to improve the management efficiency of the groundwater resources in the area.

Materials and Methods

Study area and Sampling

To know the major ionic composition of groundwater, 55 groundwater samples were collected from randomly selected well locations in the study area, which includes five adjoining Kalaroa, Satkhira sadar, Debhata, Kaligonj and Shyamnagar Thana of Satkhira district of Bangladesh, having the surface area of about 3293.22sq. km., and the area is confined between latitude $21^{\circ} 45' N$ to $23^{\circ} 00' N$ and longitude $88^{\circ} 55' E$ to $89^{\circ} 20' E$ (Fig. 1). All samples were collected during the period of May in 2011, when water table was approximately in the lowest level. Samples for collection, preservation and analysis have been followed the suggested methods of APHA (1995), Hem (1985), ICMR (1975), Brown et al. (1970) and Rainwater and Thatcher (1960).

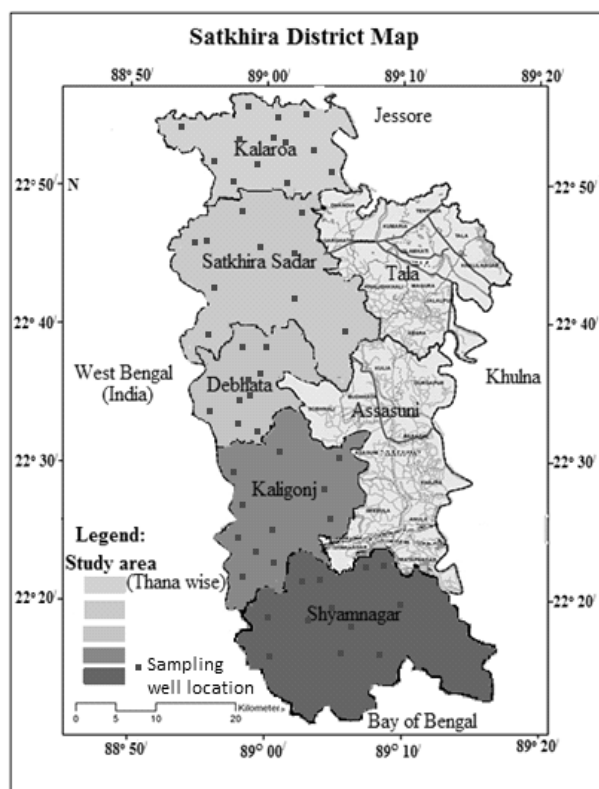


Fig. 1 Water sampling well locations in the study area of Satkhira district.

Bore log or Lithological data

To identify the aquifer system in the area, lithological

samples or bore log data of each Thana of the area which was collected from the department of public health engineering office (DPHE, 2008). The data was presented in each formation in cm scale from meter, where uses $1 \text{ cm} = 25 \text{ m}$.

Groundwater chemistry data and evaluation methods

The analyzing of major ionic composition (Na^+ , Ca^{2+} , Mg^{2+} , K^+ , Cl^- , HCO_3^{2-} , NO_3^- and SO_4^{2-}) of 55 groundwater samples in the area are shown in Table 1. All the chemical parameters were achieved using standard methods as suggested by the American Public Health Association (APHA, 1995). The major ions of groundwater and their ratios are the most important phenomena for identifying geochemical processes. These ions are closely related with total dissolved solids (TDS), which was measured by using Aqua Chem. (Version 3.70) software. Major ions constitute the most significant part of the total dissolved solids present in the groundwater and the concentration of these ions in groundwater depends mainly on the hydrochemical processes that place in the aquifer system (Lakshmanen et al., 2003). Major ions in the groundwater present a definite spatial trend (Nwankwoala and Udom, 2011). They have a special distribution in groundwater, which have been evaluated based on the major ionic composition in the study.

Mechanisms and sources of hydrochemistry in groundwater of the area have been evaluated based on the analyzed major ionic compositions by applying the various recommended methods and techniques. Gibbs (1970) mentioned a diagram which is widely employed to assess the functional sources of dissolved chemical constituents, which represents the ratio of $\text{Cl}^- : (\text{Cl}^- + \text{HCO}_3^{2-})$ as a function of TDS. In the present study this diagram has been used to identify the sources of dissolved ionic constituents in groundwater of the area. Same methods have been used to evaluate the chemical weathering of rock-forming minerals and evaporation is influencing the groundwater quality (Rao, 2006). To evaluate the origin of groundwater in the area, the cationic exchange values (CEV) have been measured, which was estimated by the equation of $\text{CEV} = [\text{Cl}^- - (\text{Na} + \text{K})]/\text{Cl}^-$ (Nwankwoala and Udom, 2011). The occurrence of ion exchange mechanism in groundwater of the area has also been evaluated by the bivariate plot of $\text{Na}^+ - \text{Cl}^-$ (meq/l) versus $\text{Ca}^{2+} + \text{Mg}^{2+} - \text{HCO}_3^{2-} - \text{SO}_4^{2-}$ (meq/l) (Jankowski et al., 1998).

Result and Discussion

Aquifer characteristics

From the stratigraphic diagram of the core samples or bore log data of five Thanas of the area indicates that there are four distinct aquifers constitute the aquifer system in the area, while two aquifers A1 and A4 were found in Kalaroa Thana within the depth of 232m, three aquifers A1, A3 and A4 were found in Satkhira sadar Thana within the depth of 194m, two aquifers A1 and A3 were found in Debhata Thana within the depth of 126m, four aquifers A1, A2, A3 and A4 were found in Kaligonj Thana within the depth of 204m, and three aquifers A1, A2 and A4 were found in Shyamnagar Thana within the depth of 252m (Fig.2). It is also shows that aquifer A1 and aquifer A2 are the shallow aquifers which exist within the 100m and aquifer A3 and A4 are deep and deeper deep aquifer respectively, both of which depth >100m from the earth surface below (Halim et al., 2008). However aquifer A1 is thicker in Kalaroa Thana, which is gradually decreased towards the coastal Thana area of Shyamnagar. In most of the area, aquifer A1 is the shallow unconfined aquifer overlain by a variable thickness of clay aquitard material, and exists within the depth of 15 m and 100 m from the earth surface and suitable for containing groundwater except in

Shyamnagar Thana where aquifer thickness is thin. The shallow aquifer A2 was mainly found in Kaligonj and Shyamnagar Thana, which exist within the depth between nearly 60m and 95m from the earth surface that are sandwiched by aquitard materials-calcy and silty clay layer. This aquifer is moderate types of aquifer may contain sufficient groundwater. The aquifer A3 is a deep aquifer found within the depth between 100m and 170m from the earth surface, which were located in the area of Satkhira sadar, Debhata and Kaligonj Thana. The aquifer A3 in most of the area makes an unsuitable for sufficient groundwater content. The aquifer A4 is a deeper deep aquifer was found in all Thana of the study area, which exists within the depth between about 195m and 252m from the earth surface. The aquifer A4 in most of the area is not suitable for adequate groundwater content. All of the aquifers are mainly consists of fine, medium and coarse sandy materials. Good aquifer is mainly located in Kalaroa Thana than any other Thana of the study area, mainly consists of coarse and medium sand, which contain adequate groundwater. So, the result concluded that the complex and unconsolidated aquifer system of the area lies solely within the high thickness of sedimentary deposits that are extending from northwest to southwest coastal belt of the area.

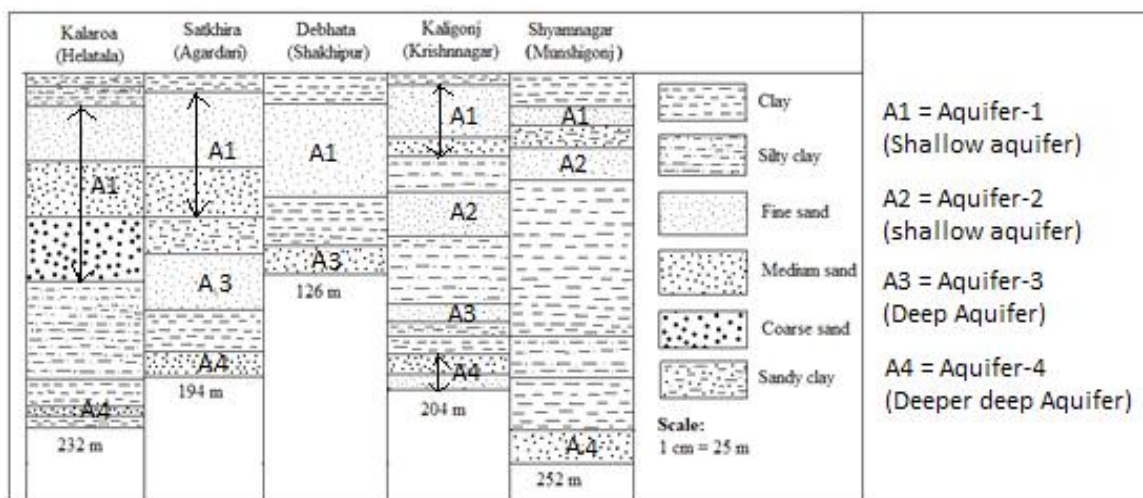


Fig. 2 Lithological succession and aquifer system in the study area.

Chemical Characteristics of Groundwater

The result obtained from the analysis of 55 groundwater samples of five Thanas of the study area (Table 1), which represents that major ionic compositions such as Na^+ , Ca^{2+} , Mg^{2+} , K^+ , Cl^- , HCO_3^{2-} and SO_4^{2-} of groundwater constitute the principal quality of groundwater in the area which typically comprises

more than 95%. These elements are non-conservative as they participate in and are subject to changes in concentrations due to geochemical reactions (Chowdhury et al., 2004). The result also shows that the order of relative abundance of major cations in groundwater of the area is $\text{Na}^+ > \text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^+$ while that of anions is $\text{Cl}^- > \text{HCO}_3^{2-} > \text{SO}_4^{2-}$.

Table 1 Major ionic compositions and their calculations of the groundwater in the study area.

Study area	Sample ID	Na ⁺	Ca ²⁺	Mg ²⁺	K ⁺	Cl ⁻	HCO ₃ ²⁻	SO ₄ ²⁻	TDS	Cl/(Cl+HCO ₃)	Na-Cl	Ca+Mg-HCO ₃ -SO ₄	CEV
Kalaroa Thana	S1	171.29	124.36	101.25	10.03	480.32	280	25.21	1192.4	0.63	-6.097	9.421	0.6225
	S2	700.12	118.38	92.68	8.28	1800.28	580	169.35	3469	0.76	-20.326	0.499	0.6065
	S3	49.48	98.1	75.28	3.83	72.19	430	10.25	739.1	0.14	0.116	3.827	0.2615
	S4	52.78	99.59	78.24	3.98	82.32	452	14.25	783.1	0.15	-0.026	3.701	0.3105
	S5	50.38	98.49	76.29	3.59	78.83	448	13.27	768.8	0.15	-0.033	3.572	0.3154
	S6	481.23	103.75	92.48	8.43	1378.15	554	28.2	2646.2	0.71	-17.941	3.117	0.6447
	S7	49.32	97.23	89.29	7.99	77.32	422	9.25	752.3	0.15	-0.036	5.088	0.2588
	S8	50.92	101.09	91.27	3.32	78.98	413	10.24	748.8	0.16	-0.013	5.57	0.3132
	S9	53.76	38.07	22.16	3.69	83.04	446	12.30	317	0.16	-0.004	-3.844	0.3082
	S10	489.14	106.12	97.41	6.25	1389.64	576	37.84	2702.3	0.71	-17.921	3.08	0.6435
	S11	51.12	98.85	89.75	8.14	134.32	425	13.68	820.8	0.2	-1.565	5.066	0.5581
	S12	503.35	121	99.07	10.64	1597.48	579	41.21	2951.7	0.73	-23.165	3.84	0.6782
	S13	50.68	96.75	87.42	7.95	58.47	397	14.07	712.3	0.13	0.555	5.22	-0.003
Satkhira sadar Thana	S14	38.02	91.15	81.54	2.47	79.24	403	9.83	706	0.16	-0.581	4.445	0.489
	S15	302.57	118.29	95.67	2.87	855.25	410	24.59	1812.1	0.68	-10.962	6.542	0.6429
	S16	18.05	89.59	76.18	2.25	36.78	312	8.24	543.9	0.11	-0.252	5.452	0.4481
	S17	36.89	56.71	43.27	3.15	48.85	296	7.46	804.5	0.14	0.227	1.382	0.1803
	S18	19.43	39.49	29.45	3.27	42.59	322	10.25	270.3	0.12	-0.356	-1.097	0.467
	S19	17.62	87.13	69.48	5.08	28.48	304	8.62	520.8	0.09	-0.037	4.902	0.2029
	S20	23.49	59.24	45.14	3.43	31.41	306	9.57	478.7	0.09	0.136	1.455	0.1429
	S21	26.4	52.36	46.31	2.31	40.72	320	5.63	494.3	0.11	-0.001	1.061	0.2949
	S22	39.24	86.74	73.41	4.38	81.07	391	9.61	686.2	0.17	-0.58	3.758	0.4619
	S23	41.57	74.93	66.41	2.87	61.86	369	13.17	730.3	0.14	0.063	2.881	0.2816
	Debhata Thana	S24	17.53	39.21	24.58	3.46	31.41	334	16.28	243.7	0.09	-0.123	-1.835
S25		32.91	83.14	52.16	8.14	81.24	403	21.06	682.6	0.17	-0.86	1.396	0.4947
S26		19.45	51.29	41.28	1.79	36.67	342	5.48	498.4	0.1	-0.188	0.235	0.4208
S27		18.62	41.02	37.89	3.12	41.21	283	4.27	431.1	0.1	-0.352	0.436	0.4725
S28		23.14	58.62	42.15	4.07	46.57	387	9.74	370.6	0.11	-0.307	-0.153	0.4157
S29		21.54	40.31	33.57	3.86	39.57	336	17.12	288.8	0.11	-0.179	-1.095	0.2317
S30		28.30	76.41	48.63	6.58	75.23	387	19.47	642.5	0.16	-0.891	1.066	0.5364
S31		31.47	79.48	51.07	7.08	79.13	389	20.07	659.5	0.17	-0.863	1.374	0.5128
S32		16.34	51.07	46.27	2.81	29.47	327	8.24	481.7	0.08	-0.12	0.823	0.3502
Kaligonj Thana		S33	803.23	89.99	74.18	28.38	2012.68	296	56.28	3362.4	0.87	-21.832	4.57
	S34	794.14	58.04	49.07	12.73	1905.21	396	3.41	3219.6	0.83	-19.196	0.371	0.5765
	S35	51.74	79.68	59.86	18.31	73.69	302	34.98	623.2	0.2	0.172	3.223	0.0521
	S36	185.75	32.92	22.19	53.48	285.14	613	18.26	611.9	0.32	0.037	-6.959	0.161
	S37	792.48	108.32	86.57	58.68	1892.19	418	34.26	3392.2	0.82	-18.901	4.962	0.5502
	S38	208.71	30.83	24.87	18.42	289.37	608	20.15	689	0.32	0.916	-6.802	0.2164
	S39	743.69	87.42	76.58	27.54	1534.72	299	49.52	2821.2	0.84	-10.941	4.73	0.4975
	S40	48.62	53.08	46.75	11.45	67.19	398	3.25	423.8	0.14	0.22	-0.097	0.106
	S41	48.63	41.79	47.40	12.74	289.27	397	3.23	621.5	0.42	-6.044	-0.589	0.7878
	S42	32.58	68.44	59.25	6.92	49.63	432	5.26	654.6	0.1	0.017	1.099	0.2041
	S43	702.41	81.06	63.27	21.14	612.76	301	39.45	1823.8	0.67	13.269	3.495	-0.181
Shyamnagar Thana	S44	92.71	48.31	30.47	10.31	138.44	368	2.16	459	0.27	0.128	-1.159	0.2572
	S45	967.53	56.14	52.07	18.31	1704.86	857	46.37	3030.5	0.67	-6.003	-7.927	0.4217
	S46	1642.18	32.38	58.92	20.41	2306.98	865	62.38	4280.1	0.73	6.358	-9.014	0.2793
	S47	1592.7	60.14	53.15	18.91	2290.45	860	69.35	4264.2	0.73	4.673	-8.167	0.2964
	S48	1593.25	67.26	54.89	12.86	2197.13	864	66.41	4187.5	0.72	7.329	-7.673	0.269
	S49	883.47	57.06	51.47	19.63	1679.04	852	42.35	2920.8	0.66	-8.932	-7.766	0.4621
	S50	848.41	51.89	46.27	12.48	1363.60	608	33.26	2529	0.69	-1.559	-4.283	0.3687
	S51	1735.92	68.48	59.39	14.76	2845.83	928	98.26	5011.5	0.75	-4.763	-8.954	0.3848
	S52	1563.47	65.74	58.51	15.06	2214.34	917	67.58	4186.3	0.71	5.549	-8.344	0.2871
	S53	1768.15	43.67	32.45	11.32	2864.74	376	102.41	4904.8	0.88	-3.894	-3.446	0.3788
	S54	94.08	53.75	51.75	16.57	179.85	441	5.87	608.3	0.29	-0.981	-0.411	0.3848
	S55	1614.54	69.58	57.36	13.17	2292.30	763	70.31	4320.1	0.75	5.573	-5.78	0.2899

The chemical composition of groundwater indicates that the concentration of Na^+ ranged from 16.34 mg/l to 1768.15 mg/l with an average of 406.20 mg/l which is much higher than WHO (2006) permissible limit (10 to <20 mg/l), Ca^{2+} concentration varied from 30.83 mg/l to 124.36 mg/l with an average of 72.43 mg/l which is within the WHO permissible limit (75 to 200 mg/l), Mg^{2+} concentration ranged from 22.16 mg/l to 101.25 mg/l with an average of 60.25 mg/l, which are also within the WHO permissible limit (40 to 150 mg/l), the concentration of K^+ varied from 1.79 mg/l to 58.68 mg/l with an average of 11.14 mg/l, where most of the samples are within the WHO permissible limit (10 to 15 mg/l) and few samples exceed the limit., Cl^- concentration ranged between 28.48 mg/l and 2864.74 mg/l with an average of 748.50 mg/l which is more high and exceed the WHO permissible limit (200 to 400 mg/l), HCO_3^{2-} concentration ranged from 280.0 to 928.0 mg/l with an average of 468.73 mg/l which is within the WHO permissible limit (200 mg/l to 600 mg/l), SO_4^{2-} concentration ranged from 2.16 to 169.35 mg/l with an average of 27.22 mg/l which is also within the WHO permissible limit (150 to 250 mg/l), NO_3^- concentration ranged from 0.01 to 0.45 mg/l with mean of 0.15 mg/l which is within the WHO permissible limit (20 – 45 mg/l). Total dissolved solids (TDS) in groundwater of the area shows the ranges of 243.70

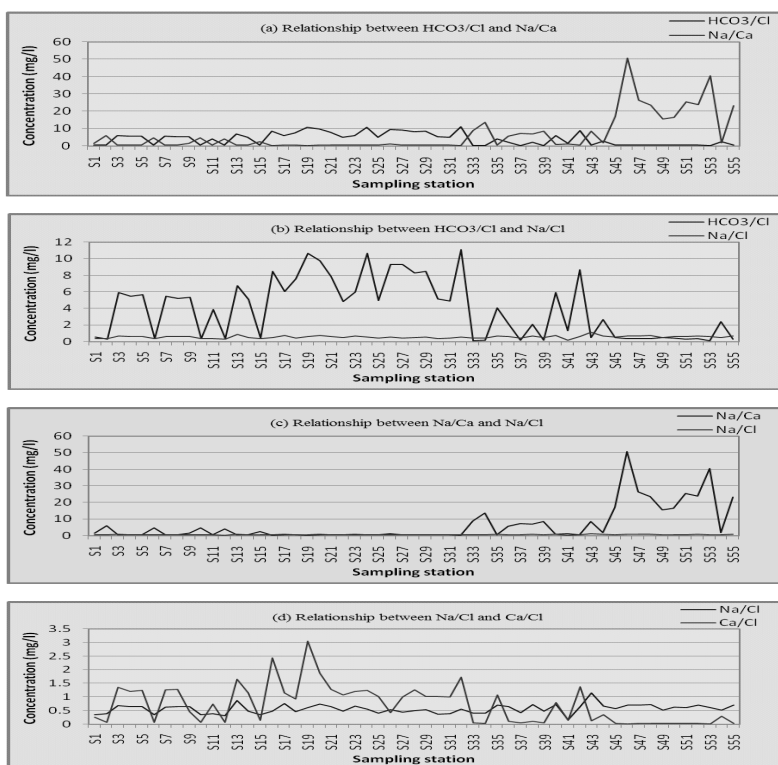
mg/l to 5011.50 mg/l with an average of 1630.43 mg/l which is bit above the WHO permissible limit (500 to 1500 mg/l) for drinking purposes.

Distribution of major ions in groundwater

The major ions of groundwater and their ratios are the most important for identifying geochemical processes and sources of salinity. These ions are closely related with total dissolved solids (TDS) which is an important indicator to measure groundwater salinity. The major ionic distribution of the groundwater samples (Fig. 3) indicate that major ions in groundwater of the area have a definite special trend, which also represent that these ions constitute the significant parts of the total dissolved solids in groundwater of the area.

Origin of groundwater and salinity in the area

The calculated cation exchange value (CEV) of the major ionic compositions in groundwater samples of the area represent in Table-1. In general, the CEV for seawater ranges from +1.2 to +1.3, where low-salt inland waters give values close to zero, either positive or negative (Custodio et al., 1983). However the CEV values for groundwater of the area are generally below one ranging from -0.003 to 0.7878 (Fig. 4). So it indicates that groundwater in the area is mainly inland origin but sea water mixing of low to medium salt water was found in some well locations of the study area.



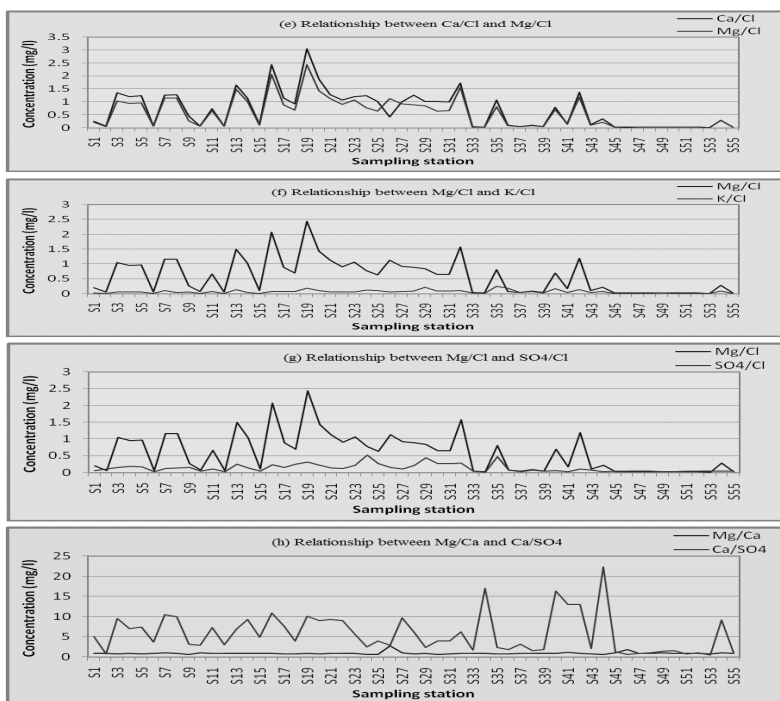


Fig. 3 Relationship of major ionic composition of groundwater in the study area.

Mechanisms of controlling groundwater chemistry

The plotting of ionic ratio of $Cl^- : (Cl^- + HCO_3^{2-})$ as a function of TDS in Gibb’s diagram (Fig. 5) shows that 35 out of 55 samples represent their chemical constituent under the influence of rock dominance and rest of 20 samples which ionic compositions are influenced by evaporation and crystallization.

also observed that comparatively high TDS (1812.4 to 5011.5 mg/l) and high ionic ratios (0.63 to 0.88) containing groundwater samples are fallen as the evaporation and crystallization dominance ionic water and comparatively low TDS (243.70 to 1192.40) and low ionic ratios (0.08 to 0.63) containing groundwater samples are in the rock dominance ionic water (Table 1).

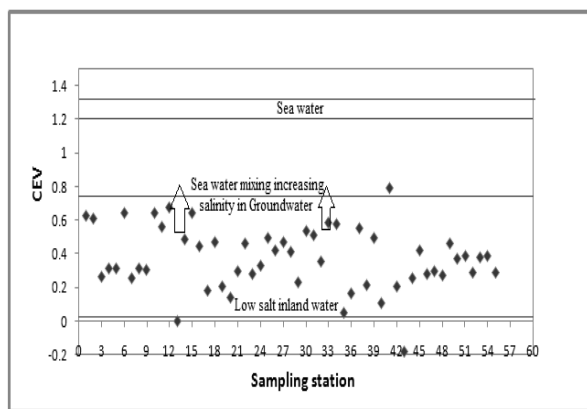


Fig. 4 Origin of groundwater in the study is based on the CEV.

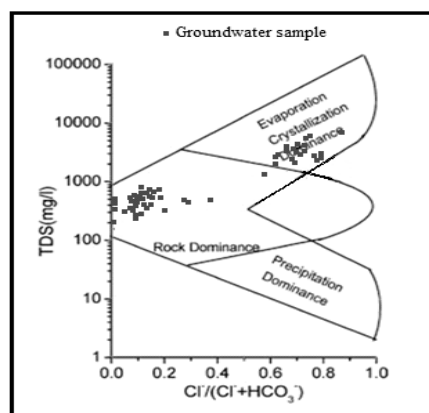


Fig. 5 Mechanism of controlling groundwater chemistry in the area (after Gibbs, 1970).

The groundwater composition is also influenced by ion exchange mechanism which can be evaluated by a bivariate plot of $Na^+ - Cl^-$ (meq/l) versus $Ca^{2+} + Mg^{2+} - HCO_3^{2-} - SO_4^{2-}$ (meq/l) result along a line with a gradient of -1 (Jankowski et al., 1998). According to Jankowski,

the figure 6 shows that the plotting of ion values along a line with a slope of -0.17 which is few above -1 but approximately equal to one ($-0.17 \approx -1$) indicating that ion exchange is occurring in groundwater of the study area.

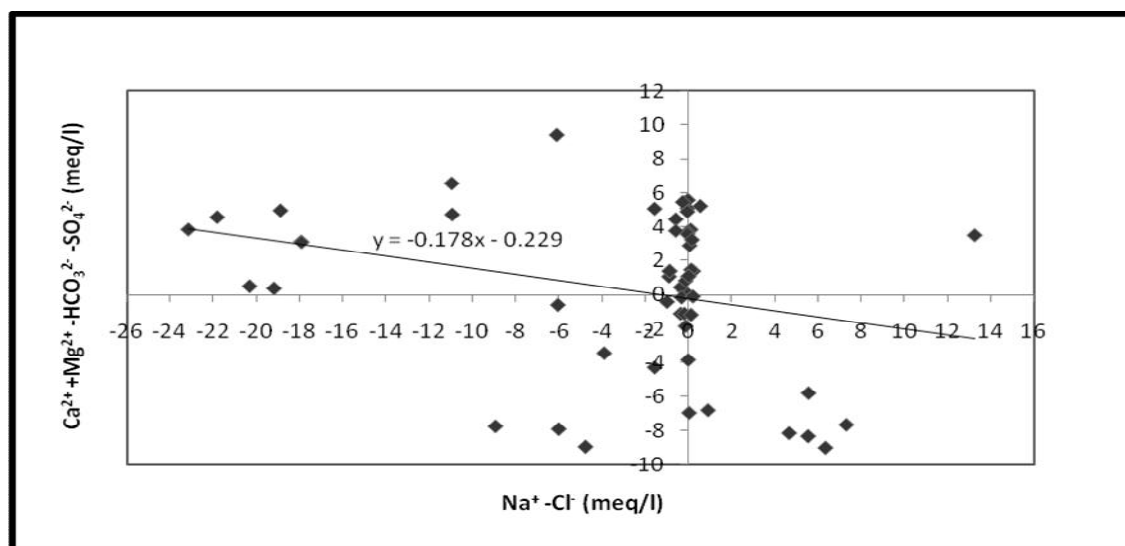


Fig. 6 Bivariate plot of $\text{Ca}^{2+}+\text{Mg}^{2+}-\text{HCO}_3^{2-}-\text{SO}_4^{2-}$ versus Na^+-Cl^- .

Conclusion

The major groundwater hydro chemical and lithological data presented in the study shows that groundwater occurs in the four distinct aquifers A1, A2, A3 and A4 constitute the aquifer system in the area. Aquifer A1 and A2 shows the shallow aquifer having depth within the 100 m. However aquifer A1 is common in overall the area which is a significant aquifer except in Shyamnagar Thana. Other aquifer A2, A3 and A4 varies from places to place, but in most of the area which are not significant. Aquifer A3 and A4 belongs in the deep aquifer which exist above 100 m below from the earth surface and found in most of the area, but these are not suitable as a good aquifer due to the low thickness. The major hydrochemistry such as Na^+ , Ca^{2+} , Mg^{2+} , K^+ , Cl^- , HCO_3^{2-} and SO_4^{2-} of groundwater in the area represent that Na^+ and Cl^- concentration is higher than any other constituents in groundwater, while the order of relative abundance of major cations is $\text{Na}^+ > \text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^+$ and of major anions is $\text{Cl}^- > \text{HCO}_3^{2-} > \text{SO}_4^{2-}$. The distribution of major ionic components of groundwater in the area shows that ions in the groundwater present a definite spatial trend. These ionic constituents constitute the total dissolved solids in groundwater and ionic concentrations occur mainly by the hydro chemical processes in the aquifer systems of the area. The CEV values of groundwater are generally below one (-0.003 to 0.7878), which indicates most of the groundwater is inland origin, while sea water mixing low to medium salt water also found in some well locations of the area. The Gibb's diagram indicates that 35 out of 55 samples are shown their chemical constituent under the influence of rock

dominance, which contains comparatively low TDS and low ionic ratios. While rest of 20 samples which ionic compositions are influenced by evaporation and crystallization. These samples contain comparatively high TDS and high ionic ratios. From the bivariate plot of Na^+-Cl^- (meq/l) versus $\text{Ca}^{2+}+\text{Mg}^{2+}-\text{HCO}_3^{2-}-\text{SO}_4^{2-}$ (meq/l), which also indicates ion exchange was taking place in groundwater of the area.

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SELF-ESTEEM AS RELATED TO ACHIEVEMENT MOTIVATION

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Abstract: In order to investigate the relationship between self-esteem and achievement motivation the Bengali version (Ilyas, 2003) of Rosenberg's Self-esteem Scale (Rosenberg 1965) and the Achievement Motivation Scale (Afsaruddin 1987) were administered to a sample of 160 (80 male and 80 female) undergraduate students to measure their self-esteem and achievement motivation respectively. The respondents were classified into three groups - high (above 50th percentile), medium (from 25th to 50th percentile) and low (below 25th percentile) on the basis of their obtained achievement motivation scores. Comparisons were made among the three groups on their self-esteem scores employing one way ANOVA and t-test. The results of the study showed that there was a significant difference among high, medium and low achievement motivation groups regarding self-esteem. The results also revealed significantly higher self-esteem in high achievement motivation group than in medium and low achievement motivation groups and self-esteem of medium achievement motivation group was also significantly higher than that of low achievement motivation group.

Key words: Self-esteem and Achievement motivation

সারাংশ : আত্ম-মর্যাদা ও কৃতি প্রেষণার মধ্যে সম্পর্ক অনুসন্ধানের জন্য রোজেনবার্গ (১৯৬৫) এর আত্ম-মর্যাদা মানক -এর বাংলা সংস্করণ (ইলিয়াস, ২০০৩) এবং কৃতি প্রেষণা মানক (আফছারউদ্দিন ১৯৮৭) প্রয়োগ করে ১৬০ জন (ছেলে ৮০ এবং মেয়ে ৮০) স্নাতকপূর্ব ছাত্র-ছাত্রীর আত্ম-মর্যাদা ও কৃতি প্রেষণা পরিমাপ করা হয়। উত্তরদাতাদেরকে তাদের অর্জিত কৃতি প্রেষণা সাক্ষর্যাংকের উপর ভিত্তি করে উচ্চ (৫০ পার্সেন্টাইল এর উপরে), মধ্যম (২৫ হতে ৫০ পার্সেন্টাইল এর মধ্যে) এবং নিম্ন কৃতি প্রেষণা (২৫ পার্সেন্টাইল এর নিচে) দলে ভাগ করা হয়। তিনটি দলের মধ্যে আত্ম-মর্যাদার তুলনা করার জন্য একমুখী ভেদাংক বিশেষণ ও টি-পরীক্ষা ব্যবহার করা হয়। গবেষণার ফলাফল হতে দেখা যায় যে, উচ্চ, মধ্যম ও নিম্ন কৃতি প্রেষণা দলের মধ্যে আত্ম-মর্যাদার ক্ষেত্রে তাৎপর্যপূর্ণ পার্থক্য বিদ্যমান। উচ্চ কৃতি প্রেষণা সম্পন্ন ছাত্র-ছাত্রীদের আত্ম-মর্যাদা মধ্যম ও নিম্ন কৃতি প্রেষণা সম্পন্ন ছাত্র-ছাত্রীদের চাইতে বেশি এবং মধ্যম কৃতি প্রেষণা সম্পন্ন ছাত্র-ছাত্রীদের আত্ম-মর্যাদা নিম্ন কৃতি প্রেষণা সম্পন্ন ছাত্র-ছাত্রীদের চাইতে বেশি।

Introduction

Self-esteem is generally considered the evaluative component of the self-concept, a broader representation of the self that includes cognitive and behavioral aspects as well as evaluative or affective ones. Self-esteem refers to an individual's overall assessment of his or her worth, or the extent to which a person values, approves, prizes, appreciates or likes him or herself (Blascovich and Tomaka 1991). Rosenberg (1965) described self-esteem as a favorable or unfavorable attitude toward the self. According to Coopersmith (1967) self esteem is æa personal judgment of worthiness that is expressed in the attitudes the individual holds toward himself." In fact, self-esteem is the global emotional judgments a person makes about himself that affects his / her understanding and behavior.

Achievement motivation is a distinct human motive that determines a wide variety of individual social behavior and mode of action. The Harvard University Psychologists McClelland and his colleagues (1953) have defined achievement motivation as a "behavior toward competition with a standard of excellence." According to McShane and Glinow (2005) "Need for achievement is a learned need in which people want to accomplish reasonably challenging goals through their own efforts, like to be successful in competitive situations and desire unambiguous feedback regarding their success." Achievement motivation is an internal energizing state of a person that drives him to achieve unique success in any challenging situations.

Review of literature

Various researches have investigated the relationship between self-esteem and achievement motivation. Ajayi (2002) reported that there was a significant relationship between self-esteem and achievement motivation. Aktop and Erman (2006) explored significant positive correlation between achievement self-esteem and achievement motivation. Balogun, Ojedokun and Tijani (2012) found a positive relationship between achievement motivation and self-esteem. Nwankwo et al. (2013) explored positive relationship between self-esteem and achievement motivation among university undergraduates. Radziwillowicz et al. (2014) also found positive relations between self-esteem and achievement motivation.

In all these studies the correlation between self-esteem and achievement motivation had been computed. From the findings of these studies cause-effect relationship cannot be done. However, in a few studies higher self-esteem had been reported for individual with high achievement motivation (Korman 1970 and Jamader and Manjula 2013). But all these studies were done in foreign cultures. The authors realize the importance of conducting a similar study using achievement motivation as an independent variable of self-esteem in Bangladeshi cultural context. The findings of the present research will add new knowledge to the existing literature in self-esteem.

Objective and hypothesis of the study

The objective of the study was to investigate the relationship between self-esteem and achievement motivation. Specifically,

- (1) To investigate whether self-esteem varies with the variation of achievement motivation.
- (2) To examine whether the self-esteem of the respondents with high achievement motivation is significantly higher than those with medium or lower achievement motivation.
- (3) To investigate whether the self-esteem of the respondents with medium achievement motivation is significantly higher than those with lower achievement motivation.

Hypothesis of the study

There is a direct relationship between self-esteem and achievement motivation.

Materials and method

Sample

The sample of the study consisted of 160 undergraduate respondents (80 male and 80 female). They were selected randomly from different departments of Rajshahi University, Bangladesh. Their age ranged from 19 through 24 years. They belong to middle class socio-economic status.

Instruments

The following measuring instruments were used in the present study.

(1) The Achievement Motivation Scale (AMS): This scale was constructed by Afsaruddin (1987) to measure achievement motivation. It consists of 59 items out of which 44 items measure achievement motivation and the rest 15 are used to measure the consistency of responses. Each of the statements is provided with a 5 point scale. Each statement is provided with letter "Y" for agreement or "Yes" response and letter "N" for disagreement or "No" response. The scale points range from 1 to 5 expressing the degree of agreement or disagreement as very low, low, moderate, high and very high respectively. At first the respondents are to decide whether he agrees or disagrees with the statement and then to mark the degree of his agreement or disagreement with the statement in the scale. The highest score of the scale is 220 and the lowest score is 44. Each of the statements was presented both in Bangla and English form so that the respondent would have no difficulty in understanding the idea expressed in it. A hand scoring system was used. This key had the holes for all the possible answers of an item

corresponding to all the number of scale points. When this key was properly placed over the answer sheet the number of scale points properly marked by the respondent appeared through the holes of the key. These marked scale points were then counted and summated to get a raw score for each individual. The split-half reliability of the scale was 0.82 and the test-retest reliability co-efficient was .46 ($p < 0.01$). The validity of the scale in terms of correlational fertility was found to be 0.69 ($p < 0.01$). The criterion-related validity of the test has also been established by comparing the AMS scores of subjects from entrepreneur family with those from agriculture and professional family and the difference was found significant beyond 0.001 levels (Afsaruddin and Latif, 1992).

(2) Bengali version (Ilyas, 2003) of Rosenberg's Self-esteem Scale (SES): The adapted Bengali version (Ilyas, 2003) of Rosenberg's self-esteem scale (Rosenberg 1965) was used to measure global positive or negative attitude of one's self esteem. The 10 item scale contained 5 positive and 5 negative items. Items were scored on 4-point Likert-type scale with strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Respondents were asked to reflect their current feelings. For positive items (1,3,4, 6 and 7) score was given for SA=3, A=2, D=1 and SD=0. For negative items, the scoring was reversed. That is SA=0, A=1, D=2, and SD=3. Then the scores of the total items were summed together. Higher score indicated higher self-esteem. Test-retest reliability coefficients of the original scale ranged from .77 to .88 (Blascovich and Tomaka, 1991). Significant correlation between English and Bengali Version ($r = .87$, $P < .0005$) indicated translation reliability of the Scale and high Cronbach's Alpha ($\alpha = .87$) of Bengali version further indicated internal consistency of the scale (Ilyas, 2003).

Procedure

Standard data collection procedure was followed to collect the data from the respondents in this study. Each respondent was approached individually. A personal data form (PIF) including students' gender, age, department, socio-economic status and the adapted Bengali version (Ilyas, 2003) of Rosenberg's self-esteem scale and The Achievement motivation scale (Afsaruddin 1987) with two separate answer sheets attached together were supplied to each of the respondents. They were instructed to read the items of the scales attentively and to respond accordingly. Although there was no time limit for completing the whole task, the respondents were requested to finish it

without wasting time. After completing the task, they were thanked for their sincere participation.

Results

The present study was designed to investigate the relationship between self-esteem and achievement motivation. The respondents were classified into three categories on the basis of their obtained scores on achievement motivation scale. The categories were: (1) high achievement motivation group (above 75th percentile), (2) medium achievement motivation group (from 25th to 75th percentile) and (3) low achievement motivation group (below 25th percentile). Comparisons were made among these three groups employing one way ANOVA on the scores of the respondents' self-esteem. The obtained results have been presented in Table 1.

Table 1 Summary of ANOVA on self-esteem scores

Source of variation	Sum of Squares	df	Mean Square	F	p
Between Groups	206.485	2	103.243	9.468	.000*
Within Groups	1712.008	157	10.905		
Total	1918.494	159			

Table 1 shows a highly significant difference among the three groups - high, medium and low achievement motivation groups ($F = 9.468$, p is .000) which indicates that self-esteem varies with the variation of achievement motivation.

Comparisons were also made between high and low, high and medium, medium and low groups employing t-test. The obtained results have been presented in Table 2.

Table 2 Results of the comparisons on self-esteem scores among the three groups.

Group	N	M	SD	df	t	p
High & Low	26	21.81	2.77	84	3.76	0.000*
	60	18.52	4.06			
High & Medium	26	21.81	2.77	98	2.86	0.005*
	74	20.01	2.74			
Medium & Low	74	20.01	2.74	132	2.53	0.01*
	60	18.52	4.06			

Table 2 reveals a significant difference in self-esteem ($t = 3.76$, $df = 84$, p is .000) between high ($M = 21.81$) and low achievement motivation ($M = 18.52$) groups. Results also show a significant difference in self-esteem ($t = 2.86$, $df = 98$, $p < .005$) between high ($M = 21.81$) and medium ($M = 20.01$) achievement motivation groups and a significant difference in self-esteem ($t = 2.53$, $df = 132$, $p < .01$) between medium ($M = 20.01$) and low ($M = 18.52$) achievement motivation groups is also found. The self-esteem of high achievement motivation group is higher than that of low and medium

achievement motivation groups and the self-esteem of medium achievement motivation group is higher than that of low achievement motivation group.

Discussion

The study was conducted to investigate the relationship between self-esteem and achievement motivation. It was hypothesized that there is a direct relationship between self-esteem and achievement motivation. In order to test the hypothesis, the present study conducted on 160 undergraduate students (80 male and 80 female) of Rajshahi University. The self-esteem and achievement motivation of the respondents were measured using the adapted Bengali version (Ilyas, 2003) of Rosenberg's self-esteem scale (Rosenberg 1965) and the Achievement Motivation Scale (Afsaruddin 1987) respectively. The respondents were divided into three groups - high, medium and low on the basis of their obtained achievement motivation scores. Comparisons were made on self-esteem scores among these three groups employing one way ANOVA and t-test.

Results of the present research show that self-esteem and achievement motivation are directly related. The results in table 1 reveal that self-esteem of the respondents varies as a function of the achievement motivation. The results in table 2 show that self-esteem of the respondents with high achievement motivation is significantly higher than that of the respondents with medium and low achievement motivation. The results also indicate that respondents with medium achievement motivation have higher self-esteem than that of respondents with low achievement motivation. These findings confirmed the present hypothesis.

In explaining these findings it can be argued that individuals with high achievement motivation are generally found to be high achievers. High achievement motivated people have persistence (Feather 1962); perceptual efficiency, expectancy of success (Heckhausen 1967); tendency to achieve unique success (Moghni 1968); competence and hard work, regularity and punctuality (Lynn 1969); setting a goal object in advance, assertiveness, more initiative in a joint responsibility, sociability, inquisitiveness, leadership tendency (Ali 1976). High self-esteemed people have higher performance expectations (Atkinson et al. 1960), the prerequisite knowledge and skills to perform the work effectively (Chen et al. 2001); more persistence in difficult tasks, less depression (Greenwald and Partkanis 1984) and more success (Seligman 1990). They show high self-worth and confidence to meet any challenges (Bowker Shannon and Cornock 2003). From

the characteristics of high achievement motivation and high self-esteem it can be concluded that high achievement motivated people have high self-esteem. The self-esteem of medium achievement motivated group exhibits lower level of self-esteem than high achievement motivation group but their self-esteem was higher than that of low achievement motivated groups. These results are expected. In explaining these findings it can be pointed out that individuals with low achievement motivation are unwilling to take risks, poor confident and are more susceptible to external influence (Robbins 1999); pessimistic, nervous and heavy self-critic (Kassin 1998) and carry feelings of failure, even when failure did not happen (Moradi and Razavivayan, 2013). So it can be said that people with high achievement motivation have higher self-esteem than those with medium and low achievement motivation. Kulka (1972) and Annelaslim (2010) found that the higher the achievement motivation of the individuals the higher was their self-esteem. These finding suggest that, high achievement motivation of the subjects may enhance their self-esteem. In fine, it can be concluded that achievement motivation is directly related to self-esteem. However, further researches on a large sample in this field are needed to be done.

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THE RELATIONSHIP BETWEEN ACADEMIC PERFORMANCE AND FAMILY RELATION OF SECONDARY SCHOOL STUDENTS

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Abstract: The present study designed to investigate the relationship between academic performance and family relation of 9th and 10th grade secondary school students. The study was conducted on 120 respondents selected purposively from four educational institutions of Rajshahi District, Bangladesh. Measuring instrument used in this study was Family Relation Scale (Parvin, M., 2003). Children's academic performance was measured through obtained GPAs in their last annual exam. Data analyzed through correlation coefficients and simple regression revealed that academic performance of secondary school students was significantly positively associated with their family relations. Results also showed that family relation and its different dimensions were the significant predictors of secondary school students' academic performance.

Key words: Family Relation, academic performance, secondary school students

সারাংশ : মাধ্যমিক বিদ্যালয়ের নবম ও দশম গ্রেড এর শিক্ষার্থীদের শিক্ষাগত দক্ষতা ও পারিবারিক সম্পর্কের মধ্যে সম্পর্ক অনুসন্ধানের জন্য বর্তমান গবেষণাটি পরিকল্পিত হয়েছিল। এ উদ্দেশ্যে বাংলাদেশের রাজশাহী জেলার চারটি শিক্ষা প্রতিষ্ঠান হতে উদ্দেশ্যমূলকভাবে নির্বাচিত ১২০ জন শিক্ষার্থীর উপর বর্তমান গবেষণাটি পরিচালিত হয়। গবেষণায় তথ্য সংগ্রহ কাজে পারিবারিক সম্পর্ক মানক (পারভীন, ২০০৩) ব্যবহৃত হয়। সর্বশেষ বার্ষিক পরীক্ষায় প্রাপ্ত জি.পি.এ. এর ভিত্তিতে শিক্ষার্থীদের শিক্ষাগত দক্ষতা পরিমাপ করা হয়। সহসম্পর্ক ও নির্ভরনের মাধ্যমে উপাত্ত বিশ্লেষণ করে দেখা যায় যে, শিক্ষার্থীদের শিক্ষাগত দক্ষতা ও পারিবারিক সম্পর্কের মধ্যে তাৎপর্যপূর্ণ একমুখী সহসম্পর্ক বিদ্যমান। ফলাফলে আরো দেখা যায় যে, পারিবারিক সম্পর্ক এবং এর বিভিন্ন মাত্রাসমূহ মাধ্যমিক বিদ্যালয়ের শিক্ষার্থীদের শিক্ষাগত দক্ষতার তাৎপর্যপূর্ণ প্রভাবক হিসাবে কাজ করে।

Introduction

The quality of students' performance remains at top priority for educators. It is meant for making a difference locally, regionally, nationally and globally. Educators, trainers, and researchers have long been interested in exploring variables contributing effectively for quality of performance of learners. These variables are inside and outside school that affect students' quality of academic achievement. These factors may be termed as student factors, family factors, school factors and peer factors (Crosnoe, Johnson and Elder, 2004). Among these factors, considering the family factors this study was an attempt to explore the family relations and academic performance of 9th and 10th grade secondary school students of Rajshahi District, Bangladesh. Worldwide, 'Secondary Education' is the term most frequently used to designate the second stage of formal schooling. In Bangladesh perspective, usually secondary level education starts approximately at the age of 11 or 12 and ends up between the ages of fifteen and sixteen. However, it may vary depending on the country and its organization for education. In this study, 9th and 10th grade students selected as sample whose age range lie in between 14 to 15 years. Respondents' obtained GPAs in last annual exam regarded as their academic performance where higher GPAs indicate better academic performance.

The academic performance of students depends upon the parental involvement in their academic activities to attain the higher level of quality in academic success (Barnard, 2004; Henderson, 1988; Shumox and Lomax,

2001). Research findings have also shown that a continued effort of parental involvement throughout the child's education can improve academic achievement (Driessen, Smit and Slegers, 2005; Fan, 2001; Hong and Ho, 2005). In the present study, family relationship means parents' relationship with their children and the attitudes which parents express towards their children especially affection-negligence, supervision, love and appreciation in any academic or daily living activities as well as children's perception towards their parents like parental relationships, parents' behavioral and emotional patterns, their overall attitudes towards their children etc. Parent-child interaction has long been considered to have a crucial influence on a child's academic performance and development (Prindle and Resinski, 1989; Van Meter, 1994; Barnard and Kelly, 1990). Children's higher school achievement rates, higher attendance rates, lower delinquency and dropout rates, and increased high school completion rates are enhanced by a strong parent-child relationship (Ziegler, 1987). A number of studies have reported that a warm and responsive parent-child interaction is positively related to self-esteem, social acceptability, and achievement in young children (Estrada, Arsenio, Hess and Holloway, 1987; Bradley, Caldwell and Rock, 1988). Researchers have reported that parent-child interactions, specifically stimulating and responsive parenting practices, are important influences on a child's academic development (Christian, Morrison and Bryant, 1998; Committee on Early Childhood Pedagogy, 2000).

Numerous studies, mostly from developed countries, have shown that parents are more likely to be involved with their children's education at home than in school (Lee and Bowen, 2006; Mau, 1997; Patrikakou and Weissberg, 2000). Research also has demonstrated that a positive relationship exists between at-home parental involvement and a range of school-related outcomes, including academic achievement, school engagement, and socio-emotional adjustment (Izzo et al., 1999). At-home parental involvement activities (e.g., checking homework, communicating about school, and reading with children) are shown to be related to positive academic outcomes of minority students in the United States (Jeynes, 2003; Sui-Chu and Willms, 1996). Likewise, parental involvement at home in Ghana is associated positively with youth academic performance (Nyarko, 2010). Rafiq et al. (2013) conducted a study to explore the parental Involvement and academic achievement of Secondary School Students of Lahore City. A total of 150 students (boys and girls) of 9th class of secondary schools (public and private) were taken as respondents. It was found from the study that parental involvement had significant effect on better academic performance of their children. Catsambis (2001) also found that parental involvement in children's education has a powerful impact on their academic attainment.

Aktar, Shahrier and Hridoy (2013) investigated the relationship between parental acceptance and academic achievement of tribal and non-tribal children of Bangladesh. From the results, parental acceptance (maternal and paternal acceptance) was found to be a stronger predictor of academic achievement where maternal acceptance created 8.3% variations and paternal acceptance created 10.3% variations in academic achievement of tribal and non-tribal children. Kalhotra (2013) carried out a study to identify parent child relationship among high and low achieving high school students and found that high achievers are loved more by their fathers than low ones and are given due importance at home. In contrast, their mothers love both high and low achievers equally.

The school personnel, members of the families and communities provide help and support to students for the quality of their academic performance. This social assistance has a crucial role for the accomplishment of performance goals of students at school (Goddard, 2003). Besides the social structure, parents' involvement in their child's education increases the rate of academic success of their child (Furstenberg and Hughes, 1995). Chohan and Khan (2010) investigated the impact of parental support on the academic

performance and self concept of grade-4 public school students. The findings of the study revealed that parent's contribution to their children's education has a consistent and positive effect on academic achievement and on the self –concept. Schmitt and Kleine (2010) studied the influence of family–school relations on academic success of children at age 3 to 12. Researchers found that not only parent's relations do matter, but also children's contacts to their classmates and their teachers affect their academic success. Bhatia (2012) investigated the family relationships in relation to emotional intelligence of the students of secondary level. A sample of 340 secondary school students was taken by using simple random sampling method. The findings revealed that healthy family relationships greatly influence emotional intelligence of the adolescents. Kraft and Dougherty (2012) investigated the effect of teacher–family communication on student engagement. 6th and 9th grade students were the sample of the present study. Results revealed that frequent teacher – family communication immediately increased student engagement as measured by homework completion rates, on-task behavior, and class participation.

Mo and Singh (2008) studied parent's relationships and involvement effects on students' school engagement and performance. The data on seventh and eighth grade students' school and family experiences were analyzed using structural equation modeling. The results confirmed the importance and significance of parent's involvement in middle school students' school engagement and performance. Chowa, Masa and Tucker (2013) studied parental involvement's effects on academic performance. This study uses baseline data from the youth save Ghana Experiment. The baseline sample consists of 6,252 youth and 3,083 parents. Results suggest that parental involvement is a bi dimensional construct consists of home and school involvement. The effect of parental involvement on youth academic performance appears to be a function of the type of involvement. Home – based parental involvement is associated positively with academic performance, while school-based parental involvement has a negative association.

Krashen (2005) concluded that students whose parents are educated scored higher on standardized tests than those whose parents were not educated. Educated parents can better communicate with their children regarding the schoolwork, activities and the information being taught at school. They can better assist their children in their work and participate at school (Fantuzzo and Tighe, 2000; Trusty, 1999). Gadsden

(2003) stated that greater parental involvement at early stage in children's learning, positively affects the child's school performance including higher academic achievement. Gonzalez- Pienda, et al. (2002) indicated, "Without the children's parental support, it is hard for teachers to devise academic experiences to help students learn meaningful content" (p.281).

The general profile of several studies indicates that families that are in conflict, are not cohesive, are overly protective and intrusive, have poor internal organization, are not nurturing, and have poor general parenting quality have children who perform poorly in school (Cohen, 1990; Kurdek and Sinclair, 1988; Campbell and Mandel, 1990; Loeber and Dishion, 1984). Several studies have consistently documented that children and adolescents raised in families practice the authoritative parenting style perform better in school compared to those who raised in families in which other types of parenting styles (i.e., authoritarian, indulgent, and neglecting parenting styles) are adopted (Darling and Steinberg, 1993; Dornbusch, et al., 1987; Ingoldby, Schvaneveldt, Supple, and Bush, 2004; Spera, 2005, 2006). Turner and Heffer (2005) reported that students from a family displaying more involvement, higher levels of nurturance, and encouragement of more autonomy (i.e., the characteristics of authoritative parents) were more academically successful.

Strage and Brandt's (1999) study revealed that both current and childhood levels of parental autonomy, granting, demandingness, and supportiveness significantly and positively predicted students' academic achievement, as measured by Grade-Point-Average (GPA), and other personal characteristics, such as confidence, persistence, task involvement, and rapport (i.e., relationship) with their teachers. Dubois et al. (1994) showed that family support and the quality of parent-child relationships significantly predicted school adjustment in a sample of 159 young US adolescents (aged 10 –12) followed in a two year longitudinal study. At-home parental involvement clearly and consistently has significant effects on pupil achievement and adjustment that far outweigh other forms of involvement. Garg et al. (2002) showed that the impact of family factors had their influence on shaping students' educational aspirations through their impact on extracurricular reading, attitudes towards school and homework and students' perceptions of their parents' educational aspirations. Research also demonstrates that parental involvement at home and in school is linked positively to a variety of academic outcomes (Jeynes, 2003, 2007).

Studies of the effects of in-school parental involvement in the United States also have yielded mixed results. Parental involvement in school is associated positively with academic outcomes, including grades (Barnard, 2004; Hill, 2001; Marschall, 2006), classroom behavior (Hill et al., 2004; Oyserman et al., 2007), students' aspirations (Hill et al., 2004), and school completion (Barnard, 2004). Kamble and Adsul (2012) aimed at investigating the effect of parental acceptance and academic climate on academic performance of adolescents. 180 students studying at 10th class in various schools of Sangli and Kolhapur districts of Maharashtra State, India were selected by random sampling method. 2 X 2 factorial research design was employed. Two- way ANOVA was used to analyze the collective data. The findings of the study revealed that parental acceptance and academic climate strongly and significantly affects academic performance of adolescents. Tope (2012) indicated that although students are primarily the ones for whom curricula are designed, textbooks are written, and schools built, parents are primarily the ones held responsible for preparing students for learning – preparation physically, psychologically, behaviorally, attitudinally, emotionally, and motivationally, just to name a few.

Objective of the study

The main objective of the study is to explore the relationship between academic performance and family relations of 9th and 10th grade secondary school students. Some specific objectives of the study are as follows:

- 1) To determine how much variation 'family relation' as the predictor can create in explaining secondary school students' academic performance.
- 2) To determine how much variation 'different dimensions of family relations' can create as predictors in explaining secondary school students' academic performance.

Rationale of the study

Family is the primary agent of social and emotional development of children. Sufficiency or insufficiency of healthy and stable socio-emotional atmospheres in family determines children's development of skill and knowledge in academic as well as non-academic pursuits. Family factors like good parental education, healthy parental relationship, good parent-child interactions, parental acceptance-rejection, proper parental supervision, feeling of love, affection, appreciation of parents towards their children etc. have been said to be significantly linked with the quality of education and academic achievement of children. These

factors may in turn contribute to protect the dropout rate of children from primary to secondary and from secondary to higher secondary levels that will help to save the resources and energy of parents as well as the state. Nevertheless, if these determining factors of a smooth family relation are somehow absent in children's life then it may be assumed that the impact of these factors badly affect the academic performance and school adjustment of children. In the light of these views, the present study attempted to explore the relationship between academic performance and family relations of 9th and 10th grade secondary school students of Rajshahi District, Bangladesh.

Hypotheses of the study

Reviewing the available literatures in detail, it was hypothesized that

- 1) There would be a significant relationship between academic performance and family relations of secondary school students.
- 2) Family relations and its different dimensions will be the stronger predictors to explain secondary school students' academic performance.

Materials and methods

The sample

The sample of the study has been selected in two phases. *School Selection:* Purposively four schools were selected from Rajshahi District.

Respondents Selection: The sample of the present study comprised of 120 respondents who were the 9th and 10th grade secondary school students purposively selected from four educational institutions of Rajshahi district. Their ages ranged from 14 to 15 years. Respondents were from the educational institutions of rural as well as urban residential backgrounds securing different GPA's in a 5-point scale at their last annual examination. Their parents were from different professions with varied levels of monthly income. Respondents' obtained GPAs in last annual exam were regarded as their academic performance. Higher GPAs indicated better academic performance. The sample distribution of the respondents according to their grade and gender are stated below:

Table 1 Sample Distribution of the Respondents According to Gender and Grade

	Male	Female	Total
9 th Grade	30	30	60
10 th Grade	30	30	60
Total	60	60	N=120

Instruments

Instruments used in this study include: 1) Personal and Demographic Information Form (PIF) and 2) Family

Relation (FR) Scale (Parvin, M., 2003). Following is a description of the instruments.

1) Demographic and personal information form

A demographic and personal information form was used to collect personal and demographic information of the respondents such as: Age, Gender, Class, Name of Institution, GPA in Last Annual Examination, Residence, Father's Profession, Mother's Profession, Family Members, Family Monthly Income etc.

2) Family Relation (FR) Scale (Parvin, M. 2003)

The family relation scale is a new scale, which has been developed in Bangladesh perspective. The scale was constructed and standardized by Parvin, M. (2003). Fifty two items were included in this scale. At first 60 items were judged by 10 professors of Psychology Department, Dhaka University. Items having entered into judge agreements, 86% were taken into consideration. This scale is designed to measure four variables: Affection-Negligence, Supervision, Parental Relationship and Mental Illness/Legal Involvement. The reliability of the FR scale was determined by administering this scale on 20 normal adult males and females by using split-half method. Reliability of each sub scale was determined separately and correlation coefficients for affection-negligence were found to have 0.74, for supervision 0.85, for parental relationship 0.86 and for mental illness/legal involvement were 0.79. The scale has satisfactory content and criterion validity gathered from reviews concerning the scale's psychometric properties. Among the 52 items of the scale, 13 items were for affection-negligence (9 positive and 4 negative items), 13 for supervision (8 positive and 4 negative items), 13 for parental relationship (6 positive and 7 negative items) and 13 for mental illness (all are negative). Thus, among the 52 items, 23 were positive and 29 items were negative. There were 5 response alternatives of 'Never', 'Rarely' 'Often', 'Almost always' and 'Always'. For positive items, 0, 1,2,3,4 are given according to the above response alternatives and for negative items 4, 3, 2, 1, 0 is given according to the above response alternatives. The sum total of all items was the total score of an individual in this scale. Higher score indicates better family relations and lower score indicates lower family relations.

Procedure

The data of the present study were collected from four schools of Rajshahi district such as: 1) Rajshahi University School (40 respondents having the parental profession of 'University Teachers', 'Teachers', 'University Officers' and 'Govt. Employees'); 2) Chuniapara High School, Tanore (30 respondents possessing the parental profession of 'Agriculture', 'Business' and 'Teachers'); 3)

Prokashnagar High School, Tanore (30 respondents possessing the parental profession of ‘Agriculture’, ‘Business’, ‘Govt. Employee’ and ‘Teachers’); 4) Mundumala High School, Tanore (20 respondents possessing the parental profession of ‘Agriculture’, ‘Business’, ‘Govt. Employee’ and ‘Teachers’). The respondents were 9th and 10th grade students studying at these institutions. The investigator contacted each student individually in his or her classrooms. For this purpose, the investigator had to seek permission from the heads of each institution. All measures along with the PIF were administered to students in classroom settings. Before the administration, necessary rapport was established with respondents. Respondents were asked to complete the questionnaires at their own pace. Respondents were assured that their responses would be kept confidential and that there was nothing like right or wrong responses to any question. Finally, respondents were encouraged to ask questions coming in their minds during the task and they were informed about their right to withdraw themselves from the study at any time. It took half an hour on an average to complete the task. On completion, every respondent was given a token gift with a note of thanks for their participation in the study.

Results

To analyze the collected data, correlation coefficients and regression analyses were used. The results of the present study are presented in the following section:

Table 2 Correlation Coefficients of Family Relations and Academic Performance of Secondary School Students

Variables	Family Relations	Academic Performance
Family Relations		
Academic Performance	.332**	

** = p<0.01

Table 4 Regression Analyses of Secondary School Students (SSS)’ Academic Performance on their Family Relations and its Different Dimensions

Regression	Predictors	Unstd. Coefficients B SE	Std. Coeff. β	t	p
SSS’ Academic Performance on Family Relation ¹	Constant	2.93 .347	.332	8.44	.000
	Family Relation	.008 .002		3.82	.000
SSS’ Academic Performance on Affection-Negligence ²	Constant	3.614 .237	.242	15.26	.000
	Affection-Negligence	.017 .006		2.71	.008
SSS’ Academic Performance on Parental Supervision ³	Constant	3.468 .262	.266	13.24	.000
	Parental Supervision	.021 .007		3.00	.003
SSS’ Academic Performance on Parental Relationship ⁴	Constant	3.648 .256	.212	14.23	.000
	Parental Relationship	.015 .006		2.35	.020
SSS’ Academic Performance on Mental Illness ⁵	Constant	2.068 .466	.396	4.44	.000
	Mental Illness	.045 .010		4.68	.000

1. Adjusted R²=0.102, (F_{1, 118}=14.572, P<0.01), 2. Adjusted R²=0.050, (F_{1, 118}=7.316, P<0.01)
 3. Adjusted R²=0.063, (F_{1, 118}=9.019, P<0.01), 4. Adjusted R²=0.037, (F_{1, 118}=5.527, P<0.05)
 5. Adjusted R²=0.150, (F_{1, 118}=21.943, P<0.01)

Table-2 indicated that a significant positive correlation existed between family relations and academic performance of secondary school students (r=.332, p<0.01).

Table 3 Correlation Matrix of Academic Performance and Family Relations Subscales of Secondary School Students

	1	2	3	4	5
Academic Performance		.242**	.266**	.212*	.396**
Affection-Negligence			.519**	.578**	.214*
Supervision				.514**	.316**
Parental Relationship					.493**
Mental Illness					

** Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Table 3 indicated that the academic performance of secondary school students was significantly positively associated with family relations variables like affection-negligence (r=.242, p<0.01), parental supervision (r=.266, p<0.01), parental relationship (r=.212, p<0.05) and parental mental illness (r=.396, p<0.01). Results presented in Table 3 also revealed that there existed significant positive correlations between affection-negligence and parental supervision (r=.519, p<0.01), parental relationship and affection-negligence (r=.578, p<0.01), parental mental illness and affection-negligence (r=.214, p<0.05). Significant positive correlations were also found between parental supervision and parental relationship (r=.514, p<0.01), parental mental illness and parental supervision (r=.316, p<0.01), parental relationship and parental mental illness (r=.493, p<0.01).

The value of adjusted R^2 in Table 4 revealed that the predictor variable or family relation explained 10.2% variance of criterion variable 'academic performance'. Thus, family relation was a stronger predictor to create variations in secondary school students' academic performance. Again, the value of adjusted R^2 in Table 4 revealed that the predictor variables i.e. affection-negligence explained 5.0%, parental supervision explained 6.3%, parental relationship explained 3.7%, mental illness explained 15.0% variances of criterion variable 'academic performance'. Thus, different dimensions of family relations were stronger predictors to create variations in secondary school students' academic performance.

Discussion

The main objective of the present study was to explore the relationship between academic performance and family relations of 9th and 10th grade secondary school students of Rajshahi district, Bangladesh. The study was conducted on 120 respondents conveniently selected from four educational institutions of Rajshahi district. Family Relation Scale of Pervin, M. (2003) was used for this purpose. Academic performance of the respondents in this study was measured through the GPAs obtained at their last annual examination. The results of the present study are discussed below in a coherent manner.

The first hypothesis of the study was that there would be a significant relationship between academic performance and family relations of secondary school students. Results reported at Table-2 revealed that academic performance of the 9th and 10th grade secondary school students was significantly positively associated with their family relations. Results also presented in Table 3 revealed that the different dimensions of family relations i.e. 'parental affection-negligence', 'parental supervision', 'parental relationship' and 'mental illness/legal involvement' were significantly positively associated with the academic performance of the secondary school students. The results supported the first hypothesis of the study. The findings have similarities with several previous studies (Estrada, Arsenio, Hess & Holloway, 1987; Prindle & Resinski, 1989; Van Meter, 1994; Barnard & Kelly, 1990; Rafiq et al., 2013; Nyarko, 2010; Chowa, Masa and Tucker, 2013).

The second hypothesis of the study was that family relations and its different dimensions would be the stronger predictors to explain secondary school students' academic performance. From the results, it was seen that the predictor variable or family relation

explained 10.2% variance of criterion variable 'academic performance'. Thus, family relation was a stronger predictor to create variations in secondary school students' academic performance. Again it was also found from the results that the predictor variable 'affection-negligence' explained 5.0% variance of criterion variable 'academic performance'. Thus, parental affection-negligence was a strong predictor to create variations in secondary school students' academic performance. The results of the present study also showed that the predictor variable 'parental supervision' explained 6.3% variations of criterion variable 'academic performance'. Thus, parental supervision was a stronger predictor to create variations in secondary school students' academic performance. Again, another predictor variable 'parental relationship' explained 3.7% variance of criterion variable 'academic performance'. Thus, parental relationship seemed to be an important predictor of academic performance. Lastly the predictor variable 'parents' mental illness' in this study explained 15.0% variance of criterion variable 'academic performance'. Thus, parents' mental illness was a stronger predictor to create variations in secondary school students' academic performance. The results provided confirmation to the second hypothesis of the study. Results of the study are consistent with several previous findings (Kamble and Adsul, 2012; Catsambis, 2001; Chohan and Khan, 2010; Schmitt and Kleine, 2010; Turner and Heffer, 2005). Consistent with these findings, the study of Strage and Brandt's (1999) revealed that both current and childhood levels of parental autonomy granting, demandingness, and supportiveness significantly and positively predicted students' academic achievement, as measured by Grade-Point-Average (GPA), and other personal characteristics, such as confidence, persistence, task involvement, and rapport (i.e., relationship) with their teachers.

Implications of the study

- 1) The findings of the study will be beneficial to parents, students, educators and significant others of the society in a sense that an insight will develop among them about the importance of family relation for better academic performance and school adjustment of children.
- 2) The study would emphasize to create awareness among parents about how their involvement at various dimensions of family relationships will affect their children's learning ability.
- 3) The findings of this study may also be helpful to the authorities of educational institutions. The results

would emphasize to develop school programs related to the parental involvement in school activities, decisions and homework. These programs might be helpful to bridge the gap between home and school and will enhance student's academic performance.

- 4) The result of this study might be useful for the educational policy planners to sort out the reasons behind an unstable atmosphere in the family and would help to take proper initiatives through economic and psycho-social supports so that the child in a family can easily adapt to his school environment and excels in academic activities.

Limitations and suggestions for further research

Although the present study tried to maintain a sound methodology and analysis of collected data, nevertheless it is not free from certain limitations. The data of 9th and 10th grade secondary school students in this study were collected only from four institutions of Rajshahi District. But if it was collected covering secondary level students of different educational institutions of more than one district of Bangladesh by taking a relatively large sample size, it would be more representative and the results of this study would become more accurate. Moreover, the significant findings of the study could not be emphatically generalized without substantial empirical researches in this area with reference to other relevant variables. Here, the basic necessity for future research lies. It can be argued that the problem of researching family relations and academic performance of secondary school students is too vast to be dealt with in such a relatively short research. However, it throws light into the area which needs further studies and exploration.

Conclusion

In conclusion, the findings of the research indicate that parents have a significant influence on the academic performance of their children. Interacting and becoming involved with their children's life on a daily basis is a way parents can socialize their children and enhance their children's academic performance. Parental aspirations, goals, and values are related to their children's setting of academic goals, persistence in school, course enrollment, intellectual accomplishments and ultimately better academic performance. Thus it may be concluded that every child born with innately good abilities and then it is up to family, especially up to parents and society to uphold and nurture the inherent abilities in children through supportive environmental stimulation.

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EFFECTS OF SOCIO-DEMOGRAPHIC FACTORS ON THE MARITAL ADJUSTMENT OF WORKING WOMEN IN BANGLADESH

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Abstract: The study was designed to investigate the effects of socio-demographic factors on marital adjustment of women working outside the home in Bangladesh. The study was conducted on 220 working women selected purposively from Chittagong city, Bangladesh. Bengali version of Dyadic Adjustment Scale (Ilyas, 2001), originally developed by Spanier (1976) was used for data collection. Data analyzed through t-test and F-test indicated that working women having 2 or less than 2 children showed better marital adjustment compared to women having more than 2 children. While considering the family types of working women, it was found that working women from joint families showed better marital adjustment as compared to women of single-families. Women having lower length of marriage showed better marital adjustment compared to women having higher length of marriage and working women having higher educational qualifications showed better marital adjustment compared to women having lower educational qualifications. It was also found from the findings of the study that women of higher household monthly income showed better marital adjustment compared to women of lower household monthly income.

Key words: Demographic factors, marital adjustment, working women

সারাংশ : বাংলাদেশের গৃহের বাইরে কর্মরত কর্মজীবী নারীদের বৈবাহিক উপযোগনের উপর কতিপয় সমাজ-জনতাত্ত্বিক উপাদানের প্রভাব দেখার জন্য বর্তমান গবেষণাটি পরিকল্পিত হয়েছিল। এ উদ্দেশ্যে বাংলাদেশের চট্টগ্রাম শহরের ২২০ জন উদ্দেশ্যমূলকভাবে নির্বাচিত কর্মজীবী নারীর উপর গবেষণাটি পরিচালিত হয়। স্পেনার (১৯৭৬) কর্তৃক তৈরীকৃত বৈবাহিক উপযোজন মানক এর বাংলা ভার্সন (ইলিয়াস, ২০০১) তথ্যসংগ্রহ কাজে ব্যবহৃত হয়। t-টেস্ট এবং F-টেস্ট এর মাধ্যমে উপাত্ত বিশ্লেষণে দেখা যায়, দুই বা তার কম সন্তানবিশিষ্ট কর্মজীবী নারীরা দুই এর অধিক সন্তানবিশিষ্ট কর্মজীবী নারীদের তুলনায় বেশি মাত্রায় বৈবাহিক উপযোজন প্রদর্শন করে। পরিবারের গঠন বিবেচনায় দেখা যায়, যৌথ পরিবারের কর্মজীবী নারীরা একক পরিবারের কর্মজীবী নারীদের তুলনায় অধিক মাত্রায় বৈবাহিক উপযোজন প্রদর্শন করে। আরো দেখা যায় কর্মজীবী নারীদের বৈবাহিক সম্পর্কের সময়কাল যতবেশি হয় বৈবাহিক উপযোজন তত কম হয় এবং তাদের শিক্ষাগত যোগ্যতা যত বেশি হয় বৈবাহিক উপযোজন তত ভাল হয়। গবেষণার ফলাফলে আরো দেখা যায়, কর্মজীবী নারীদের ক্ষেত্রে যাদের পারিবারিক মাসিক আয় বেশি তাদের বৈবাহিক উপযোজন যাদের পারিবারিক মাসিক আয় কম তাদের তুলনায় ভাল হয়।

Introduction

Marital adjustment is “the state in which there is an overall feeling in husband and wife of happiness and satisfaction with their marriage and with each other” (Thomas, 1977). It is the quality of relationship, in which both of the partners can enjoy life from the companionship characterized by lack of stress and unhappiness. Psychologist defines ten areas of marital adjustment, i.e. values, couple growth, communication, conflict resolution, affection, roles, cooperation, sex, money and parenthood (Margolin, 1980). Smith (1961) mentioned social activities and recreation, training and disciplining of children, religion, in law relationship, financial matters, sexual relationship, communication, mutual trust and companionship as the areas of marital adjustment. The study of past concepts in marital adjustment showed that it is permanently necessary for those processes of acquiring a balanced and functional marital relationship (Bradbury, Fincham and Beach, 2000). Locke and Wallace (1959) define marital adjustment as “accommodation of husband and wife to each other at a given time”. According to Spanier and Cole (1976), marital adjustment is a process, the outcome of which determined by the degree of: a) troublesome marital differences, b) interpersonal tensions and personal anxiety, c) marital satisfaction, d) dyadic cohesion, and e) consensus on matters of importance to marital functioning.

Bangladesh is a third world's developing country whose economic growth in the last few years is uprising. The main reason behind this is that women (who belong almost half of the total population) of this country have markedly changed their attitude towards female employment and now a days they have greater involvement in all sectors of economy through the paid employment outside the home environment. Still the vast majority of women in Bangladesh are fully homemakers and the wife still cooks, does household work and takes care of the family members. An employed woman has to manage three careers - her home, her employment and her children. An unemployed woman has to manage two careers - her home and herself.

Krishnaveni (1984), in her report on “Status of Indian Women”, mentioned that a “Working Women” refers to a woman who works outside her home for a wage or salary. Now-a-days most of the women are coming forward to work in order to create a meaning for themselves out of economic necessity. Being subjected to the dual demands of home and workplace, working women are likely to face problems of adjustment (Kapur, 1970). In addition, the educated, employed woman's changing concept of her status within her family, both as a wife and an earning member of the family is likely to pose problems on her marital

adjustment, if she fails to arrive at mutually satisfying consensus with her husband. Moves toward more gender equality have impact on marital expectations. Both men and women enter marriage with higher expectations of interpersonal communication, intimacy and sexual satisfaction (Furstenberg, 1996). Couples are striving for fulfilling the needs and unmet needs are resulted in stress and dissatisfaction. Earlier studies found that marital satisfaction was related to higher occupational status, higher income, and higher educational level, similarities between spouses in age and religion, esteem for the spouse, sexual satisfaction and companionship (Steinmetz, Clavan and Stein, 1990).

Role theory is a perspective in sociology and in social psychology that considers most of everyday activity to be the acting out of socially defined categories (e.g., mother, manager, and teacher). Each social role is a set of rights, duties, expectations, norms and behaviors that a person has to face and fulfill. The model is based on the observation that people behave in a predictable way, and that an individual's behavior is context specific, based on social position and other factors. Role theory attempts to explain the interactions between individuals in organizations by focusing on the roles they play. Role behavior is influenced by role expectations for appropriate behavior in that position, and changes in role behavior occur through an iterative process of role sending and role receiving (Thompson, 2001). A working woman has to play dual roles: as housewife and as breadwinner of the family. Traditionally the role of women was confined to cooking, cleaning, raising children etc. They were looked upon as caregiver or as home keeper and were denied access outside home. But now the story is different. They have an important role to play even outside the home. With the improved education and employment opportunities today, most homes became dual earners because of increase in expenses and necessities. The expansion of higher education has also enhanced job prospects for women and there is a shift in the role models from stay-at-home mothers to successful professional women. Women achieved tremendous progress in every occupation and made a mark wherever they are. Nevertheless, her role at home has not changed much. Thus, sometimes work-role strain and sometimes family-role strain with the influence of certain socio-demographic factors create a barrier in work-family balance for a woman and then conflict arises in the family and the quality of marital relationship may then deteriorate. A smooth work-family balance of a working woman depends on her ability to manage family through the division of work at

home with husband and family members and to manage workplace through cooperative attitudes of colleagues at work. For this, she must be aware of her role expectation for appropriate behavior in appropriate situation.

Some specific empirical studies revealing the effects of certain socio-demographic variables on the marital adjustment of working women are stated below. Zainah, Nasir, Hashim, and Noraini (2012) aimed to ascertain the differences in marital satisfaction based on demographic variables. Results indicated significant differences in marital satisfaction based on the length of marriage and income. It was found from the results of another study that marital adjustment was better in the later years of marriage as compared to the early years (Jyoti and Prabha, 2012). Marital relationships have a strong tendency to decrease in satisfaction over the first twenty years of the marriage. Most newly married couples report very high satisfaction and any change from that point would probably be in a downward direction (Broderick, 1988). Huston, McHale, and Crouter (1986) found a substantial decline in reported marital satisfaction during the first year of marriage. Glenn (1989) estimated that marital satisfaction indicated by the percentage of people who claim their marriages are "very happy" decreases steadily for at least the first 10 years and maybe for 25 years or longer (Glenn, 1990). Research by Guo and Huang (2005) found demographic variables such as age, gender, educational attainment, number of children, presence of male children, and health conditions as significant contributors of marital adjustment. Education and income have also a linkage to marital satisfaction and marital conflict, with greater levels of education and income predicting greater marital satisfaction and less conflict. Financial stress has a negative effect on marital satisfaction and a positive influence on relationship dissolution (Johnson and Booth, 1990). The presence of children has both negative and positive relation on marital satisfaction. In addition, studies have shown that there is a relationship between number of children, particularly preschool children, and marital satisfaction (Stevens, Kiger and Riley, 2001). Being an important element of marital life, sexual relationship and satisfaction derived from it has significant relation to have a warm and sustaining relationship between spouses. Husbands and wives' ratings of satisfaction with their sexual relationship have a significant relation to the overall satisfaction with their marital relationship (Young and Luquis, 1998). Singh, Thind, and Sushma (2006) examined the existing level of marital adjustment of employed and non-employed women

across different educational levels from Ludhiana city. It was observed that wives employed and educated up to Level I or Level II and their husbands were significantly more socially adjusting than wives non-employed and educated up to Level III and their husbands respectively. Hashmi, Khurshid and Hassan (2007) showed that highly educated working and non-working married women can perform well in their married life and they are free from depression as compared to educated working and non-working married women. On the contrary, Jamabo and Ordu (2012) found in their study that the educational attainment of women does not affect their marital adjustment.

A study conducted by Jyoti and Prabha (2012) revealed that women from nuclear families found to have better marital adjustment compared to the women from joint families. Maciver and Dimpka (2012) found in their study that social, behavioral, domestic, sexual, religious and financial factors influence marital stability. Mantri and Krishnaswamy (1994) worked with one hundred and seventy randomized married working women under fifty years of age with minimum education of being graduates and married for a minimum of five years. Five variables which were examined for their relation to marital adjustment were, husbands wanting wife to work, adjustment with parents-in-law and mutual agreement between the respondent and her husband regarding each other's status in the family and how her income should be spent. Except for the first, all other variables found to be significant and positively correlated with marital adjustment of the respondents. When these significant variables were tested for their inter-correlations, they were found to be significantly and positively interrelated implying that these are powerful dynamics whose interaction in the family affect marital adjustment. Considering the theoretical aspects and previous research findings relevant to this area, the present study was an attempt to investigate the effects of certain socio-demographics (i.e. number of children, types of family, duration of marriage, education and income) on the marital adjustment of working women in Bangladesh.

Objective of the study: The objective of the present study is to investigate the effects of socio-demographic factors (i.e. number of children, types of family, duration of marriage, education and income) on the marital adjustment of women working outside the home in Bangladesh.

Hypotheses of the study: Following hypotheses were formulated for the present study.

1. There would be a difference in marital adjustment with reference to number of children and family types of working women.
2. Duration of marriage, educational qualifications and family household income would create variations in marital adjustment of working women.

Rationale of the study

Being a third world's developing country the economic growth rate of Bangladesh in the last few years is uprising. Reason behind this may be that the women (who belong almost half of the total population) of this country have markedly changed their attitude towards female employment and now a days they have greater involvement in all sectors of the economy through paid employment outside the home environment. Working women have to face dual challenges, i.e. inside and outside the family but non-working women have to face single challenge i.e. inside the family. Culturally and traditionally, women are engaged in household labor and child rearing but the societal changes now motivating women to have employment in diverse fields. Thus, socio-demographic factors that influence marital satisfaction have a double effect in case of working women. As their role in household labor still have no marked changes and sharing of responsibility in the grounds of household matters is not actively practiced they are often stressed by the dual role in the office and home. Earlier studies found that marital satisfaction was related to higher occupational status, higher income, and higher educational level, similarities between spouses in age and religion, esteem for the spouse, sexual satisfaction and companionship (Steinmetz, Clavan and Stein, 1990). Considered on these perspectives, the present study aimed to investigate the effects of number of children, types of family, duration of marriage, working women's educational qualifications and household monthly income on the marital adjustment of women working outside the home in Bangladesh.

Materials and Methods

The sample

The sample of the present study comprised of 220 working women aged between 36 to 45 years. They were selected purposively from different areas of Chittagong City, Bangladesh. The working women's professions included primary school teachers, high school teachers, bankers and garment employees. Based on their work hours, the characteristics of the sample were equivalent. They have to work in their institutions around 8 hours in a day. Their educational qualifications ranged from H.S.C to post graduate levels. The following table describes the distribution of the sample according to different characteristics.

Table 1 Sample Distribution according to Socio-demographic Variables

Variable	Level/s	n	Variable	Level/s	n
No. of Children	2 or below 2	114	Education	Hr. Secondary	60
	Above 2	106		Graduation	110
Marital Duration	01-09 Yrs.	120		Post Graduation	50
	10-18 Yrs.	80	Husbands' Education	Hr. Secondary	20
	19-27 Yrs.	20		Graduation	76
Monthly Household Income	10000-20000	20		Post Graduation	124
	21000-30000	104	Family Type	Single	110
	Above 30000	96		Joint	110

Measuring instruments

In this study, the following instruments were used to collect data.

a) Demographic and personal information sheet

A demographic and personal information sheet was used to collect personal and demographic information of the respondents such as marital duration, number of children, educational qualifications of women, husband's education, monthly household income, family type etc.

b) Bengali Version (Ilyas, 2001) of the Dyadic Adjustment Scale (DAS)

The Bengali version (Ilyas, 2001) of Spanier's (1976) Dyadic Adjustment Scale (DAS) was used to measure marital adjustment of working women. The original scale is a 32-item questionnaire, which measures four aspects of the relationship, dyadic satisfaction, dyadic cohesion, dyadic consensus and affection expression. Most of the items are Likert type, but there are only two items in yes-no format. The total score is generated by summing up the scores of individual items and it ranges from 0 to 151. Higher score reflects a higher level of marital adjustment. The original DAS have shown good reliability (Cronbach's $\alpha = .96$). Construct validity data indicate that the DAS discriminates well between divorced and currently married samples, and highly the Locke-Wallace Marital Adjustment Test (Trief et.al. 2001). In the original scale, there three items (item no 23, 29 and 30) dropped from the Bengali version of the scale because it assumed that these items might offend the respondents and reduce their response rates (Ilyas, 2001). Thus, the Bengali version of DAS (Ilyas, 2001) includes 29 items. Significant correlations ($r = .78$, $p < .0001$) between scores of English and Bengali versions indicated the high reliability of this measure and indicated that the English and Bengali versions measured the same thing (Ilyas, 2001). This scale has content, criterion related and construct validity. It has high correlations with other well-established measures of marital adjustment. The total number of items falls

into a Likert type instrument. The possible total score of an individual in this scale ranges from 0 to 120, where a high score indicates high marital adjustment and low score indicate low marital adjustment.

Procedure

Standard data collection procedure was followed to collect data from the respondents in this study. At the beginning, participants were briefed about the general purpose of the study and good rapport was established with them. The data of the respondents were collected from different educational institutions, banks and garments situated at the area of Chittagong City Corporation, Bangladesh. While collecting data from these institutions, the respondents were informed that the investigation was purely academic and their responses to the questionnaires would be kept confidential. Then the above instruments were administered individually to the members of the sample. Prior to responding the items, participants were requested to give a silent reading of the standard instructions on the questionnaire. Along with this, they also were given verbal instructions. The respondents were told to read the items of the scale attentively and to respond carefully. All necessary clarifications were made regarding the items. They were asked to give a tick (\checkmark) mark in the appropriate box. They were also requested not to omit any item in the questionnaire and told that there was no right or wrong answer and had no time limit for answering the items. Generally, each participant took 35 to 40 minutes to fill up the above questionnaires.

Results

Table 2 Differences in Marital Adjustment based on No. of Children and Family Type of Working Women

Variable/s	Level/s	n	M	SD	df	t
No. of children	2 or <2	114	109.31	4.48	218	13.80*
	Above 2	106	91.58	12.91		
Family Type	Single	110	93.10	14.16	218	10.81*
	Joint	110	108.43	4.55		

* $p < .01$

From Table-2 it was found that there existed a significant difference ($t = 13.80, df = 218, p < 0.01$) in marital adjustment of working women based on the number of children and family types ($t = 10.81, df = 218, p < 0.01$). That is, working women having 2 or less than 2 ($M=109.31$) children showed better marital adjustment compared to women having more than 2 children ($M=91.58$). Again, working women from joint family structure ($M=108.43$) showed better marital adjustment as compared to women of single-family structure ($M=93.10$). The findings are graphically plotted in Figure 1.

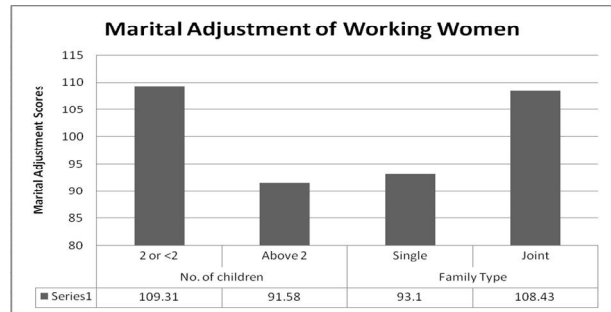


Fig 1 Marital Adjustment of Working Women according to Number of Children and Family Type

Table 3 Differences in Marital Adjustment of Working Women based on Marital Duration, Women’s Education, and Monthly Household Income

Variable	Level/s	n	M	SD	df	F
Marital Duration	1-9 years	120	108.19	5.40	2/217	161.27*
	10-18 years	80	96.20	11.39		
	19-27 years	20	74.45	7.84		
Women’s Education	Hr. Secondary	60	84.00	12.17	2/217	247.47*
	Graduation	110	104.35	4.50		
	Post Graduation	50	112.98	2.59		
Monthly Household Income	10000-20000	20	70.20	4.35	2/217	417.54*
	21000-30000	104	97.43	7.72		
	Above 30000	96	110.74	3.46		

*p < .01

Table 4 Post Hoc tests (LSD) for Marital Duration, Women’s Education, and Monthly Household Income on the Marital Adjustment Scores of Working Women

Variables	(I) Marital Duration	(J) Marital Duration	Mean Difference (I-J)	Std. Error	Sig.
Marital Duration	1-9 years	10-18 Years	11.99*	1.196	.000
		19-27 Years	33.74*	2.001	.000
		10-18 Years	-11.99*	1.196	.000
	10-18 Years	19-27 Years	21.75*	2.071	.000
		19-27 Years	-33.74*	2.001	.000
	19-27 Years	10-18 Years	-21.75*	2.071	.000
Educational Qualification	(I) Educational Qualifications Higher Secondary	(J) Educational Qualifications Graduation	-20.35*	1.157	.000
		Post Graduation	-28.98*	1.381	.000
		Graduation	20.35*	1.157	.000
	Graduation	Higher Secondary	-8.63*	1.230	.000
		Post Graduation	28.98*	1.381	.000
	Post Graduation	Higher Secondary	8.63*	1.230	.000
Monthly Household Income	(I) Monthly Household Income 10000-20000	(J) Monthly Household Income 21000-30000	-27.23*	1.448	.000
		above 30000	-40.54*	1.458	.000
		21000-30000	10000-20000	27.23*	1.448
	21000-30000	above 30000	-13.31*	.840	.000
		Above 30000	10000-20000	40.54*	1.458
	Above 30000	21000-30000	13.31*	.840	.000

*p < .01

Findings of the study presented in Table-3 showed significant variations in marital adjustment of working women in terms of marital duration ($F = 161.27$, $df = 2/217$, $p < 0.01$), working women's educational qualifications ($F = 247.47$, $df = 2/217$, $p < 0.01$) and monthly household income ($F = 417.54$, $df = 2/217$, $p < 0.01$). In Table-4, significant mean differences at .01 level of significance through post-hoc tests (LSD) reveal that working women possessing the marriage length of 1-9 years showed better marital adjustment ($M = 108.19$) followed by the women possessing the marriage length of 10-18 years ($M = 96.20$) and women possessing the marriage length of 19-27 years ($M = 74.45$). Significant mean differences at .01 level of significance through post-hoc tests (LSD) showed that working women who were the postgraduates showed better marital adjustment ($M = 112.98$) followed by the graduates ($M = 104.35$) and H.S.C pass ($M = 84.00$) working women. Again, significant mean differences at .01 level of significance through post-hoc tests (LSD) showed that working women having the household monthly income of above 30000tk. showed better marital adjustment ($M = 110.74$) followed by the women whose household monthly income ranged from 21000-30000tk. ($M = 97.43$) and women whose household monthly income ranged from 10000-20000tk. ($M = 70.20$) (Table-3 and Table-4).

The results are graphically plotted in Figure-2.

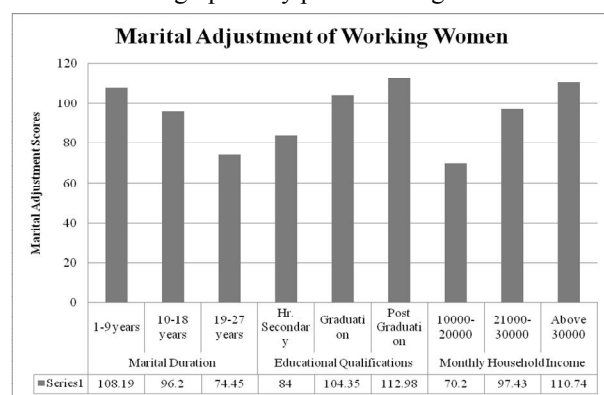


Fig 2 Marital Adjustment of Working Women according to Marital Duration, Women's Educational Qualifications and Monthly Household Income

Discussion

The present study attempted to investigate the effects of certain socio-demographic factors like number of children, types of family, duration of marriage, education and income on the marital adjustment of women working outside the home in Bangladesh. The study was conducted on 220 working women selected purposively from Chittagong city Bangladesh.

Reviewing the relevant literatures in detail, it was hypothesized: 1) there would be a difference in marital adjustment with reference to number of children and family types of working women and 2) duration of marriage, educational qualifications and family household income will create variations in marital adjustment of working women. Following standard procedures the instruments used in this study were administered to measure the marital adjustment of working women with reference to certain socio-demographics. Obtained data were analyzed using descriptive statistics, t-test and F-test. Important features of the findings are discussed below in a coherent manner.

From the findings of the present study, it was revealed that working women having 2 or less than 2 children showed better marital adjustment compared to women having more than 2 children (Table 2). Studies consistent with this finding have shown that there is a relationship between number of children, particularly preschool children, and marital satisfaction (Stevens, Kiger & Riley, 2001). Other previous studies (Graham, et al., 2000; Guo & Huang, 2005; Parron, 1982) are also in accordance with the present finding. While considering the family types of working women, it was found that working women from joint family structure reported better marital adjustment as compared to women of single-family structure (Table 2). This finding is somewhat opposite to the previous study of Jyoti & Prabha (2012) revealing that women from nuclear families were found to have better marital adjustment than women from joint families reveal. The results revealed in Table 2 provided confirmation to the first hypothesis of the present study.

Findings of the study also revealed that working women having lower length of marriage showed better marital adjustment compared to women having higher length of marriage and working women having higher educational qualifications showed better marital adjustment compared to women having lower educational qualifications. It was also found from the findings of the study women of higher household monthly income showed better marital adjustment compared to women of lower household monthly income (Table 3). These findings provided confirmation to the second hypothesis of the present study. These results are consistent with several previous studies. For example, Zainah, et. al. (2012) found significant differences in marital satisfaction based on the length of marriage. Most newly married couples report very high satisfaction and any change from that

point would probably be in a downward direction (Broderick, 1988). Johnson & Booth (1990) in their study revealed that education and income have a linkage to marital satisfaction and marital conflict, with greater levels of education and income predicting greater marital satisfaction and less conflict. Financial stress has a negative effect on marital satisfaction and a positive influence on relationship dissolution. Maciver & Dimpka (2012) also found in their study that financial factor influences marital stability. Hashmi, et al. (2006) showed that highly educated working and non-working married women can perform well in their married life and they are free from depression as compared to educated working and non-working married women.

Conclusions and recommendations

Bangladeshi people have markedly changed their attitude towards female employment and more women are now involved in all sectors of economy. From past to present, there are several diversities in the study of marital adjustment over the world showing a significant contribution in psychology as well as in social psychology independently. Regarding this, the present study has concentrated on the marital adjustment of working women with reference to certain socio-demographic factors. The study revealed significant differences in marital adjustment with reference to number of children, family types, marital duration, education and income of working women. The findings of the study are expected to extend the role theory relating women's marital adjustment. The study comprised of some drawbacks (i.e. few socio-demographic factors, limited participants etc.). The significant findings of the study could not be emphatically generalized without substantial empirical researches in this area with reference to other relevant variables. It can be argued that the problem of researching marital adjustment of working women is too vast to be dealt with in such a relatively short research. However, it throws light into the area which needs further studies and exploration. Despite these limitations, it may be asserted that this area of interest is a promising one from global aspects and it is valuable to understand the situation in Bangladesh.

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BANGLA ADAPTATION OF THE PERCEIVED STRESS SCALE

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Abstract: The purpose of the present study was to adapt the Perceived Stress Scale of Sheldon Cohen and Williamson Gail M (1988), for its use with Bangla speaking people, specially in Bangladesh. For this purpose the original version of the stress scale was translated into Bangla. Then, to examine its validity, confirmatory factor analysis was carried out on its items and its reliability was calculated. Reliability of the Bangla version of the scale was tested by applying parallel form and test-retest methods. The reliability coefficient in both techniques were found to be 0.85 & 0.83. The obtained high parallel form and test-retest reliability coefficients proved that Bangla version of the perceived stress scale was definitely a dependable tool for identifying stress of the individuals of Bangla language and culture.

Key Words: Perceived Stress Scale, Reliability, Validity: Bangla Adaptation

সারাংশ: শেলডন কোহেন এবং উইলিয়ামসন গেইল এম (১৯৮৮), এর আত্মউপলব্ধিমূলক মানসিক চাপ স্কেলটি বাংলা ভাষা-ভাষীদের বিশেষ করে বাংলাদেশের মানুষের ব্যবহার উপযোগী করার উদ্দেশ্যে এই গবেষণাটি পরিচালনা করা হয়েছে। এই উদ্দেশ্যে মূল মানসিক চাপ স্কেলটি বাংলায় অনুবাদ করা হয়েছে। তারপর এর যথার্থতা নির্ণয়ের জন্য confirmatory factor analysis এবং নির্ভরযোগ্যতা নির্ণয় করা হয়েছিল। সমান্তরাল এবং অভীক্ষণ-পুনরভীক্ষণ পদ্ধতি প্রয়োগের মাধ্যমে এই স্কেলের বাংলা সংস্করণের নির্ভরযোগ্যতা নির্ণয় করা হয়েছিল। উভয় পদ্ধতির ক্ষেত্রে নির্ভরযোগ্যতার সহ-সম্পর্কের মান পাওয়া যায় ০.৮৫ এবং ০.৮৩। প্রাপ্ত সহ-সম্পর্ক মান বিবেচনায় দাবী করা যায় যে, আত্ম-উপলব্ধিমূলক মানসিক চাপ স্কেলের বাংলা সংস্করণটি বাংলা ভাষা-ভাষী ও সংস্কৃতির ব্যক্তিদের মানসিক চাপ সনাক্ত করণের একটি নির্ভরযোগ্য ও উপযোগী স্কেল।

Introduction

A common mental health disorder is stress. Stress is a key concept in health research. It is an overwhelming crisis. People always try to come out of this crisis employing various coping strategies. The impact of stressors varies from person to person. Selye (1974) viewed stress as the common denominator of all adaptive reactions in the body and complete freedom from stress as death. In his first publication on stress in Nature in 1936, Selye defined stress as “the nonspecific response of the body to any demand made on it” (p.32). He again defined stress as “a state manifested by a specific syndrome which consists of all the nonspecifically induced changes within the biological system” (Selye 1976b). From stress theory, Roy (1984) selected the concepts of stressor, stress and adaptation for her model. She defines stress as “a constantly changing point, made up of focal, contextual, and residual stimuli, which represent the person’s own standard of the range of stimuli to which one can respond with ordinary adaptive responses”. A review of psychological literature reveals a lack of reliable tools in Bangladesh for identifying personal stress. Although a number of stress scales are available from different languages and culture such as Arabic, Swedish, Spanish, Chinese, Japanese and Turkish (Chaaya et al. 2010, Eskin et al. 1996, Remor 2006, Leung et al. 2010, Mimura et al. 2004, Orucu et al. 2008), yet they are unlikely there is no suitable original or adapted stress scale in Bangla language and culture. Hence the authors intend to translate and adapt widely-used Perceived Stress Scale (Cohen et al. 1988) to make it suitable for identifying personal stresses of the people of Bangladesh.

Description of the Peerceived Stress Scale

The Peerceived Stress Scale (PSS) is the most widely used psychological instrument for measuring the perception of stress. It is a measure of the degree to which situations in one’s life are appraised as stressful (Cohen et al. 1983). Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct queries about current levels of experienced stress.

The original scale contained 14 items. Then Sheldon Cohen and Williamson Gail M developed a revised version of PSS in the year of 1988. The revised PSS scale is a 10-item self report questionnaire. The PSS was designed for use in community samples with at least a junior high school education. The items are easy to understand, and the response alternatives are simple to grasp. Moreover, the questions are of a general nature and hence are relatively free of content specific to any subpopulation group. The questions in the PSS ask about feelings and thoughts during the last months. In each case, respondents are asked how often they felt in a certain way.

PSS scores obtained by reversing responses (e. g., 0=4, 1=3, 2=2, 3=1 & 4=0) to the four positively stated items (items 4,5,7, & 8) and then summing across all items of scale. Scores range from 0 to 40, with higher scores indicating higher level of stress. This instrument demonstrates the internal reliability (alpha coefficient=.78) Cohen et al. (1988).

Method

Procedure and Sample

For adaptation of the Bangla version of the Perceived Stress Scale, the items were translated into Bangla and were judged independently by four judges. Three of the judges were Professors of the Department of Psychology, and the other one was Professor of the Department of English, University of Rajshahi. Each item of the Bangla version was selected on the basis of agreement of all four judges. Then, the reliability of the Bangla version of the stress scale was determined by employing both the parallel form and test-retest reliability techniques. Correlation coefficient of both types of reliability were computed through SPSS.

The parallel form reliability (i.e., correlation between the Bangla and the English version) was determined by using 70 subjects aged 20 to 30 years. All the subjects were students of 4th year Honours & M.S. final year from the Department of Psychology, University of Rajshahi, but care was taken to select those who were proficient in both English and Bangla languages. English and Bangla versions of the perceived stress scale were then administered on the subjects in two sessions and counter-balancing method was used for presenting the two forms of the perceived stress scale. In the first session, one half of the subjects were presented with the English form and the other half were presented with the Bangla form. In the second session, after ten days of the first session, the two forms of the perceived stress scale were presented in a reverse condition following the standard procedure. The test-retest reliability of the Bangla version of the perceived stress scale was computed by administering the stress scale on the same respondents. The same form of Bangla version was administered again on the same group of subjects after a time interval of fifteen days.

To examine its validity, confirmatory factor analysis was carried out and Cronbach's Alpha coefficient, Spearman-Brown split-half coefficient and Guttman split-half coefficient were calculated to determine the extent of the tool's reliability.

Results

Diagram 1 display factorial structure of the stress scale in the present study. As observed in diagram 1, all items have suitable factorial load in running the confirmatory factor analysis of the stress scale and all coefficients are higher than 0.40 except one item. In other words, the

items significantly affected their own related factor ($P < 0.001$).

Moreover, in this study, Cronbach's Alpha coefficient, Spearman-Brown split-half coefficient and Guttman split-half coefficient were calculated to determine the reliability value of the scales; the respective results are shown in table 1. This table displays the questionnaire's reliability using three methods of Cronbach's Alpha coefficient, Spearman-Brown split-half coefficient and Guttman split-half coefficient. Contents of table 1 shows that stress questionnaire have acceptable reliability coefficients.

Table 1 Reliability Coefficients of Stress Scale in Present Study

Scale	Cronbach's Alpha	Spearman-Brown Split-half	Guttman Split-half
Stress Scale	.55	.71	.71

In order to examine the reliability of the Bangla version of Perceived Stress Scale parallel form and test-retest reliability were tested. In both cases, reliability coefficient for the scale were done using SPSS-20. Table 2 shows the parallel form and Table 3 shows the test-retest reliability. Figures in the tables indicate that both the correlation coefficients (r) were significant at 0.001 level and the ' r ' values for the parallel form 0.85 and 0.83 in case of Test-retest reliability.

Table 2 Parallel form reliability coefficient and level of significance ($N=70$, $df=68$)

Scale	Pearson Correlation/ ' r ' Values	Significant Level
Perceived Stress Scale Bangla	0.85	0.01
Perceived Stress Scale English		

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3 Test-retest reliability coefficient and level of significance ($N=70$, $df=68$) of Bangla version Perceived Stress Scale.

Administration	Pearson Correlation/ ' r ' Values	Significant Level
Perceived Stress Scale Bangla 1 st test	0.83	0.01
Perceived Stress Scale Bangla 2 nd test		

** . Correlation is significant at the 0.01 level (2-tailed).

Item 1



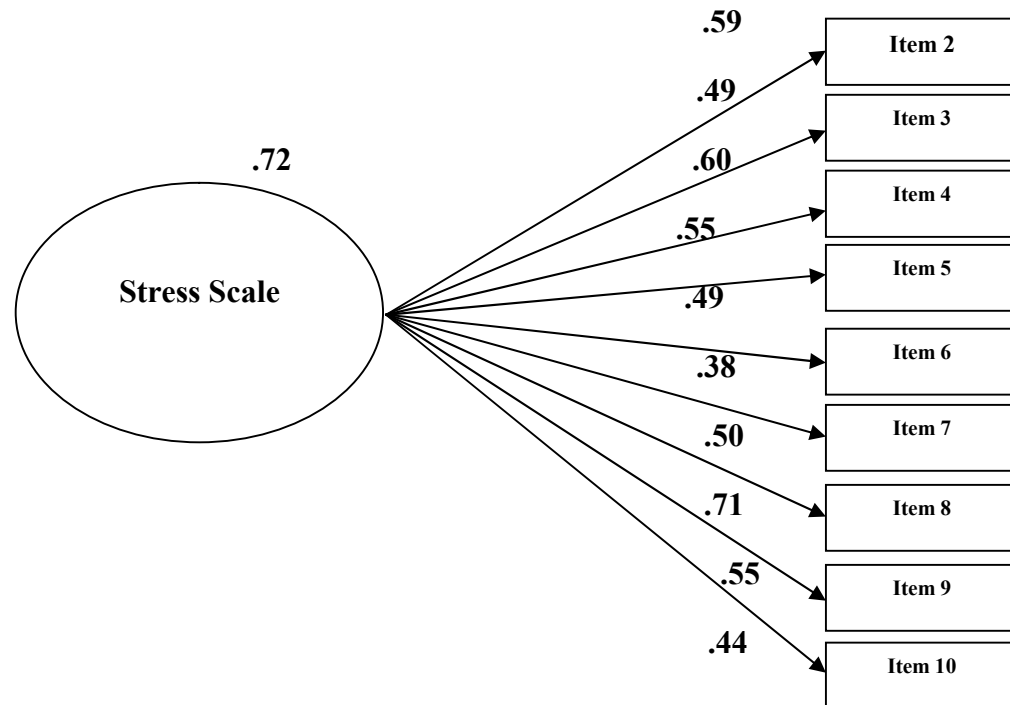


Diagram 1 Factorial structure of Stress Scale

Discussion and Conclusion

The main purpose of the present study was to adapt and find out the reliability of the Bangla version of the Perceived Stress Scale to make it suitable for administration on Bangla speaking people, specially in Bangladesh. For this purpose, the stress scale was translated into Bangla and then examined by four judges. Each item of the Bangla version was selected on the basis of agreement of all four judges. After this the final form was prepared, then parallel form and test-retest reliabilites of the Bangla version were tested. The parallel form reliability coefficient for the scale was 0.85. On the other hand, the test-retest reliability coefficient for the scale was 0.83. Both the parallel and test-retest reliability coefficients were highly significant. Results demonstrated that all items of the present study also had suitable factorial load on their related factor and the reliability of the scale have been satisfactory. Cronbach's Alpha, Spearman-Brown Split-half, Guttman Split-half reliability coefficients were also high and all these coefficients are very consistent with the reliability coefficient of the study of Eleni et al. (2011).

Thus, the high reliability of the Bangla version of the perceived stress scale shows that the adapted Bangla

version of the Perceived Stress Scale, is definitely a dependable tool for identifying the personal problems of Bangla speaking people, specially in Bangladesh.

Note: Publisher (Mind Garden, Inc., www.mindgarden.com) of the scale (Perceived Stress Scale of Sheldon Cohen and Williamson Gail M. 1988) has been given open consent to use it freely for research in all society and culture.

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EFFECTIVENESS OF TV PROGRAMMES FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN BANGLADESH

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Abstract: Media can play a vital role for sustainable agricultural development in Bangladesh. This study was undertaken to find out the extent of effectiveness of TV programmes for sustainable agricultural development. Also to explore the relationship between the extent of effectiveness of TV programmes for sustainable agricultural development and the selected characteristics of the TV viewer farmers. The study area was carried out in the Kurigram district of Bangladesh and six villages under the Upazilla, namely Kurigram Sadar and Ulipur from this district were selected. One hundred eighty seven TV owned farmers were randomly selected sample for data collection. A pre-tested questionnaire was used to collect the data from the respondents during January to June 2011. Four psychological aspects of the respondents namely cognitive effectiveness, emotional effectiveness, attitudinal effectiveness and behavioral effectiveness were considered to measuring the effectiveness of TV programme for sustainable development. Data indicated that medium effectiveness was found highest proportion in every aspect and in case of overall effectiveness, the 68.45 percent of the respondents had medium effectiveness, while 13.90 percent had low effectiveness and only 17.65 percent had high effectiveness. Pearson correlation test depicted that out of 15 variables, 10 had significant relationship with the effectiveness of TV programmes for sustainable agricultural development. Out of 10 significant independent variables only age had negative relationship. TV viewer farmers, who had young, high educated, received more training and mass media exposure, high knowledge in relation to sustainable agriculture, high income and innovative, more cosmopolite and positive attitude towards agriculture & TV were found to better effectiveness of TV programmes for sustainable agricultural development.

Keyword: effectiveness, TV, programmes, sustainable, agriculture, development

সারাংশ : বাংলাদেশে টেকসই কৃষির উন্নয়নে মিডিয়া গুরুত্বপূর্ণ ভূমিকা পালন করছে। টেকসই কৃষির উন্নয়নে টেলিভিশনের প্রভাবের মাত্রা বের করার জন্য এই অধ্যয়ন নেওয়া হয়েছিল। টেকসই কৃষির উন্নয়নে টেলিভিশনের প্রভাব এবং টেলিভিশন দেখা কৃষকদের বৈশিষ্ট্যের মধ্যে সম্পর্ক বের করাও একটি উদ্দেশ্য ছিল। এই গবেষণা বাংলাদেশের কুড়িগ্রাম জেলায় করা হয়েছিল এবং এই জেলার কুড়িগ্রাম সদর ও উলিপুর উপজেলার ৬টি গ্রাম নির্বাচিত করা হয়েছিল। একশত সপ্তাশি জন টেলিভিশন দেখা কৃষক নমুনা হিসাবে উপাত্ত সংগ্রহের জন্য দৈবায়াতভাবে নির্বাচিত করা হয়েছিল। জানুয়ারী থেকে জুন, ২০১৬ পর্যন্ত পূর্ব-পরীক্ষিত প্রশ্নপত্র ব্যবহার করে উপাত্ত সংগ্রহ করা হয়েছিল। তথ্যদাতার মানসিক দিক যেমন কগনিটিভ প্রভাব, আবেগময় প্রভাব, মনোভাবের প্রভাব এবং আচরণগত প্রভাব বিবেচনা করা হয়েছিল টেলিভিশনের কার্যকারিতার প্রভাব পরিমাপের জন্য। বিভিন্ন মানসিক দিক এর মধ্যে মধ্যম মাত্রার কার্যকারিতার প্রভাবের সংখ্যা বেশী পরিলক্ষিত হয়েছিল। মোটের উপর ৬৮.৪৫% তথ্যদাতা ছিল মধ্যম কার্যকারিতার যেখানে ১৩.৯০% ছিল নিম্ন কার্যকারিতার এবং ১৭.৬৫% ছিল বেশী কার্যকারিতার। পেয়ারসন কোরিলেশনের মাধ্যমে দেখা যায় ১৫ চলকের মধ্যে ১০টির টেকসই কৃষির উন্নয়নে টেলিভিশনের প্রভাবের সাথে তাৎপর্যময় সম্পর্ক রয়েছে যার মধ্যে একটি ঋণাত্মক তাৎপর্যময়। টেলিভিশন দেখা কৃষক যারা যুবক, শিক্ষিত, প্রশিক্ষণপ্রাপ্ত, গণযোগাযোগমুখী, টেকসই কৃষি উন্নয়নে উচ্চ জ্ঞান সম্পন্ন, উচ্চ আয়ের অধিকারী, ইনোভেটিভ, কসমোপলিটেন এবং কৃষি ও টেলিভিশনের প্রতি ভালমনোভাব তাদের ক্ষেত্রে টেকসই কৃষির উন্নয়নে টেলিভিশন কর্মসূচীর কার্যকারিতার প্রভাব বেশী দেখা যায়।

Introduction

Television was treated as a powerful mass media which also considered as a good effective social change maker. It can be used effectively for transfer of agricultural technologies to the farming communities (Muhammad et al., 2004). Television has an important role to establish any new idea among the illiterate people. Because television is such a medium for which education is not compulsorily necessary. It is easy for the uneducated people to access the information because of its simultaneous audio-visual capacity. Moeller (1996) speculated that television is a very accessible medium, it has the potential to reach learners that have not been able to participate in traditional adult literacy programmes. Television is accessible both in terms of its technology and in terms of its content. Decreasing the gap between information need and information available is necessary to enhance the

effectiveness of any media. Traditionally the messages distributed by electronic media, especially agriculture related, are entirely target oriented. However, although the target people can be reached by media there can have some other biological and social conditions which may affect the ultimate goal. Besides, the information disseminated thorough television may be wrong or misinterpreted. So, only the mutual coexistence is not enough to make any television programme effective. So, there is a vehement necessity to identify the factors which influence the effectiveness of electronic media for sustainable agricultural development.

Television is a medium by which can inform mass people about any issue within a short span of time. It is possible to inform the farmers of our country about the latest agricultural invention by using television. According to Pandey and Tewary (2004), "Mass media

consisting of newspapers, magazines, traditional media, radio, TV and information technology are powerful opinion makers as they cover more people in less time and cost". Among the other mass media television is more important. Because people kept in their mind 84% of any information by viewing (Haider, 2001). Once upon a time, people would just think about the more production in agriculture. They did not think about the long time fertility and productivity of the land because of the great danger of food insecurity of Bangladesh at near past. But, at present, the country is in such a situation that very soon she will be able to avail the food self-sufficiency. On the other hand, only the higher production of food cannot ensure the long time food security while it is damaging the environment. So, those days are not in distance, when people should think about the sustainable food security in place of somehow livelihood. But, only agricultural information cannot fulfill this target. Rather, there need to have the sustainable agricultural information by which agriculture can be developed in a sustainable way. So, it is possible to teach the farmer about the process of farming high yielding variety with an environment friendly way by television easily. It is hopeful that government own television as well as privately own TV channels are broadcasting some agriculture-based programmes from long time ago. Already there are some positive improvements occurred in this sector. So, television can play an important role. It will inform the people firstly, and then educate them by the information, after educating the common people media persuade them to make a decision about the issue and finally media lead them to have an action. At first individual learns of the existence of the new item (awareness stage) then if he feels interested seek more information about it (interest stage). In third stage he mentally applies the new item to his or her present and expected future situation and decides whether to try it (evaluation stage) next he applies the new idea on small scale (trial stage) and finally he uses the new item or idea continuously on a full scale (adoption stage) (DeFleur and Dennis, 1991). Keeping all these in view, this study was undertaken with several objectives: 1) to find out effectiveness of TV programmes for sustainable agricultural development and 2) to explore the relationship between the extent of effectiveness of TV programmes for sustainable agricultural development and the selected characteristics of farmers.

Methodology

The study was carried out in the district of Kurigram District in Bangladesh. Two Upazilla (administrative unit), namely, Kurigram Sadar and Ulipur from this

district were selected for data collection. Finally, three villages from each Upazilla were selected randomly as a locale of the study. Total numbers of farm family heads having TV set or TV media exposure of these six villages was 1249 which constituted the population of the study, 187 farm family head as TV exposure were selected randomly as the representative covering 15% of active population. Data were collected during the month of January to June 2011. Necessary secondary data were also collected from different sources in addition to primary data. Descriptive statistical measures such as number, percentage distribution, range, mean, standard deviation and coefficient variation were used in describing the selected variables. To examine the relationship between predict and response variables, Pearson's product moment correlation coefficient (r) was done.

Measurement of independent variables

The predict variables such as age, education, family size and farm size were measured by using measuring units of year, year of schooling, number of family members and hectare. The annual income was measured on the basis total earning annually by all the members of the family and expressed in Taka. Knowledge about sustainable agriculture of a respondent was measured by asking 25 questions covering the different aspects of sustainability. The knowledge about sustainable agriculture scores could range from 0 to 50. The training experience was indicated by the number of days of training that a farmer had received during period of last year under different agricultural training programs. A score 1 (one) was assigned for each training received each day. For measuring the supervision of crop production, 15 statements were asked to indicate their opinion against four type of responses, such as 'regularly', 'occasionally', 'randomly' and 'not at all' with the weights of 3, 2, 1 and 0, respectively. Innovativeness was measured on the basis of time required like within for adoption or non-adoption of the selected 10 improved agricultural technologies. If a respondent adopt new technology within one year after hearing, he/she receive 5 point. A 4-point Likert of scale was prepared in this study for measuring psychological variables like attitude towards sustainable agriculture, attitude towards television, aspiration, and risk orientation. The other variables like cosmopolitaness and mass media exposure were measured by as usual methods which exist in social arena.

Measurement of dependent variables

For measuring the effectiveness of TV programme for sustainable agricultural development, researcher

selected four psychological aspects of respondents. These were (1) cognitive effectiveness, (2) emotional effectiveness, (3) attitudinal effectiveness and (4) behavioral effectiveness. Firstly 40 statements in relation of each aspect were collected from different articles, journal, review of literatures, different experts, university teachers, agriculture officer, sub assistant agriculture officer and farmers and edited according to Thrustone and Chave (1929), and Edward and Kilpatrick (1948). Finally, 25 statements were selected in relation to each aspect through judge rating, validity, reliability test. Each statement of cognitive, emotional, attitudinal and behavioral effectiveness of television programme for sustainable agricultural development was measured by using a 3 point Liker type scale such as strongly effective, effective, ineffective and strongly ineffective with corresponding weight of 3, 2, 1 and 0 respectively. The overall effectiveness of television programme for sustainable agricultural development was determined by summing up the four components of effectiveness scale which range from $4 \times (0-75) = 0$ to 300. Hence, the overall effectiveness scores are given below:

Table 1 Overall effectiveness score

Aspect of effectiveness	Range of score
Cognitive effectiveness scores	0 – 75
Emotional effectiveness scores	0 – 75
Attitudinal effectiveness scores	0 – 75
Behavioral effectiveness scores	0 – 75
Overall effectiveness scores	0 – 300

Results and discussion

Effectiveness of television programme for sustainable agricultural development

Effectiveness of television programme for sustainable agricultural development was measured by measuring the four psychological stages of the respondents. Farmers need agricultural information predominately regarding sustainable agriculture. Data regarding effectiveness of television programme for sustainable agricultural development were analyzed in the light of four psychological aspects of farmers, namely, cognitive effectiveness, emotional effectiveness, attitudinal effectiveness and behavioral effectiveness. Cognition is an area for the processing of information, applying knowledge and changing preferences. Learning a fact from the mass media is the most straightforward type of cognitive effect. Less obvious and considerably more complicated are the ways that mass media stimulate different cognitive processes. Building awareness among farmers is the main and first way of making media effective. In this study, score of

cognitive effectiveness of the farmers computed within the range 0 to 75 while respondents got the scores from 31 to 73 with the mean value of 53.74, standard deviation 9.14 and variance 83.56. According to the observed scores, farmers were classified into three categories. The distribution of farmers according to their cognitive effectiveness scores has been shown in Table 2.

Table 2 Distribution of the farmers according to their scores in relation to different aspect of effectiveness

Aspect	Categories	Farmers		Mean ± SD
		Number	Percent	
Cognitive	Low effectiveness (up to 45)	35	18.72	53.74
	Medium effectiveness (46-60)	110	58.82	±
	High effectiveness (>60)	42	22.46	9.14
Emotional	Low effectiveness (up to 45)	52	27.81	51.64
	Medium effectiveness (46-60)	101	54.01	±
	High effectiveness (>60)	34	18.18	9.52
Attitudinal	Low effectiveness (up to 45)	46	24.60	52.22
	Medium effectiveness (46-60)	108	57.75	±
	High effectiveness (>60)	33	17.65	9.29
Behavioral	Low effectiveness (up to 45)	40	21.39	50.12
	Medium effectiveness (46-57)	131	70.05	±
	High effectiveness (>57)	16	8.56	6.37

The highest proportion (58.82 percent) of farmers had medium effectiveness compared to 22.46 percent having high effectiveness and 18.72 percent had low cognitive effectiveness. Emotional reactions are often accompanied by some physiological change. Some effects like crying during a sad scene we are readily aware of, but others like an increase in blood pressure may not be accessible at a conscious level. The scoring range from 0 to 75 while respondents got the scores from 30 to 74 with the mean value 51.64, standard deviation 9.52 and variance 90.65. The highest proportion (54.01 percent) of farmers had medium effectiveness compared to 27.81 percent having low effectiveness and 18.18 percent had high emotional effectiveness. Attitudes predict behavior, but they are also important in their own right (Huston et al., 1998). Only attitude cannot forward the respondents towards the destination. The attitudinal effectiveness were being judged within the scoring range from 0 to 75 while respondents got the scores from 32 to 75 with the mean value of 52.22, standard deviation 9.29 and variance 86.24. Findings showed in Table 2 indicates that the

highest proportion (57.75 percent) of the respondents had medium effectiveness, while 24.60 percent had low effectiveness and only 17.65 percent had high effectiveness. More than four-fifths (82.35 percent) of the farmers had medium and low attitudinal effectiveness. By the agricultural television programmes farmers were influenced moderately in attitudinal effectiveness. Behavioral effectiveness is the final stage of effectiveness. Normally farmers can be informed too many new idea regarding sustainable agriculture through television. The computed behavioral effectiveness scores of the farmers ranged from 30 to 65 against the possible range 0 to 75. The mean, standard deviation and variance were 50.12, 6.37 and 40.55 respectively. Table 2 indicates that 70.05 percent farmers had shown their nod towards medium effectiveness while 21.39 percent shown low effectiveness and only 8.56 percent shown high effectiveness. Data also revealed that majority (91.44 percent) of the respondents had low or medium effectiveness.

Overall effectiveness of TV programme

Effectiveness in total is the aggregate of the four scales namely cognitive, emotional, attitudinal and behavioral. The four scales can separately measure the level of effectiveness. But if it computed in a single table it can depict the partial picture of the exact scenarios. Because although there were a limited behavioral effect shown in the separate discussion but in totality the degree of effectiveness can be more positive because of the high cognitive, emotional and attitudinal effectiveness. Albeit is important because of the lack of effectiveness measuring any other tool. The computed total effectiveness scores of the farmers ranged from 130 to 281 against the possible range 0 to 300. The mean, standard deviation and variance were 207.72, 29.46 and 865.76 respectively. Based on the effectiveness of agricultural television programmes scores, farmers were classified into three categories viz. low effectiveness (up to 180), medium effectiveness (181-230) and high effectiveness (above 230). The distribution of farmers based on their total effectiveness scores has been shown in Table 3.

Table 3 Distribution of the farmers according to their overall effectiveness

Categories (scores)	Farmers		Mean ± SD
	Number	Percent	
Low effectiveness (up to 180)	26	13.90	207.72
Medium effectiveness (181-230)	128	68.45	±
High effectiveness (>230)	33	17.65	29.46
Total	187	100	Max- 281,

Min- 130
Range- 151

Findings showed in Table 3 indicates that the highest proportion (68.45 percent) of the respondents had medium effectiveness, while 13.90 percent had low effectiveness and only 17.65 percent had high effectiveness. More than four-fifths (82.35 percent) of the farmers had medium and low effectiveness. By the agricultural television programmes farmers were influenced moderately.

Characteristics of the farmers

The distribution of farmers based on their characteristics has been shown in Table 4. The result indicated that maximum farmers (58.29 percent) were middle aged category in this study area. More than half of the respondents (54.01 percent) had secondary education compared to 24.06 percent having primary education and 0.53 percent could sign only. On the other hand, illiterate and above secondary level of educated farmers were same at the number, they were 10.70 percent. Highest proportions (62.03 percent) of the family were medium in size while 33.16 percent family was small and only 4.81 percent family were large in size. About one-thirds (28.34 percent) of the farmers did not have any training experience while 9.09 percent had low and 13.90 percent had high training experience. More than half (57.22 percent) farmers had low mass media exposure while 35.83 percent had medium and only 6.95 percent farmers had high mass media exposure.

Highest proportion (43.85) of the farmers had the experience of medium crop supervision whereas 39.57 percent respondents answered high level of supervision of crop production and 16.58 percent had low experience of supervision of crop production. Majority (49.20 percent) proportion of the farmers had medium sustainable agricultural knowledge while 28.34 percent had low sustainable agricultural knowledge and only 22.46 percent had high sustainable agricultural knowledge. More than two-thirds of the total respondents were possessed small farm while 31.55 percent had medium farm, 1.07 percent had marginal farm and no farmers had large farm in the research area. It was found that low income category (46 percent) was highest in the study area. Highest (37.43 percent) proportion of the farmers was medium cosmopolite, 30.48 percent were low cosmopolite and 32.09 percent were high cosmopolite. Majority (44.92 percent) of the farmers had medium innovativeness compared to 29.41 percent had high innovativeness and 25.67 percent had low innovativeness. Highest percentage (54.01 percent)

of farmers had moderately positive attitude toward sustainable agriculture while 25.67 percent had highly positive attitude toward sustainable agriculture and 20.32 percent had slightly positive attitude toward sustainable agriculture. Large portion (64.17 percent) of farmers had moderately positive attitude toward television while 28.34 percent had highly positive attitude toward television and only 7.49 percent had

slightly positive attitude toward television. It was found that 59.90 percent of farmers had medium risk orientation while 24.06 percent had low risk orientation and only 16.04 percent had high risk orientation in agricultural works. Highest proportion (66.31 percent) of the farmers had medium aspiration compared to 18.18 percent low and 15.51 percent high aspired.

Table 4 Farmer's characteristic profile

Characteristics	Measuring unit	Observed value	Categories	No	%	Mean \pm SD
Age	Year	27-90	Young	40	21.39	43.36 \pm 8.59
			Middle	109	58.29	
			Old	38	20.32	
Education	Scores	0.00-16	Illiterate	20	10.70	6.95 \pm 3.62
			Sign only	1	0.53	
			Primary	45	24.06	
			Secondary	101	54.01	
Family size	Scores	2-11	>Secondary	20	10.70	5.44 \pm 1.74
			Small	62	33.16	
			Medium	116	62.03	
Training	Scores	00-18	Large	9	4.81	6.02 \pm 4.61
			No	53	28.34	
			Low	17	9.09	
			Medium	91	48.67	
Mass media exposure	Scores	2-16	High	26	13.90	6.41 \pm 3.22
			Low	107	57.22	
			Medium	67	35.83	
Supervision of crop production	Scores	10-45	High	13	6.95	29.05 \pm 6.83
			Low	31	16.58	
			Medium	82	43.85	
Sustainable agricultural knowledge	Scores	20-48	High	74	39.57	34.00 \pm 6.57
			Low	53	28.34	
			Medium	92	49.20	
Farm size	Hectare	0.19-0.82	Marginal	2	1.07	0.86 \pm 0.43
			Small	126	67.38	
			Medium	59	31.55	
			Large	00	00	
Annual income	Scores	20-320	Very low	28	14.97	120.94 \pm 62.60
			Low	86	46.00	
			Medium	52	27.81	
			High	21	11.22	
Cosmopolitaness	Scores	5-19	Low	57	30.48	11.01 \pm 3.52
			Medium	70	37.43	
			High	60	32.09	
Innovativeness	Scores	17-45	Low	48	25.67	31.45 \pm 6.67
			Medium	84	44.92	
			High	55	29.41	
Attitude toward Sustainable agriculture	Scores	18-46	Slight	38	20.32	35.67 \pm 4.73
			Moderate	101	54.01	
			High	48	25.67	
Attitude toward television	Scores	20-46	Slight	14	7.49	32.13 \pm 6.15
			Moderate	120	64.17	
			High	53	28.34	
Risk orientation	Scores	8-44	Low	45	24.06	29.89 \pm 5.06
			Medium	112	59.90	
			High	30	16.04	
Aspiration	Scores	7-39	Low	34	18.18	27.92 \pm
			Medium	124	66.31	

Relationship between the effectiveness of TV programme for sustainable agricultural development and selected characteristics of the farmers

Coefficient of correlation was computed in order to explore the relationships between the effectiveness of television programme for sustainable agricultural development and selected characteristics of the farmers has been presented in Table 5.

Table 5 Coefficient of correlation between the selected characteristics of farmers and the effectiveness of TV programmes for sustainable agricultural development

Dependent variable	Independent variables	Computed 'r' values	Table of 'r' at 185 df	
			0.05	0.01
Effectiveness of television programme for sustainable agricultural development	Age	-0.188*		
	Education	0.637**		
	Family size	-0.128 ^{NS}		
	Training experience	0.602**		
	Mass media exposure	0.216**		
	Supervision of crop production	0.128 ^{NS}		
	Knowledge about sustainable agriculture	0.660**	0.144	0.140
	Farm size	0.137 ^{NS}		
	Annual income	0.301**		
	Cosmopolitaness	0.527**		
	Innovativeness	0.731**		
	Attitude towards agriculture	0.508**		
	Attitude towards television	0.287**		
	Risk orientation	0.60 ^{NS}		
	Aspiration	0.88 ^{NS}		

** = Correlation is significant at 0.01 level of probability (2-tailed),

* = Correlation is significant at 0.05 level of probability (2-tailed), ^{NS}

= Non-significant

Pearson correlation test depicted that out of 15 variables, age, education, training exposure, mass media exposure, knowledge about sustainable agriculture, annual income, cosmopolitaness, attitude towards agriculture and attitude towards television had significant relationship with the effectiveness of TV programmes for sustainable agricultural development. It was found that age had negative relationship that means effectiveness increased from old to young TV viewer farmers. Education upgrades individuals at all aspects. It facilitates individual to gain adequate knowledge and thus increase their level of understanding, consequently broadened their outlook and horizon of knowledge is expanded which boost the effectiveness. The results

indicated that the training had immense influence on increasing effectiveness of TV programmes. Similarly, mass media exposure like TV viewer easily motivated to adopt new technology and play a significant role on effectiveness. There was significant and positive relationship between knowledge about sustainable agriculture and effectiveness of TV programmes by the TV viewer farmers, which indicate that with the increase of knowledge on sustainable agriculture of the TV viewer, their effectiveness also increases. If annual incomes of the TV viewer farmers increase then their effectiveness of TV programmes will also increases. The findings indicate that with the increase of cosmopolitaness of the TV viewer, the increase of the effectiveness also increases. Innovative nature of the TV viewer farmers are more curious about various agricultural technologies which they watch on TV and adopt them accordingly. That is why high effectiveness was found from high innovative nature farmers. Attitude organizes the mental alertness to response for positive or negative attitude of an object. So, high effectiveness comes from the increasing of positive attitude towards agriculture and television by the watcher. The variables named family size, supervision of crop production, farm size, risk orientation and aspiration was not found significant relationship with the effectiveness of TV programmes for sustainable agricultural development.

Conclusion

Television can be used as an important communication media in the rural areas for dissemination information to the rural peoples. It telecasts agricultural programmes besides its other events. This topic provides different types of information in relation agriculture for sustainable development. From the preceding discussion, medium effectiveness was the highest proportion in case of every aspect of effectiveness. Overall findings indicate that more than four-fifths of the farmers had medium and low effectiveness that means by the agricultural television programmes farmers were influenced moderately. An attempt needs to be taken to organize useful scientific agricultural programmes in relation to sustainable development giving due to the nature of topics, farmers' needs and interests, farmers' availability of time and farmers' problems in matters of watching television. Also should be made by the government and nongovernment organizations to arrange some training programme for increasing literacy rate, mass media exposure, knowledge, cosmopolitaness,

innovativeness and attitude of the television viewer farmers for increasing their effectiveness. Further study needs to be undertaken from other districts of Bangladesh to draw definite conclusion.

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A CHECK LIST AND ABUNDANCE OF PHYTOPLANKTON IN RAMSAGARDIGHI, DINAJPUR, BANGLADESH

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Abstract: Phytoplankton is a micro-organism which acts as a natural source of foods for fish and other aquatic organisms in the water. It is not only as primary producer in food chain but also one of the parameters for fertility level of the water. This study was conducted to determine the abundance of phytoplankton in Ramsagardighi, Dinajpur, Bangladesh. The study was carried out from May 2011 to March 2012. Result showed that the study area pertained a total of 48 species of phytoplankton belonging to 36 genera among which Chlorophyceae was dominant group with 13 genera and 15 species. The dominancy and abundance of phytoplankton is followed by Cyanophyceae with 10 genera and 10 species and Bacillariophyceae with 6 genera and 10 species and Euglenophyceae with 3 genera and 9 species and Dinophyceae with 3 genera and 3 species as well as Xanthophyceae with 1 genera and 1 species. The phytoplanktonic peak was recorded in the month of July, 2011 and the least one was observed during the month of March, 2012.

Keywords: Checklist, abundance, phytoplankton, Ramsagardighi, Dinajpur, Bangladesh

সারাংশ : ফাইটোপ্ল্যাংকটন হলো একজাতীয় অনুজীব, যা পানিতে বিদ্যমান মাছ ও অন্যান্য জলজ জীবের খাদ্যের প্রাকৃতিক উৎস হিসাবে কাজ করে। এটি কেবলমাত্র খাদ্য জালকে প্রাথমিক উৎপাদকই নয় বরং পানির উর্বরতা শক্তির বৃদ্ধিরও পরিমাপক। এই অধ্যয়নটি দিনাজপুর জেলার রামসাগর দিঘীতে বিদ্যমান ফাইটোপ্ল্যাংকটনের প্রাচুর্যতা নির্ণয় করার জন্য করা হয়েছে। এই অধ্যয়নটি মে, ২০১১ থেকে মার্চ, ২০১২ পর্যন্ত করা হয়। অত্র গবেষণার ফলাফলে দেখা যায় যে, রামসাগর দিঘীতে সর্বমোট ৩৬টি গণের ৪৮ প্রজাতির ফাইটোপ্ল্যাংকটন রয়েছে। তার মধ্যে ক্লোরোফাইসি দলের প্রভাব সবচেয়ে বেশী, যার ১৩টি গণের ১৫টি প্রজাতি বিদ্যমান। তারপরে সাইনোফাইসির অবস্থান, সেখানে ১০টি গণের ১০টি প্রজাতি রয়েছে। ব্যাসিলারোফাইসির ৬টি গণ ও ১০টি প্রজাতি রয়েছে। তার পরে ইউগেনোফাইসি ও ডায়নোফাইসির অবস্থান এদের যথাক্রমে ৩টি গণ ও ৯টি প্রজাতি এবং ৩টি গণ ও ৩টি প্রজাতি বিদ্যমান। ১টি গণ ও ১টি প্রজাতি বিশিষ্ট জ্যান্থোফাইসির প্রাচুর্যতা সবচেয়ে কম। আর জুলাই ২০১১ সালে সবচেয়ে বেশী ও মার্চ, ২০১২ সালে সবচেয়ে কম ফাইটোপ্ল্যাংকটনের উপস্থিতি লক্ষ্য করা যায়।

Introduction

Bangladesh is a land of aquatic ecosystem which is surrounded with different kinds of ponds, rivers, canals, lakes, haors, baors and ditches (Akonda 1989) where the aquaculture is a profitable business. These aquatic environments support various communities of living organisms which constituted the biotic load of a pond. Among which planktons are the vital constituents. Plankton is the heterogeneous assemblage of minute organisms which occur in the natural water and float about by the wave action and movement of water (Moss 1982). Plankton designates the community of pelagic organisms, composed of various groups, which are in suspension in water and hence restricted mobility, often less than that of the water which carried (Declince 1992). Plankton is divided into phytoplankton or photosynthetic organisms and zooplankton or heterotrophic organisms. Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality (Bhatt et al. 1999; Saha et al. 2000). Beside, phytoplankton are very suitable organisms for the determination of the impact of toxic substances on the aquatic environment because any effect on the lower level of the food chain will also have consequence on the higher level (Joubert 1980). Phytoplankton was used for assessing the degree of pollution or as indicator of water pollution of different water bodies (Trivedy 1986; Sudhaker et al. 1994). Dwivedi and

Pandey (2002) observed that the distribution and population density of phytoplankton species depend upon the physico-chemical parameters of the environment. The abundance of phytoplankton in the waters can be seen on the basis of their abundance influenced by several environmental parameters and their physiological characteristics. It will be changed at various levels as a response to the changes in physical, chemical and biological environmental conditions. Abundance assessment of phytoplankton in water body is necessary. Because phytoplankton is the key indicator for the aquaculture pond as a natural food for fishes. Therefore, Mathew (1975) reported the abundance of phytoplankton as 74 genera in Govindgarh lake. Sreenivasan (1966) listed 12 forms of phytoplankton from India. Harron and Zaman (1974) recorded 194 species of phytoplankton. Phytoplankton is natural food for various fishes and shrimps inhabiting first producer level in energy flows. It, as primary producer in the water, is also one of the life sources for all animals. Phytoplankton is dissolved oxygen producer in the water as well. In food chain, phytoplankton is eaten by herbivores (such as zooplankton) which will also be eaten by larger carnivores (fish and others) and etc. Study of plankton is a very useful tool for the assessment of water quality in any type of water body, and also it contributes to an understanding of the basic nature and general economy of the concerned habitats. Phytoplankton has been

termed as the real grass of the water affording foods for fishes and zooplanktons. Abundance of phytoplanktons in a water body indicates that whether the supplementary feed is necessary to supply in the corresponding fish ponds or not. And thus the abundance of phytoplankton may reduce the cost of aquaculture. The objectives of the present study are to find out the abundance of phytoplankton in Ramsagardighi, Dinajpur, Bangladesh. Because Ramsagardighi is one of the greatest historical ponds of Bangladesh. But there is a little work has been done on the study of phytoplanktonic population. Therefore, the present study was designated to assess the abundance of phytoplankton as fish foods along with some important physico-chemical parameters in Ramsagardighi, Dinajpur, Bangladesh to reduce the cost of aquaculture and make the aquaculture profitable.

Materials and methods

Ramsagardighi is located at Tajpur village, in Dinajpur district, Bangladesh. This reservoir is mainly used for domestic work and aquaculture. The only zooplankton samples were collected twice in month between 7 am to 8 am by using plankton net of 64 μ mesh size for a period of 11 months from May, 2011 to March, 2012. The collected samples were kept in plastic bottles containing 4% formaldehyde. Phytoplankton identification is done by following systematic keys of Edmondson (1992) and Battish (1992). Main characters were considered for identification as lorica, corona and type of trophi for rotifers; antennules, postabdomen, number and arrangement of spines, location of lateral setae and rostrum for cladocera; antennules, antenna, caudal setae, and endopodite for copepoda and antenna, valve shape and setae for ostracods. Population density was quantified by Drop count method of Lackey (1938). The materials such as centigrade mercury thermometer (range 0-120°C), a rope, digital pH meter, pipette, stopper bottle, conical flask, reagent bottle and a diary etc were used for the determination of physico-chemical parameters of water of the study area. The

methods used to test different parameters are described below:

Water quality measurement

Sampling at the study area was carried out fortnightly from May 2011 to March 2012. Water samples were collected from the depth of 20-30 cm below the surface and also from the bottom. Physical data of the study area were recorded immediately. Water temperature was taken by using a centigrade mercury thermometer with a range of 0° to 120°C at the time of sampling. The bottom temperature of water was recorded by descending the thermometer until reaching to the bottom. The Dissolved Oxygen (mg/L) was estimated by using the Winkler's Method (APHA, 1976). Manganese sulphate, sulfuric acid, starch solution and sodium thiosulfate were used as reagents for the determination of dissolved oxygen. A sample of 300-mL glass Biological Oxygen Demand (BOD) stopper bottle brim was filled with sample water which carefully added to 2mL of manganese sulphate so that no bubble can be introduced. Finally, the sample was titrated with sodium thiosulfate up to pale straw color. Next 2 ml of starch solution was added, which imparted blue color to the solution. Thus the titration indicated the culminating point of the experiment and the data were recorded. P^H refers to the amount of hydrogen ions in a solution, which was determined by using a digital pH meter (*Model HI, Hanna 96107*). Free CO₂ (mg/l) was determined by titration of the water sample with NaOH solution (sodium hydroxide) using Phenolphthalein as an indicator (Welch, 1948). The test was done immediately after collecting the sample.

Results and discussion

A total of 48 species of phytoplankton belonging to 36 genera were recorded from the study area that is mentioned in Table 5 and 6. The physico-chemical properties of the water like water temperature (WT), pH, free carbon dioxide (fCO₂) and total dissolved oxygen (DO) of the study area were mentioned in the Table 1.

Table 1 Monthly average fluctuation of water temperature, pH, free carbon dioxide and total dissolved oxygen in Ramshagar dighi, Dinajpur, Bangladesh from May, 2011 to March, 2012.

Parameters	Months											Mean±SD
	2011					2012						
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	
WT	29.1	28.3	28.5	27.1	28.5	27.7	23.8	17.5	15.6	20.7	24.6	24.6±4.76
p ^H	7.3	6.9	7.9	8.2	7.8	7.1	7.7	7.2	7.9	8.1	8.3	7.7±0.48
freeCO ₂	2.2	1.8	0.0	0.0	1.2	0.0	0.7	2.2	0.0	0.0	1.3	0.85±0.92
DO	4.9	5.8	4.2	3.9	4.4	5.6	5.1	4.3	4.5	4.1	4.4	4.6±0.6

SD, Standard Deviation

The highest phytoplankton density was observed in the month of July and the lowest one was recorded in the month of March as well as the maximum and minimum abundance groups were recorded as Chlorophyceae and Xanthophyceae during the study period of 11 months from May, 2011 to March, 2012 (Table 2, 3 and 4, and Fig.1)

Table 2 Monthly fluctuation of Phytoplanktons (units/l) in the study area of the Ramshagar from May, 2011 to March, 2012.

Year	Month	Phytoplankton
2011	May	7855
	June	13200
	July	18500
	August	17665
	September	16975
	October	15594
	November	13225
2012	December	6460
	January	5935
	February	4370
	March	3950
Mean ±SD		11248±5625.011

Table 3 Abundance of phytoplankton in Ramsagardighi from May, 2011 to October, 2011.

Months	Phytoplankton	Abundance (Unit/l)	Abundance (Unit/l) %
May	Chlorophyceae	3215	40.93
	Cyanophyceae	2205	28.07
	Bacillariophyceae	1293	16.46
	Euglenophyceae	641	8.16
	Dinophyceae	309	3.93
	Xanthophyceae	192	2.44
June	Chlorophyceae	5493	41.6
	Cyanophyceae	3751	28.41
	Bacillariophyceae	1962	14.86
	Euglenophyceae	1271	9.63
	Dinophyceae	509	3.85
	Xanthophyceae	214	1.62
July	Chlorophyceae	7067	38.2
	Cyanophyceae	5031	27.2
	Bacillariophyceae	2505	13.5
	Euglenophyceae	1751	9.46
	Dinophyceae	1204	6.5
	Xanthophyceae	942	5.09
Aug	Chlorophyceae	6947	39.32
	Cyanophyceae	5029	28.67
	Bacillariophyceae	2321	13.14
	Euglenophyceae	1707	9.66
	Dinophyceae	1102	6.23
	Xanthophyceae	559	3.16
Sept	Chlorophyceae	6081	35.82
	Cyanophyceae	4944	29.15
	Bacillariophyceae	2505	14.75
	Euglenophyceae	1683	9.91
	Dinophyceae	1013	5.96
	Xanthophyceae	749	4.41
Oct	Chlorophyceae	6021	38.61
	Cyanophyceae	4572	29.32
	Bacillariophyceae	2380	15.26
	Euglenophyceae	1507	9.66
	Dinophyceae	805	5.16
	Xanthophyceae	309	1.98

Table 4 Abundance of phytoplankton in Ramsagardighi from, November, 2011 to March, 2012.

Months	Phytoplankton	Abundance (Unit/l)	Abundance (Unit/l)
Nov	Chlorophyceae	5286	39.97
	Cyanophyceae	3801	28.74
	Bacillariophyceae	1890	14.29
	Euglenophyceae	1303	9.85
	Dinophyceae	598	4.52
	Xanthophyceae	347	2.62
Dec	Chlorophyceae	1898	29.38
	Cyanophyceae	1408	21.79
	Bacillariophyceae	1187	18.37
	Euglenophyceae	827	12.8
	Dinophyceae	703	10.88
	Xanthophyceae	437	6.76
Jan	Chlorophyceae	1707	28.76
	Cyanophyceae	1315	22.15
	Bacillariophyceae	1023	17.23
	Euglenophyceae	874	22.21
	Dinophyceae	601	10.12
	Xanthophyceae	415	7
Feb	Chlorophyceae	1603	36.68
	Cyanophyceae	1211	27.71
	Bacillariophyceae	718	16.4
	Euglenophyceae	502	11.48
	Dinophyceae	223	5.1
	Xanthophyceae	113	2.58
Mar	Chlorophyceae	1404	35.54
	Cyanophyceae	1101	27.87
	Bacillariophyceae	712	18.02
	Euglenophyceae	297	7.52
	Dinophyceae	243	6.15
	Xanthophyceae	193	4.88

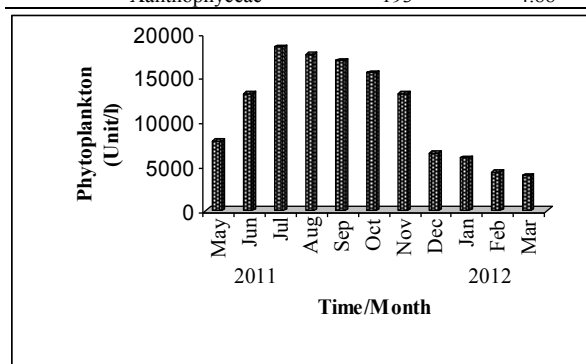


Fig. 1 Abundance of Phytoplanktons (units/l) in Ramsagardighi during the study period of May, 2011 to March 2012.

Chlorophyceae

Chlorophyceae was a dominant group of phytoplanktons by 15 species belonging to 13 genera of the study area of Ramsagardighi, Dinajpur, Bangladesh (Table 5). The generic diversity of Chlorophyceae has more dominance than those of others. Welch (1948) stated that this dominance of Chlorophyceae might be due to lower temperatures and high DO contents. Raymond (1937) opined that the green algae prefer

water with higher concentrations of DO. Vyas and Kumar (1968) added that high nutrients and increase in water temperature appeared to be congenial for growth of Chlorophyceae. The role of temperature in the growth and development of the green algae has been emphasized by many workers from time to time (Singh et al., 1980). According to Singh et al. (1980) high air or water temperature along with bright sunshine was important factors in the productivity of green algae. Khondker and Parveen (1988) observed more abundance of Chlorophyceae during monsoon months, which is in conformity with the present findings.

Cyanophyceae

Cyanophyceae was represented by 10 species belonging to 10 genera showing dominance in the present study area. Blue green algae were represented as the second dominant group (Table 5). Gonapati (1940) reported the absence of Cyanophyceae bloom in water with high organic contents. Vyas and Kumar (1968) noticed abundant growth of blue green algae under nutrient rich conditions. The presence of *Microcystis* sp. in the study area is indicative of a eutrophic or highly productive nature of the water body, which is supported by Sreenivasan (1964).

Table 5 A checklist of phytoplankton (genera/species) prevailing in Ramshagardighi, Dinajpur, Bangladesh during the investigation period of May 2011 to March 2012.

Serial no.	Genera/Species
1.	Tetraodon verrucosum
2.	Chlorella vulgaris
3.	Chodetella longesita
4.	Pediastrum simplex
5.	Ulothrix gonata
6.	Ulothrix cylindricum
7.	Oedogonium sp.
8.	Chlorophyceae Closterium sp.
9.	Euastrum sp.
10.	Cosmarium sp.
11.	Xanthidium mammosum
12.	Spirogyra sp.
13.	Tetrastrum sp.
14.	Microspora sp.
15.	Volvox carteri
	Chroococcus sp.
	Microcystis sp.
	Aphanocapsa sp.
	Oscillatoria sp.
	Nostoc corneum
	Anabaena sp.
	Cylindrospermum indicum
	Rivularia sp.
	Lyngbya sp.
	Alusira sp.

Bacillariophyceae

In the present study, Bacillariophyceae was represented by 6 genera with 10 species. It was the third dominant group of phytoplanktons in the study area (Table 6). Naz (1999) observed the minimum abundance of Bacillariophyceae during the summer months which supported the present study. This abundance may be due to the temperature and some other physico-chemical properties of water of the study area. Kant and Anand (1978) suggested that high temperature favoured the growth of Bacillariophyceae. Pearsall (1930) opined that rain wash accelerated the growth of diatoms which is in conformity with the present results. George (1961) and Zafar (1964) observed that the poor diatom populations were due to deficiency of silica in water along with moderate pH (7.5-8.1) favoured the growth of diatoms. The dominant species to this group were *Navicula*, *Pinnularia* which indicated the waterbody as more productive or eutrophic.

Euglenophyceae

The class, Euglenophyceae represented mainly by *Euglena*, *Phacus* and *Trachelononcus* with total of 9 species and 3 genera exhibiting lower abundance in the study area of Ramsagardighi (Table 6). George (1966) recorded the abundance of Euglenophyceae and Hutchinson (1957) reported that this group as a whole is facultative by heterotrophic nutrition, and was generally abundant in water that was rich in organic matter. This abundance in the present study may be due to the variation in P^H value and some other physico-chemical properties of water. George (1964) observed that high pH value promotes the growth of the phytoplankton. It was supported that the pH value favoured the growth of phytoplankton as observed by Gonzalves and Joshi (1946).

Dinophyceae

Three genera and 3 species of Dinophyceae were reported in the present study area of Ramsagardighi with less abundance among the phytoplankton population (Table 6). Anjana (1998) showed the abundance of the phytoplanktons and its correlation with the physico-chemical properties of water. This abundance may be due to the variations in water parameters. Munawar (1974) reported that dissolved oxygen and p^H had the impact on the abundance of phytoplanktons. Verma and Mohanty (1995) showed that the density of phytoplankton was dependent on different abiotic factors either directly or indirectly.

Xanthophyceae

Xanthophyceae, as lowest dominant group among the phytoplanktons is represented by one genus with one

species only and occurred sporadically (Table 6). Rao (1953) reported the abundance of Xanthophyceae which had much more abundance in winter than in spring months, and was frequently noticed in acidic ponds.

Table 6 A checklist of phytoplankton (genera/species) prevailing in Ramsagardighi, Dinajpur, Bangladesh during the investigation period of May 2011 to March 2012.

Serial no.	Genera/Species
1.	Navicula sp.
2.	Melosira granulata
3.	M. variance
4. Bacillariophyceae	Synedra acus
5.	S. ulna
6.	Pinnularia radiosa
7.	P. tabellaria
8.	P. viridis
9.	Amphicampa eruca
10.	Cymbella sp.
1.	Euglena acus
2.	Euglena spirogyra
3.	Euglena rostrifera
4.	Euglena sp.
5. Euglenophyceae	Phacus obulus
6.	Phacus longicauda
7.	Phacus sp.
8.	Trachelomonas hispida
9.	Trachelomonas sp.
1.	Gonyaulax apiculata
2. Dinophyceae	Glenodinium sp.
3.	Peridium sp.
1. Xanthophyceae	Ophiocytium capitatum

Our results are in close conformity with those reported above. However, more comprehensive works are to be solicited.

Conclusion

The abundance of phytoplankton indicated that Ramsagardighi was considerably productive. The abundance of phytoplankton population showed that natural foods for fishes were available in the study area where suitable and cost effective aquaculture could be solicited.

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VERTEBRATE DIVERSITY OF BABU-DYING IN RAJSHAHI- CHAPAINAWABGONJ DISTRICTS, BANGLADESH

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Abstract: With a view to gather information on the diversity, habitat, distribution and residential status of vertebrates (except bird) of "Babu-Dying" which is under Mohonpur Union, Godagari Upazila, Rajshahi district and Jhilim Union, Sadar Upazila, Chapainawabgonj district, a systematic field study was conducted for a period of six months from December 2007 to May 2008. A total of 35 of vertebrates (except birds), belonging to 10 orders, 20 families and 29 genera were recorded. Out of 35 species, 22 (63%) comprised mammals, 9 (26%) reptiles and 4 (11%) amphibians. The study revealed that most of the species used more than one habitat and the highest number of species, 15 (43%) were observed on the human habitation and the lowest number of species, 1 (2.68%) was found in bamboo clumps. The highest number of species 8 (23%) were domestic and the lowest number of species 4 (11%) were few or rare. A number of environmental and man-made factors appeared to be responsible for decline in the population and species diversity of the vertebrates in the study area.

Keywords: Vertebrates, Diversity, Habitat, Babu-Dying, Rajshahi-Chapainawabgonj.

সারাংশ : রাজশাহী বিভাগের রাজশাহী-চাঁপাইনবাবগঞ্জ জেলায় বারু-ডাইং-এ মেরুদণ্ডী প্রাণিবৈচিত্র্য, (পাখি ব্যতীত) তাদের আবাসস্থল ও স্থিতি সম্পর্কিত তথ্যবলী সংগ্রহের জন্য ডিসেম্বর, ২০০৭ হতে মে, ২০০৮ পর্যন্ত ছয় মাস মার্চ পর্যায়ের জরিপ চালানো হয়। পর্যবেক্ষণের সময় ৩৫ প্রজাতির মেরুদণ্ডী দেখা গেছে, এরা ১০ টি বর্গের ২০টি গোত্রের এবং ২৯টি গণের অন্তর্ভুক্ত। ৩৫ প্রজাতির মেরুদণ্ডীর মধ্যে ২২ টি (৬৩%) স্তন্যপায়ী, ৯ টি (২৬%) সরীসৃপ এবং ৪ টি (১১%) উভচর, প্রজাতিগুলোর সর্বোচ্চ ৮ টি (২৩%) গৃহপালিত এবং ৪ টি (১১%) বিরল। বেশীর ভাগ মেরুদণ্ডীদের একাধিক আবাসস্থল ব্যবহার করতে দেখা গেছে। গবেষণা এলাকার মেরুদণ্ডী বৈচিত্র্য এবং এদের সংখ্যা দিন দিন কমে যাওয়ায় পেছনে পরিবেশগত ও মানুষ সৃষ্ট বিভিন্ন কারণ দায়ী বলে প্রতীয়মান হয়।

Introduction

Babu-Dying is a small area situated at 24°33'N to 24°40'N and 88°20'E to 88°26'E in between the Mohonpur Union, Godagari Upazila, Rajshahi district and Jhilim Union, Sadar Upazila, Chapainawabgonj district.

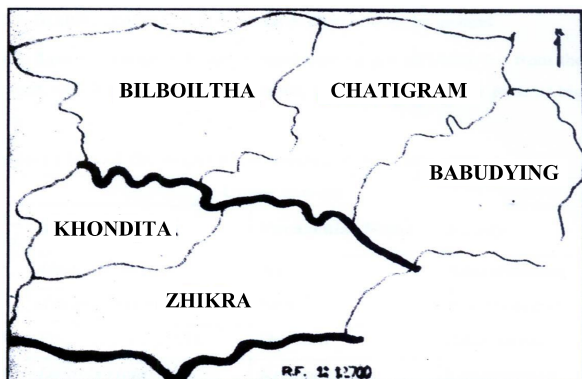


Fig. 1 Map of Babu-Dying Area.

Biodiversity probably is the most burning questions in news and public media now-a-days. The emphatic conversation with this affair among people is going on from United Nations to more or less all countries. The very consciousness and awareness about environment in the world has drawn considerable attention to this matter.

For community study of flora and fauna, species diversity is a function of the number of different species, the number of individuals per species, and the total number of individuals of all species present in that community at a definite time period (Southwick 1979).

It is a challenging parameter to measure because diversity is an organized hierarchically, and as a consequence, pattern of diversity at one level is linked statistically and by evolutionary history of the patterns of higher and lower levels (Gottelli 2002). Out of the total number of species in the trophic component, or in a community as a whole, relatively small percentages are usually abundant and a large percentage is rare. While the few common species, or dominants, largely account for the energy flow in trophic group, it is the large number of rare species that largely determine the species diversity of trophic groups and whole communities (Odum 1971). Abundance and distribution is one of the major characteristics of species in a community. It indicates the status of particular species and shows the ecological conditions of a particular environment.

Vertebrate diversity is a part of biodiversity. It deals with mammals, birds, reptiles, amphibians and fishes. During the last three decades or so the wildlife of the different parts of Bangladesh has been studied by different workers (Hussain 1974, 1996; Islam and Islam 1997; Sarkar and Sarker 1988; Rahman 1995; Das 1964; Khan 1985, 1987; Haque 1986; Hussain and Rahman 1978; Khan 1995, 1996, 1998; Chakma 1995; Jahan 1995; Jaman 1996; Khanam 1978; Akhter 1997; Mannan et al., 1998).

A literature survey shows that no recent work has been done on the vertebrate fauna of Babu-Dying in Rajshahi-Chapainawabgonj. The present work therefore was undertaken to describe the existing non-avian vertebrate

fauna of Babu-Dying in Rajshahi-Chapainawabgonj district with special reference to their habitats, abundance and residential status, which will provide some basic information for future in-depth studies and conservation of the vertebrates in the study area.

Materials and methods

Materials

To observe the vertebrates of the study area the following materials were used:

- i) **Side bag:** For carrying essential things.
- ii) **Books:** Different books related to species-identification, e.g.-Bangladesher Bannapran, booklets, etc.
- iii) **Field binoculars:** ORIGINAL CROWN, TRIPLE TESTED, 8×30, Field 7.5 binoculars to watch clearly from a distance.
- iv) **Camera:** SONY, cyber-short. Digital still camera (DSC-W55). 7.2 Megapixels, 2.5" LCD monitor. Macro function 2 cm, for using photography of different animals and their habitats.
- v) **Torch light:** 'TIGERHEAD' three battery torch light to search different species of wildlife at night and in the bush lands during the study period.
- vi) Note book, pencil, pen, polythene bags, thin rope, safety match, candle etc. for different purpose.

Methodology

The study was based on direct observations with the help of the local inhabitants. The study was started in December 2007 and continued up to May 2008. The observations were carried for one to four days in a month.

Direct observation

Direct observation of the vertebrates was conducted by the following methods.

- a. **Transact method:** Data were collected in several crossings which were made by vehicle as to cover the whole area. Sometimes the study were visited on foot.
- b. **Call and song:** Though sharp eyes and alertness are important in running down wildlife, a good ear is also valuable for identification animals by following their calls and songs. These were utilized in tracking down the relevant vertebrates under study.
- c. **Capturing:** For identification some vertebrates were captured and were released after taking notes (identifying characters) .

Species that were not possible to identify in the field, were noted and identified later with the help with the help of the museum specimen.

Observations with the help of local inhabitants

To collect data, a set of questionnaires were distributed among some of the inhabitants residing in the Babu-Dying area. These included:

- i. Local names of the species,
- ii. Colour, shape and size of the species,
- iii. Call and activities of the species,
- iv. Present status of the species- very common (VC), common (C), fairly common (FC), few (F) and rare (R).

The supplied questionnaires were collected duly and analyzed properly with the help of different published materials and documents.

Results

A total of 35 species of vertebrates belonging to Mammalia, Reptilia and Amphibia were recorded from the study area (Tables 1, 2 and 3). They were found to belong to 10 orders, 20 families and 29 genera.

Table 1 A list of mammals of Babu-Dying

Order	Family	Scientific Name	English Name	Bengali Name	Country Status	Status of abundance
Insectivora	Soricidae	<i>Suncus murinus</i>	Shrew	Chika	C	C
Chiroptera	Pteropodidae	<i>Pteropus giganteus</i>	Flying fox	Badur	C	C
Chiroptera	Vespertilionidae	<i>Pipistrellus coromandra</i>	Gray Indian Pipistrelle	Lakkhi Badur	R	VC
Carnivora	Canidae	<i>Canis aureus</i>	Asiatic jackel	Shial	C	VC
Carnivora	Canidae	<i>Canis familiaris</i>	Dog	Kutta/Kukur	VC	VC
Carnivora	Viverridae	<i>Herpestes edwardsii</i>	Mongoose	Beji	C	VC
Carnivora	Viverridae	<i>Viverricula indica</i>	Small Indian civet	Khatas	R	VR
Carnivora	Felidae	<i>Felis catus</i>	Cat	Biral	V	VC
Carnivora	Felidae	<i>Felis chaus</i>	Jungle cat	Gabra	VC	VC
Rodentia	Hystricidae	<i>Hystrix indica</i>	Saderu	Sojaru	R	R
Rodentia	Muridae	<i>Mus booduga</i>	Field mouse	Metho indur	VC	FC
Rodentia	Hystricidae	<i>Mus musculus</i>	House mouse	Negti indur	VC	VC
Rodentia	Hystricidae	<i>Bandicota bengalensis</i>	Mole rat	Dhare indur	VC	VC
Pholidota	Manidae	<i>Manis crassicaudata</i>	Scaly anteater	Bonrui	VR	VR
Lagomorpha	Leporidae	<i>Rufous tailis</i>	Hare	Kankhara/Khorgos	R	VR
Artiodactyla	Suidae	<i>Sus serofo</i>	Wild boar	Sukur	VC	VC
Artiodactyla	Bovidae	<i>Capra falconeri</i>	Goat (large)	Ramchagal	VC	F
Artiodactyla	Bovidae	<i>Capra indicus</i>	Goat (small)	Bokri/Chagol	VC	C
Artiodactyla	Bovidae	<i>Ovis aries</i>	Sheep	Vera	VC	VC
Artiodactyla	Bovidae	<i>Bos indicus</i>	Cow	Goru	VC	VC
Artiodactyla	Bovidae	<i>Bubalus bubalis</i>	Buffalow	Mohis	C	R
Perissodactyla	Equidae	<i>Equus caballus</i>	Horse	Ghora	R	VR

Table 2 A list of reptiles of Babu-Dying

Order	Family	Scientific Name	English Name	Bengali Name	Country Status	Status of abundance
Squamata	Gekkonidae	<i>Gekko gekko</i>	Lizard	Tokkhok	C	VC
Squamata	Gekkonidae	<i>Hemidactylus brooki</i>	House lizard	Khoskhose tiktiki	VC	C
Squamata	Gekkonidae	<i>Hemidactylus flaviviridis</i>	Large lizard	Goda tiktiki	R	C
Squamata	Gekkonidae	<i>Calotes versicolor</i>	Lizard	Rokto chosa	C	VC
Squamata	Scineidae	<i>Mabuya carinata</i>	Lizard	Anjon	C	F
Squamata	Varanidae	<i>Varanus flaviscens</i>	Four limb snake	Sona guei	R	VR
Squamata	Elapidae	<i>Naja naja</i>	Indian cobra	Nag	R	R
Squamata	Colubridae	<i>Ahaetulla nasutus</i>	Tree snake	Laudoga shap	C	C
Squamata	Colubridae	<i>Ptyas mucosus</i>	Large eye snake	Daraj	R	F

Table 3 A list of amphibians of Babu-Dying

Order	Family	Scientific Name	English Name	Bengali Name	Country Status	Status of abundance
Anura	Bufo	<i>Bufo melanostictus</i>	Toad	Kuno bang	VC	VC
Anura	Ranidae	<i>Rana tigerina</i>	Bull Frog	Kola/sona bang	C	C
Anura	Ranidae	<i>Rana cynophlyctis</i>	Skipper Frog	Kotkoti bang	C	C
Anura	Rhacophoridae	<i>Rhacophorus leucophorus</i>	Tree Frog	Gecho bang	R	R

* C = Common; VC = Very common; F = Few; R = Rare; VR = Very rare; FC = Fairly common.

Out of 22 mammals very common were 50%, common 13%, fairly common 5%, few 5%, rare 9%, very rare 18%. Representing 9 reptiles very common are 22%, common are 34%, few 22%, rare 11% and very rare 11%. Representative 4, amphibians 25% were very common, 50% common and 25% rare. So, the results on different vertebrates 40% were very common, 23% indicated that common, 3% fairly common, 9% few, 11% rare and 14% very rare.

Table 4 Status of the recorded vertebrate groups of Babu-Dying.

Status	Mammals		Reptiles		Amphibians		Total	
	No.	%	No.	%	No.	%	No.	%
Common (C)	3	13	3	34	2	50	8	23
Very Common (VC)	11	50	2	22	1	25	14	40
Fairly Common (FC)	1	5	0	0	0	0	1	3
Rare (R)	2	9	1	11	1	25	4	11
Very Rare (VR)	4	18	1	11	0	0	5	14
Few (F)	1	5	2	22	0	0	3	9
Total	22	100	9	100	4	100	35	100

The availability status of the recorded species is shown in (Table 4). The species diversity for different habitats of the study period is presented in Table 5. It was found that majority of the species used their habitats. The highest number of 12 species (45.71%) was observed to human habitation areas whereas the lowest number of 1 species (2.68%) was observed to agricultural land, jungle, open area, ditches and bamboo clamp.

Table 5 Habitat-wise species diversity of the vertebrates of Babu-Dying.

Habitats	Number of Vertebrates			Total No. of Habitats	% of total recorded species
	Mammals	Reptiles	Amphibians		
human habitatio	12	3	1	16	45.71
Tree	1	1		2	5.71
Bush	5	3		8	22.86
Agricultural land	5	1		6	17.14
Jungle	2	3		5	14.29
Open area		1		1	2.86
Hedges		1		1	2.86
Pond		1	2	2	8.57
Ditches			1	1	2.86
Bamboo clamp			1	1	2.86

Discussion

A total of 35 species of vertebrates were recorded during the study period. According to Husain (1996), Khan (1998), Rahman (1995) and Sarker & Sarker (1983) 746-1165 species of vertebrates exist in Bangladesh. Unfortunately, 18-20 important species became extinct from Bangladesh (IUCN 1996).

Mammalian Diversity:

A total of 22 species of mammals were recorded under 12 families. Among them the maximum number of species belonged to the family, Bovidae. It can be mentioned here that Babu-Dying is an area of most diversified mammalian group.

The status of vertebrates of the study area was based on villagers information. Out of the 22 mammals eight species were domestic, seven wild, two very common, three common, one fairly common and one was few or rare.

Reptilian Diversity :

A total of 9 species of reptiles were recorded and categorized in a single order. Among them four species belong to the family- Gekkonidae, two to Colubridae, one to Scineidae, one to Varanidae and the rest one to the family- Elapidae. According to Khan (1998) and Jahan (1995) 124-154 species of reptiles are present in Bangladesh. Among the total 9 species of reptile, 2 were very common, 3 common, 2 fairly common and 2 very few or rare.

According to CITES 6 species of reptiles viz. *Aspideretes hurum*, *Lissemys punctata*, *Ptyas mucosus*, *Naja naja*, *Varanus bengalensis* and *Varanus flavescens* are enlisted from Bangladesh.

Amphibian diversity:

A total of 4 species of amphibians were recorded under three families. Among them two were in the family- Ranidae, one in Rhacophoridae and one in Bufonidae. According to Sarker & Sarker (1983), 15-23 species of amphibians are found in Bangladesh.

Out of the four species of amphibians, one was very common, two common and two very few or rare. According to CITES schedule, only one species of Amphibia (*Hoplobatrachus tigerinus/Rana tigerina*) is enlisted.

In the present work it was found that wild animals of Babu-Dying was very few in number. It is mainly due to the shrinkage of the habitats, over-hunting and killing, and destroying of their feeding and breeding grounds.

Conclusion

Although the study area harbours a considerable number of non-avian vertebrates, some potential threats to vertebrates were identified during the study period. The major threats were illegal cutting of trees and bamboo, conversion of natural forests to monoculture plantations and agricultural fields, and hunting and trapping of vertebrates, especially by the ethnic tribal people. Some general considerations need attention for protecting vertebrates and their habitats from the above mentioned threats. It is therefore recommended that further intensive studies need to be conducted on the protection and conservation of vertebrates of Babu-Dying in Rajshahi-Chapainawabgonj Districts in the near future.

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SUBJECTIVE WELL-BEING AND SELF-ESTEEM OF THE UNDERGRADUATE STUDENTS

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Abstract : The present study attempted to investigate the relationship between subjective well-being and self-esteem of undergraduate students. Self-esteem of 200 undergraduate students was measured by administering the Bangla version (Ilyas, 2003) of Rosenberg's (1965) Self-esteem Scale. Subjective well-being of the same subjects were also measured by the Bengali version of (Akter, B, 2003) MUNSH scale. Then the subjects were divided into three groups-high, medium and low on the basis of their obtained score on subjective well-being scale and comparison were made among the three groups on subjective well-being by employing a ANOVA and t-test. The results of the study reveal that self-esteem increases with the increase in subjective well-being of the respondents.

Key words: Subjective well-being, Self-esteem

সারাংশ : বর্তমান গবেষণার উদ্দেশ্য ছিল বিশ্ববিদ্যালয়ের ছাত্র/ছাত্রীদের ব্যক্তিগত সুখবোধ ও আত্ম-মর্যাদার মধ্যে সম্পর্ক অনুসন্ধান করা। ২০০ জন স্নাতকপূর্ব ছাত্রের আত্ম-মর্যাদা পরিমাপের জন্য Rosenberg এর আত্ম-মর্যাদা মানকের বাংলা সংস্করণ (ইলিয়াস, ২০০৩) ব্যবহার করা হয়। একই উত্তরদাতাদের ব্যক্তিগত সুখবোধ পরিমাপের জন্য MUNSH মানকের বাংলা সংস্করণ (আকতার, ২০০৩) প্রয়োগ করা হয়। অতঃপর অংশগ্রহণকারীদের আত্ম-মর্যাদা/ব্যক্তিগত সুখবোধ মানকে প্রাপ্ত উপাত্তের উপর ভিত্তি করে উচ্চ, মধ্যম ও নিম্ন দলে ভাগ করা হয়। এবং তিনটি দলের মধ্যে তুলনা করার জন্য একমুখী ভেদাংক বিশ্লেষণ ও টি-পরীক্ষা ব্যবহার করা হয়। গবেষণার ফলাফল হতে দেখা যায় যে, উত্তরদাতাদেরও ব্যক্তিগত সুখবোধ বাড়লে আত্ম-মর্যাদাও বাড়ে।

Introduction

Subjective well-being is a person's own assessment of his happiness and satisfaction with life. The term "subjective well - being" (SWB) refers to people's evaluations of their lives. Diener, Eunkook, & Shigehiro, (1997) define subjective well-being as positive and negative emotional feelings about personal quality of life. According to Diener et al (1997) People are said to have high SWB if they are satisfied with their life conditions and experience frequent positive emotions and fewer negative emotions. Subjective well-being is the psychological term for "happiness" and is preferred because of the many connotations of the latter term. Ostrom (1969) defines subjective well-being as an attitude, and it includes at least two basic components of attitude cognitive and affective. The cognitive component refers to the logical or intellectual aspects of subjective well-being and the affective component involves emotional aspects. According to Diener (2003) high subjective well-being is a reflection of positive thoughts and feelings about person's life, consisting of three components: frequent positive affect, infrequent negative affect, and a global sense of satisfaction with life. Rosenberg (1965) defines self-esteem as a positive or negative orientation towards the self and reflects a sense of self-regard and self-worth. According to Skodol (1998) self-esteem is the sense of self-worth, self-respect, and self-acceptance that is usually linked to an expectation of success in life. Self-esteem is one's attitude towards oneself or one's opinion or evaluation of oneself, which may be positive (favorable or high), neutral, or negative (unfavorable or low). Self-esteem is also called self-evaluation. A person's self-esteem

affects his or her behavior, his or her understanding of how the world works and where he or she fits into it.

A review of literature reveals that a large number of studies have been conducted to investigate the relationships between self-esteem and subjective well-being. As for examples, Padhy, Rana and Mishra (2011) in their study found a significant positive relation between self-esteem, subjective well-being and academic achievement. The study also revealed that female students possessed significantly higher self-esteem and subjective well-being than their male counterparts. Joshanloo & Asshari (2011) found that self-esteem is one of the strongest predictors of mental well-being in Iran. Freire and Tavares (2011) also reported a strong and positive correlation between self-esteem and life satisfaction from the results of their study. Many other investigators (Diener and Diener 1995; Emmons and Diener 1985; Lewinson and Workers 1991; Pearlin, 1989; Suh, 2000; Kwan, Bond & Singelis, 1994) reported similar findings from the results of their study. But these findings do not allow us to draw cause-effect relationship between self-esteem and subjective well-being because the findings were obtained through correlational research. Secondly, the above mentioned studies were done in a different culture, not the Bangladeshi culture. Therefore, the author feels that it is necessary to conduct a study to investigate whether self-esteem is a significance variable of subjective well-being or not. The present study was designed for this end.

Objective of the study

The objectives of the present study were as follows:

1. To investigate whether self-esteem varies with the variation of subjective well-being.
2. To examine whether the self-esteem of the respondents with high subjective well-being is significantly higher than those with middle or lower self-esteem.
3. To investigate whether the self-esteem of the respondents with medium subjective well-being is significantly higher than those with lower subjective well-being.

Hypothesis

Self-esteem of undergraduate students is directly related to their Subjective well-being.

Materials & Methods

Sample

Sample of the present study consisted of 200 undergraduate male students. They were readily available selected from different disciplines of Rajshahi University. Their age ranged from 18 to 24 years.

Measuring Instruments

Bangla version (Akter, B 2003) of MUNSH Scale and Bangla version (Ilyas, 2003) of Rosenberg Self-esteem scale was used as measuring instruments.

MUNSH happiness scale

The scale was originally developed by Kozma & Stones (1980). The Bangla version of the scale was developed by Bilkis. The test-retest and parallel form reliability coefficients of the Bangla version were .81 ($p < 0.01$) and .33 ($p < .01$) respectively. The MUNSH Scale consists with 24 items. Among them there are five for Positive Affect (PA), (those includes- 1,2,3,4,10); five for Negative Affect (NA), (those includes- 5,6,7,8,9); seven for Positive Experience (PE), (those includes- 12,14,15,19,21,23,24); and seven for Negative Experience (NE) items (11,13,16,17,18,20,22).

Respondents were asked to put a tick mark (✓) to the box at the right columns of the test booklet that is befitting to him or his feelings in the form of "Yes" "Don't know", and "No". Scoring: yes = 2, don't know = 1, and No = 0. Item 19: Present Location = 2; Other Location = 0. Item 23: Satisfied = 2; Not Satisfied = 0. Four separate scales scores were computed: A Positive Affect (PA) Scale score (the sum of responses to all positive affect questions). A Negative Affect (NA) Scale score (the sum of responses to all negative affect questions). A Positive Experience (PE) Scale score (the sum of responses to positive experience questions). A Negative Experience (NE) Scale score (the sum of responses to negative experience questions). The difference between the Affect Scales (PA-NA) and the

Experience Scales (PE-NE) are summed up. Therefore, because of the nature of computation formula (PA-NA + PE-NE), the scores varies from -24 to +24. Then a constant of 24 is added to obtain a total MUNSH score to avoid minus scores. Thus, MUNSH Total = (PA-NA+ PE- NE) + 24. Therefore, the MUNSH score range varies from zero to 48. A high total score indicates higher level of subjective well-being and a low total score indicates a lower level of subjective well-being.

Rosenberg Self-esteem Scale (Rosenberg, 1965)

The scale was originally developed by Rosenberg (1965) to measure adolescent's feeling of self-worth or self-acceptance. It is a 10 item Likert type scale with four alternative responses ranging from 'strongly agree' (4), 'agree' (3), 'disagree' (2) and 'strongly disagree' (1). The scale contains 5 positive and 5 negative items where negative items are scored reversely. The total raw score of this scale ranges from 10-40, where high score indicates higher level of self-esteem and low score indicates lower level of self-esteem. Test-retest reliability coefficients of the original scale ranged from 0.82 to 0.88, and Cronbach's Alpha for various samples ranged from 0.77 to 0.88 (Blascovich and Tokama, 1991). The scale was adapted in Bangla by Ilyas (2003) considering the socio-cultural context of Bangladesh. Significant correlation between English and Bengali Version ($r = .87$, $P < .0005$) indicated translation reliability of the Scale and high Cronbach's Alpha ($\alpha = .87$) of Bengali version further indicated internal consistency of the scale (Ilyas 2003).

Design of the study

The study was designed to investigate the effect of subjective well-being of undergraduate students on their self-esteem. The independent variable was self-esteem and dependent variable was subjective well-being of the respondents. The respondents were classified into high, average and low subjective well-being groups on the basis of their subjective well-being score. Respondents obtaining score above 75th percentile were considered as high, below 25th percentile as low and between 25th and 75th percentiles as medium subjective well-being group. Comparisons were made among the three groups on the basis of the scores on self-esteem employing one way ANOVA.

Procedure

The standard procedure was followed to collect data. They were informed about the purpose of the present study and were simply briefed about the questionnaire. Firstly, they filled up their personal information sheet and then they were asked to indicate his or her feelings towards all the items of the two scales. After

completion of their task, the questionnaire was collected from them. The raw scores for each item were summed up to get the total score. Thus, the total score of each respondent was computed.

Results

The respondents were classified into three subjective well-being groups- high, medium and low. The data obtained from this study were analyzed employing ANOVA. The obtained results have been presented in table 1.

Table-1 Summary of ANOVA on self-esteem scores

Source of variation	Sum of Squares	df	Mean Square	F	p
Between Groups	730.776	2	365.388	25.380	0.00*
Within Groups	2836.099	197	14.396		
Total	3566.875	199			

Table-1 shows a highly significant difference among the three groups which indicate that Self-esteem varies significantly as a function of Subjective well-being. Comparisons were also made between high and low, high and medium, medium and low group employing t-test. The results have been presented in table-2, below

Table-2 Results of comparisons among three groups.

Groups compared	N	Mean	SD	df	t	p
High & Low	45	31.84	3.54	85	6.85	0.00*
Medium & Low	113	28.92	3.68	153	4.11	0.00*
High & Medium	45	31.84	3.54	156	4.56	0.00*
	113	28.92	3.68			

The table shows significantly (p is 0.00) higher self-esteem for high subjective well-being group than those of medium and low subjective well-being group. The medium subjective well-being group was also found to have significantly (p is 0.00) higher self-esteem than the low subjective well-being group.

Discussion

The aim of the present study was to investigate the relationship of subjective well-being of undergraduate students on their self-esteem. The subjective well-being of 200 undergraduate students of Rajshahi University was measured by administering MUNSH Scale. The self-esteem of the same respondents was also measured applying Rosenberg's self-esteem scale. The respondents were divided into three groups- high,

medium and low subjective well-being groups on the basis of their obtained score. The comparisons were made among three groups employing one way ANOVA.

It was hypothesized that self-esteem is directly related to subjective well-being. The results of ANOVA reveal that self-esteem varies as a function of subjective well-being of the respondents. Comparisons were also made between high & medium, high & low and medium & low subjective well-being group. The results indicate that the self-esteem of high subjective well-being group was significantly higher than medium and low subjective well-being group. The self-esteem of medium subjective well-being group was also found significantly higher than that of low subjective well-being group. Thus the results of the study confirm the hypothesis of the study.

Conclusion

Thus the findings of the study suggest that subjective well-being is a significant determinant of self-esteem. Self-esteem is found to be increased with the increase of subjective well-being. Admitting the different limitations it is expected that the present findings will enrich our knowledge about the relationship between self-esteem and subjective well-being. However, further research with larger representative sample from different socio-economic backgrounds and different areas of Bangladesh are required to draw a clear cut conclusion on the relationship between subjective well-being and self-esteem.

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EFFECT OF TOPICAL APPLICATION OF DIASULIN[®] 30/70 ON SOME COMMERCIAL CHARACTERS OF SILKWORM, *BOMBYX MORI* L.

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Abstract: The effect of insulin "Diasulin[®] 30/70" was tested against III, IV and Vth instar larvae of silkworm, *Bombyx mori* commercial crossbreed race-Urbashi for improving the performance of growth, cocoon and egg characteristics. In the present investigation Diasulin[®] 30/70 was used in 4 concentrations (20 ml/0.5 liter water (LW), 10 ml/0.5 liter water (LW), 5 ml/0.5 liter water (LW) and 2.50 ml/0.5 liter water) dissolved in distilled water. Ten micro liters of each selected concentrations of Diasulin[®] 30/70 were topically applied to individual larvae of silkworm once a day. The larval weight, cocoon and egg characteristics were influenced by various concentrations of Diasulin[®] 30/70. Among the different concentrations 5 ml/0.5 LW concentration of Diasulin[®] 30/70 was highly effective against the mean larval weight, cocoon weight, shell weight, pupal weight, silk gland weight, total number of eggs and hatching percentage over the control. In the present study moderate concentration of Diasulin[®] 30/70 used for topical application was found to improve the economic traits of silkworm, *B. mori* and can be used in sericulture for yield improvement.

Keywords: *Bombyx mori*, Diasulin[®] 30/70, insulin

সারাংশ : লার্ভার বৃদ্ধি, কোকুন এবং ডিমের বৈশিষ্ট্যে ও উন্নতির জন্য রেশমপোকা *Bombyx mori* এর বাণিজ্যিক সঙ্কর জাত উরবসী এর তৃতীয়, চতুর্থ এবং পঞ্চম দশার লার্ভার উপর Diasulin[®] 30/70 এর প্রভাব পরীক্ষা করা হয়েছে। বর্তমান অনুসন্ধানে Diasulin[®] 30/70 এর চারটি মাত্রা (২০ মি.লি/ ০.৫ লি. পানি, ১০ মি.লি/ ০.৫ লি. পানি, ৫ মি.লি/ ০.৫ লি. পানি এবং ২.৫ মি.লি/ ০.৫ লি. পানি) পাতন করা পানিতে দ্রবীভূত করে ব্যবহার করা হয়েছে। প্রত্যেক নির্বাচিত মাত্রার Diasulin[®] 30/70, ১০ মাইক্রোলিটার করে নিয়ে দিনে একবার করে রেশম পোকার লার্ভার উপর বাহ্যিক ভাবে প্রয়োগ করা হয়েছে। লার্ভার ওজন, কোকুন এবং ডিমের বৈশিষ্ট্যগুলি বিভিন্ন মাত্রার Diasulin[®] 30/70 দ্বারা প্রভাবিত হয়েছে। বিভিন্ন মাত্রার মধ্যে ৫ মি.লি/ ০.৫ লি. পানি Diasulin[®] 30/70 মাত্রাটি সবচেয়ে বেশী কার্যকরী হয়েছে গড় লার্ভার ওজন, কোকনের ওজন, পিউপার ওজন, খোলকের ওজন, মোট ডিমের পরিমাণ এবং ডিম ফুটার শতকরা হার বৃদ্ধি ও উপর নিয়ন্ত্রণ দলের তুলনায়। বর্তমান অধ্যয়নে পরিমিত মাত্রার Diasulin[®] 30/70 বাহ্যিকভাবে ব্যবহারের ফলে রেশম পোকা, *B. mori* এর অর্থনৈতিক উন্নতি ঘটতে দেখা গেছে এবং ফলন এর উন্নতি সাধনের জন্য ইহা রেশম চাষে ব্যবহার করা যেতে পারে।

Introduction

Homologues of vertebrate insulin receptors have been characterized from the fruit fly, *Drosophila melanogaster* (Fernandez et al. 1995), the silkworm, *B. mori* (Fullbright et al. 1997) and the mosquito, *Aedes aegypti* (Graf et al. 1997). The administration of vertebrate hormones to enhance the economic parameters of the mulberry silkworm, *B. mori* L. has gained much importance in recent years. It was first reported by Akai and Kobayashi (1971) that the administration of juvenile hormone (JH) prolongs the larval duration and results in a significant increase in cocoon weight and cocoon shell weight in *B. mori*. Since several investigators have shown that the treatment with JH-analogues including Manta increased the larval duration (Akai et al. 1973; Kobari and Akai 1978; Shigematsu 1978; Washida 1984) larval weight (Krishnaswamy et al. 1981), Silk gland weight (Shigematsu 1978; Chen et al. 1982), cocoon weight and cocoon shell weight (Kobasri and Akai 1978; Krishnaswamy et al. 1981) and egg productivity (Kimura et al. 1986) in different races of Japanese silkworms.

The administration of insulin, thyroxine and adrenalin yielded higher cocoon weight in the eri silkworm in comparison to controls. Kramer (1983) reported that the

vertebrate insulin can affect lower forms of life physiologically in many ways. Morasha and Ohkuma (1986) suggested the injection of vertebrate insulin or adrenalin of the female pupa which is to lay diapause eggs resulting in the development of eggs without diapause. Recent studies have shown that the treatment with insulin improves the pre-cocooning and some of the post cocooning parameters of the silkworm (Magdum and Hooli 1989; Mali and Khyade 2010). These reports suggested that the economic parameters of the silkworm are improved after treatment with JH-analogues or insulin. However, there are no reports on the effect of insulin on the economic parameters of silkworms. Therefore, present study was undertaken to find out the effect of insulin "Diasulin[®] 30/70" on the economic parameters of the polyvoltine breed Urbashi of *B. mori*.

Materials and Methods

The silkworm, *B. mori* breed selected for the experiment was multivoltine hybrid, Urbashi. Disease free layings of the selected breed were obtained from the germplasm bank of Bangladesh Sericulture Research and Training Institute Rajshahi. After hatching larvae were isolated from stock culture and feeding them with appropriate quantity of fresh mulberry leaves. The III, IV and Vth instar larvae were utilized for the experiment. After

second instar, the larvae were acclimatized to the laboratory condition and divided into five experimental groups including control. During this period larvae were fed four times a day and maintain necessary disinfection condition. The larvae were taken in equal number of 50 in each of the 15 trays to form five triplicate sets for the treatment in selected doses. A control batch was maintained for respective ages by feeding the larvae as in distilled water. The "Diasulin[®] 30/70" manufactured in Bangladesh by ACI limited was used in this experiment as the study material. Diasulin[®] 30/70 were dissolved in distilled water and diluted to 20 ml/ 0.5 LW, 10 ml/ 0.5 LW, 5 ml/ 0.5 LW and 2.5 ml/ 0.5 LW concentration). Accordingly the Diasulin[®] 30/70 diluted separately in 0.5 lw distilled water. Therefore, in the selected larval stages ten micro liters of each concentration of Diasulin[®] 30/70 were topically applied to respective group to the individual larva. Ten micro liters of each selected concentrations of Diasulin[®] 30/70 were sprayed on 50 silkworm larvae of each batches once a day. Therefore, the silkworm larvae were sprayed just ten times (3 times in III, IV instar and 4 times in 5th instar). The silkworm larvae fed mulberry leaves sprayed with distilled water and served as control. The feeding was maintained throughout the larval period. Larval weight, length, breadth; cocoon weight, length, breadth; shell weight, pupal weight, length, breadth; silk gland weight, total number of eggs laid per female, egg hatching percentage, unfertilized egg percentage, dead egg percentage and blue egg percentage were determined for all doses.

Results and Discussion

The data on the topical application of various concentration of Diasulin[®] 30/70 on larval, cocoon and eggs characteristics of silkworm, *B. mori* are presented in Table-1, 2 and 3. The overall performance of *B. mori* with response to the influence of Diasulin[®] 30/70 treatment observed in the present study show that most of the parameters increase in the set that received of Diasulin[®] 30/70 treatments. All concentrations of the Diasulin[®] 30/70 recorded higher larval, cocoon, shell and pupal weight than the control groups of larvae. Increase in the gradual yield of silk was observed in the concentration of Diasulin[®] 30/70 (20 ml/0.5 LW, 10 ml/0.5 LW, 5 ml/0.5 LW and 2.5 ml/0.5 LW) for topical application. The results indicate that the larval weight significantly increased after Diasulin[®] 30/70 treatments (Table-1) which suggested that the growth stimulating effect of Diasulin[®] 30/70 on the larvae. The topical application with various concentrations (20 ml/ 0.5 LW, 10 ml/ 0.5 LW, 5 ml/ 0.5 LW and 2.5 ml/ 0.5

LW water) of Diasulin[®] 30/70 to the silkworm larvae resulted in an increase in larval weight. The first day of fifth instar larvae in the control group grow with on initial weight of 3.47 gm. The recorded maximum weight was gradually increased up to the fifth day of fifth instar larvae 11.83 gm at 5 ml/ 0.5 lw concentration of Diasulin[®] 30/70.

The treatment with manta followed by insulin has been reported to increase the larval duration thereby extending the feeding period which results in increased larval weight (Kobari and Akai 1978; Washida 1984; Magdum and Hooli 1989; Seal 1998; Mali and Khyade 2010). Similar results are reported after treatment with JH or JH-analogues in Japanese races of silkworms (Akai and Kobayashi 1971; Shigematsu 1978; Shigematsu et al. 1978; Akai et al. 1973). The data from Table-2 clearly indicated that there was a significant improvement in the quantity of cocoon and pupal characters in the Diasulin[®] 30/70 treated group. The larvae produced cocoon and weight of cocoon from control group (1.38gm) were more less than experimental groups where larvae topically applied with various concentration of Diasulin[®] 30/70. The maximum cocoon weight obtained in the present experiment was 1.71 gm at the concentration of 5 ml/ 0.5 LW water of Diasulin[®] 30/70 topically applied to silkworm larvae. Mali and Khyade (2010) observed the enrichment of mulberry leaves with juvenile hormone and insulin to increase the cocoon and pupal characters like cocoon weight, shell weight, cocoon / shell ratio and pupal weight. The economic characters of the silk cocoon were reported to improve by topical application of Diasulin[®] 30/70 (Seal, 1998). Isaiarasu and Ganga (2000) reported that administration of JH analogue and Methaprene to fifth instar larvae of *B. mori* through hypodermic injection increased the shell weight by 16 percent over the control. The results also indicate that the silk glands weight significantly increased after treatment with Diasulin[®] 30/70. The pupae weight and silk gland weight of control group were also smaller than the experimental groups. The maximum weight of pupa and silk gland were 1.52 gmat 10 ml/ 0.5 LW and 0.96 gm at 20 ml/ 0.5 LW concentration of Diasulin[®] 30/70 respectively.

The increase in silk gland weight after treatment with manta followed by insulin might be due to increased synthetic activity of the silk glands. Since the treatment with JH or JH-analogue reported to increase the silk protein synthesis, replication of DNA and accumulation of RNA in silk gland (Akai et al. 1973; Amori et al. 1977; Chen et al. 1982; Seal 1998; Mali and Khyade

2010). The increase in silk gland weight after treatment with insulin might be due to the stimulatory effect of insulin on the synthetic activity of silk gland as suggested by Kramer (1983). The data given in Table-3 clearly indicates that, the total number of eggs in control group was 523 while in experimental group, maximum total number of eggs was 598 at 5 ml/ 0.5 LW concentration of Diasulin[®] 30/70. The hatching percentage of eggs in control group was 346.67 while maximum hatching percentage was 452 recorded in experimental group at 5 ml/ 0.5 LW concentration. Fecundity and hatching percentage increased significantly but blue, dead and unfertilized eggs

percentage was significantly reduced over the control. Similar trend was observed by Seal (1998).

The present study clearly indicated that the topical application of Diasulin[®] 30/70 at the concentration of 20 ml/0.5 LW, 10 ml/0.5 LW, 5 ml/0.5 LW and 2.5 ml/0.5 LW may have beneficial effect on all economic parameters of silkworm, *B. mori*.

Conclusion

In the present study, the treatment of Diasulin[®] 30/70 at the concentration of 5ml/0.5 liter water may have beneficial effects on some commercial characters of silkworm, *Bombyx mori*, which improve silk yield and best for silk industry.

Table 1 Effect of different concentrations of Diasulin[®] 30/70 on larval weight of the silkworm, *B. mori*.

Concentration of Diasulin 30/70	Fifth instar larval weight(gm)				
	First day	Second day	Third day	Fourth day	Fifth day
20ml/0.5L W	3.83±0.24	7.00±0.058	9.60±0.35	9.43±0.15	11.23±0.12
10ml/0.5L W	3.67±0.03	7.00±0.20	8.66±0.09	10.30±0.21	11.50±0.25
5ml/0.5L W	3.97±0.15	6.53±0.20	8.70±0.10	10.30±0.21	11.83±0.18
2.5ml/0.5L W	3.67±0.19	6.33±0.18	9.17±0.20	10.00±0.25	10.37±0.22
Control	3.47±0.12	5.90±0.25	8.60±0.35	8.93±0.15	10.63±0.09
F-ratio	1.10	5.21*	5.62*	8.00**	21.55**

SE = standard error; * = significant at 5% level; ** = significant at 1% level.

Table 2 Post cocoon characters after treatment with four concentrations of Diasulin[®] 30/70

Concentration of Diasulin 30/70	CW	CL	CB	SW	PW	PL	PB	SGW
20ml/0.5LW	1.51±0.06	3.00±0.12	1.75±0.04	0.17±0.00	1.37±0.07	2.39±0.04	1±0.01	0.96±0.03
10ml/0.5LW	1.63±0.06	3.34±0.02	1.76±0.07	0.19±0.01	1.52±0.10	2.44±0.02	1.12±0.01	0.83±0.08
5ml/0.5LW	1.71±0.08	3.15±0.01	1.64±0.03	0.18±0.01	1.50±0.08	2.45±0.07	1.12±0.02	0.8±0.05
2.5ml/0.5LW	1.53±0.07	3.15±0.03	1.63±0.03	0.17±0.00	1.45±0.09	2.34±0.02	1.04±0.03	0.86±0.06
Control	1.38±0.01	2.9±0.05	1.45±0.02	0.13±0.00	1.24±0.10	2.12±0.01	0.95±0.02	0.76±0.03
F-ratio	1.68	7.11**	19.15**	12.91**	1.24	9.26**	6.11*	1.73

SE = standard error; * = significant at 5% level; ** = significant at 1% level.

CW = Cocoon weight, CL = Cocoon length, CB = Cocoon Breadth, SW = Shell weight, PW = Pupal weight, PL = Pupal length, PB = pupal breadth, SGW = silk gland weight,

Table 3 Effect of different concentrations of Diasulin[®] 30/70 on fecundity and hatchability of the silkworm, *B. mori*.

Concentration of Diasulin 30/70	TEL	EHP	UEP	DEP	BEP
20ml/0.5LW	575±17.50	437.66±17.48	44±3.60	17.33±0.33	78.33±3.66
10ml/0.5LW	590±50.86	451±33.30	42.33±13.64	17.33±1.66	82±8.96
5ml/0.5LW	598±49.23	452±27.20	50.66±8.83	17.33±3.28	77.33±11.40
2.5ml/0.5LW	564.66±17.83	424.33±34.84	37±6.11	11.33±2.02	91.33±4.97
Control	523±7.21	346.67±5.87	53.33±2.40	26±0.57	97.1.15
F-ratio	1.23	0.33	0.83	6.11*	1.28

SE = standard error; * = significant at 5% level; ** = significant at 1% level.

TEL = Total number of eggs laid per female, EHP = Egg hatching percentage, UEP = Unfertilized egg percentage, DEP = dead egg percentage, BEP = blue egg percentage

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WATER QUALITY AND PRESENT STATUS OF INDIGENOUS FISH FAUNA OF CHALANBEEL IN BANGLADESH

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Abstract: Sixteen physicochemical parameters were found in the Chalnanbeel. The study area is permanently alkaline in nature. The fish fauna of Chalnanbeel were studied from July, 2011 to June, 2014. Sampling was carried out by several fishing nets and traps on a fortnight basis. A total of 116 fish species belonging to 66 genera, 29 families, 12 orders and 1 class. Out of 116 species (31.03%) were rare, (31.17%) were common, (26.72%) were very common and (12.07%) were few. This study concluded that the Atrai River could be an excellent place for the natural conservation of fish species.

Key words: Physico-chemical conditions, Chalnanbeel fish diversity, seasonal abundance, indigenous fish fauna.

সরাংশ: চালনবিলে ১৬ প্রকার জৈবরসায়নিক উপাদান পাওয়া যায়। গবেষণা এলাকাটির পানির প্রকৃতি স্থায়ীভাবে ক্ষারীয়। বিভিন্ন ধরনের জাল ও ফাঁদ ব্যবহার করে তথ্যবলী সংগ্রহের জন্য জুলাই, ২০১১ থেকে জুন, ২০১৪ পর্যন্ত মার্চ পর্যায় জরিপ চালানো হয়। পর্যবেক্ষণের সময় ১১৬টি মাছের প্রজাতি পাওয়া গেছে। ৬৬টি গণ, ২৯টি পরিবার, ১২টি গোত্র ও ১টি শ্রেণীভুক্ত। ১১৬টি প্রজাতির মধ্যে বিরল (৩১.০৩%), পরিচিত (৩১.১৭%), অতিপরিচিত (২৬.৭২%) এবং (১২.০৭%) সামান্য প্রজাতির। চালনবিল প্রাকৃতিকভাবে মাছ সংরক্ষণের একটি চমৎকার পরিবেশ।

Introduction

Bangladesh is a home to at least 265 freshwater fish species (Rahman 2005). Huge number of water bodies in various forms viz. ponds, ditches, rivers, beels, haors, baors etc. support these large number of fish species. Chalnanbeel is one of the largest beel in Bangladesh produces a huge amount of fish to the people of the country. At present, reduction in the abundance and fish species from the inland waters of Bangladesh is a burning issue in the country (Galib et al. 2009, Imteazzaman and Galib 2013). However, a total of 54 fish species of Bangladesh have been declared threatened by IUCN (IUCN Bangladesh 2000) but most of the wild populations have seriously declined in Chalnanbeel of Bangladesh due to over exploitation augmented by various ecological changes and degradation of the natural habitats (Galib et al. 2009, 2013a). All these findings clearly indicate the need for water body specific detailed biodiversity studies which is essential to assess the present status and for the sustainable management of a body of water (Galib et al. 2013b; Imteazzaman and Galib 2013). Though such type of research efforts are much common in neighboring countries like India (Dahanukar et al. 2012, Kharat et al. 2012, Baby et al. 2010, Jadhav et al. 2011, Patra 2011, Johnson and Arunachalam 2009, Heda 2009, Sana and Bordoloi 2009), but very few in Bangladesh.

Environmental parameters are very important for organism living in a habitat. A lot of work has been shown between environmental parameters and seasonal abundance of fish in Bangladesh. The present study was carried out with a view to prepare an updated checklist of fish species focusing their present status and

hydrological status in the Chalnanbeel. The relationship between environmental parameters and availability of fishes was established in this research.

Methodology

Study Area and Duration:

Chalnanbeel in Bangladesh lies between 24.23° North and 89.05 to 89.180 East. The beel is situated at a distance of about 50 km, towards South East from Rajshahi city and is connected by Rajshahi - Bogra National highway. The study was done on between July, 2011 and June, 2014.

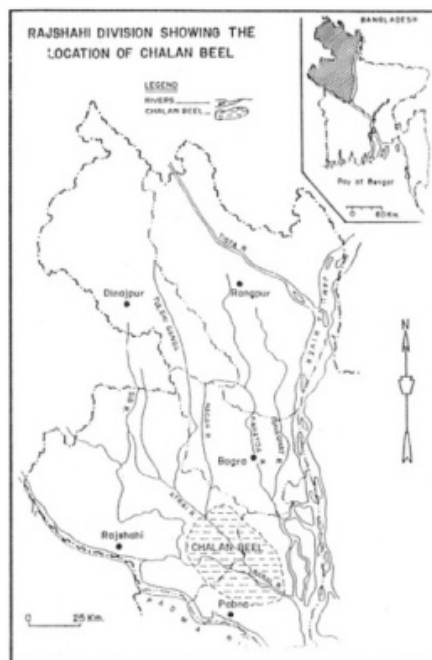


Fig. 1 Location of Chalnanbeel.

Sampling: Fish were caught by a variety of fishing nets (cast net, seine net, drag net, and lift net) and traps (locally called *Kholsun*, *Brittiand Dohair*). All these fishing gears were operated with the help of professional fishermen.

Preservation and identification: Fish were preserved in 5-7% buffered formalin and identified using the literatures- Rahman (1989 and 2005) and Talwar and Jhingran (1991). After identification, fish were classified following Nelson (2006).

Study of aquatic physico-chemical parameters:

Water samples were collected by using 250 ml glass stoppered bottle from a depth of 10-15 cm below the surface. Some of the physico-chemical studies were done on the spot, while others were done in laboratory. Temperature was measured by a centigrade thermometer, transparency was measured by a Secchi disc while pH and TDS were measured by a digital pH meter (model-pH 211, HANNA) and a multi-range TDS meter (model no. HI-9635). Dissolved oxygen (DO) content of water was determined by DO meter (model- JENWAY-9015). Titrimetric methods were used to determine free CO₂, CO₃ and HCO₃ alkalinities. Chloride content was measured by Argentometric method, biological oxygen demand (BOD₅) by Winkler modified method and all hardness were measured by following APHA (1989). Phosphate and silicate were measured following Gautam (1990).

Data collection: Extensive field survey was conducted for the gathering of primary data. Information regarding the fishing technique, mode of operation and catch composition encountered with them was collected through personal interview and detailed discussion with local fishermen as well as resident of different areas. The information collected during the field survey was then compared with secondary data from various sources.

Data Analysis: Collected data and information obtained from the survey were grouped and interpreted according to the objective as well as parameters. Some data contained numeric and some contained narrative facts. The data were then presented in graphical and tabular forms. Data were analyzed using MS Excel 2003.

Results and Discussion

State of water quality (Physico-chemical condition):

Hydrological status of the study area are shown in Table 1. Air temperature water temperature, transparency, TDS, dissolved oxygen, silicate and phosphate were similar in three years. pH values were

more or less same in three years and shown the alkaline in nature. BODs value varied from 5.5 to 6.9, 4.3 to 5.8 and 5.8 to 6.9 mg.l⁻¹. During the study period CO₂ was absent in 1st year and CO₃ alkalinity was absent in 2nd year and 3rd year. HCO₃ alkalinity ranged of the three years were (153-65) mg.l⁻¹ (69-75) mg.l⁻¹ and (68-75) mg.l⁻¹. Chloride content varied from 498 to 543 and 500 to 532 and 498 to 543 mg.l⁻¹. Total hardness, calcium hardness and magnesium hardness were found to vary respectively from 900-1180, 866-1131, 500-543 and 21-48 mg.l⁻¹ in 1st year, 853-1220, 763-1202 and 17-89 mg.l⁻¹ in 2nd year and 500-543, 698-1132 and 16-90 mg.l⁻¹ in 3rd year.

Among the physico-chemical conditions, pH values indicate that the study were permanently alkaline innature. Maximum values of TDS, BOD₅, chloride, hardness and phosphate contents were recorded in the months of April and May when water level was minimum in the summer, while the lowest values were recorded in the month of August when water level was maximum due to rainfall. Similar observations were made by Islam et al. (1998), Fakruzzaman and Zaman (1996), Naz (1999) in their studies. Maximum transparency, DO were recorded in the month of August when all dissolved solids, organic and inorganic materials were more diluted due to increase of water level. Chowdhury and Zaman (2000) also expressed similar views.

Fish species diversity:

A total of 116 fish species belonging 66 genera, 29 families, 12 orders of Osteichthyes. Table-2 shows the name of species, their local name, hydrological status and present status. Among 116 species the present status of majority of fishes 31.03% rare, 30.17% common, 12.07% few and 26.72% very common. Image-1 represents some of the fish species collected from Chalanbeel. Number of recorded species (116) was found highest than that of the number of fish species reported by Galibet *al.*, (2009) who recorded 81 fishes species in the same beel. Joadder (2009) surveyed fish markets and landing centers where fishes from both the Atrai River and nearby aquaculture ponds are landed. Lower number of fish species (63) was recorded by Galib et al. (2013c) in the ChotoJamuna River, a tributary of the Atrai River reflecting that fishes were more abundant in the main stream of river. Sixty nine fish species were reported in the river Padma by Mohsin et al. (2013). In a coastal river, the Andharmanik, 54 species fish species were recorded by Mohsin et al. (2014).

Table 1 Physico-chemical condition of Chalanbeel.

Parameters	1st year		2nd year		3rd year	
	July, 2011 To June, 2012	Mean±SD	July, 2012 To June, 2013	Mean±SD	July, 2013 To June, 2014	Mean±SD
Air temperature (°C)	20.2-32.2	27.2±0.9	20.2-32.2	27.2±0.9	20.2-32.2	27.2±0.9
Water temperature(°C)	19-25.5	23.9±0.6	19-25.6	24±0.6	19-25.5	23.9±0.06
Transparency (cm)	33-36	34±1	33-37	34±2	33-35	34±1
TDS (mg.l ⁻¹)	910-1190	1057±115	910-1190	1050±114	910-1190	1057±115
pH	7.9-9.1	8.4±0.5	7.5-7.8	7.6±0.1	7.5-7.9	7.6±0.1
Dissolved oxygen mg.l ⁻¹)	2.7-4.8	4.3±0.3	2.8-5.0	4.4±0.5	2.7-5.0	4.4±0.5
BOD ₅ (mg.l ⁻¹)	5.5-6.9	5.8±0.4	4.3-5.8	4.8±0.8	5.8-6.9	5.8±0.4
CO ₂ (mg.l ⁻¹)	-	-	12-18	16±3	-	-
CO ₃ alkalinity(mg.l ⁻¹)	31-36	34±2	-	-	-	-
HCO ₃ , alkalinity (mg.l ⁻¹)	153-65	159±5	69-75	71±3	68-75	71±3
Chloride (mg.l ⁻¹)	498-543	519±18	500-532	521±15	498-543	519±18
Total hardness (mg.l ⁻¹)	900-1180	1076±126	853-1220	983±167	500-543	521.5±30.41
Ca. hardness (mg.l ⁻¹)	866-1131	1042±124	763-1202	919±200	698-1632	1030± 469.52
Mg. hardness (mg.l ⁻¹)	21-48	34±11	17-89	63±32	16-90	53±52.33
Silicate (mg.l ⁻¹)	0.0001-0.0006	0.0003±0.0002	0.0001-0.0006	0.0003±0.0002	0.0001-0.0006	0.0003±0.0004
Phosphate (mg.l ⁻¹)	0.04-0.07	0.05±0.01	0.05-0.07	0.05±0.01	0.04-0.07	0.05±0.01

Table-2 List of indigenous fishes from Chalanbeel.

Sl. No.	Family/Species	Local name	Hydrological status	Present status
1	Family- Notopteridae <i>Notopterusnotopterus</i> (Pallas, 1969)	Pholi	Deep area, and, river, ditches, kua.	Common
2	<i>Notopteruschitala</i> (Hamilton, 1822)	Chithol	Deep area, Pond, river, ditches, kua.	Common
3	Family-Engraulidae <i>Setipinnaphasa</i> (Hamilton, 1822)	Phasa	Deep area, rivers canals, ditches	Common
4	<i>Setipinnataty</i> (Valenciennes-1848)	Teliphasa	Deep area, rivers canals, ditches	Few
5	Family- Clupeidae <i>Gadusiachapra</i> (Hamilton, 1822)	Chapra	Deep area, rivers, canal ditches	Very Common
6	<i>Gadusiavariiegata</i> (Day- 1889)	Chapila	Deep area, rivers, canal ditches	Rare
7	<i>Hilsailisha</i> (Hamilton, 1822)	Ilish	Rarely found, rivers central zone of beel	Rare
8	<i>Hilsa toll</i> (valenciennes, 1847)	Ilish	Vary rare in rivers and canals.	Rare
9	<i>Gonialosamanminna</i> (Hamilton, 1822).	Khoira.	Surface layer, central zone.	Rare
10	<i>Coricasoborna</i> (Hamilton, 1822)	Kaschi.	Weed less area of the beel.	Common
11	Family- Cyprinidae; <i>Chela atpar</i> (Hamilton, 1822)	Chap chela	Surface water, all parts of the beel.	Common
12	<i>Chela laubuca</i> (Hamilton, 1822).	KashKhira.	Almost everywhere in the beel.	Few
13	<i>Chela phulo</i> (Hamilton, 1822)	Phul Chela.	Almost everywhere in the beel.	Few
14	<i>Chela bacaila</i> (Hamilton, 1822)	Katara.	Almost everywhere in the beel.	Common
15	<i>Chela cachiis</i> (Hamilton, 1822)	Chela	Weed less area of the beel.	Common
16	<i>Aspidopariajaya</i> (Hamilton, 1822)	Piale	Rivers, canals.	Rare
17	<i>Aspidopariamorar</i> (Hamilton, 1822)	Morer.	Rivers, canals of the beel.	Rare
18	<i>Esomusdanricus</i> (Hamilton, 1822)	Darika.	Almost every where in shallow water	Very Common
19	<i>Oxygastergora</i> (Hamilton, 1822)	Gora chela	Surface feeder, insects larva, crustacea etc.	Common
20	<i>Oxygasterbacaila</i> (Vanhassel,1823)	Katara chela.	Rivers, canals, ponds, flood plains etc.	Very Common
21	<i>Oxygasterphulo</i> (Hamilton, 1822)	Phul chela	Surface layer of almost all parts of the beel.	Rare
22	<i>Rasborarasbora</i> (Hamilton, 1822)	Leazza	Shallow and Stagnant water of the beel.	Rare
23	<i>Rasboradaniconius</i> (Hamilton, 1822)	Darkina.	Almost all parts of the shallow water of the beel.	Common
24	<i>Rasboraelanga</i> (Hamilton, 1822)	Elong	Rivers, canals, and running water of the beel.	Rare
25	<i>Amblypharyngodonmola</i> (Hamilton, 1822)	Mola	Shallow stagnant water, pond kua	Very Common
26	<i>Amblypharyngodonmicrolepis</i> (Sleeker, 1860)	Moya.	Shallow stagnant water, pond kua, canals etc.	Very Common
27	<i>Rohtecotio</i> (Hamilton, 1822)	Dhela,	Rivers, canals and deep area of the beel.	Very Common
28	<i>Daniodevario</i> (Hamilton, 1822)	Chebli	Rivers, canals and deep area of the beel.	Rare
29	<i>Daniorerio</i> (Hamilton, 1822)	Daricka.	Surface layer of shallow water of the beel.	Few

Sl. No.	Family/Species	Local name	Hydrological status	Present status
30	<i>Labeogonius</i> (Hamilton, 1822)	Ghona.	In aquatic weeds of beel, rivers, canals.	Rare
31	<i>Labeoboga</i> (Hamilton, 1822)	Bhangon	Rivers canals and deep area of the beel.	Common
32	<i>Cirrhinusreba</i> (Hamilton, 1822)	Raikhor	Rivers, Canals, pond in current water	Common
33	<i>Salmostomaphulo</i> (Hamilton, 1822)	Fuichela	Rivers, canals, ponds and near paddy fields.	Common
34	<i>Salmostomabacaila</i> (Hamilton, 1822)	Narkele chela	Rivers, canals, ponds and flood plains.	Common
35	<i>Punliusurana</i> (Hamilton, 1822)	Sarpute	April to July.	Common
36	<i>Puntiuschola</i> (Hamilton)	Cholapute	Almost everywhere in the beel.	Common
37	<i>Puntiusphutunio</i> (Hamilton, 1822)	Futiniputi	Rivers, mainly in the aquatic weeds.	Common
38	<i>Puntiussticto</i> (Hamilton, 1822)	Tetputi	Rivers, canals, ponds shallow water of the beel	Very Common
39	<i>Puntiusguganio</i> (Hamilton, 1822)	Molaputi	Rivers, canals, ponds and flood plain	Very Common
40	<i>Puntiusophore</i> (Hamilton, 1822)	Jatputi.	Almost everywhere in the bee!	Very Common
41	<i>Puntiussterio</i> (Hamilton, 1822)	Ten puti	Ponds, kuas, mainly into the aquatic weeds.	Very Common
42	<i>Puntiusgelius</i> (Hamilton, 1822)	Puti	Rivers canals ponds, ditches, and flood plains,	Very Common
43	<i>Puntiuscosuatis</i> (Hamilton)	Bagraputi	Rivers, canals and flood plains	Rare
44	Family-Cobitidae; <i>Botiadayi</i> (Hamilton, 1822)	Bou	Mainly deep and running water of the beel.	Few
45	<i>Botiadarario</i> (Hamilton, 1822)	Rani	Mainly running water of the beel.	Common
46	<i>Botiabirdi</i> (Chaudhuri, 1909)	Putul	Mainly deep and running water of the beel.	Rare
47	<i>Botialohachata</i> (Chaudhuri, 1909)	Beti.	Rare, deep and current water of the beel.	Rare
48	<i>Lepidocephalusguntia</i> : (Hamilton, 1822).	Gut	Shallow and muddy area of the beel.	Very Common
49	<i>Lepidocephalusberdmorei</i> : (Blyth, 1860).	Puiya.	Shallow and muddy area of the beel.	Common
50	<i>Acanthopthalmuspangia</i> (Hamilton, 1822)	Panja	Shallow and muddy area of the beel.	Rare
51	Family-Siluridae. Species- <i>Wallagoattu</i> (Bloch, 1801)	Boal	Rivers, canalsditches, kua, pond etc.	Very Common
52	<i>Ompokpabda</i> (Hamilton, 1822)	Pabda	Rivers, canals, pond, ditches etc.	Very Common
53	<i>Ompokpaho</i> (Hamilton, 1822)	Poba	Rivers, canals, ponds, ditches.	Very Common
54	<i>Ompokbimaculatus</i> (Bloch, 1794)	Boali	Rivers, canals, kuas, ponds, ditches etc.	Very Common
55	Family- Bagridae; <i>Rita rita</i> (Hamilton, 1822)	Eta	Deep and running water.	Common
56	<i>Mystusaor</i> (Hamilton, 1822).	Air	Rivers, canals, ponds, kuas, ditches etc.	Very Common
57	<i>Mystusseenghala</i> (Sykes, 1841)	Guja	Rivers, canals, and ditches.	Common
58	<i>Mysiusmenoda</i> (Hamilton, 1822)	Ghoratangara	All parts of the bed.	Common
59	<i>Mysiuscavasius</i> (Hamilton, 1822)	Gulsatangra	Rivers, canals and ditches.	Very Common
60	<i>Mystusbleekeri</i> (Day, 1878)	Cabasitangra.	Rivers, canals, ponds, and ditches.	Common
61	<i>Mystustengara</i> (Hamilton, 1822)	Tengara	All parts of the beel	Very Common
62	<i>Mystusvittatus</i> (Bloch, 1797)	Tangra.	All parts of the beel.	Very Common
63	<i>Mystusarmatus</i> (Day, 1865)	Tangra.	All parts of the beels.	Very Common
64	<i>Rama rama</i> (Hamilton, 1822)	Buguritengra	Rivers, beel	Rare
65	<i>Chandramarachandramara</i> (Hamilton, 1822)	Tangra.	Rivers, canals ditches.	Rare
66	<i>Batasiobatasio</i> (Hamilton, 1822)	Tangra.	Deep area of the beel	Rare
67	<i>Batasiolengara</i> (Hamilton, 1822)	Tangra.	Rivers, canals and flood plains	Rare
68	Family-Chacidae; <i>Chacachaca</i> (Hamilton, 1822)	Chaca.	Generally deep and muddy area of the beel.	Rare
69	Famely- Schilbeidae. <i>Clupisomagarua</i> (Hamelton, 1822)	Ghaira.	Deep and running water of the beel.	Common
70	<i>Clupisomamurius</i> (Hamilton, 1822)	Muribacha.	Generally deep running water of the bed.	Common
71	<i>Siloniaselondia</i> (Hamilton, 1822)	Sillong	Running water of the beel.	Rare
72	<i>Pseudotropheusatherinoides</i> (Bloch, 1794)	Patasi.	All most all parts of the beel.	Very Common
73	<i>Eutropiichthysvacha</i> (Hamilton, 1822)	Bacha.	Generally deep and running area of the beel	Common

Sl. No.	Family/Species	Local name	Hydrological status	Present status
74	<i>Eutropiichthysmurius</i> ; (Hamilton, 1822)	Bacha.	Deep and running water of the beel.	Rare
75	<i>Ailiacoila</i> (Hamilton, 1822)	Kajuli.	Generally running water of the beel.	Common
76	<i>Ailichthyspunctata</i> (Day, 1878)	Baspata	Deep and running water of the beel	Common
77	Family- Claridae; <i>Clariasbatrachus</i> (Linnaeus)	Magur.	Swamp, shallow and muddy area of the beel.	Few
78	Family- Heteropneustidae; <i>Heteropneustesfossilis</i> (Bloch, 1797)	Shing	Swamp, pond, kua, shallow and muddy area of the beel.	Very Common
79	Family- Amblycipitidae <i>Amblycepsmangois</i> (Hamilton, 1822)	Bis-cat	Rivers, kua	Rare
80	Family- Olyridae; <i>Olyrakempi</i> (McClelland, 1842)	Kempi.	Rivers, canals, swamps.	Few
81	Family- Sisoridae; <i>Sisorrhabdophorus</i>	Scissor	Rivers, canals and deep area of the beel.	Few
82	<i>Bagariusbagarius</i> (Hamilton, 1822)	Baghair.	Rivers, canals and deep area of the beel.	Rare
83	<i>Gagatagagata</i> (Hamilton, 1822)	Gangtengra.	Rivers, canals and deep area of the beel.	Rare
84	<i>Gagaraviridescens</i> (Hamilton, 1822)	Gang tengra	Mainly deep and running water of the beel	Rare
85	<i>Gagatacenia</i> (Hamilton, 1822)	Gang tengra	Rivers, canals and ditches etc.	Rare
86	<i>Gogatayoussoufi</i> (Rahman, 1989)	Gang tengara	Rivers, canals, deep running water of the beel.	Rare
87	<i>Hara jerdoni</i> (Day, 1879)	Harkate.	Rivers, canals, ponds, ditches etc.	Few
88	Family- Anguillidae <i>Anguilla bengalensis</i> (Gray, 1834)	Barnoch.	Rivers, canals	Rare
89	Family- Symbbranchidae <i>Monopterusuchia</i> (Hamilton, 1822)	Cuchia.	In mud hole of swamps, kuas and paddy fields	Few
90	Family- Belonidae <i>Xenentodoncancila</i> (Hamilton, 1822)	Kakila.	Everywhere in the beel.	Very Common
91	F- Hemirhamphidae <i>Hemirhamphusgaimardi</i> (Valenciennes, 1846)	Ektutya.	Rare, in the beel.	Rare
92	Family- Anabantidae <i>Anabas testudineus</i> (Bloch, 1801)	Koi.	All parts of the beel.	Very Common
93	<i>Colisafasciatus</i> (Bloch, 1801)	Ban colisa.	All parts of the beel.	Very Common
94	<i>Colisasota</i> (Hamilton, 1822)	Chunacolisa.	Shallow water of the beel	Common
95	<i>Colisalalius</i> (Hamilton, 1822)	Lalkolisa.	Shallow water of the beel.	Common
96	<i>Colisalabiosa</i> (Day, 1878)	Chunakolisa.	Canal of the beel	Rare
97	Family- Pristolepididae <i>Badisbadis</i> (Bleeker, 1853)	Naftani	Shallow water in the aquatic weeds	Rare
98	Family- Nandidae <i>Nandusnandus</i> (Hamilton, 1822)	Bheda.	Shallow water, in aquatic weeds.	Rare
99	Family- Centropomidae <i>Chanda name</i> (Hamilton, 1822)	Chanda,	All parts of the beel.	Very Common
100	<i>Chandaranga</i> (Hamilton, 1822)	Rangachanda	All parts of the beel	Common
101	<i>Chandabaculis</i> (Hamilton, 1822)	Charida	Almost everywhere in the beel.	Common
102	Family- Gobiidae <i>Glossogobiusgiuris</i> (Hamilton, 1822)	Bela	Shallow water of the beel, pond, kua etc.	Very Common
103	Family- Cyprinodontidae <i>Aplocheiluspanchax</i> (Ham., 1822)	kanpona.	Almost surface layer of all parts of the beel	Few
104	Family- Channidae; <i>Channastratus</i> (Bloch, 1794)	Shol.	Kua, ponds, canals of the beel	Common
105	<i>Channamarulius</i> (Hamilton, 1822)	Gajar.	Kuas, ponds, canals, ditches.	Rare
106	<i>Channapunctatus</i> (Bloch, 1794)	Taki	Kuas, ponds, canals, swamps.	Very Common
107	<i>Channagachua</i> (Hamilton, 1822)	Ghaira	Swamps, shallow water.	Common
108	<i>Channaorientalis</i> (Schneider, 1801)	Chaitan	Swamps, shallow muddy water.	Common
109	Family- Tetraodontidae <i>Tetraodoncutcutia</i> (Hamilton, 1822)	Tepa	Rivers, canals flooded jute and paddy fields	Few
110	<i>Chelonodonpatoca</i> (Hamilton, 1822)	Patoka.	Deep and running water of the beel.	Rare
111	<i>Chelonodonfuviatilis</i> (Hamilton, 1822)	Tepa.	Deep and running water of the beel.	Rare
112	Family- Mugilidae <i>Rhinomugilcorsula</i> (Hamilton, 1822)	Khorsal.	Everywhere in shallow water of the beel.	Few
113	<i>Mugilcascasia</i> (Hamilton, 1822)	Khorsal.	Rivers, canals ponds, ditches, kuas etc.	Few
114	Family- Mastacembelidae; <i>Macrornathusaculeatus</i> (Bloch)	Liaguchi	All parts of the beel.	Very Common
115	<i>Mastacembeluspancalus</i> (Hamilton, 1822)	Guchi.	All parts of the beel.	Very Common
116	<i>Mastacembelusarmatus</i> (Lacepede, 1803)	Baim.	Rivers, canals, ponds, kuas, ditches etc.	Common

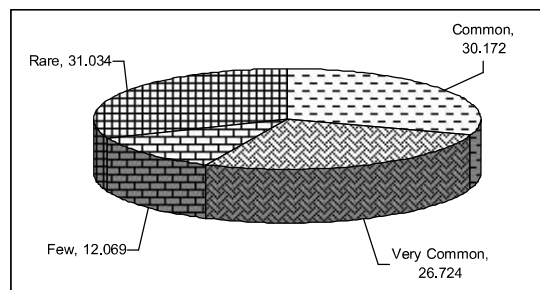


Fig. 1 Seasonal abundance of fishes in Chalanbeel.











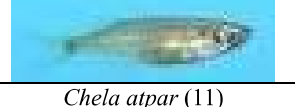













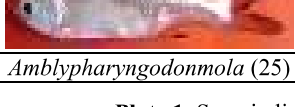
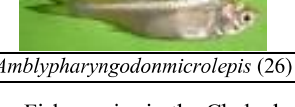

		
<i>Notopterus notopterus</i> (01)	<i>Notopterus chitala</i> (02)	<i>Setipinnaphasa</i> (03)
		
<i>Setipinnataty</i> (04)	<i>Gadusiachapra</i> (05)	<i>Gadusiavariegata</i> (06)
		
<i>Hilsailisha</i> (07)	<i>Hilsatoli</i> (08)	<i>Goniosamanminna</i> (09)
		
<i>Coricasoborna</i> (10)	<i>Chela atpar</i> (11)	<i>Chela laubuca</i> (12)
		
<i>Chela phulo</i> (13)	<i>Chela bacaila</i> (14)	<i>Chela cachi</i> (15)
		
<i>Aspidopariajaya</i> (16)	<i>Aspidopariamorar</i> (17)	<i>Esomus danricus</i> (18)
		
<i>Oxygastergora</i> (19)	<i>Oxygasterbacaila</i> (20)	<i>Oxygasterphulo</i> (21)
		
<i>Rasborarasbora</i> (22)	<i>Rasboradaniconius</i> (23)	<i>Rasbora elanga</i> (24)
		
<i>Amblypharyngodon mola</i> (25)	<i>Amblypharyngodon microlepis</i> (26)	<i>Rotheecotio</i> (27)

Plate 1 Some indigenous Fish species in the Chalanbeel (Source : Internet)

Conclusion

Although the study area harbours a considerable number of fish species, some potential threats to fishes were identified during the study period. The major threats were illegal net use for fishing and trapping of fishes especially by the fishers community. Hydrological parameters of Chalanbeel more or less suitable for aquatic species. Some general considerations need attention for protecting fishes from above mentioned threats. The current status of fish fauna is maintained by minimizing anthropogenic impacts, especially the fishing pressure.

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THE EFFECTS OF SOME PLANT LEAF POWDERS IN SINGLE AND COMBINATION WITH CINNAMALDEHYDE ON ADULT *Callosobruchus maculatus* (F.) IN COWPEA SEEDS

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Abstract: In this study long pepper (*Piper longum* L.), big-sage (*Lantana camara* L.), dahlia (*Dahlia rosea* Cav.) and garden cosmos (*Cosmos bipinnatus* Cav.) leaves have been selected for insecticidal investigation in powder form in single and combination with terpene oil cinnamaldehyde against the cowpea weevil *Callosobruchus maculatus* (F.) in cowpea seeds [*Vigna unguiculata* (L.) Walp. (Fab.)]. The average mortalities (percentages) of the beetles (n= 20) at 1-, 12-, 24-, 48-, and 72 h of treatments and at 2-, 3-, 4-, and 5 g doses of leaf powders with 100g cowpea seeds have been recorded for single treatment. Dose mortalities of the beetles (n= 10) combination with cinnamaldehyde at 1-, 12-, 24-, 48-, and 72 h of treatments and ratios of powders + cinnamaldehyde at 5 + 0.6, 5 + 0.1, 3 + 0.6 and 3 + 0.1 (g + ml) with 100g cowpea seeds have been assessed. The data were subjected to arcsine transformation for the calculation of ANOVA. The mortality of single treatment was showed considerably effect in all the treatments on *C. maculatus* (F.) except *P. longum* L. When leaf powder was applied in mixed formulation with cinnamaldehyde all treatments showed significantly higher mortality in contrast to single treatment. The order of mortality percentage in combination with cinnamaldehyde was: *C. bipinnatus* Cav. > *D. rosea* Cav. > *P. longum* L. > *L. camara* L. to *C. maculatus* (F.).

Key words: *Callosobruchus maculatus* (F.), Plant powders, *Piper longum* L., *Lantana camara* L., *Dahlia rosea* Cav., *Cosmos bipinnatus* Cav., Cinnamaldehyde.

সারংশ: গুঁড়া অবস্থায় এককভাবে এবং তারপিন তৈল Cinnamaldehyde -এর সাথে সম্মিলিতভাবে শূঁড়ী পোকাকার [*Callosobruchus maculatus* (F.)] বিরুদ্ধে বরবটির বীজের [*Vigna unguiculata* (L.) Walp. (Fab.)] উপর কীটনাশকতা পরীক্ষণের জন্য এই অধ্যয়নে লম্বা গোলমরিচ (*Piper longum* L.), বড় তুলসী (*Lantana camara* L.), ডালিয়া (*Dahlia rosea* Cav.) এবং গার্ডেন কসমস (*Cosmos bipinnatus* Cav.) -এর পাতাকে নির্বাচন করা হয়েছে। একক চর্চায়, শূঁড়ী পোকাকার (সংখ্যা= বিশ) গড় মৃত্যুর হার এক-, বার-, চব্বিশ-, আটচল্লিশ- এবং বাহান্তর ঘন্টা পরীক্ষা সময়ে একশত গ্রাম বরবটি বীজে দুই-, তিন-, চার- এবং পাঁচ গ্রাম পাতার গুঁড়া ডোজের ফলাফল রেকর্ড করা হয়েছে। Cinnamaldehyde তৈল + পাতার গুঁড়াকে সম্মিলিতভাবে ৫ + ০.৬, ৫ + ০.১, ৩ + ০.৬ এবং ৩ + ০.১ (g + ml) অনুপাতে একশত গ্রাম বরবটি বীজের সাথে মিশিয়ে শূঁড়ী পোকাকার (সংখ্যা= দশ) গড় মৃত্যু হার এক-, বার-, চব্বিশ-, আটচল্লিশ- এবং বাহান্তর ঘন্টা পরীক্ষা সময়ের ফলাফল মূল্যায়ন করা হয়েছে। প্রাপ্ত উপাত্তকে ANOVA হিসেবের জন্য arcsine transformation প্রয়োগ করা হয়েছে। একক চর্চায় শূঁড়ী পোকাকার মৃত্যুর হার লম্বা গোলমরিচ বাদে অন্য সব পরীক্ষণের প্রভাব উল্লেখযোগ্যভাবে কার্যকরী হিসেবে প্রকাশ পেয়েছে। যখন পাতার গুঁড়া Cinnamaldehyde তৈলের সাথে মিশিয়ে প্রয়োগ করা হয়েছে, তখন সকল ক্ষেত্রে শূঁড়ী পোকাকার মৃত্যুর হার একক চর্চায় তুলনায় তাৎপর্যভাবে বৃদ্ধি পেয়েছে। Cinnamaldehyde তৈলের সাথে সমন্বিত পরীক্ষার ক্ষেত্রে শূঁড়ী পোকাকার মৃত্যু হারের অনুক্রম ছিল: গার্ডেন কসমস > ডালিয়া > লম্বা গোলমরিচ > বড় তুলসী।

Introduction

Cowpea [*Vigna unguiculata* (L.) Walp. (Fab.)], a dietary protein, is a staple food crop of significant economic importance in Asia, Africa and worldwide (Magloire 2005; Emeasor et al. 2007). Cowpea seed pods and leaves are consumed in fresh form as green vegetables in some Asian and African countries (Ghaly and Alkoaik 2010), while the rest of the cowpea plant after harvesting the pods serves as a nutritious fodder for livestock (Abebe et al. 2005) and also a source of cash income (Dugje et al. 2009). The nutritive value of cowpea makes it an extremely important protein source to vegetarian and people who cannot afford animal protein (Adeyemi et al. 2012). It can be referred to “protein source for all” because it is affordable for both the rich and poor citizens.

The cowpea weevil, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae), is a cosmopolitan field-to-store pest ranked as the principal post-harvest pest of cowpea in the tropics (Caswel, 1981). It causes substantial quantitative and qualitative losses manifested by seed perforation and reductions in weight, market value and germination ability of seeds

(Oluwafemi 2012). It may damage 20–30% of legume seeds in the tropical countries (Kirado and Srivastava 2010) and can cause up to 100% loss when masses of cowpea beans are untreated (Gbaye et al. 2011). The females deposit eggs on the surface of maturing cowpea pods and seeds. The newly emerged larvae burrow into and feed on a single seed until pupation, and adults do not need to feed (Mitchell 1975; Southgate 1978). Several holes are left in the seed by the emerging adults with severe weight loss facilitating fungal and mycotoxin contamination, which reduces the commercial bean value (Kirado and Srivastava 2010; Kedia et al. 2013).

In order to reduce serious losses experienced during storage, various techniques and control methods have been developed and more are still being developed. Management of cowpea seed storage pests relies heavily on the use of chemical insecticides. Insecticides also have negative impact on the environment, humans and non-target organisms. However, most of the small scale farmers have not adopted these new techniques due to some financial and technical reasons. Therefore, there is a need to develop cheap, safe and easy methods

of protecting stored cowpeas against cowpea weevil (Tiroesele et al. 2015). Moreso, researches have shown that botanicals have been extensively used on agricultural pests and to very limited extent on insect pests of stored products (Berger 2005). There have also been some degrees of success and achievements in the use of leaf powders of neem and bitter leaf against insect pests of stored products (Schmutterer 1990; Khalequzzaman and Khanom 2000).

The application of plant materials with insecticidal or repellent properties to stored grains is a common traditional method in rural areas around the world (Regnault-Roger et al. 2012; Kedia et al. 2013). Tropical ecosystems are particularly rich in plants that are used by local communities to treat diseases, thus indicating the potential to discover new compounds (Albuquerque et al. 2007, 2008). Talukder (2006) has listed 43 plant species as insect repellents, 21 plants as insect feeding deterrents, 47 plants as insect toxicants, 37 plants as grain protectants, 27 plants as insect reproduction inhibitors, and 7 plants as insect growth and development inhibitors. Eighteen species showed insecticidal potential, and antiovipositional properties against *Sitophilus oryzae* (Devi and Devi 2013). Plant extracts, powder, ash and oil from nishinda (*Vitex negundo* L.), eucalyptus (*Eucalyptus globules* Labill.), bankalmi (*Ipomoea sepiaria* K.), neem (*Azadirachta indica* L.), safflower (*Carthamus tinctorius* L.), sesame (*Sesamum indicum* L.) and bablah (*Acacia arabica* L.) were evaluated for their oviposition inhibition, surface protectant, residual toxicity and direct toxicity effects on *C. maculatus*; the powdered leaves and extracts of nishinda, eucalyptus and bankalmi, at a 3% mixture, provided good protection for black gram seeds by reducing insect oviposition, F₁ adult emergence, and grain infestation rates (Rahman and Talukder 2006).

Insecticidal natural products, such as powders of locally available plants, used by farmers in developing countries in their storage facilities, appear to be safe and promising (Paul et al. 2009; Silva et al. 2013; Tavares et al. 2013, 2014; Fouad et al. 2014; Melo et al. 2014; Suleiman and Suleiman 2014). Powders of the leaves and stems of 9 plant species, including *Amburana cearensis* A. C. Smith (Fabales: Fabaceae), *Croton sonderianus* Müll. Arg. (Malpighiales: Euphorbiaceae), *Cleome spinosa* Jacq. (Capparales: Cleomaceae), *Mimosa tenuiflora* Benth. (Fabales: Fabaceae), *Anadenanthera macrocarpa* (Benth.) Brenan (Fabales: Fabaceae), *Aspidosperma pyriformis* Mart. (Gentianales: Apocynaceae), *Senna occidentalis* (Fabales: Fabaceae), *Hyptis suaveolens* (L.) Poit. (Lamiales: Lamiaceae), and *Ziziphus joazeiro* Mart.

(Rosales: Rhamnaceae), were applied on masses of cowpea seeds, and their effects on *C. maculatus* longevity as well as their repellent activities were evaluated by de Melo et al. (2015).

Therefore, this investigation has been designed to evaluate the efficacy of the plant powder as a possible source of biologically active plant secondary metabolites to be used as environment friendly pest control agents. In this proposition long pepper (*Piper longum* L.), big-sage (*Lantana camara* L.), dahlia (*Dahlia rosea* Cav.) and garden cosmos (*Cosmos bipinnatus* Cav.) have been selected for pesticidal investigation in powder form and in conjunction with terpene oil Cinnamaldehyde.

Materials and Methods

Test insect: The *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) is commonly known as cowpea weevil and widely found in stored pulse in all parts of Bangladesh. The experimental beetles used in experiments were collected from a private store house of Shaheb Bazar, Rajshahi and Nowdapara, Meherpur. The cultures were maintained in the Crop Protection and Toxicology Laboratory, Department of Zoology, University of Rajshahi, Bangladesh.

Preparation of the Plants Leaf Powder: Four different plants leave e.g. long pepper (*Piper longum* L.), big-sage (*Lantana camara* L.), dahlia (*Dahlia rosea* Cav.) and garden cosmos (*Cosmos bipinnatus* Cav.) were used in this experiment. The selected plants leaves were collected from the botanical garden of the Rajshahi University. Collected plants were cut into small pieces and dried in an incubator at 40°C for 12 hours. Dried leaves were then powdered in a hand grinder, and sieved separately to obtain the finest particles. The separate leaves powders were kept in separate plastic containers for the further experiment.

Preparation of the Food Medium: Cowpea seeds [*Vigna unguiculata* (L.) Walp. (Fab.)] were used as food medium for *C. maculatus* through the experiments. The seeds were collected from the stores and disinfected by heating them for 24 hours at 60°C in an incubator. Then the seeds were thoroughly washed with tap water to remove dust and other insects present in the materials and carefully dried under sunlight, having 13-14% moisture content and stored in air tight containers.

Essential Oil: The essential oil cinnamaldehyde was purchased as pure oil (Branded in India) from a shop at Dhaka, Bangladesh. It was dehydrated in a vacuum rotary evaporator. The oil were then collected in glass containers and stored at 4°C until it was used.

Single and combined treatment: For single treatment, 2-, 3-, 4- and 5 g fine powdered of each leaves with three replication was put in different plastic containers. Then 100 gm weighed seeds were put in each plastic container and mixed with powder leaves properly. A control batch replicated three was maintained on normal food only. 20 adult beetles were released in these plastic containers. The mortality of the beetles was recorded after 1, 12, 24, 48, 72 hours of treatment. For combined treatment, leaves powder were mixed in different ratios with cinnamaldehyde. The ratios were 5:0.6, 5:0.1, 3:0.6 and 3:0.1 (g + ml). The mixed formulations were used for the bioassay on the 10 adult *C. maculatus* with respective food and in each case a control batch was also maintained on untreated food. Other procedures were the same as described above.

Mortality Test: The mortality test used was adopted by the method of McDonald et al. (1970) with some modifications by Talukder and Hawse (1993, 1995). The Beetles mortality was continuously counted at every 1, 12, 24, 48 and 72 hours from the release of the beetles and its position was noted at least once an hour until 72 h after release. The average of the counts was

converted to percentage mortality (PM) using the formula of Talukder and Hawse (1993, 1995) which was again developed by arcsine transformation for the calculation of ANOVA.

Results

Effect of *P. longum* in single and combined doses with cinnamaldehyde: The effect of *P. longum* leaf powder on *C. maculatus* at different hours of treatment and doses has been presented in Table 1. All the mortality values were arcsine transferred and shown in the parenthesis of the table. The analysis of variance showed that both dose and exposure period were insignificant indicating no differences between the means in single treatment.

However, the effects of *P. longum* leaf powder in combined doses with cinnamaldehyde on *C. maculatus* at different hours of treatment and doses have also been showed highly significance differences ($P < 0.001$) (Table 1). All the mortality values were arcsine transferred and shown in the parenthesis of the table, and the LSD value has also been calculated and as differences in the means is also shown in Table 1.

Table 1. Dose mortality (%) of *P. longum* L. plant leaf dust in single and combination with cinnamaldehyde on adult *C. maculatus* after 1, 12, 24, 48, 72 hours of treatment. ns = not significant; *** = $p < 0.001$.

Dose g/100g seeds	Mortality% (Arcsine transferred value) after					Mean ±SE				
	1h	12 h	24 h	48 h	72 h					
Treated seeds alone										
2	0 (0)	3.30 (10.46)	1.66 (7.40)	0 (0)	1.66 (7.40)	5.05 ±2.88				
3	1.6 (7.40)	0 (0)	1.6 (7.40)	6.60 (14.88)	1.66 (7.40)	7.41 ±3.24				
4	0 (0)	3.30 (10.46)	0 (0)	0 (0)	8.3 (16.77)	5.44 ±2.74				
5	0 (0)	3.30 (10.46)	0 (0)	5.00 (12.92)	11.60 (19.91)	8.65 ±5.37				
Mean±SE	1.85 ±2.13	7.845 ±3.33	3.70 ±5.34	6.95 ±3.237	12.87 ±4.292					
Treated in conjunction with Cinnamaldehyde										
5+0.6	25 (30)	25 (30)	55 (47.86)	65 (53.72)	65 (53.72)	43.06 ±5.43				
5+0.1	15 (22.78)	5 (12.92)	40 (39.23)	35 (36.27)	55 (47.86)	31.81 ±6.20				
3+0.6	10 (18.43)	10 (18.43)	20 (26.56)	25 (30)	40 (39.23)	26.53 ±3.90				
3+0.1	5 (12.92)	5 (12.92)	15 (22.78)	15 (22.78)	45 (42.13)	22.70 ±5.33				
Mean±SE	21.03±3.60	18.56±4.16	34.10±5.77	35.69±6.60	45.75 ±3.20					
ANOVA										
Source of Variation	Treated seeds alone					Treated in conjunction with Cinnamaldehyde				
	SS	df	MS	F	P	SS	df	MS	F	P
Rows	43.10	3	14.36	0.37	ns	1174.35	3	391.45	20.88	***
Columns	287.79	4	71.94	1.89	ns	2010.84	4	502.71	26.82	***
Error	454.52	12	37.87			224.90	12	18.74		
Total	785.42	19				3410.10	19			

For combined treatment, the LSD values (1%) = 8.36 for dose and 9.35 for exposure period.

Effect of *L. camara* in single and combined doses with cinnamaldehyde: The effects of *L. camara* leaf powder on *C. maculatus* at different hours of treatment and doses have been presented in Table 2. All the mortality values were arcsine transferred and shown in the

parenthesis of the table. The analysis of variance showed that both dose ($P < 0.05$) and exposure period ($P < 0.01$) were statistically significant.

The effects of *L. camara* leaf powder in combined with cinnamaldehyde on *C. maculatus* at different hours of treatment and doses have been presented in Table 2. All the mortality values were arcine transferred and shown in the parenthesis of the table. The analysis of variance

showed significant difference both in dose ($P < 0.001$) and exposure period ($P < 0.05$). The LSD values have also been calculated and as differences in the means were also shown in Table 2.

Table 2. Dose mortality (%) of *L. camara* L. plant leaf dust in single and combination with cinnamaldehyde on adult *C. maculatus* after 1, 12, 24, 48, 72 hours of treatment. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

Dose g/100g seeds	Mortality% (Arcsine transferred value) after					Mean ±SE				
	1h	12 h	24 h	48 h	72 h					
Treated seeds alone										
2	0 (0)	0 (0)	0 (0)	1.66 (7.40)	0 (0)	1.48 ±1.48				
3	0 (0)	0 (0)	0 (0)	0 (0)	1.66 (7.40)	1.48 ±1.48				
4	0 (0)	1.66 (7.40)	1.60 (7.40)	5.00 (12.92)	5.00 (12.92)	8.12 ±2.37				
5	0 (0)	3.3 (10.46)	8.33 (16.77)	16.60 (24.08)	8.33 (16.77)	13.61 ±4.02				
Mean±SE	0 (0)	4.46 ±2.65	6.04 ±3.97	11.10 ±5.07	9.27 ±3.46					
Treated in conjunction with Cinnamaldehyde										
5+0.6	37.5 (37.73)	57.5 (49.31)	82.5 (65.27)	82.5 (65.27)	87.5 (69.29)	57.37 ±5.98				
5+0.1	32.5 (34.75)	72.5 (58.37)	50 (45)	72.5 (58.37)	62.5 (52.23)	49.74 ±4.48				
3+0.6	25 (30)	42.5 (40.68)	62.5 (52.23)	67.5 (55.24)	70 (56.78)	46.98 ±5.09				
3+0.1	22.5 (28.31)	47.5 (43.56)	52.5 (46.23)	55 (47.86)	70 (56.78)	44.58 ±4.63				
Mean±SE	32.69 ±2.16	47.98 ±3.90	52.23 ±4.61	56.68 ±3.61	58.77 ±3.66					
ANOVA										
Source of Variation	Treated seeds alone					Treated in conjunction with Cinnamaldehyde				
	SS	df	MS	F	P	SS	df	MS	F	P
Rows	516.34	3	172.11	9.15	**	461.93	3	153.97	5.27	*
Columns	299.68	4	74.92	3.98	*	1718.03	4	429.50	14.70	***
Error	225.72	12	18.81			350.50	12	29.20		
Total	1041.75	19				2530.47	19			

For single treatment, the LSD values (1%) = 8.38 for dose and 9.37 for exposure period, and the combined treatment, the LSD values (1%) = 7.44 for dose and 11.67 for exposure period.

Table 3. Dose mortality (%) of *D. rosea* Cav. plant leaf dust in single and combination with cinnamaldehyde on adult *C. maculatus* after 1, 12, 24, 48, 72 hours of treatment. * = $p < 0.05$; *** = $p < 0.001$.

Dose g/100g seeds	Mortality% (Arcsine transferred value) after					Mean ±SE				
	1h	12 h	24 h	48 h	72 h					
Treated seeds alone										
2	0 (0)	0 (0)	0 (0)	10 (18.43)	0 (0)	3.68 ±3.685				
3	0 (0)	3.3 (10.46)	6.6 (14.88)	13.3 (21.38)	6.6 (14.88)	12.32 ±3.53				
4	3.30 (10.46)	23.3 (28.86)	16.6 (24.04)	13.3 (21.38)	23.3 (28.86)	22.72 ±3.38				
5	6.6 (14.88)	16.6 (24.04)	43.6 (41.32)	36.6 (37.22)	36.6 (37.22)	30.93 ±4.96				
Mean±SE	6.33 ±3.76	15.84 ±6.56	20.06 ±8.64	24.60 ±4.26	20.24 ±8.17					
Treated in conjunction with Cinnamaldehyde										
5+0.6	5 (12.92)	25 (30)	65 (53.72)	75 (60)	65 (53.72)	42.07 ±8.91				
5+0.1	0 (0)	15 (22.78)	35 (36.27)	40 (39.23)	55 (47.86)	29.22 ±8.34				
3+0.6	0 (0)	15 (22.78)	25 (30)	45 (42.13)	50 (45)	27.98 ±8.07				
3+0.1	0 (0)	5 (12.92)	20 (26.56)	10 (18.43)	20 (26.56)	16.89 ±4.95				
Mean±SE	3.23 ±3.22	22.12 ±3.50	36.63 ±6.03	39.94 ±8.51	43.28 ±5.86					
ANOVA										
Source of Variation	Treated seeds alone					Treated in conjunction with Cinnamaldehyde				
	SS	df	MS	F	P	SS	df	MS	F	P
Rows	2127.02	3	709.00	17.87	***	1592.56	3	530.85	15.89	***
Columns	767.53	4	191.88	4.83	*	4374.63	4	1093.65	32.75	***
Error	476.02	12	39.66			400.66	12	33.38		
Total	3370.58	19				6367.86	19			

For single treatment, the LSD values (1%) = 12.14 for dose and 9.70 for exposure period, and for combined treatment, the LSD values (1%) = 11.16 for dose and 12.48 for exposure period.

Effect of *D. rosea* in single and combined doses with cinnamaldehyde:

The effects of *D. rosea* leaf powder (single and combined with cinnamaldehyde) on *C. maculatus* at different hours of treatment and doses have been presented in Table 3. All the mortality values were arcsine transferred and shown in the parenthesis of the table. The analysis of variance for single treatment showed that both dose ($P < 0.05$) and exposure period ($P < 0.001$) were notably significant.

In case of combined, treatment the analysis of variance showed highly significant differences both in dose ($P < 0.001$) and exposure period ($P < 0.001$). The LSD values have also been calculated and shown in Table 3.

Effect of *C. bipinnatus* in single and combined doses with cinnamaldehyde:

The effects of *Cosmos*

bipinnatus leaf powder on *C. maculatus* at different hours of treatment and doses have been presented in Table 4. All the mortality values were arcsine transferred and shown in the parenthesis of the table. For both in dose ($P < 0.001$) and exposure period ($P < 0.001$) the ANOVA results were highly significant.

The effects of *C. bipinnatus* leaf powder in combined with cinnamaldehyde on *C. maculatus* at different hours of treatment have also been presented in Table 4. All the mortality values were arcsine transferred and shown in the parenthesis of the table. The results of ANOVA were highly significant both in dose ($P < 0.001$) and exposure period ($P < 0.001$). The LSD values have also been calculated and as differences in the means were also shown in Table 4.

Table 4. Dose mortality (%) of *C. bipinnatus* Cav. plant leaf dust in single and combination with cinnamaldehyde on adult *C. maculatus* after 1, 12, 24, 48, 72 hours of treatment. *** = $p < 0.001$.

Dose g/100g seeds	Mortality% (Arcsine transferred value) after					Mean ±SE				
	1h	12 h	24 h	48 h	72 h					
Treated seeds alone										
2	0 (0)	0 (0)	3.30 (10.46)	3.3 (10.46)	3.30 (10.46)	6.27 ±2.562				
3	0 (0)	0 (0)	6.60 (14.88)	6.6 (14.88)	13.30 (21.41)	10.23 ±4.344				
4	0 (0)	6.60 (14.88)	16.60 (24.04)	16.60 (24.04)	33.3 (35.24)	19.64 ±5.875				
5	0 (0)	10 (18.43)	23.30 (28.86)	36.60 (37.22)	46.6 (43.05)	25.51 ±7.605				
Mean±SE	-	8.32 ±4.86	19.56 ±4.19	21.65 ±5.91	27.54 ±7.24					
Treated in conjunction with Cinnamaldehyde										
5+0.6	5 (12.92)	15 (22.78)	45 (42.13)	30 (33.21)	70 (56.78)	33.56 ±7.59				
5+0.1	0 (0)	5 (12.92)	25 (30)	15 (22.78)	30 (33.21)	19.78 ±6.05				
3+0.6	0 (0)	10 (18.43)	10 (18.23)	15 (22.78)	45 (42.13)	20.31 ±6.71				
3+0.1	0 (0)	5 (12.92)	10 (18.23)	15 (22.78)	25 (30)	16.78 ±5.04				
Mean±SE	3.23 ±3.22	16.76 ±2.38	27.14 ±5.71	25.38 ±2.60	40.53 ±5.99					
ANOVA										
Source of Variation	Treated seeds alone					Treated in conjunction with Cinnamaldehyde				
	SS	df	MS	F	P	SS	df	MS	F	P
Rows	1150.82	3	383.60	11.72	***	835.89	3	278.63	12.75	***
Columns	1963.70	4	490.92	15.00	***	3036.83	4	759.20	34.75	***
Error	392.48	12	32.70			262.15	12	21.84		
Total	3507.00	19				4134.87	19			

For single treatment, the LSD values (1%) = 11.04 for dose and 12.35 for exposure period, and for combined treatment, the LSD values (1%) = 9.03 for dose and 10.09 for exposure period.

Discussion

Plant powders can control insects by eroding the cuticle layer and causing dehydration (Kedia et al. 2013); blocking the spiracles and causing asphyxiation (Denloye 2010); or impairing physiological processes by penetrating the insect body via the respiratory or alimentary system (Ofuya and Dawodu 2002). Mahdi et al. (2007) and Mahdi and Rahman (2008) were investigated the insecticidal potency of some spices

powders e.g. Clove (*Syzygium aromaticum*), black pepper (*Piper nigrum*), ceylon cinnamon (*Cinnamomum zeylanicum*), black cardamom (*Amomum subulatum*), nutmeg (*Myristica fragrans*), black cumin (*Nigella sativa*), turmeric (*Curcuma longa*), red pepper (*Capsicum frutescens*), cumin (*Cuminum cyminum*), green cardamom (*Elettaria cardamomum*) and bay leaf (*Cinnamomum tamala*), against the pulse beetle, *Callosobruchus chinensis* L. C.

maculatus (F.) All the spices were effective as protectants of black gram seeds; however, clove and black pepper were most effective.

Khalequzzaman and Goni (2009) used leaf of *Vitex negundo* L., *Annona squamosa* L., *Nicotiana tabacum* L., *Polygonum hydropiper* L. and leaf, bark and seed kernel powders of *Azadirachta indica* A. juss. at the rate of 1-, 2- and 3g per 50g cowpea seeds on *C. maculatus* and observed mortality up to seven days between 26.66% ± 12.01 to 100%. Yusuf et al. (2011) conducted to investigate the insecticidal activities of seven plant materials (1-5g/100g cowpea seeds) namely: citrus peel powder, *Acacia* leaf powder, *Occimum* leaf powder, mahogany bark powder, hot pepper powder, ginger powder and mahogany wood ash against *C. maculatus* and mahogany wood ash was superior at all rates of application in reducing cowpea seed weight loss and seed damage. Ntonifor et al. (2010) studied dried seed powders of *Syzygium aromaticum* [L.] Merr. ET Perry, *Piper guineense*, *Ocimum basilicum* (Lamiaceae), *Aframomum citratum* (Pareira) K. Schum and leaf powders of *Cyperus aequalis* Vahl and *Eucalyptus camaldulensis* Dehnh. against *C. maculatus* in cowpea grains and found all plant powders killed more insects than control.

Ekeh et al. (2013) investigated the comparative efficacy of some botanicals and pirimiphos methyl powder in the suppression of *C. maculatus* damage in some stored legume seeds. The results indicated that *O. gratissimum* gave highest mortality rate of 29.01 ± 2.90 %, 23.00 ± 1.35% and 37.29 ± 3.29% over four days against *V. subterranean*, *C. cajan* and *V. unguiculata* respectively. Regmi et al (2012) used pesticidal materials (*Xanthoxylum armatum* DC fruit dust, *Acorus calamus* L. rhizome dust, *Cinnamom camphora* balls, *Sesamum indicum* L. oil, and *Azadirachta indica* A. Juss. leaf dust; and the mortality of adult bruchids was obtained significantly higher in chickpea treated by *C. camphora* balls (25.17%) followed by *A. calamus* rizome dust (24.83%) and *Sesamum* oil (24.50%).

Su (1983) reported that oil of black pepper extracted in hexane reduced F_1 emergence of cowpea weevil on cowpea. Fruit powder of *Piper guineense*, was found to have comparable best effects as actellic super dust on fecundity of the cowpea weevil in a trial involving 3 botanicals and the synthetic pesticide (Abdullahi and Mahammad, 2004). These findings are consistent with results of this study where black pepper powder reduced significantly the number of bruchids and consequently the number of damaged seeds. Morya et al. (2010) studied *Lantana camara* leaf powder on

Corcyra cephalonica (Stainton) and found delay in the pupal-adult moult after treatment. It also reduces total haemocyte count, total protein and glycogen content resulting mortality.

Hossain et al. (2014) studied the effectiveness of 17 indigenous plant powders as grain protectant against *C. chinensis* (L.) and the results indicated that among all the tested plant materials, tobacco leaf powder had promising effects on inhibiting oviposition and reducing adult emergence, seed infestation, and weight loss. Longe (2016) evaluated the comparative efficacy of seven (7) botanical plant powders on *C. maculatus* infesting stored cowpea seeds. The results indicated that the powders of *Corymbia citrodora* (Lemon-scented Gum plant) and *Nicotiana tabacum* (Tobacco) exhibited total control (100% efficacy) in all its developmental stages, while *Citrus aurantifolia* (Lime) and *Alstonia boonei* (Cheesewood) plant powders were found to be moderately effective against the insect.

For single treatment, the order of maximum average mortality (percentage) was: *L. camara* > *P. longum* > *D. rosea* > and *C. bipinnatus* for treatment periods, and *P. longum* > *L. camara* > *C. bipinnatus* > and *D. rosea* for treatment doses. Alternatively, for combined treatment, the order of maximum average mortality (percentage) was: *C. bipinnatus* > *D. rosea* > *P. longum* > and *L. camara* for treatment periods, and *C. bipinnatus* > *D. rosea* > *P. longum* > and *L. camara* for treatment doses. Dose mortality test showed promising effect in all the treatments except single treatment of *P. longum* on *C. maculatus*. When leaf powder was applied in mixed formulation with monoterpene oil cinnamaldehyde, all treatments showed higher mortality, and the mortality of the weevils were significantly increased in comparison to single treatment with only leaf powder. Altogether, the present results indicated the mortality effect of the studied plant powders on *C. maculatus* (F.). Future studies will be necessary to establish the exact mechanism by which these plant powders and cinnamaldehyde oil function together in controlling stored grain against pulse beetles.

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