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Original Article

Peat Resources, its Quality and Condition of Deposition, Bijoyagar Upazila, B'Baria District, Bangladesh

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Abstract

The report is prepared on the basis of peat exploration at 4000 hectre areas of Bijoyagar Upazila at B'Baria district which is in the north-eastern part of Bangladesh. Nine peat bearing areas were identified in the studied area are covering six unions of Paharpur, Haraspur, and Chompoknagar and Uttar Singair beel. Peat was randomly found in surface to near surface at different places of investigated area. The total reserve of peat is about 32.61 million tons in wet condition or 13.044 million tons in dry condition. The chemical analysis of the peat shows average fixed carbon-20.5%, Ash content-32% and calorific value-7000 B.T.U. The quality of this peat is good. Geology, tectonics and environment of any area are controlling parameter for peat deposition. Fluvial and deltaic plain with area of active subsidence are suitable for peat deposition. The peat of the area may deposit from plant material that accumulated *in situ* (Autochthonous) and transported from short distance (Hypoautochthonous). The peat layers of the study area are found at surface or at shallow depth ranging from few centimeters to 7 meters below surface. Present of clay and silt of the upper part of the deposits indicating that the sediments are deposits usually in the winter season when the current of the water become weak. Moreover, the sediment may also be laid down in stagnant water after the recession of the flood. Peat deposited underlain by dark clay or peaty clay indicating these deposits have formed from the decay and decomposition of initial vegetal growth. The study area is bounded by some small hillock and which is extension of Tripura Hills of India in the eastern part. Vegetation occurred in these hillocks which have been destroyed and transported by any natural hazard or tectonic reason. On the other hand vegetation occurred in this depression as aquatic plants which might have been destroyed by large natural disasters or any tectonic reason. As environment dictates the characteristics and the source of sediments, various aspects of the sediment are indicators of their condition of deposition.

1. Introduction**1.1 Location, Extents and Accessibility**

The surveyed area is included in the topographic sheet no- 79 0/13, B/16, C/1, and F/4 of the scale 1:50000 that lies latitudes: A- 24°02'40"N; B-24°01'32"N; C-23°57'40"N; D-23°58'10" and longitudes A-91°15'30"E, B- 91°18'32"E, C-91°16'10"E, D- 91°13'30"E. 4000 hectare area is covered by depressed swamps and floodplain under the Chandhura, Pattan, Uttar Ichapur, Paharpur, Haraspur and Chompoknagar union of Bijoyagar upazila, B, Baria district (figure-1). This area is bounded by Habigonj and Sarail upazila in the north; Tripura state of India in the east; Akhaura and Kasba upazila in the south and B'Baria sadar in the west (figure-1). Total mapped area covers about 40 square kilometer. The location of nine peat bearing areas comprises of different villages (Manikpur, Chandhura, Borochal, Ariol, Pachgaon, Ichapur, Shohdevpur, Mirjapur, Bijoyagar, Dhariapur, Hazipur, Paikpara, Bonderbari, and Tulatola) of Bijoyagar upazila, Brahmanbaria district. The surveyed area is located about 20-25 km northeast from the B, Baria district town, which is well connected to the Dhaka-Sylhet national highway. Peat deposited area is connected with B, Baria district town by metalloid road.

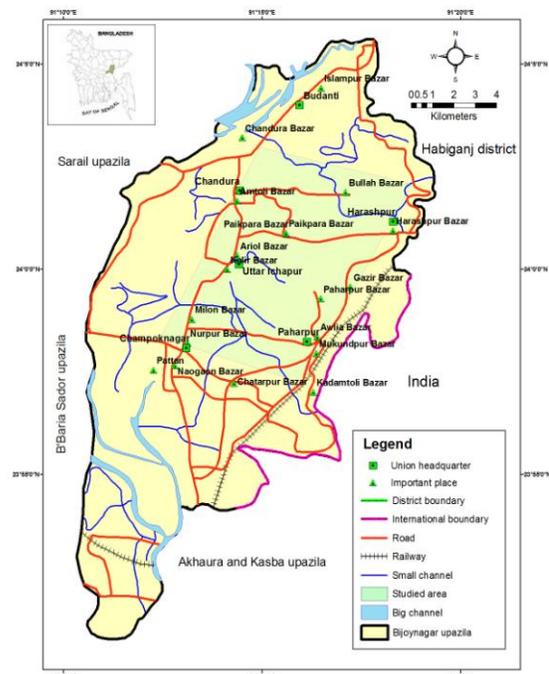


Figure-1: Location map of the studied

1.2 Previous Study of the area

Geological survey of Bangladesh has no detail published survey report on the study area. Only one published report “Quaternary Geomorphic Evolution of the Brahmanbaria-Noakhali Area, Comilla and Noakhali districts, Bangladesh” by M A Bakar in 1977 [1]. Unpublished report on Geological map, Geomorphological pattern change and Stratigraphy of B’ Baria sadar upazila, B’Baria district by Md Khairul Islam [2] in 1995-96, he mentioned in this report about peat deposits of B, Baria sadar upazila. Unpublished report on preliminary investigation of peat deposits at different areas of B, Baria sadar upazila, B’Baria district by M.A Sayem and M. Masum [3] in 2008 was the initial report on this peat. Besides Peat resources at Brahmanbaria Sadar, Brahmanbaria district, Bangladesh: Economic and Environmental Aspects by Uddin et al [4] was published in 2009 in the Proceedings-Geoscience for Global Development (GeoDev). Badrul Imam [7] in 2005 also mentioned in his report Energy resources of Bangladesh about peat at B, Baria.

2. Methodology

Peat exploration works are carried out by mainly augering during the fieldwork. Lithological data of every auger hole (ranges from 0.1 m-11 m below the surface) was collected at different places of the study area during the field investigation. GPS data was taken for the demarcation of peat deposition and map preparation. Final maps were prepared by using Arc GIS software. Cross section of every peat bearing area prepared with the help of surfer software. Total exploration work was carried out by stages. In the first stage, the location was demarcated and GPS data (especially latitude and longitude) was written down in the field notebook. In the second stage, auguring and lithological information of every auger hole as well as thickness of the peat were written down. In the third stage, snapped the samples and view of augering as well as surrounding area peat field, sampling (collected samples at different depth of auger hole) and labeled, then it was preserved for further analysis. In the fourth stage, samples were analyzed in the G.S.B Laboratory after that final maps and report were prepared. Topographic survey was done by survey team of G.S.B. The

spot heights of 241 points at different areas of specified 4000 hectare of Bijoy Nagar upazila points were taken by the height of instrument method. In this method heights were carried away from a georeferenced point (Benchmark) using a leveling machine and a Global Positioning System (GPS).

2.1 General Geologic Settings

The surveyed area is situated in the northeastern part of Bangladesh and occupies the southern part of greater Sylhet district. Major portion of the mapped area is occupied by Meghna floodplain in the west and the Titas floodplain in the east, so formed an extensive floodplain in the southern part of the Sylhet depression. Alluvial sediments are covered in the entire floodplains, thus all of the surficial deposits of floodplains are of Holocene age. Low-lying areas with depression and flood basins occupied the major portion of the investigated area. Small portion of the B’Baria area is occupied by some small hillocks of Pleistocene age which formed some small valleys. These hillocks are characterized by thick sediments (more than 33 m) and tectonic mobility or instability causing rapid subsidence and sedimentation in relatively short span of geologic time. These hillocks are the continuation of the Chittagong-Tripura folded belt/Tripura uplift. The anticline forms the hills and the syncline form the valleys are seen in topography of Chittagong-Comilla/B’Baria-Sylhet regions [5]. The intensity of the folding is greater toward the east causing higher topographic elevation in the eastern part than that of the western part.

2.2 Description of peat bearing area

The peat bearing areas are in low-lying alluvial plain or flood plain. Nine peat bearing areas were identified during the field investigation (Figure 2). The peat deposited areas are located in a topographically depressed part within the flood basin. The thickness of the peat varies from 0.2 m to 6.0 m in place to place and are found in surface to near surface of the surveyed area. These areas are submerged under water for three or four months in a year. Maximum peat bearing areas are low lying agricultural land. Several types of crops have been grown in the peat bearing area in two or more times in a year. Some peat bearing areas are also present under the residential places (Plate-1).

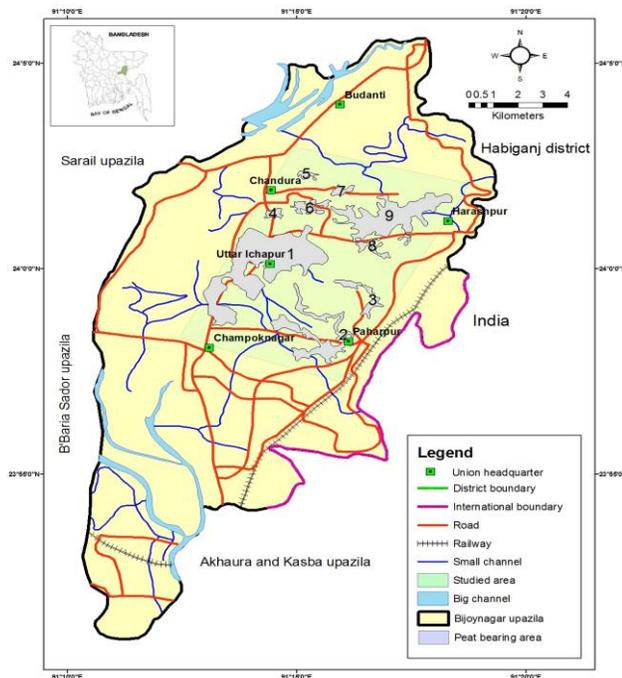


Figure 4: Different peat bearing area.



Plate 1: A showing peat extracting, B showing submergible peat bearing land and C showing peat bearing agricultural as well as residential area.

2.3 Stratigraphic Position of Peat

The peat is found within the Alluvium Formation of Holocene age during the field investigation. It has been observed that every location of peat deposits is within the Alluvium Formation. Most of the peat is found in subsurface (0.3 m to 2.3 m below the surface) condition. Peat invariably overlies the bluish grey clay. Two units are observed

over the peat, one is bluish grey silt which overlies the peat and other is brownish grey silty clay which overlies the silt. Bluish grey clay considered as base of the peat (fig.3). It should be mentioned that this peat is absent in and below the Madhupur Formation of Pleistocene age. Peat occurs at the study areas which are in different thickness and their clear picture showing in the cross section.

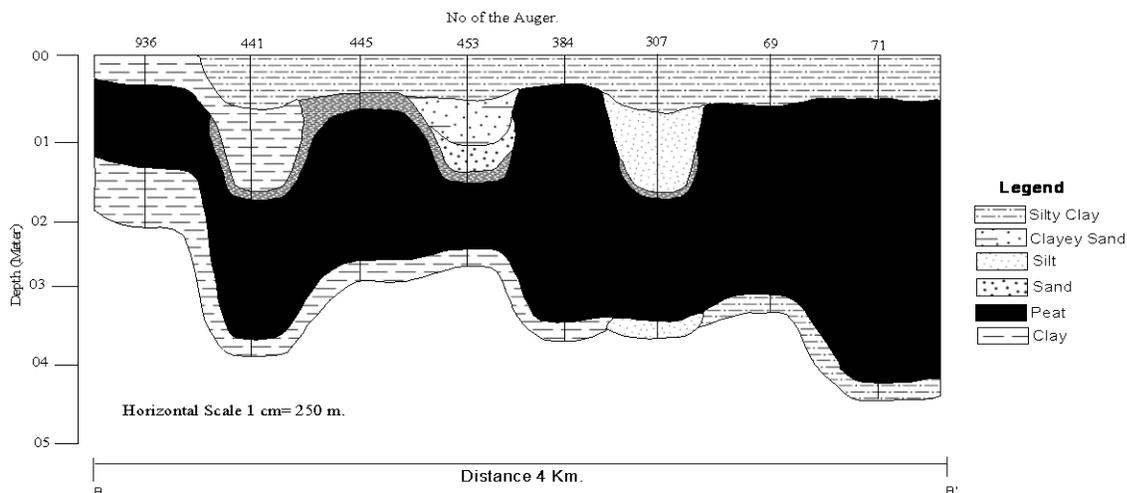


Figure 3: Cross section of the peat bearing area.

2.4 Physical and Chemical Characteristics of Peat

Peat is grayish brown (5YR 3/2) to grayish black (N2) coloured, fibrous, less to medium compacted, friable on finger pressure, partially decomposed woody matters are observed, water content varies from 30%-80% in wet peat, some of them are medium hard, compacted, fibrous and friable (dry peat), woody matters, several types of trees or parts of trees are observed within the peat formation in some places. The average chemical composition of the peat (especially moisture content 4.9%-9.6 %, fixed carbon 15%-25% and calorific value-5000-8000 BTU) suggests that the peat is medium to good quality. Some peat

samples at western extreme part of the study area comprise of more than 8000 B.T.U which is nearly similar to lignitic coal. This type of peat observed 10 m 15 m below the surface. The chemical composition of the peat is shown in table 1. It should be mentioned here that normal calorific value of peat 4700 B.T.U to 6800 B.T.U and fixed carbon is 10%-20% as well as their moisture level more than 50%. The comparative discussion of peat of the study area reveals that the peat has high calorific value, sufficient carbon content and moisture content is very less (below 8%). So, the surveyed area content one of the best quality peat among the world.

Table-5a: Chemical composition of peat of the surveyed area, Bijoyagar, B'Baria district, Bangladesh.

SI No	Sample No	GS Lab No	Sulphur %	Moisture %	Volatile matter %	Fixed carbon %	Ash %	Calorific value (B.T.U)	Fe ₂ O ₃ %	CaO %	MgO %
1	Sam-1	4168(1)	.274	7.10	33.80	16.40	42.7	4582	2.70	1.12	1.40
2	Sam-2	4168(2)	.315	8.10	34.60	19.80	37.5	5047	2.40	1.40	1.20
3	Sam-3	4168(3)	.185	8.90	43.70	17.30	30.10	7083	2.05	0.84	1.00
4	Sam-4	4168(4)	.133	7.30	37.90	20.10	34.70	5587	2.59	1.12	1.00
5	Sam-5	4168(5)	.078	7.50	42.10	22.30	28.10	6285	1.51	0.84	1.60
6	Sam-6	4168(6)	.352	7.90	45.20	25.60	21.30	6858	1.29	2.24	1.00
7	Sam-7	4168(7)	Nil	9.70	44.60	25.80	19.90	6752	2.05	1.12	0.80
8	Sam-8	4168(8)	„	7.70	38.80	15.70	37.80	4589	2.59	1.40	1.00
9	Sam-9	4168(9)	„	7.90	40.40	23.20	28.50	8046	1.62	0.84	1.00
10	Sam-10	4168(10)	„	7.20	34.50	20.10	38.20	5064	1.94	0.56	1.60
11	Sam-11	4168(11)	1.00	8.20	42.30	29.30	20.20	7073	2.26	0.28	1.20
12	Sam-12	4168(12)	.818	7.30	33.60	17.90	41.20	4745	3.45	0.84	1.20
13	Sam-13	4168(13)	Nil	7.30	33.00	14.90	44.80	4511	4.96	1.12	1.40
14	Sam-14	4168(14)	„	7.40	35.70	18.90	38.00	4981	4.32	1.68	1.20
15	Sam-15	4168(15)	„	8.10	43.10	17.70	31.10	6488	2.48	1.12	0.40
16	Sam-16	4168(16)	Nil	4.60	21.20	10.50	63.70	2382	5.29	0.56	1.80
17	Sam-17	4168(17)	„	4.70	19.20	9.90	66.20	2102	4.86	1.96	1.20
18	Sam-18	4168(18)	„	6.50	31.80	18.60	43.10	4491	3.99	0.84	1.00
19	Sam-19	4168(19)	.626	6.40	23.70	11.80	58.10	2727	4.42	1.96	0.60
20	Sam-20	4168(20)	.595	5.80	33.0	15.00	46.20	3874	3.99	2.24	0.40
21	Sam-21	4168(21)	.379	6.90	34.40	14.70	44.00	4089	2.70	1.12	1.20
22	Sam-22	4168(22)	.505	6.80	33.50	17.90	41.80	4572	3.02	1.68	0.40
23	Sam-23	4168(23)	Nil	4.4	20.0	8.8	66.80	-	4.21	1.12	1.00
24	Sam-24	4168(24)	„	5.8	30.80	17.00	46.40	4054	3.88	0.84	1.20
25	Sam-25	4168(25)	„	6.80	40.70	4.70	47.80	4490	2.48	1.12	1.20
26	Sam-26	4168(26)	„	3.10	51.50	16.60	28.80	5044	4.10	2.24	0.80
27	Sam-27	4168(27)	„	2.80	39.10	18.10	40.00	4961	3.02	0.84	1.20
28	Sam-28	4168(28)	„	4.00	49.10	26.50	20.40	7007	1.83	0.56	0.60
29	Sam-29	4168(29)	„	3.10	39.00	19.90	38.00	5244	3.13	0.56	1.40
30	Sam-30	4168(30)	„	1.90	26.20	10.60	61.30	-	4.64	1.12	1.00

2.5 Formation of the Peat

Peat is partially decomposed swampy plants/vegetal matters or heterogeneous mixtures of partly decomposed plant materials resulted by mainly microbial and chemical changes. Aerobic bacteria, actinomycetes and fungi are the most important factors for peat formation. Aerobic bacteria are more active and oxidation more prominent near the surface. Consequently, the decaying plants will be decomposed more if they are deposited on or near the surface. If the decomposition of these plants is complete, peat will not form, as the peat consists of disintegrated and partially decomposed vegetal matters. Activity of aerobic bacteria, actinomycetes and fungi causes and the anaerobic bacteria become active and effecting partial decomposition of vegetal matters, these decaying processes must be buried under a cover of clay or sand if they are to be transformed into peat. In the prospected area where the top portion of the peat bed is on or near surface, the plant materials are excessively decomposed due to prolonged exposure in (Francies.1954, p-143-150), the middle part of the bed the proportion of the undecomposed plant materials increases and the composition approaches that of peat, indicating rapid burial of the vegetal matters during the early part of their decomposition. The bottom part of the bed also indicates from the colour and structure of the peat that forming plant materials remained unburied for the longer periods allowing aerobic bacteria to cause advanced decomposition. The part of the bed which is under an overburden of clay is more consolidated than the peat without having any overburden. The degree of the consolidation increases with the thickness of overburden.

2.6 Condition of Peat Deposition

Geology, tectonics and environment of any area are controlling parameter for peat deposition. Fluvial and deltaic plain with area of active subsidence are suitable for peat deposition. For the

formation and preservation of significant peat deposits, a depositional setting is required in which there is high organic productivity, slow continuous subsidence and groundwater table is or at close to peat surface. Drainage controls the distribution and preservation of plant types as well as the overall reservation potential of plant deposits. Peat deposits only remain preserved in areas of subsidence. Climate controls the rate of plant growth, type of plant growth and to a large extent, depositional rates, all of which ultimately determine whether or not peat will form. Warm, wet tropical and subtropical climate are most favorable for the development of forest swamps. Such climatic areas are characterized by both high rates of plant accumulation and degradation.

In Bengal plain marshy land and swamps developed since mid-Holocene. The C14 dating of the Faridpur and B'Baria peat suggest that the calendar age in between 3000 to 6000 years [6]. According to Fairbridge, 1961 highest sea level occurred in Bangladesh in 5.5 K. At that time sea level was one to two meters above from present sea level. During the last Himalayan upheaval in Pleistocene time, many folds and low lying areas were formed in the Bengal delta and these low lying areas were inundated during the high sea level condition in the mid Holocene time. Moreover, southwest monsoonal wind became stronger in Bangladesh since 12K, which caused heavy rainfall in Bangladesh and adjoining area. Although Pettijohn,1984 suggested that peat forming condition area nearly everywhere associated with freshwater swamp but the valley of the area may have connections to the sea peat deposition took place [6].

The area includes the warm sub-tropical climatic region. This climatic condition is suitable for quick vegetation growth. Although the condition is complex one and depends on the interaction of species with different water requirements, rainfall and its annual distribution, evapotranspiration, runoff etc. Repeated growth, decay and

decomposition of these vegetal matter result in the formation of peat. Floating plant also make an appreciable contribution in the formation of that peat.

The Peat of the area has been deposited from plant material that accumulated insitu (Autochthonous) and transported from short distance (Hypoautochthonous). Evidence for autochthonous origin of the peat is upraise tree roots in its original portion, trace of rooting and stumps in growth position. Wood trunks are found in the middle and upper part of the peat deposits which are derived by flood water and indicating hypo autochthonous. Moreover, huge tree trunks are found to lay down in one homogeneous direction. This evidence indicating that the trunks are transported by vigorous unidirectional flow like cyclone surge.

The peat layers of the area are found at surface or at shallow depth ranging from few centimeters to 3 meters below surface. Present of clay and silt of the upper part of the deposits indicating that the sediments are deposits usually in the winter season when the current of the water become weak. Moreover, the sediment may also be laid down in stagnant water after the recession of the flood. Peat deposited underlain by dark clay or peaty clay indicating these deposits have formed from the decay and decomposition of initial vegetal growth.

Age of peat at Khulna and Dhaka estimated between 1200 to 6000 years before present; so it is assumed that peat formation becomes end about thousands of year before present. At that period depositional environment change considerably. The alternated environment helps to provide overburden sediment under which the peat is preserved. Change of sedimentation pattern in stratigraphic sequence is smooth. This reflecting that after peat deposition there is no sudden diastrophic change of depositional environment.

3. Conclusion & Recommendation

Based on the surveyed information of peat exploration of the 4000 hectors area of Bijoynagar upazila of B'Baria district, the following conclusions and recommendations are made:

1. The peat of the investigated area is good quality according to the results physical and chemical properties of peat.
2. The reserve of wet peat in the surveyed area is about 32.61 million tons whereas the dry peat is 13.044 million tons.
3. This peat may be used at different purposes of domestic and small industrial purposes after mining. Small power plant like 20 MW may be run using this peat.
4. A proper planning for land use, environmental management and policy should be taken before extraction of peat.
5. Total price of cultivated crops in a year in the peat dominant cultivated land must be correlated to that of estimated peat reserve.
6. Mining of peat must be in such ways that prevents every kind of environmental hazards like landslide/subsidence of the peat dominant surrounding area.

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