J. Agrofor. Environ. 4 (2): 181-183, 2010 ISSN 1995-6983

Effect of Barapukuria coal mine on soil environment

S.K. Sarker, M.A. Baten, M.E. Haque[1], M.S. Hossain[2] and S.M.M. Rahman
Department of Environmental Science, Bangladesh Agricultural University, Mymensingh,
[1]UAO, DAE and [2]Controller of Examination Section, BAU, Mymensingh.

Abstract: An investigation was carried out at Barapukuria coal mine area to determine the nutrient status and trace metal content in coal, coal water, sedimentation tank soil, coal water treated farm soil, normal farmers' field soil and plant samples to determine the effects of coal mine on soil fertility and its environment. Samples were collected from the mine site, coal mine water from the drain, sedimentation tank soil from the sedimentation tank outside of the coal mine and the other soil and plant samples from the adjacent agricultural field of coal mine. The study results revealed that the concentration of K, Ca, Mg, P, S, Zn, Cu, Fe, Pb and Cd was higher in plant samples collected from coal water treated farmers' field than the untreated farmers' field. The p^H value of normal farmers' field soil was nearby neutral but in coal water treated farm soil it was alkaline. Organic carbon content of coal water treated farm soil was higher than untreated farmers' field soil. Thus, the effects of coal water discharge from Barapukuria coal mine to the surrounding agricultural fields was found good for organic carbon, K, Ca, Mg, P, S, Zn, Cu, and Fe for the fertility of soil but the continuous deposition of trace metals in the agricultural field soil may cause a serious deterioration of soil environment.
Key words: coal mine water, trace metal, heavy metal, soil fertility.

Introduction

The pace of development of any nation is intimately linked with her level of energy consumption. Bangladesh, like many other third world countries, has been rated poor for its low per capita energy use. Although it is a natural resources rich country but now it is going on a severe energy crisis. Yet there have been significant discoveries of commercial energy resources in the country specially coal, intensive exploration and exploitation of these energy resources can boost the economic development and facilitate industrial growth. Boropukuria coal mine project had been taken seriously for energy production. An underground coal mine is being completed at Barapukuria by early 2005 under Chinese technical and financial assistance (Imam, 2005) by which Bangladesh entered into an era of coal mining. The coalfield has a proved area of about 5.25sq km. In addition, the field is suggested to have possible extension for 1 to 1.5 sq km area to the south (Anon, 1991). Mine hazard irrespective of the choice of mining methods some disturbances to the mine site and its surrounding environment are inevitable. Issues of safety and environmental concerns for mines under construction in Bangladesh are water pollution and control of mine drainage, sedimentation in water courses, noise pollution, ground vibration, air pollution, socio-economic disturbances, loss of agricultural land, danger of land subsidence, hazards of mine fire, problems of dust and human discomfort. Barapukuria coal mine water is being discharged to the surrounding paddy fields and watercourses without being treated. This practice causes serious threat to the environment as the mine water may be acidic and generally contains lot of sediments which ultimately contaminate the surface water and soil. Farmer's of Barapukuria coal mine adjacent area are using this coal water for irrigating their fields without knowing its quality and its effect on land. The information on coal mine water quality will help to assess its suitability for using this water in irrigational purposes. Therefore, the present study was undertaken to assess the effect of coal water on soil, plants nutrients and trace metals content adjacent to mine area.

Materials and Methods

The investigation was carried out on 2007, at Barapukuria coal mine area to determine the nutrient status and trace metal content in coal, coal water, sedimentation tank soil, coal water treated farm soil, normal farmers' field soil and plant samples collected from coal water treated farm soil and normal farmers' field soil to see the effects of coal mine on soil fertility and its environment. The survey was mainly conducted to know the using pattern of coal water for rice production and its effect on soil environment from having a conversation with the local people and officials of the project. At first physical observation of the study area was performed to get an over all idea about the surrounding existing environment such as present condition of the study area, project activities, nearby crops, forest and agricultural activities. Coal sample was collected from the mine site, coal mine water from the drain, sedimentation tank soil from the sedimentation tank outside of the coal mine. Samples of coal water treated farm soil; normal farmer's field soil and plants from coal water treated farm soil and normal farmer's field soil were collected from the adjacent agricultural field of coal mine. The soil samples were carried at Soil Resources Development Institute (SRDI), Rajshahi and Humboldt Soil Testing Laboratory and Central Laboratory of the Bangladesh Agricultural University, Mymensingh for analysis.

Results and Discussion

Chemical properties: Results on p^H of sedimentation tank soil, coal, coal water, coal water treated farm soil and normal farmers' field soil are presented in Table 1. P^H of coal was 6.46 whereas the p^H of coal water was 6.6. The soils collected from sedimentation tank showed p^H value higher than coal and coal water. Kusel (2003) found such type of result that Lakes caused by coal mining processes were characterized by low p^H. The p^H of soil further increased over coal, coal water and sedimentation tank soil and become the highest when the coal water was added to the normal farmland. The p^H of farmer's field soil nearby the coal water treated land was found 6.1. This indicated that application of coal water increased the p^H of soil by almost 1.22 times over the farmers' field soil. It is apparent from the results that between coal, coal water and soil of sedimentation tank, the p^H of coal were the lowest and the p^H of sedimentation tank soil was the highest. The relatively high p^H of coal water over the coal suggests that some soils basic cations were dissolved in coal mine water keeping the p^H high. The increase in p^H of farmland soils due to application of coal mine water seems possible for deposition of basic cations in soils from the coal mine water whose basic cations content was also considerably high.

Table 1. Chemical properties of soil and plant samples collected from Barapukuria coal mine area.

	p^H	OC (%)	K (ppm)	Ca (ppm)	Mg (ppm)	P (ppm)	S (ppm)	Zn (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)	Pb (ppm)	Cd (ppm)
Coal	6.46	51.07	3.91	106.21	0.12	3.51	4800	0.61	0.46	0.06	0.00	0.0151	0.0065
Coal water	6.66	___	7.20	180.39	52.28	0.334	0.19	0.68	1.36	0.685	0.001	0.486	0.0906
Sedimentation tank soil	7.21	7.10	93.84	502.83	183.36	9.08	199.53	8.67	3.53	39.19	4.99	1.09	0.261
Coal water treated farm soil	7.45	7.82	113.39	555.31	200.73	11.10	220.20	9.93	6.11	156	13.32	1.48	0.128
Normal farmer's field soil	6.10	1.55	105.37	145.09	197.06	6.16	30.78	8.19	2.16	41.28	27.83	0.99	0.098
Plant (Coal water treated farm soil)	___	___	226.20	670.00	960	3000	1820	114	46	610	208	0.590	0.196
Plant (Normal farmer's field soil)	___	___	205.40	390.00	880	2200	1360	74	6	121	549	0.401	0.138

The results on Organic Carbon content of soils from sedimentation tank soil, coal water treated farm soil and normal farmers' field soil appears in Table 1 that the organic carbon content of coal was extremely high (51.07). The organic carbon content of sedimentation tank soil was 7.10% which indicated lower organic carbon than coal. The organic carbon content of sedimentation tank soil (7.1) and coal water treated farm soil (7.82) was nearly same but both indicated higher organic carbon whereas normal farmer's field soil nearby the coal water treated land it was found 1.55. This indicated that application of coal water increased the organic carbon of coal water treated farm land by almost 6.27 units over the organic carbon percentage of normal farmers' field soil of 1.55. Coal is a readily combustible sedimentary rock composed essentially of lithified plant materials which gives the evidence of its higher Organic Carbon content. On the other hand, lower organic carbon content of sedimentation tank soil than coal suggest that dilution of coal in water reduced its organic carbon content than coal. Again, among the sedimentation tank soil, coal water treated farmers' field soil and normal farmers field soil, the organic carbon of coal water treated farm soil was the highest and that of normal field soil was the lowest. The organic carbon content of coal water treated farm soil and sedimentation tank soil was high due to deposition of organic carbon from coal water over this tank soil and normal farmer's field soil. Moreover in farmers' fields, the farmers used to add organic matter as a usual practice of rice production. Additional organic matter was not added in coal water treated farmers field soil. In spite of this, the percentage of organic carbon in coal water treated farmers field soil was higher than the normal farmers' field soil. It suggests that the main source of organic carbon in coal water treated soil was the high organic carbon containing coal.

The available potassium and phosphorus content of coal, coal water, sedimentation tank soil, coal water treated farm soil, normal farmers' field soil and plant samples, collected from coal water treated farm soil and normal farmers' field soil was 3.91, 7.20, 93.84, 113.39, 105.37, 22620 and 20540 ppm for potassium and 3.51, 0.334, 9.08, 11.10, 6.16, 3000 and 2200 ppm for K respectively. K and P content in soil and plant samples collected from coal water treated farm soil was higher than untreated farmers' field soil due to gradual deposition of K and P containing sediments from coal water treated farm soil. The exchangeable calcium, magnesium and iron content in soil and plant samples collected from coal water treated farm soil was also higher than untreated farmers' field soil due to gradual deposition of this metal ion containing sediments in coal water treated farm soil carried by coal water. S content in soil and plant samples collected from coal water treated farm soil was higher than untreated farmers' field soil due to sorption of sulphur from coal water at deeper depths. Zinc, copper, lead and cadmium content in soil and plant samples collected from coal water treated farm soil was also higher than untreated farmers' field soil due to application of these metal containing coal water. Market (1993) reported that the heavy metals may cause soil pollution to a great extent by their accumulation. Wang (2006) stated that heavy metal polluted the soil in certain distance to the coal mining waste dump and the content is negative correlation with the distance to the coal mining waste dump. Morozkin *et al.* (2001) found a negative effect of heavy metals on the growth of lichens in the Nizhnekamsk industrial complex of Tatar Republic, Russia.

Results obtained by testing the samples of coal, coal water, sedimentation tank, coal water treated farmers' field and untreated farmers' field soil indicated that the use of coal mine coal water for irrigation increase the organic carbon, K, P, S, Ca, Mg, Zn, Cu and Fe fertility of soils. In addition to these nutrients the coal water was also adding considerable amount of toxic heavy metals (Pb, Cd etc) in soils. Analysis of plant samples also confirmed the findings. The assessed impact of Barapukuria coal mine needs confirmation through repeated long term studies.

References

Imam, B. 2005. Energy Resources of Bangladesh. University Grants Commission of Bangladesh. Agargaon, Dhaka, Bangladesh. pp.179-191.

Kusel, K. 2003. Microbial cycling of iron and sulphur in acidic coal mining lake sediments. Water, Air and Soil Pollution. J. Indian Soc. Soil Sci. 3(1): 67-90.

Market, B. 1993. Plant as biomonitor indicators for heavy metals in the terrestrial environment. VCH Verlags Gesellschaft MBH, D-6940. Weinheim (FRG). pp. 95-99.

Morozkin, A.I., Kalimullina, S.N., Salova, L.V. and Shpak, T.L. 2001. Status of forest ecosystem in the impact zone of the Nizhnekamsk Industrial Complex, Pochvovedenie, Russia. 12: 1483-1492.

Anonymous, 1991. Techno-economic Feasibility Study, Barapukuria coal project, Dinajpur, Bangladesh, 12 volumes. Report submitted by Wadrell Armstrong Ltd. to Ministry of Energy and Mineral Resources, Government of People's Republic of Bangladesh (Unpublished).

Wang, X. 2006. Research of change of heavy metal concentration in soil around the coal mining waste dump. Jiaozuo Institute of Environmental Science, Beijing, 100875. pp 102-105.