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IMPACTS OF BRICK MANUFACTURING ON AGRICULTURAL LAND AT TANGAIL REGION OFBANGLADESH

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Abstract

The study was conducted to compare the soil nutrients between productive agricultural land (PAL) and top soil removal land (TRL) at Nagarpur Upazila of Tangail, Bangladesh, during the period from July to December 2016. A total of 30 soil samples were collected from 3 different stations. Among them, 10 samples were collected from each station whereas 5 samples from PAL and 5 samples from TRL at the depth of 0 to 15 cm. The result of the study showed that the mean contents of pH, organic matter (OM), potassium (K), magnesium (Mg), calcium (Ca), nitrogen (N), phosphorus (P), sulfur (S), boron (B) and zinc (Zn) were found 6.19, 2.49%, 0.16Meq/100g soil, 4.35 Meq/100g soil, 6.36 Meq/100g soil, 0.14%, 3.34µg/g, 22.8µg/g, 0.28µg/g and 3.80 µg/g, respectively in Productive agricultural land (PAL). The pH, OM, K, Mg, Ca, N, P, S, B and Zn were found 7.54, 0.92%, 0.09Meq/100g soil, 1.26 Meq/100g soil, 1.25 Meq/100g soil, 0.05%, 4.82µg/g,35.07µg/g, 0.42 µg/g and 4.14 µg/g, respectively in the top soil removal land (TRL). The overall study revealed that the soil nutrients of PAL were mostly within the suitable limit for agricultural production whereas the soil nutrients of TRL were not within the suitable level, and nutrient contents were found higher at all stations in PAL than that of the TRL soils. The study also found that due to the action of top soil removal agricultural land converted to the unproductive bare land. Thus, thoughtful measures should be obtained to brickfield management system for achieving the suitable quality of soil for agricultural activities.

Key words: Brickfield, soil nutrients, top soil, agricultural land, Bangladesh

Introduction

Soil is a natural resource for which there is no substitute and it is a thin covering layer over the land consisting of a mixture of minerals, organic materials, living organisms, air and water that together support the growth and development of plant life (Huq and Shoaib, 2013). Topsoil is one of the earth's most vital resources and the upper surface of

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the earth's crust. It is naturally deposited material that mixes rich humus with minerals and composted material (Tucker *et al.*, 1995). But topsoil degradation is the serious problem in the world today as a result of natural or anthropogenic factors, because of their adverse effects on agriculture and the life on earth (Eswaran *et al.*, 2001; Khan *et al.*, 2007). Brick burning is one of the principal agents of topsoil degradation. Brick kilns operations significantly remove topsoil from agricultural land for brick manufacturing (Sharmin *et al.*, 2015). The negative impact of topsoil removal results in reduction of agricultural land (Das, 2015). These are destroying large area of land every year especially in Bangladesh (Rahman and Khan, 2001). These affected areas are expanding rapidly due to unplanned brick production (IUSS, 2002).

There are about 6000 brick manufacturers in Bangladesh which produce about 18 billion pieces of brick a year (Rahman, 2012). The brick kiln operation over the years covers not only the neighboring area of vegetation with layers of brick dust, but also consistently dissipates heat all around. It alters the physicochemical properties and habitats of nearby soil by destroying the topsoil nutrient elements and soil biota (Islam *et al.*, 2015). Moreover, emission of gaseous pollutants and ash significantly affect the human health and vegetation, also have adverse effects on biodiversity and biogeochemical cycling (Gupta and Narayan, 2010). Unfortunately, brick kilns are mostly situated on fertile agricultural land, as brick manufacturers need silty clay loam to silty clay soils with good drainage conditions (Gupta and Narayan, 2010).

In the Nagarpur upazila, soil is mainly used for agricultural production but the soil quality is decreasing due to the negative effects of brickfields. The temperature surrounding the brickfield is very high, for this reason rust increases in paddy in the study area and agricultural production is decreasing year to year in this area (SRDI, 2009). Top soils are used for making bricks that causes loss of nutrients in the agricultural land and decreasing the soil fertility. For this reason farmers had to increase use of fertilizer to rice production and the costs of agricultural production also increases day by day. Moreover, the cropping patterns like rice, jute and mastered crops were found to be disturbed in the Nagarpur upazila. Thus, the study was an attempt to assess the soil nutrient status in productive agricultural lands and top soil removal land of Nagarpur upazila of Tangail district, Bangladesh.

Materials and Methods

Study area

The study area was located in the Nagarpur upazila under the Tangail district which was situated between23°58' to 24°10'N latitudes and 89°46' to 90°01'E longitudes. The total area of Nagarpur upazila is 266.77 km^2 and bounded by the Tangail sadar and Delduar upazila on the north, Daulatpur and Saturia upazila on the south, Mirzapur and Dhamrai upazila on the east, Chauhali and Shahjadpur upazila on the west (Banglapedia, 2017).

Sample collection and preparation

A total of 30 soil samples were collected from three different stationsasSt-1 (Shahabatpur union), St-2 (Nagarpur union) and St-3 (Bekra union) of Nagarpur upazila. Ten samples were collected from each station, among them 5 samples were from productive agricultural land (PAL) and 5 samples from top soil removal land (TRL). Soil sampling points of agricultural land were denoted as consecutively A-1 to A-15, and consecutively R-1 to R-15 for the sampling point of top soil removal land, respectively. The soil sample were scraped from the top to bottom (0-15cm) by auger and each of the samples were mixed thoroughly and kept separately on a brown paper according to the Soil Resource Development Institute (SRDI, 2009) guidelines. About 500 gm soil was collected from each brown paper to give a representative sample which placed in a sealed polythene bag and labeled including collection date, location and code number. The collected soil samples were carried to the laboratory of the Soil Resource Development Institute (SRDI), Jamalpur, Bangladesh. After that samples were air dried for 7 days at room temperature and visible roots and debris were removed. The larger and massive aggregates were broken by wooden hammer and then screened to pass through a 2mm stainless steel sieve and again screened to pass through a 0.5mm sieve. The sieved samples were then mixed thoroughly for making composite samples. Finally, the soil samples were kept in a clean polythene bag for chemical analysis.

Sample analysis

The pH level of soil was measured by digital pH meter (Farmtek: MN-103398). The organic matter (OM) was determined by Walkley and Black’s wet oxidation method (Huq and Alam, 2005). The available potassium (K) was determined by ammonium acetate extraction method (Satter and Rahman, 1987). The magnesium (Mg) and calcium (Ca) were analyzed with EDTA (Ethylenediamene Tetra acetic acid) titration method by Huq and Alam (2005). Total nitrogen (N) was analyzed by micro Kjeldahl method (Satter and Rahman, 1987), while the available phosphorus (P) was determined by the Olsen method (Satter and Rahman, 1987). The available sulfur (S), boron (B) and zinc (Zn) were analyzed by calcium chloride extraction method, Curcumin method and DTPA (Diethylenetriamine Pentaacetic acid) method (Roberts *et al.*, 1971).

Statistical analysis

The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. The Microsoft Office Excel software was used to present and interpret the collected data. The results of the study were presented in charts and tabular forms.

Results and Discussion

The level of pH in productive agricultural land (PAL) soils were ranged from 5.65 to 7.07 which indicated slightly acidic to neutral condition whereas top soil removal land (TRL) soils found 7.30 to 7.80 as well as neutral to slightly alkaline state (Table 1). Islam *et al.* (2015) reported that the pH level ranged from 6.52 to 7.23 in the burnt soils and from 5.62 to 6.15 in the un-burnt soils at Shingair village at Balla union of Kalihati upazila in Tangail district, Bangladesh. All kinds of crops are grown well in the range of 5.60 to 7.30, because of all types of essential nutrients are available in this pH range (SRDI, 2009). Due to the degradation of agricultural soils arising from brick field burning or removal in western part of Bangladesh showed that gradually decreased in the mean pH level of soils by 0.4 (Khan *et al*., 2007).

Table 1. Soil nutrients of productive agricultural land (PAL) and top soil removal land (TRL)

Sampling stations	pH		OM (%)		Nutrients (Meq/100g soil)						N (%)	
					K		Mg		Ca			
	PAL	TRL	PAL	TRL	PAL	TRL	PAL	TRL	PAL	TRL	PAL	TRL
St-1	5.80	7.45	3.16	0.62	0.10	0.08	5.00	1.20	7.50	1.80	0.16	0.03
	5.70	7.46	1.65	1.17	0.10	0.10	5.50	0.83	7.50	1.20	0.08	0.06
	5.65	7.33	2.75	1.99	0.10	0.11	3.30	1.67	5.00	2.00	0.14	0.10
	5.90	7.50	2.12	0.50	0.10	0.09	3.50	1.65	6.50	1.10	0.18	0.04
	5.95	7.60	2.30	0.65	0.10	0.05	4.50	1.75	5.50	1.20	0.17	0.05
St-2	6.80	7.80	3.30	1.03	0.10	0.09	3.30	2.50	7.50	1.80	0.17	0.05
	7.07	7.50	2.40	1.17	0.10	0.16	5.50	1.33	7.50	0.60	0.12	0.06
	6.05	7.55	2.26	1.03	0.10	0.11	3.30	1.67	5.00	1.60	0.11	0.05
	5.95	7.50	2.50	0.50	0.20	0.05	3.60	0.75	6.50	0.80	0.16	0.04
	6.10	7.80	2.25	0.40	0.10	0.04	4.40	0.50	5.50	0.90	0.17	0.03
St-3	6.90	7.51	2.40	0.83	0.10	0.08	4.50	0.63	7.20	1.50	0.12	0.04
	6.10	7.70	2.75	1.23	0.20	0.16	5.00	1.50	6.50	1.70	0.14	0.06
	6.18	7.80	2.75	1.40	0.10	0.19	4.20	1.70	5.30	0.84	0.14	0.12
	6.32	7.40	2.55	0.60	0.20	0.03	5.10	0.60	6.30	0.95	0.18	0.03
	6.45	7.30	2.35	0.80	0.20	0.05	4.50	0.70	6.20	0.80	0.17	0.04
Max	7.07	7.80	3.30	2.44	0.23	0.19	5.50	2.50	7.50	2.00	0.18	0.12
Min	5.65	7.30	1.65	0.40	0.11	0.03	3.30	0.50	5.00	0.60	0.08	0.03
Mean	6.19	7.54	2.49	0.92	0.16	0.09	4.35	1.26	6.36	1.25	0.14	0.05
SD	0.43	0.16	0.40	0.42	0.03	0.04	0.78	0.57	0.93	0.44	0.02	0.02

Organic Matter (OM)

The OM content of PAL soils were ranged from 1.65 to 3.30% stated low to medium fertility and in TRL soils ranged from 0.40 to 1.99% which revealed that very low to medium fertility (Table 1). The study indicated that OM content of PAL and TRL were lower than the standard limit for good yield production, moreover, OM contents of PAL was higher than the TRL soils. Soil OM is a reservoir for plant nutrients, enhances water holding capacity, protects soil structure against compaction and erosion, and thus determines the soil productivity (Martius *et al.*, 2001). The study found that the OM content of the agricultural land in Nagarpur upazila around the brick field area was decreasing day by day due to the removal of topsoil. Similar results were also observed by Khan *et al.* (2007) and Sharmin *et al.* (2015).

Available Potassium (K)

The available K content of PAL soils were ranged from 0.11 to 0.23 Meq/100g indicated low to medium enrichment along with 0.03 to 0.19 Meq/100g in TRL soils indicated very low to medium enrichment (Table 1). The study found that the available K content of PAL was higher than the TRL and the available K content of both PAL and TRL were not within the suitable range for agricultural activities. Singh *et al.* (2000) reported that the exchangeable K of old alluvial soils of some basin was 0.04 to 0.87 Meq/100g soil.

Available Magnesium (Mg)

The available Mg content of PAL soils were ranged from 3.30 to 5.50 Meq/100g which stated that low to medium availability and in TRL soils ranged from 0.50 to 2.50 Meq/100g revealed that very low to medium availability (Table 1). The study indicated that Mg content of PAL and TRL were within the standard limit for crop production, moreover, Mg contents of PAL were higher than the TRL soils. Due to the removal of agricultural top soil for brick field activities the available Mg contents of the surrounding areas of brick fields are decreased gradually (Sharmin *et al.*, 2015).

Available Calcium (Ca)

The available Ca content of PAL soils were ranged from 5.00 to 7.50 Meq/100g depicted that optimum to high enrichment and in TRL soils were ranged from 0.60 to 2.00 Meq/100g stated that very low to low enrichment (Table 1). The SRDI (2001) reported that the exchangeable Ca content of high land, medium high land and medium low land under the Madhupur upazila were 0.80, 1.30 and 1.30 Meq/100g soil, respectively. Ahamed *et al.* (2014) reported that due to illegal brick field activities the available K contents of the surrounding areas of brick fields are decreased gradually.

Total Nitrogen (N)

The total N content of PAL soils were ranged from 0.08 to 0.18% and in TRL soils were ranged from 0.03 to 0.12% indicated very low to low (Table 1). According to BARC (2012) the standard level of total N in soil is 0.32%. The study observed lower level of total N in both the PAL and TRL soils, where TRL soil contains much less quantity than the PAL soil. Lower content of N is due to loss of organic carbon which contains nitrogen and nitrogen fixing microorganisms in soil (Rai *et al.*, 2009). The total N contents of the PAL and ALB were ranged from 0.10 to 0.18 and 0.05 to 0.09%, respectively which showed that the N content of PAL and ALB were much lower than the suitable limit for agricultural production (Sarkar *et al.*, 2016). Moreover, due to the burning of agricultural top soils similar results also found by Islam *et al.* (2015).

Available Phosphorous (P)

The available P contents of PAL and TRL soils were fluctuated from 1.40 to 8.70 and 1.2 to 5.96 µg/g, respectively, which indicated very low to low enrichment of available P in the both studied soils where the lower amount of P was found in TRL soil than the PAL soil (Fig. 1). This could be the negative impact of brick burning of the topsoil P content. Similar result also found by Sarkar *et al.* (2016). The SRDI (2009) reported that the available P values of Balla union agricultural soil was ranged from 0.90 to 1.67 µg/g. Thus, the study revealed that the P content in the study area was relatively higher than the finding of SRDI (Islam *et al.*, 2015).

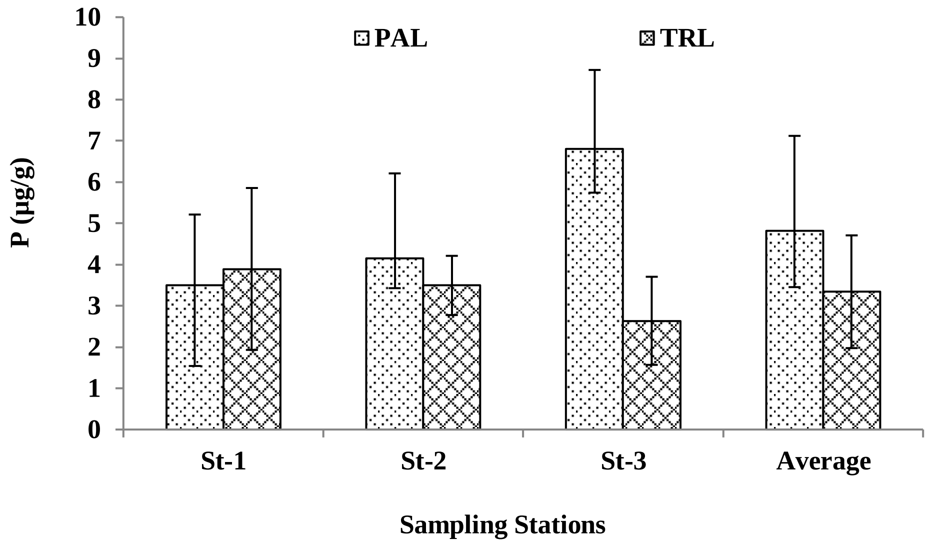

Fig. 1. Available phosphorous contents in PAL and TRL soils at different sampling stations

Available Sulfur (S)

The available S contents of PAL soils were ranged from 23.37 to 47.95 µg/g, indicated that optimum to very high availability whereas in TRL soils ranged from 15.20 to 37.43 µg/g indicated that medium to high availability (Fig. 2). Sarkar *et al.* (2016) reported that the available S content were ranged from 28.10 to 37.44 µg/g soil and 14.64 to 25.56 µg/g soil of productive agricultural land and agricultural land close by brickfield, respectively. The standard level of available S content for crop cultivation is 31.5 µg/g soils and the critical value is 10 µg/g soil (BARC, 2012). The study also showed that the available S content of the PAL soils was higher than the TRL soils and both were within the suitable level for agricultural activities.

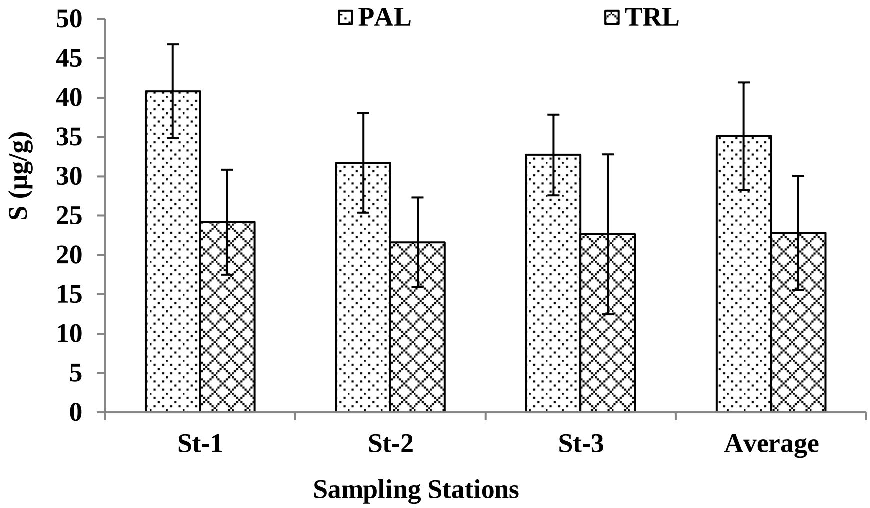

Fig. 2. Available sulfur contents in PAL and TRL soils at different sampling stations

Available Boron (B)

The available B content of PAL soils were ranged from 0.33 to 0.51 µg/g (medium to optimum), and in TRL soils were ranged from 0.18 to 0.43 µg/g (Fig. 3). For agricultural activities the available B content of should be 0.45 to 0.60 µg/g (SRDI, 2009). In productive agricultural soil, the available B content was within the suitable limit whereas agricultural field close to brick field soil showed lower level of available B in Sherpur district (Sarkar *et al*., 2016), which is almost similar to that of the present study.

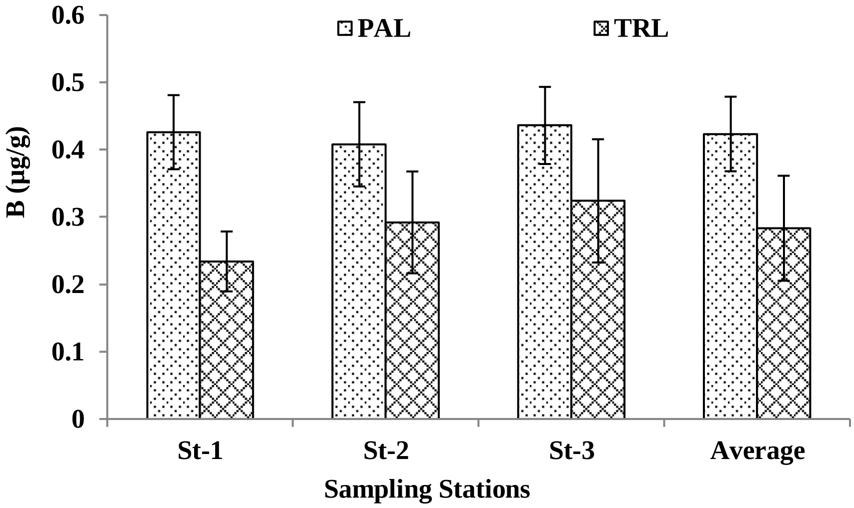

Fig. 3. Available boron contents in PAL and TRL soils at different sampling stations

Available Zinc (Zn)

The available Zn contents of PAL soils were ranged from 3.30 to 5.90 µg/g (very high), and in TRL soils were ranged from 2.90 to 5.10 µg/g (Fig. 4). The study depicted that the available Zn content of the PAL and TRL were within the suitable limit as well as suitable for agricultural production while the PAL showed higher level of available Zn content than TRL for agricultural activities. Islam *et al.* (2015) found that total Zn contents were ranged from 2.03 to 2.08 µg/g in the burnt and from 2.11 to 2.99 µg/g in the unburnt soil.

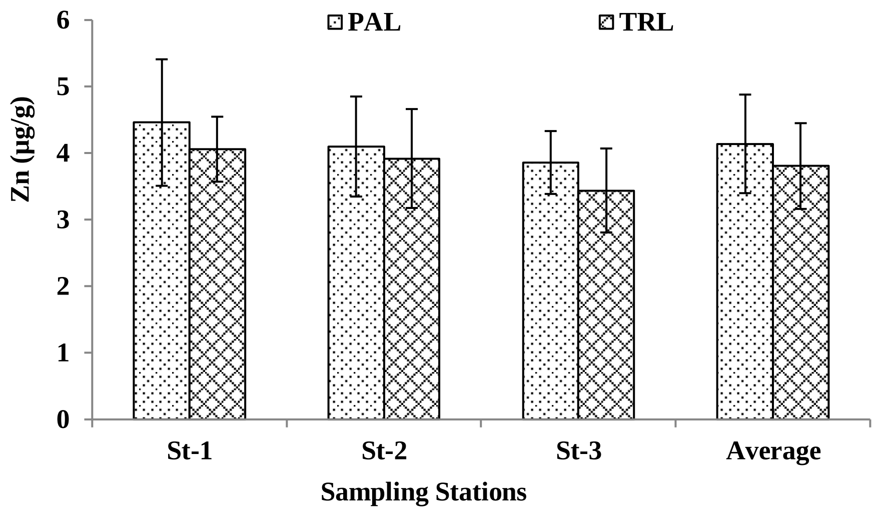

Fig. 4. Available zinc contents in PAL and TRL soils at different sampling stations

Cropping pattern analysis

The result showed that cropping pattern decreased tremendously due to removal of top soil from the productive agricultural land (Table 2). In the productive agricultural land three types of seasonal crops were found such as Boro-Jute-Mustard but in the top soil removal land that was found only Jute occasionally. The study also found that due to top soil removal activities medium high land was converted to medium low land resulting in the changing of land type from agricultural land to unproductive land.

Table 2. Cropping pattern of the study area in relation to land type

Stations	Category of land	Cropping pattern
St-1	Productive agricultural land	Boro-Jute-Mustard
	Top soil removal land	Fallow-Jute-Fallow
St-2	Productive agricultural land	Boro-Jute-Mustard
	Top soil removal land	Fallow-Jute-Fallow
St-3	Productive agricultural land	Boro-Jute-Mustard
	Top soil removal land	Fallow-Jute-Fallow

Conclusion

The study found that the average level of pH was lower in the PAL than in TRL soils. Average organic matter (OM), potassium (K), magnesium (Mg), calcium (Ca), nitrogen (N), phosphorus (P), sulfur (S), boron (B) and Zinc (Zn) contents were decreased at all stations in TRL soils and significantly lower than that of PAL soils. As a result, nutrient status, crop yield and economic benefit were declined tremendously as a consequence of top soil removal due to brick manufacturing. Therefore, the study recommended that government should take necessary initiatives for implementation of the rules and regulations to conserve the agricultural land as well as ensure food security.

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References

Ahamed, M.T., J. Shahrey, M.Y. Mia, A.K.M.M. Rahman and B. Bakali. 2014. Soil nutrients status between an agricultural land adjacent to brick field and a productive agricultural land in Gala, Tangailsadar, Bangladesh. *Jahangirnagar University of Environmental Bulletin*, **3**: 1-11.

Banglapedia. 2017. National Encyclopedia of Bangladesh, Asiatic Society of Bangladesh, Dhaka.

BARC (Bangladesh Agricultural Research Council). 1997. Fertilizer recommendation guide. BARC Publications. Farmgate, Dhaka. Bangladesh, pp. 196.

Das, R. 2015. Causes and consequences of land degradation in and around the brick kilns of Khejuri CD blocks over Coastal Medinipur in West Bengal. *International Journal of Innovative Research and Development,* **4**(2): 285.

Eswaran, H., R. Lal and P.F. Reich. 2001. Land degradation: An overview. *In*: Responses to land degradation. E.M. Bridges, I.D. Hannam, L.R. Oldeman, F.W.T. Peningde Vries, S.J. Scherr, and S. Sompatpanit (eds.). Proceedings of the 2nd international conference on land degradation and desertification, Thailand. Oxford Press. New Delhi, India. pp. 9

Gupta, S. and R. Narayan. 2010. Brick kiln industry in long-term impacts biomass and diversity structure of plant communities. *Current Science of India*, **99**(1): 72-79.

Huq, S.M.I. and J.U.M. Shoaib. 2013. The Soils of Bangladesh. World Soils Book Series, Vol. 1, Springer Science and Business Media, Dordrecht, 178.

Huq, S.M.I. and M.D. Alam. 2005. A handbook on analysis of soil, plant and water. Bangladesh-Australia Centre for Environmental Research (BACER-DU), Dhaka, 31-40 pp.

Islam, M.S., S.A. Mamun, Muliadi, S.Rana, T.R. Tusher and S. Roy. 2015. The impact of brick kiln operation to the degradation of top soil quality of agricultural land. Agrivita. *Journal of Agricultural Science*, **37**(3): 126-537.

IUSS (International Union of Soil Sciences). 2002. Soil and the environment, IUSS Commission, World Congress of Soil Science. International Union of Soil Science, 14-21 August, Thailand.

Kathuria, V. 2007. Utilization of fly-ash by brick manufacturers-environmental costs vs. benefits. Research Report. Ministry of Environment and Forests, India.

Khan, H.R., K. Rahman, A.J.M.A. Rouf, G.S. Sattar, Y. Oki and T. Adachi. 2007. Assessment of degradation of agricultural soils arising from brick burning in selected soil profiles. *International Journal of Environmental Science and Technology*, **4**(4): 471-480.

Martius, C., H. Tiessen and P. Vlek. 2001. Managing organic matter in tropical soils: scope and limitations. Proceedings of a Workshop.Plant and Soil Science Development Research Center.University of Bonn (ZEF Bonn). Germany, 7-10 June, 1999. Springer. Netherlands. pp. 236.

Prabpai, S., L. Chareentanyarak, B. Siri and M.R. Moore. 2007. Agronomic properties and heavy metals content in soil reclaimed from municipal solid waste landfill development of a knowledge-based system for foundry waste recycling. *Journal of Solid Waste Technology and Management,* **33**(2): 125-150.

Rahman, M. 2012. Brickfield. Banglapedia. National Encyclopedia of Bangladesh. Asiatic Society of Bangladesh, 34-38pp.

Rahman, M.K. and H.R. Khan. 2001. Impacts of brick kiln on topsoil degradation and environmental pollution. Research Project Report. Ministry of Science, Information and Communication Technology, Bangladesh, 210 pp.

Rai, A.K., B. Paul and G. Singh. 2009. Assessment of soil quality in the vicinity of subsided area in the south eastern partof Jharia Coalfield, Jharkhand, India. *International Journal of Report Opinion,* **1**(6): 18-23.

Roberts, S., R.V. Vodraska, M.D. Kauffman and E.H. Gardner. 1971. Methods of soil analysis used in the soil testing laboratory at Oregon State University (Special Report), 321 pp.

Sarkar, M.A.W., S.A. Lira, A. Razzaque and M.R.H. Sarker. 2016. Comparison of soil nutrients status between an agricultural land close by brickfield and a productive agricultural land for agricultural activities in sadarupazila, Sherpur, Bangladesh. *Journal of Soil and Nature,* **9**(1): 8-12.

Satter, D.M.A. and M.M. Rahman. 1987. Techniques of soil analysis. Department of Soil Science, Bangladesh Agricultural University, Mymensingh, 67-124 pp.

Sharmin, S., M.S. Islam, A.K.M.M. Rahman, M.R. Hassan and S. Roy. 2015. Impact of top soil removal from agricultural field by brick manufacturing at Ghatail areas of Tangail district. *Bangladesh Journal of Environmental Science*, **28**: 105-112.

Singh, R.N., R.N.P. Singh and D.P.S. Diwakar. 2000. Characterization of old alluvial soils of some basins of Bihar. *Journal of Indian Social Soil Science,* **48**(20): 352-357.

SRDI (Soil Resources Development Institute). 2001. Land and soil resources utilization guide (In Bengali). Upazila Nirdeshika series-Madhupurupazila. Soil Resources Development Institute, Dhaka, 60-65 pp.

SRDI (Soil Resource Development Institute). 2009. Land and soil resources utilization guide (In Bengali).Upazila Nirdeshika series-SherpurSadar upazila, Soil Resources Development Institute, Dhaka, 73-74 pp.

Tucker, M.R., J.K. Messick and C. Stokes. 1995. Soil fertility note 14: Topsoil. North Carolina Department of Agriculture and Consumer Services (NCDA andCS), Agronomic division.USA, 1-2 pp.