Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 12(X), 2023:
http://dx.doi.org/10.7770/safer-V12N1-art2672

Effect of organic manures on degrading soil due to brick manufacture industry at Changunarayan municipality of Bhaktapur district, Nepal

Efecto de los abonos orgánicos en el suelo degradado debido a la industria de fabricación de ladrillos en el municipio de Changunarayan del distrito de Bhaktapur, Nepal

Sabina Raut[1], Santosh Shrestha[2,3], Saroj Koirala[3,4]

[1] Lovely Professional University, Punjab, India; Email: rautsabeena@gmail.com

[2] Institute of Agriculture and Animal Science, Tribhuvan University, Nepal

[3]Agricultural Technology Center, Lalitpur, Nepal

[4] University of Chinese Academy of Sciences (UCAS), Beijing 100049, China; Email: sarojkoirala1@gmail.com

*Corresponding author email: santoshshrestha.soil@gmail.com +977-9840012016

ABSTRACT

A lab experiment was conducted to analyze the degraded land reclamation potential by the use of organic manure (OM) in the soil collected from Changunarayan municipality of Bhaktapur District, Nepal. Benchmark nutrient test was performed to the different soil sample collected from three land types i.e., brick kiln premises, excavated land and arable land. Samples was then replicated three times weighing 100g in each replication and lab test was carried out by adding 2% and 4% organic manure (OM) by weight per 100g of each soil samples. The samples were incubated at 32°C for 45 days and the soil chemical properties; N, P_2O_5, K_2O, pH and soil organic matter were analyzed. It was revealed that with the application of 4% OM by weight in all soil samples collected, there was increased in chemical parameters analyzed, followed by 2% OM by weight. The total soil nitrogen content and soil organic matter content was found significant ($P<0.05$) with different treatment of OM. Significant changes were noticed in the phosphorus content in the soil from brick kiln premises with the application of 4% OM. Slight increase were noticed in the potassium content. With the application of 2% and 4% OM, pH was found to be increased significantly in the soil from brick kiln premises. Thus, from this study, it is revealed that the use of 4% OM by weight might be optimal to improve the land degraded by the brick kilns and excavation to some extent but at 4-10 times higher economic cost than usual farming management practices of organic manure.

Keywords: Brick kiln, degraded soil, Excavated land, Organic manure, Soil Restoration

RESUMEN

Se llevó a cabo un experimento de laboratorio para analizar el potencial de recuperación de tierras degradadas mediante el uso de abono orgánico (MO) en el suelo recolectado del municipio de Changunarayan del distrito de Bhaktapur, Nepal. Se realizó una prueba de referencia de nutrientes para las diferentes muestras de suelo recolectadas de tres tipos de tierra, es decir, locales de hornos de ladrillos, tierra excavada y tierra cultivable. A continuación, las muestras se repitieron tres veces con un peso de 100 g en cada réplica y se llevó a cabo una prueba de laboratorio agregando 2% y 4% de estiércol orgánico (MO) en peso por 100 g de cada muestra de suelo. Las muestras se incubaron a 32°C durante 45 días y las propiedades químicas del suelo; Se analizaron N, P_2O5, K_2O, pH y materia orgánica del suelo. Se reveló que con la aplicación de 4% de MO por peso en todas las muestras de suelo recolectadas, se incrementó en los parámetros químicos analizados, seguido de 2% de MO por peso. El contenido total de nitrógeno del suelo y el contenido de materia orgánica del suelo se encontraron significativos ($P < 0.05$) con diferentes tratamientos de la MO. Se notaron cambios significativos en el contenido de fósforo en el suelo de las instalaciones del horno de ladrillos con la aplicación de 4% de MO. Se notó un ligero aumento en el contenido de potasio. Con la aplicación de 2% y 4% de MO, se encontró que el pH aumentó significativamente en el suelo de las instalaciones de los hornos de ladrillos. Por lo tanto, a partir de este estudio, se revela que el uso de 4% de MO por peso podría ser óptimo para mejorar la tierra degradada por los hornos de ladrillos y la excavación hasta cierto punto, pero a un costo económico de 4 a 10 veces mayor que las prácticas habituales de manejo agrícola de abono orgánico..

Palabras clave: horno de ladrillos, suelo degradado, tierra excavada, abono orgánico, restauración de suelos

INTRODUCTION

For a developing country like Nepal, land is one of the major natural resources. More than 65% of the population of Nepal is dependent upon the land for fulfillment of their basic needs namely food, fodder, fuel, fiber and timber (Paudel et al., 2009). Land degradation being burning challenges faced by humanity. There are several causes for land degradation; physical, chemical and biological processes which are directly or indirectly induced by human activities (Dlamini & Chaplot, 2016). Nepal is not an exception which is contributed by both the natural conditions and human activities (Acharya et al., 2008). Out of 11.6 million hectares(ha) of total agricultural land area, 3.3 million hectares (ha) of land is degraded, which means 28.24% of the agricultural land has been degraded in Nepal (MoEST, 2008). In case of Center of Nepal i.e. Kathmandu Valley; the leading causes of land degradation is due to the establishment of brick- industry and the effects of brick kilns on land are very distinct in Bhaktapur district of Nepal (Bisht & Neupane, 2015).

Bhaktapur, being the smallest district of Nepal, occupies an area of 119 square kilometers (DCCO, 2021) and 11,106 hectares of land is suitable for agriculture though only 8,077 hectors have been cultivated (CBS, 2013). Out of 500 brick kilns in Kathmandu valley, the highest numbers of brick kilns (182) exist in Bhaktapur district, followed by 173 in Lalitpur and 145 in Kathmandu district (MoEST, 2011). Generally, on an average 4 ha land is used by each kiln and this area includes land on which kiln is constructed as well (Joshi & Dudani, 2008). Local people of Bhaktapur district are compelled to lease the land to the kiln owner as their neighboring land owner leased land to brick kiln owner (Neupane, 2008). Once topsoil is removed for brick manufacture, it takes 25 to 30 years to regain its fertility and after the land lose its topsoil, paddy production reduces by 50% (Jerin et al., 2017).

Use of organic matter amendments like farmyard manure (FYM), animal waste, poultry manure, vermi-compost, press mud and crop residues, etc. help in the rejuvenation process reviving biological activities in the excavated soils (Rajonee & Uddin, 2018). It will improve soil structure and fertility status of soil, also helping to reduce bulk density, increase water holding capacity and hydraulic conductivity of excavated soil (Islam et al., 2015). Organic manure has a number of advantages, including a balanced supply of nutrients, higher soil nutrient availability due to increased soil microbial activity, the decomposition of hazardous substances, improved soil structure and root development, and greater soil water availability. (Han et al., 2016).

This study involves determination of the effect of organic manure as source to enrich degraded soil due excavation for brick manufacture process.

MATERIALS AND METHODS

Study Site: The site chosen for samples collection for this study is Changunarayan Municipality of Bhaktapur district (Figure 1). Nine composite soil samples were taken purposively from three different land forms: arable land, excavated land and brick kilns premises. Sample points were defined purposively based on higher production and marketing of agricultural products for arable land block, while major soil excavated area for excavated block and higher annual brick turnover area were selected for brick kiln premises block.

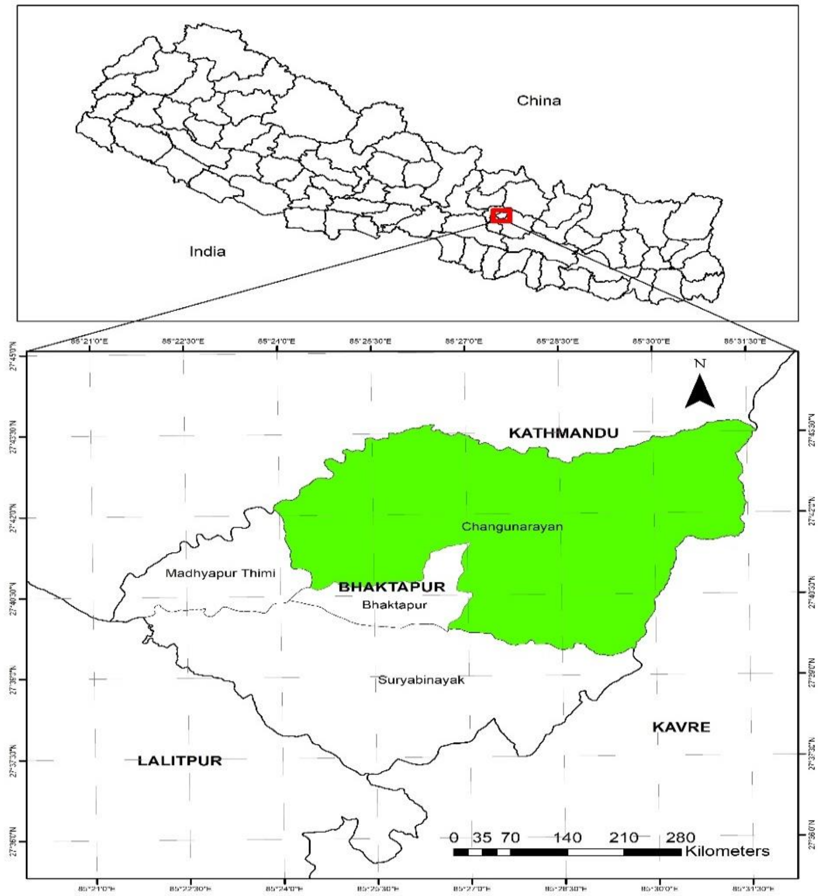

Figure 1*:* Map of study area

Research Design and Sample Preparation: Samples were replicated three times homogeneously to make 100g samples in each replicate (Figure 2). Out of three replication one was assigned as control in each land type while in remaining two one was added with

2% OM (2g OM/100g of soil) by weight and next one with 4% OM (4g OM/100g of soil) by weigh. With allocated treatments (Table 1) samples were incubated in incubator at 32℃ for 45 days with timely addition of distilled water in each unit to maintain moisture level. Applied organic manure was commercially available in the market with mean 2.5% N, 0.65% P_2O_5, 1.75% K_2O, 48% organic matter and 25% moisture level.

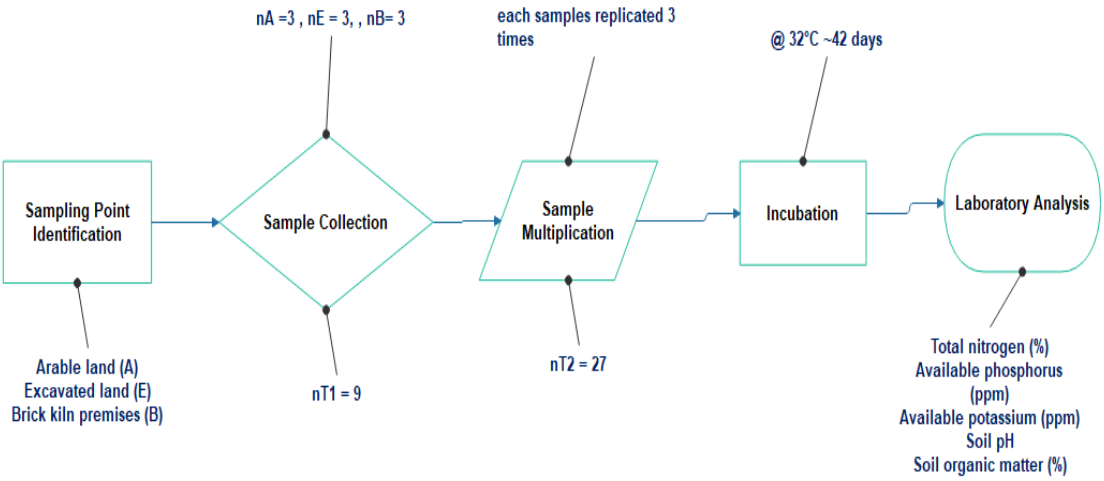

Figure 2: Schematic Diagram of Research Design

Laboratory Analysis: Laboratory analysis of the prepared soil samples was carried out to find out the status of soil total nitrogen, available phosphorus, available potassium and soil organic matter percentage (Table 2).

Statistical Analysis: Data for different parameters were tabulated in MS-Excel and analyzed performing one way analysis of variance (ANOVA) with the help of R-studio version 1.4.1106. Significant mean was tested with DMRT (Duncan Multiple Range Test) at 5% level of significance. For the visualization of data Sigma plot 14.0 was used.

Table 1: Soil processing and treatment details

	Secondary Codes	Treatments

Land Forms	Total sample collected	Primary Codes	Replicated samples in laboratory	Control	2% OM by weight	4% OM by weight	
Arable Land	3	AL1	3	AL1a	AL1b	AL1c	T1=AL1a, AL2a, AL3a
		AL2	3	AL2a	AL2b	AL2c	T2=AL1b, AL2b, AL3b
		AL3	3	Al3a	Al3b	AL3c	T3=AL1c, AL2c, AL3c
Excavated Land	3	EL1	3	EL1a	EL1b	EL1c	T4=EL1a, EL2a, EL3a
		EL2	3	EL2a	EL2b	EL2c	T5=EL1b, EL2b, EL3b
		EL3	3	EL3a	EL3b	EL3c	T6=EL1c, EL2c, EL3c
Brick Kiln Premises	3	BK1	3	BK1a	BK1b	BK1c	T7=BK1a, BK2a, BK3a
		BK2	3	BK2a	BK2b	BK2c	T8=BK1b, BK2b, BK3b
		BK3	3	BK3a	BK3b	BK3c	T9=BK1c, BK2c, BK3c
Total		9	21	9	9	9	21

(Note: T1=soil from arable land, T2=soil from arable land+2%OM, T3=soil from arable land+4%OM, T4=soil from excavated land, T5= soil from excavated land+2%OM, T6= soil from excavated land+4%OM, T7=soil from brick kiln premises, T8= soil from brick kiln premises+2%OM, T9= soil from brick kiln premises+4%OM)

Table 2: Laboratory analysis details

Parameters	Methods	Reference

Total Nitrogen	Kjeldahl Method	Bremner & Mulvaney (Bremner & Mulvaney, 1982)
Available Phosphorus	Modified Olsen's bicarbonate method	Olsen et al (Olsen et al., 1954)
Available Potassium	Ammonium acetate method	Simard (Simard, 1993)
pH	Potentiometric method (1:2.5)	SMD (SMD, 2017)
Soil organic matter	Walkely and Black method	Walkley & Black (Walkley & Black, 1934)

RESULTS AND DISCUSSION

Benchmark nutrient status of primary coded samples: The nitrogen content (%) was found to be highest in the soil of arable land (0.13%) followed by the soil from excavated land (0.03%) and least nitrogen content was found in the soil from the brick kiln premises with the mean of 0.01% (Figure 3a). Similarly, we found the highest phosphorus and potassium (ppm) content in the soil of arable land (17.84ppm, 38.85ppm), followed by the soil from excavated land (5.87ppm, 18.05ppm) and the least

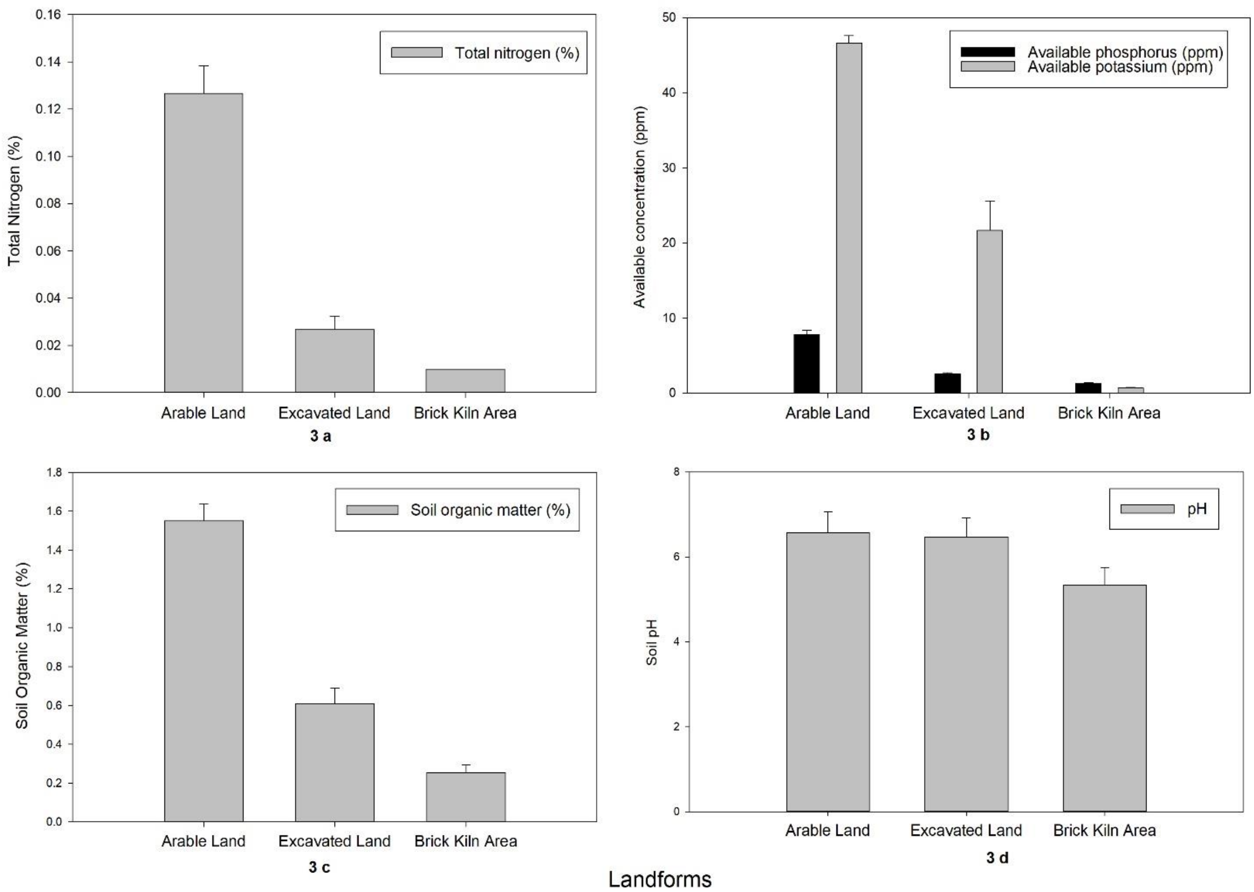

Figure 3: Benchmark nutrient status of different landforms soil

phosphorus and potassium content was found in the soil from the brick kiln premises (2.95ppm, 0.61ppm) (Figure 3b). Similarly, organic matter was found to be highest in arable land (1.55%) followed by soil from excavated land (0.61%) and least in the soil from brick kiln premises (0.25%) (Figure 3c). Soil pH was found nearly neutral in the soil of arable land (6.57) while it was slightly acidic in excavated land (6.47) and strongly acidic in brick kiln premises (5.33) (Figure 3d).

Das & Sarkar, (2020) conducted an experiment to evaluate the possible effect of brick manufacture on soil quality of agricultural land (arable land) within the study area of the Bhagirathi-Hugli River basin. They found value of organic carbon, nitrogen, phosphorus, and potassium were increasing with increasing distances from the brick kilns. Decreasing content of all nutrients nearby brick kiln premises might be due to the loss of organic carbon in soil which contains nitrogen and other essential nutrients and beneficial microbes. Also phosphorus in soil diverts to insoluble state in the soil due to lack of organic matter in soil and increased soil acidity (Rai et al., 2010). Excavation of soil destroys soil health by altering its composition and organic matter levels, exposing sub horizons (Singh et al., 2015a). The deeper soil excavation, (>0.3m) often resulted in a loss of soil fertility making the land agriculturally unproductive (Biswas et al., 2018). This might has caused lower nitrogen, phosphorus and potassium and organic matter content in excavated soil. According to Majumdar et al. (2018) the potassium contents were higher in agricultural field than that of brick field premises and they suggested that brick manufacturing processes responsible for decreasing potassium status in the soil of nearby premises. An experiment conducted by Bisht & Neupane (2015) also found that the pH of soil samples at 50m east and west showed slight acidic character which refers impact from brick kiln. They also found that the organic matter near to the brick kiln was low due to low organic carbon content and it gradually increased in soil with distance away from the kiln where agricultural area is dominant. Sikder et al. (2016) and Rajonee et al. (2018) also found lower pH with increase distance to brick kiln as we have found similar status of lower pH range in brick kiln premises. Emission of gases like sulphur dioxide (SO_2) from kiln that adds to acid rain and dumping of SO_2 enriched wastes to soils might produce sulphuric acid on reaction with water to make soil more acidic (Maithel & Uma, 2012). Suwal (2018) also found that the soil was acidic near the kiln and was neutral farther away which means the quality of soil was comparatively improving with increasing distance from the brick kiln area.

Rajonee et al. (2018) in their study found that the moisture content and organic carbon increased with distance from brick kiln premises is unfavorable for plant growth. Singh et al. (2014) also found low organic carbon, P_2O_5 and K_2O in the de-surfaced soil for brick kilns as compared to the normal soil which had resulted in poor wheat plant growth in de-surfaced soils. Study from Islam et al. (2015) found that the total N, available P and S were significantly less in the samples nearby brick kiln premises as compared to the soil samples far from the premises.

Table 3: Effect of organic manure on chemical properties of degraded soil due to brick manufacture industry at Changunarayan, Bhaktapur

	Treatments	N%	P_2O_5 (ppm)	K_2O (ppm)	OM (%)	Soil pH
1.	Arable Land	0.13^{b}	17.84^{a}	38.85^{a}	1.55^{c}	6.57^{ab}
2.	Arable Land + 2% OM	0.15^{a}	17.15^{a}	38.88^{a}	1.78^{b}	6.80^{a}
3.	Arable Land+ 4% OM	0.15^{a}	16.80^{a}	38.51^{a}	1.98^{a}	6.73^{ab}
4.	Excavated Land	0.03^{cd}	5.87^{b}	18.05^{b}	0.61^{e}	6.47^{ab}
5.	Excavated Land+ 2% OM	0.02^{cd}	5.79^{b}	18.05^{b}	0.63^{de}	6.23^{ab}
6.	Excavated Land+ 4% OM	0.03^{c}	5.98^{b}	21.66^{b}	0.74^{d}	5.93^{bc}
7.	Brick Kiln Premises	0.01^{e}	2.95^{d}	0.61^{c}	0.25^{f}	5.33^{c}
8.	Brick Kiln Premises+ 2% OM	0.01^{de}	4.26^{c}	0.84^{c}	0.33^{f}	6.43^{ab}
9.	Brick Kiln Premises+ 4% OM	0.02^{cde}	3.97^{cd}	0.84^{c}	0.53^{e}	6.17^{abc}
	P- Value	*	*	*	*	0.02
	LSD (α=5%)	0.009	1.05	3.94	0.12	0.74
	CV (%)	9.16	6.78	11.92	7.42	6.81
	Sem (±)	0.004	0.49	1.86	0.06	0.35

* indicates significant p value

Effect of organic manure on chemical properties of degraded soil: Total soil nitrogen content was found significant ($p<0.05$) with treatments of organic manure (OM) in soil and was found that nitrogen content had increased with respect to the control treatments of each landform. Total nitrogen content was found to increase with the application of OM for both; soil from the excavated land and soil from brick kiln premises. Phosphorus content in the soil from arable land and excavated land was found to be increased slightly with the application of different treatments of OM, whereas in the soil from brick kiln premises, the phosphorus content was found to be increased significantly with different rate of OM incorporation (

) Similarly, slight increment was seen in the potassium content in the soils of arable land, excavated land and soil from brick kiln premises with the application of different treatments of OM (

). Application of organic manure at rate of 2% and 4%, arable soil did not show any significant increase in the soil pH but there was decrease in soil pH on the soil from excavated land while increase on soil from brick kiln premises. Organic matter was found significant ($p<0.05$) with the application of different treatments of OM and found to be increased with respect to the control treatment. Soil organic matter was highest with the application of 4% OM for both the soils from excavated land and brick kiln premises.

Menšík et al. (2018) shows that the use of organic manures resulted in lower acidity, higher soil organic carbon content and humic substance content, predomination of humic acid, and high content of available nutrients which was at par with the result from our research. Another field experiment performed by Zhao et al. (2009), found that after 25 years cropping and fertilization, soil properties and crop yields were significantly affected by soil organic manure. They also included that the farmyard manure combined with chemical fertilizer management resulted in increase in soil organic carbon, available nitrogen, available phosphorus. A 4-year field trial was performed by Song et al. (2017) and found that the soil total phosphorus concentrations at the 0–20 cm depth increased under the organic manure (OM) and chemical fertilizer (CF) treatments by 12.11% and 4.51%, respectively. Roy & Kashem (2014) performed a lab experiment and found that the effects of manures varied with manure type and incubation period and the soil pH slightly increased with the incubation period up to 30 days there after it declined with time significantly ($p < 0.05$. Devkota et al. (2021) concluded that the combined effect of application of organic manures with inorganic fertilizers (NPK) was found to be better for soil health improvement. Since our result is based only on organic manure application, application of chemical fertilizer might have yielded more on soil properties. An experiment conducted by Kamal et al. (2016) with poultry manures and recommended dose of chemical fertilizers, significantly improved soil porosity, soil pH, field capacity, CEC, soil organic carbon (%), available P and total N along with highest value of mango yield. Beside organic manures as in our experiment such poultry manures along with chemical fertilizer can be an option to ameliorate degraded soil. Various processes for soil reclamation of the de-surfaced soils such as application of organic carbon rich sources such as poultry manure, animal waste, press mud, farm yard manure (FYM), crop residues, vermi-compost, biochar, etc., crop rotation, balanced micro and macro fertilization in the field and soil replacement were found effective (Singh et al., 2015b). The first process they suggested for soil amelioration and reclamation of de-surfaced soil was the use organic manure. Diacono & Montemurro (2010) performed a long-term field experiment on effects of organic amendments on soil fertility and found that if the composted manures are applied repeatedly, it upgrades the soil organic nitrogen content by 90% and store it for mineralization in future cropping seasons without causing nitrate leaching to the groundwater.

CONCLUSION

Though the degree of change was minimal but improved result of soil nutrient status was found in soil with 4% OM. It means that if 80-100 tons/ha of organic manure is to be used continuously on the excavated land, which is 4-10 times more than the recommended dose; 10- 20 tons/ha for recovery. More dose of OM means more quick recovery of soil which ultimately hits financial affordability. Economic cost of enriching brick kiln areas soil and excavated area soil gets increased by 4-10-fold of organic manure only. Same input of organic manure cannot get same level enrichment in soil health as for arable land. Other method of degraded soil reclamation like application of poultry manure, FYM, vermicompost and organic carbon rich sources along with chemical fertilizers are best suited. Land is a limited entity and cannot be regenerated again and again in the way we wish, so serious steps should be taken about the establishment and management of the brick kilns so that the land degradation gets reduced resulting in the fertility restoration and increment in the agricultural production.

ACKNOWLEDGEMENT

Authors would like to thank Himalayan College of Agricultural Sciences and Technology (HICAST), Purbanchal University for creating environment to carry out this research. We also pay our sincere thanks to all the brick factory owners and workers of Changunarayan Municipality for their valuable time they gave during our research

REFERENCES

Acharya, K. P., Poudel, B. S., & Dangi, R. B. (2008). State of land degradation and rehabilitation efforts in Nepal (D. K. Lee (ed.); Vol. 20, pp. 163–202). IUFRO Headquarters. https://www.academia.edu/13196244/STATE_OF_LAND_DEGRADATION_AND_REHABILITATION_EFFORTS_IN_NEPAL

Bisht, G., & Neupane, S. (2015). Impact of brick kilns' emission on soil quality of agriculture fields in the vicinity of sSelected Bhaktapur area of Nepal. Applied and Environmental Soil Science, 2015.

Biswas, D., Gurley, E. S., Rutherford, S., & Luby, S. P. (2018). The Drivers and Impacts of Selling Soil for Brick Making in Bangladesh. Environmental Management, 62(4), 792–802.

Bremner, J. M., & Mulvaney, C. S. (1982). Nitrogen total. Methods of soil analysis. In A. L. Page (Ed.), American Society of Agronomy (2nd ed., Vol. 9, pp. 595–624).

CBS. (2013). National sample census of agriculture 2011/12.

Das, S., & Sarkar, R. (2020). Impact of brickfields on soil quality of agricultural land along the Bhagirathi-Hugli river basin, West Bengal, India. Spatial Information Research, 28(4), 405–418.

DCCO. (2021). Brief introduction. District Coordination Committee Office Bhaktapur, Nepal. https://dccbhaktapur.gov.np/en/brief-introduction/

Devkota, S., Rayamajhi, K., Yadav, D. R., & Shrestha, J. (2021). Effects of different doses of organic and inorganic fertilizers on cauliflower yield and soil properties. Journal of Agriculture and Natural Resources, 4(2), 11–20.

Diacono, M., & Montemurro, F. (2010). Long-term effects of organic amendments on soil fertility. A review Long-term effects of organic amendments on soil fertility. A review. Agronomy for Sustainable Long-term effects of organic amendments on soil fertility. A review. Agronomy for Sustainable Develeopment, 30(2), 401–422.

Dlamini, P., & Chaplot, V. (2016). The Impact of Land Degradation on the Quality of Soils in a South African Communal Rangeland. In Land Degradation and Desertification - a Global Crisis. InTech. https://doi.org/10.5772/63128

Han, S. H., An, J. Y., Hwang, J., Kim, S. Bin, & Park, B. B. (2016). The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (Liriodendron tulipifera Lin.) in a nursery system. Forest Science and Technology, 12(3), 137–143.

Islam, M. S., Al Mamun, S., Muliadi, M., Rana, S., Tusher, T. R., & Roy, S. (2015). The impact of brick kiln operation to the degradation of topsoil quality of agricultural land. AGRIVITA Journal of Agricultural Science, 37(3), 204–209.

Jerin, M., Mondol, S., Sarker, B., Rimi, R., & Aktar, S. (2017). Impacts of brick fields on environment and social economy at Bagatipara, Natore, Bangladesh. Journal of Environmental Science and Natural Resources, 9(2), 31–34.

Joshi, S. K., & Dudani, I. (2008). Environmental health effects of brick kilns in Kathmandu valley - PubMed. Kathmandu University Medical Journal, 6(1), 3–11.

Kamal, A. M., Alam, M. A., Uddin, M. Z., Hossain, M. M., & Islam, M. N. (2016). Impact of organic fertilizer on physical and chemical properties of soil as well as yield and quality of mango. Journal of the Bangladesh Society for Agricultural Science and Technology, 9(1).

Maithel, D. S., & Uma, D. R. (2012). Monitoring of brick kilns & strategies for cleaner brick production in India. https://www.ccacoalition.org/sites/default/files/resources/Brick_Kilns_Performance_Assessment.pdf

Majumdar, A., Islam Khan, N., Sattar, M. A., Roy, S., & Mazumder, A. (2018). Soil nutrient status of brick and agricultural fields. International Journal of Business, Social and Scientific Research, 6(4), 24–31.

Menšík, L., Hlisnikovský, L., Pospíšilová, L., & Kunzová, E. (2018). The effect of application of organic manures and mineral fertilizers on the state of soil organic matter and nutrients in the long-term field experiment. Journal of Soils and Sediments, 18(8), 2813–2822.

MoEST. (2008). Nepal stocktaking Rreport: Land Degradation.

MoEST. (2011). Nepal state of the environment.

Neupane, D. (2008). Study on environment & health impacts of brick kilns in Bhaktapur district. https://www.researchgate.net/publication/301612488_Study_on_Environment_Health_Impacts_of_Brick_Kilns_in_Bhaktapur_District

Olsen, S. R., Cole, C. V., Watanabe, F. S., & Dean, L. A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. In U.S. Department of Agriculture.

Paudel, P. P., Devkota, B. D., & Kubota, T. (2009). Land degradation in Nepal: A review on its status and consequences. Journal of the Faculty of Agriculture, Kyushu University, 54(2), 477–479.

Rai, A. K., Paul, B., Singh, G., Scholar, R., & Head, P. (2010). Assessment of top soil quality in the vicinity of subsided area in Jharia Coalfield, Dhanbad, Jharkhand. Report and Opinion , 2(9).

Rajonee, A. A., & Uddin, M. J. (2018). Changes in soil properties with dDistance in brick kiln aAreas around Barisal. Open Journal of Soil Science, 08(03), 118–128.

Rajonee, A. A., Uddin, M. J., Rajonee, A. A., & Uddin, M. J. (2018). Changes in Soil Properties with Distance in Brick Kiln Areas around Barisal. Open Journal of Soil Science, 8(3), 118–128.

Roy, S., & Kashem, M. A. (2014). Effects of organic manures in changes of some soil properties at different incubation periods. Open Journal of Soil Science, 04(03), 81–86.

Sikder, A. H. F., Begum, K., Parveen, Z., & Hossain, M. F. (2016). Assessment of macro and micro nutrients around brick kilns agricultural environment. Information Processing in Agriculture, 3(1), 61–68.

Simard, R. R. (1993). Ammonium acetate-extractable elements. In Soil sampling and methods of analysis. Lewis Publisher.

Singh, P., Devi, R., & Hooda, R. . (2015a). Dynamics of soil desurfacing due to brick kilns and suggestive management techniques. International Journal of Multidisciplinary Research and Development, 2(4), 292–298.

Singh, P., Devi, R., & Hooda, R. S. (2015b). Dynamics of soil desurfacing due to brick kilns and suggestive management techniques. International Journal of Multidisciplinary Research and Development, 2(4). www.allsubjectjournal.com

Singh, P., Devi, R., Hooda, R. S., & Grewal, M. S. (2014). Soil desurfacing : A potential threat to soil health, productivity and fertility. Research on Crops, 15(3), 722–729.

SMD. (2017). Manual for soil and fertilizer analysis (pp. 5–6).

Song, K., Xue, Y., Zheng, X., Lv, W., Qiao, H., Qin, Q., & Yang, J. (2017). Effects of the continuous use of organic manure and chemical fertilizer on soil inorganic phosphorus fractions in calcareous soil. Scientific Reports, 7(1), 1–9.

Suwal, G. B. (2018). Impact of brick kilns' emission on soil quality of agriculture fields in the vicinity of selected Bhaktapur area. Journal of Science and Engineering, 5, 34–42.

Walkley, A. J., & Black, I. A. (1934). Estimation of soil organic carbon by the chromic acid titration method. Soil Science, 37(1), 29–38.

Zhao, Y., Wang, P., Li, J., Chen, Y., Ying, X., & Liu, S. (2009). The effects of two organic manures on soil properties and crop yields on a temperate calcareous soil under a wheat-maize cropping system. European Journal of Agronomy, 31(1), 36–42.

Received: 29th August 2021; Accepted: 09th September 2021; First distribution: 12th March 2022.