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EFFECT OF MARBLE MINES ON PHYSICOCHEMICAL PROPERTIES OF SOIL IN DISTRICT BUNER

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Abstract

The research was conducted in Bampokha District Buner to determine the effect of marble mining on soil physicochemical properties. Soil samples were collected from adjacent, 100 m and 200 m away from the marble mines at two depths 0-15 cm and 15-30 cm. The results showed significant difference in surface and subsurface soil properties. Twenty three percent samples were loamy sand, 66 loam, 7 silt loam and 4 were sandy loam in texture. Almost all soil samples had alkaline pH (pH>7) and were non-saline in nature (EC <4 dSm-1) in both surface and subsurface soil. Surface soil have relatively higher pH (7.88), electrical conductivity (0.10 dsm^{-1}), lime content (21.3%), organic matter (2.42%), total nitrogen (0.48%), AB-DTPA Ext.K (52.4 mg kg^{-1}) and P (0.35 mg kg^{-1}) than subsurface soil. Mean values of pH were high in soil at a distance of 200 m (8.1) as compared to adjacent (7.55) and 100 m (7.87) away soil. Electrical conductivity was high in adjacent soil (0.11dSm^{-1}) as compared to 100 m (0.089 dSm^{-1}) and 200 m away soil (0.095dSm^{-1}). Lime content was high in soil at a distance of 200 m away soil (23.8%) than 100 m away soil (22.05 %) and adjacent soil (16.7 %). Similarly, K was high in soil at a distance of 200 m (60.4 mg kg^{-1}) away from mine than 100 m away soil (48 mg kg^{-1}) and adjacent soil (44.2 mg kg^{-1}). Adjacent soil had high organic matter (3.32 %), P (60.4 mg kg^{-1}), total nitrogen (0.66 mg kg^{-1}) as compared to 100 m and 200 m away soil, respectively.

Key words: Marble, Mines, Physical, Chemical properties and Soil

INTRODUCTION

Soil is believed to be one of themost important medium in agriculture that can cause significant effect in production (Ali et a., 2012). Beside other production factors, soil physico-chemical properties can increase production and fertilizer use efficiency if carefully handled (Ali et al., 2011a and 2011b; Arif et al., 2012). Marble is a metamorphic rock present in the earth crust in abundance. Different types of marble are found in Buner in different places. In this study Bampokha region mines were surveyed to determine its effect on physicochemical properties of soil. Buner District is located in the northern part of Khyber Pakhtunkhwa. Soils of Buner are generally considered fertile, having potential to grow various crops (wheat, Maize, Sorghum, Rice, Tobacco, Sugarcane and Barley), Orchards (Citrus, Guava, Persimmon, Apricot, and plum) and vegetables (spinach, lady finger, potato, turnip, tinda and cauliflower) successfully. This area is mainly non-irrigated and non-saline in nature. The process or business of extracting ore or minerals from the ground is known as Mining. Here the materials (stones/gravels etc) are removed from the sites by boring and blasting and then send it for further processes like crushing, etc. Mining either-open cast or underground, cause destruction to nature. On the one hand mining has led to development in all the sectors *viz*. social, economic, transport, educational and industrial but on the other hand it led to many serious concerns related to physical, chemical and biological environment. Mining provides raw materials in the form of crusher, gravels and stones etc for construction of roads, railway lines and other infrastructures. From the last few years the mining rate has increased several times. It results in the loss of biodiversity of both flora and fauna and physiographic features of the concerned region. Mining operations in any area left bad sign for decades or even forever. It results in creation of so many environment related problems and health hazards.

Due to the excavation of marble mining, it released dust in the powder form which is mixed with water. This powder mass cause's alkalinity problem in soil when it get into fields. The water also contains calcium and other insoluble compounds which contaminate soil and causes health hazard. Previous studies on Igebti marble found caco3 (44.26-67.26%) and $mgco_3$ (37.80-45.6%) as major constituents (Emefurieta and Ekuajemi, 1995) and with radioactive materials at acceptable concentration, thus making it unsafe in building construction (Ademola *et al*., 2008). Dust particulates due to marble mining is a major environmental contamination in Igebti areas (Ademola *et al*., 2008). The particulates that spread to surrounding areas have led to considerable accumulation of Ca and Mg compounds in the soil, water and vegetable. Mining is one of the important pathway by which soils are polluted (Ademoroti 1996). Mining has considerable effect on the air and water, biodiversity, soil and land degradation (Kumar 1996). Mining also results decrease vegetation, reduces essential nutrients and organic matter of the soil, reduces biological activities and decreases productivity of the soil (Pandey and Kumar, 1996).

Ecosystem destruction by mining is an in vatable part of industrialization and civilization (Jha and Singh, 1993). In recent years proliferation of industrial concern and other anthropogenic activities increased the concentration of different pollutant in various ecosystem causing environmental degradation (Geeta & Balakrishna, 1983 and Kumar, 1996). During surface mining the flora, hydrological relations and soil biological system are drastically disturbed. Dust particulates from marble mining spread over in nearby areas and affect the vegetation, soil and other natural resources. Soil is a mixture of mineral and organic matter that is capable of supporting plant life. It is the main reservoir of the mineral and organic matter thatis capable of supporting plant life. The availability of minerals affects the specific enzymatic activity directly and eventually adversely affects plant growth (Sharma *et al*., 1999).

Air pollution (marble dust) from the marble mines forms a thin layer of deposition over the adjacent agricultural fields. For such investigation, a survey is essential which should include detailed analysis of physico chemical characteristics of soil (Adak and Purohit, 2001).

Keeping in view the effect of marble mining on the physico chemical properties the present study was conducted in district Buner. For this purpose soil samples were collected and analyzed. The test performed for soil consist of pH, E.C., organic matter of soil, lime content, soil texture, total nitrogen, and AB-DTPA extractable phosphorus and potassium.

MATERIALS AND METHODS

The research work conducted to assess the effect of marble mines on physicochemical properties soils in some areas of Bampokha District Buner Malakand Division. Soil testing was used as an approach for evaluating the effect of marble mines on soils which involved field work and laboratory work.

Collection of soil samples: The soil samples were collected from 5 sites (Umair mining corporation, Nazamin mining corporation, Mobin mining corporation, Ihsanullah mining corporation, Imran mining corporation) of Bampokha District Buner in a very carefully and systematic manner. From each spot 6 samples (Adjacent, 100 meter and 200 meter away soil from marble mines in duplicates) were collected at a depth of 0-15 and15-30 with the help of core sampler and composited. All the soil samples were properly packed, labeled and brought to the Laboratory of ARI (N) Mingora Swat in July 2014.

Sampling prepration and analysis: Soils samples thus collected were ground, sieved and prepared for analysis, than these samples will be analyzed for various soil properties that is pH (Mclean, 1982), EC

(Richards, 1954), Lime content (US Salinity Staff, 1954), Organic matter (Nelson and Sommers, 1982), AB-DTPA extract of soil for Phosphorus and AB-DTPA extract of soil for Potassium (Sultan pour,1985 and Schwab, 1977) and total nitrogen

Analytical procedures: Soil pH was determined in 1:5 soil water suspension follow 15 minutes stirring and read on pH meter (glass and calomel electrodes) (Melean,1982). Total soluble salt were determined by measuring soil EC.Soil water suspension (1:5) was used to determine the EC of soil using the electrical conductivity meter. (Richards, 1954). Five gram of soil was treated with 50mL of 0.5N HCL and back treated, in titrated with0.025N NaOH, using phenolphthalein as indicator by acid –neutralization method (US Salinity Staff, 1954). Soil organic matter was determined by the procedure as described by Nelson and Sommers (1996).

Moreover, total nitrogen (%) in soil was determined by the kjeldahl method of Bremner and Mulvaney (1982). AB-DTPA extractable phosphorous and potash concentration in soil samples were determined by extracting it in soil solution as described by Sultan-pour (1985).

Table 3.2. Guidelines used for interpretation of soil analysis data.

Property	Unit	Low	Medium	High
AB-DTPA extractable P	mg kg^{-1}	< 3	4-7	>7
AB-DTPA extractable K	mg kg^{-1}	<60	60-120	>120
Soil organic matter content	(%)	<0.86	0.86-1.29	>1.29
Lime	(%)	<3.0	3-15	>15.0
Soil pH(1:5)	-	<7.0(acidic)	7.0(neutral)	>7.0(alkaline)

Source: Rashid and Ahmad (1994); Rashid et al. (1994)

RESULT AND DISCUSSION

S**oil pH:** Soil pH ranged from a minimum value of 7.2 to a maximum value of 8.5 with a mean value of 7.84 as given in the appendices. Mean soil pH of the surface soil was7.88 and subsurface soil was 7.8. Results showed that top soil pH was relatively high as compare to subsurface soil.

Soil at a distance of 200 meter away from the mines has the highest mean pH value (8.1), followed by 100 meter away soil with a mean value of (7.87) while adjacent soil to mines has the lowest mean value of pH (7.55). Results also showed that as distance from the mines increases means pH value also increased. For example, soil pH was 4.24% higher at 100 meters away soil as compare to adjacent soil, while soil pH value was 7.28% higher at 200 meters away soil as compare to adjacent soil. Table-4.1 shows the mean values of soil pH affected by Marble mines at district Buner.

Table 4.1 Soil pH as affected by soil depth and distance from marble mines

Depth	**Adjacent soil**	**100 m**	**200 m away soil**
0-15cm	7.56	7.88	8.2
15-30cm	7.54	7.86	8.0
Mean value	7.55	7.87	8.1

Electrical conductivity: Result showed that EC of the samples ranged from a minimum value of 0.019dSm^{-1} to a maximum value of 0.18dSm^{-1} with a mean value of 0.098 as given in the appendices. Mean EC values of whole samples surface and subsurface soil were 0.1024 dSm-1 and 0.094dSm^{-1} respectively. Results reviled that surface soil has relatively high EC as compare to subsurface soil. Results also showed that adjacent soil to mines has the highest mean value of EC (0.1106), while 100 meter away soil from the mines has the lowest mean value of EC (0.0891) and 200 meters away soil from mines have (0.095) EC value. As distance from the mines increases mean EC value also decreases. For example, soil EC was 19.4% lower at 100 meters away soil as compare to adjacent soil, while soil EC value was 14.1% lower at 200 meters away soil as compare to adjacent soil. Table-4.2 shows the mean values of soil EC affected by Marble mines at district Buner.

Table 4.2 Mean values of soil EC affected by depth and marble mines

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	0.09	0.1056	0.1116
15-30cm	0.1312	0.0726	0.0784
Mean value	0.1106	0.0891	0.095

Table 4.3 Textural classes of the samples affected by marble mines

Textural class	Number of samples
Loamy sand	07
Loam	20
Silt loam	2
Sandy loam	1

Soil texture: Results showed that 23% samples were loamy sand in texture, 66% were loam, 7% were silt loam and 4% samples were sandy loam.

Lime content: Lime content in the samples ranged from a minimum value of 2.5% to a maximum value of 40% with a mean value of 20.85%. Mean values of whole surface and subsurface soil samples were 21.3% and 20.4% respectively. Results showed that surface soils have relatively high lime content as compare to subsurface soil. Soil at distance of 200 meters away soil from mines has the highest mean value of lime content (23.8%), while adjacent soil has the lowest mean lime content (16.7%) and 100 meters away soil has (22.05%) lime content value. Results showed that as distance from the mines increases mean lime content also increases. For example soil lime content was 32.036% higher at 100 meters away soil as compare to adjacent soil, while lime content was 42.5% higher at 200 meters away soil as compare to adjacent soil. Table-4.4 shows the mean values of soil lime content affected by Marble mines at district Buner.

Table 4.4 Mean values of lime content of soil affected by depth and marble mines

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	16.9	22.6	24.4
15-30cm	16.5	21.5	23.2
Mean value	16.7	22.05	23.8

Organic matter content: Organic matter content in the samples ranged from a minimum value of 0.42% to a maximum value of 4.09% with a mean value of 2.20% as given in the appendices. Mean values of surface and subsurface soils were 2.42% and 1.987% respectively. Results showed that in surface organic matter was higher as compare to subsurface soil.

Adjacent soil to mines has the highest mean value of Organic matter (3.32%), followed by 100 meter away soil from mines with a mean value of organic matter (1.85%) and adjacent soil has a mean value of (1.43%). Results revealed that as distance from the mines increases mean values organic matter decreases. For example soil organic matter was 44.27% higher at adjacent soil as compare to 100 meter away soil from mine, while soil organic matter value was 56.927% higher at adjacent soil as compare to 200 meters away soil. Table-4.5 shows the mean values of soil organic matter affected by Marble mines at district Buner.

Table 4.5 Mean values of O.M content of soil affected by depth and marble mines

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	3.5	1.95	1.80
15-30cm	3.14	1.75	1.07
Mean value	3.32	1.85	1.43

AB-DTPA Extractable potassium: AB-DTPA Extractable potassium ranged from a minimum value of 26mgkg^{-1} to a maximum value of 104 mgkg^{-1} with a mean value of 50.86 mgkg^{-1}. Mean values of extractable potassium in surface and subsurface soil samples were 52.4mgkg^{-1} and 49.33 mgkg^{-1} respectively. Results showed that surface soil contain relatively more potassium as compare to subsurface soils. Soil at a distance of 200 meter away from the mines has the highest mean value of potassium (60.4 mg kg-1), followed by soils at distance of 100 meter away from the mines with a mean value of (48 mg kg-1) while adjacent soil to the mines have the lowest mean value of potassium (44.2 mg kg-1). Results showed that as distance from the mines increases mean value of AB-DTPA extractable potassium increases. For example AB-DTPA extractable potassium was 8.6% higher at 100 meter away soil as compare to adjacent soil to the mines, while AB-DTPA extractable potassium was 36.65%% higher at 200 meter away soil as compare to adjacent soil. Table-4.6 shows the mean values of soil AB-DTPA extractable potassium affected by Marble mines at district Buner.

Table 4.6 Mean values of AB-DTPA Extractable potassium affected by depth and marble mines

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	44.8	49.2	63.2
15-30cm	43.6	46.8	57.6
Mean value	44.2	48	60.4

AB-DTPA Extractable Phosphorous: AB-DTPA Extractable Phosphorous ranged from a minimum value of 0.134 mg kg^{-1} with a mean value of 0.336 mg kg^{-1} respectively as given in the appendices. Mean value of phosphorous in surface and subsurface soil were 0.345 mg kg^{-1} and 0.3268 mg kg^{-1}. Results showed that surface soils have relatively high phosphorous as compare to subsurface soils.

Adjacent soil to the mines has the highest mean value of AB-DTPA Extractable Phosphorous (0.365 mg kg^{-1}), followed by soils at distance of 100 meter away from the mines with a mean value of (0.33 mgkg-1), while soil at a distance of 200 meter away from the mines has the lowest mean value of AB-DTPA Extractable Phosphorous (0.3128 mg kg-1). Results showed that as distance from the mines increases mean AB-DTPA Extractable Phosphorous value decreases. For example, AB-DTPA Extractable Phosphorous was 9.589% lower at 100 meters away soil as compare to adjacent soil, while soil AB-DTPA Extractable Phosphorous value was 14.30% lower in 200 meters away soil as compare to adjacent soil to the mines. Table-4.7 shows the mean values of AB-DTPA Extractable Phosphorous affected by Marble mines at district Buner.

Table 4.7 Mean values of AB-DTPA Extractable phosphorous affected by depth and marble mines at Buner

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	0.36	0.3656	0.3108
15-30cm	0.37	0.2956	0.3148
Mean value	0.365	0.33	0.3128

Soil total Nitrogen: Total nitrogen in the samples ranged from a minimum value of 0.083% to a maximum value of 0.818% with a mean value of 0.44% as given in the appendices. Mean total nitrogen in the surface and subsurface soils were 0.483% and 0.397% respectively. These results showed that surface soil contain relatively high nitrogen as compare to subsurface soil. Mean values of adjacent soil, 100 meter away from mine`s and soil at a distance of 200 meter away from mine`s were 0.664 %, 0.37% and 0.287% respectively. These results showed that as distance from the mine increases mean value of total nitrogen decreases. For example in soil at a distance of 100 meter away from the mines have 42.27% lower nitrogen as compare to adjacent soil while soil at a distance of 200 meter away from the mines have 56.77% lower nitrogen as compare to adjacent soil. Table 4.8 show mean values of total nitrogen in the samples affected by marble mine.

Table 4.8 Mean values of soil total nitrogen (%) affected by depth and marble mines at district Buner.

Depth	Adjacent soil	100 m away soil	200 m away soil
0-15cm	0.699	0.39	0.360
15-30cm	0.628	0.35	0.214
Mean value	0.664	0.37	0.287

CONCLUSION

The following conclusions could be drawn from the present research work that Marble mining and its allied activities significantly affect the flora of mining area and also affect the growth and yield of plants through pollution. Blasting during marble mining affect the local population, buildings and homes adversely by noise to the local people and cracks in homes. The pH of selected soils were slightly to moderately alkaline with a range from 7.2 to 8.5 with a mean value of 7.84. EC of soils ranged from 0.019 to 0.18 dsm^{-1} with mean of 0.0982 dSm^{-1}. Out of thirty soil samples, 7 were loamy sand, 20 loams, 2 silt loams and 1 sample was sandy loam in the texture. Organic matters in the selected soil ranged from minimum value of 0.42% to a maximum value of 4.09% with a mean value of 2.20%. Total nitrogen in the selected soil sample ranged from a minimum value of 0.083% to a maximum value of 0.818% with a mean value of 0.44%. Most of the soils samples were calcareous, lime content of the samples ranged from minimum value of 2.5% to a maximum value of 40% with a mean value of 20.85%. Phosphorous of selected soil ranges from 0.134 to 0.512 with a mean value of 0.336 this shows that all the samples were low in AB-DTPA ext. phosphorus. Potassium was ranged from 26 mg kg^{-1} to 104 mg kg^{-1} with a mean value of 50.86 mg kg^{-1} which shows that AB-DTPA ext. potassium was from low to medium.

RECOMMONDATIONS

The following recommendations are formulated based on the findings of the research work that further studies are required to completely access the effect of miming on the environment. Alternate method should be evaluated for the excavation of marble mines to reduce noise pollution and arrangement should be made for the mining waste and dust particles.

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