Jr. of Industrial Pollution Control 21 (2)(2006) pp 303-308

IMPACT OF STONE QUARRYING ON SOIL QUALITY - A CASE STUDY IN BANGALORE DIST., INDIA

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Key words : Stone quarrying, Soil quality, Dust.

ABSTRACT

Soil is the reservoir of various mineral nutrients, which are essential for meeting plant/ crop nutrient requirements. Any deficiency or excess of mineral nutrients limits the plant growth and metabolic activities which result in reduced growth and crop yield. Stone quarrying is a labor oriented small scale industry resulting in causing negative impact on various components of the environment. The generation of fine dust particles is found depositing on the near by agricultural field. Study carried out demonstrated the negative impact of various quarrying activities resulting in the degradation of soil fertility.

INTRODUCTION

Soil is the basic natural resource, which is the resultant product of weathering of the earths crust. It is the reservoir of mineral nutrients essential for meeting plant/ crop nutrient requirements. Any deficiency or excess of mineral nutrients limits the plant growth or cause plant stress like reduced growth and crop yield. Quarrying/ crushing activities is resulting in the emission of dust particles which is found depositing on the near by agricultural field resulting in considerable degradation of soil fertility characteristics. The main objective of the present study is to diagnose and foresee its impact and constituting action with possibilities of execution, which forms the most adequate instrument for the preservation of natural resources and defense of the environment. Hence the present study is an attempt to evaluate the extent of dust pollution on soil quality and suggest suitable mitigatory measures to combat the impact.

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MATERIALS AND METHODS

Soil quality analysis has been carried out in selected quarry locations in Bangalore District to understand the impact of quarrying activities on the soil quality. Soil samples were collected from agricultural fields in and around quarries/crushers along the wind direction. Soil was sampled up to 8" using a soil augur sampler, and then mixed to obtain a composite sample, which was used for further investigations. The air dried soil samples were analyzed for various physico-chemical parameters like pH, EC, Organic carbon, Available nitrogen, Available phosphorus, Potassium and heavy metals like Iron, Zinc, Copper and Boron etc., during the year 2001-2002 and 2002-2003 using Standard Procedures (Jackson, 1973). The analytical data obtained are compared with ICAR (1997) and the following observations are made. The quantity of dust deposition was estimated at various distances from the source. The results obtained are presented in the tables 1.1 to 1.3

RESULTS

The effect of quarry dust on the soil quality has been analyzed extensively and the result obtained have been tabulated in the Table 1.3 . It is evident from the results that,

- The wide range of EC values can be attributable to the spent explosive materials getting leached and in summer it accumulates on the soil surface.
- The samples collected near the quarrying/crushing area showed low and moderate amount of carbon content.
- Low carbon content may be attributed to the addition of quarry dust near the crushing sites by way of aerial deposition, thus effectively reducing the organic carbon content.
- Most of the samples showed low nitrogen content due to low organic carbon and significant accumulation of dust in the agricultural fields.
- The high phosphorus content may be due to the alkalinity of soil as phosphorus occurs mainly as calcium phosphate which inturn partly derived from rocks being quarried. Some amount of phosphorus occurs in combination with organic matter of surface soils and the remainder occurs in mineral or organic combination

Extent of deposition of quarry dust

Experiments carried out during the present investigations have indicated that on any working day an average of about 8 to 10 gms of quarry dust is deposited per sq. m of land at a distance of 100 m from the crusher point in the downward direction. The rate of dust deposition per day at Bettahalsur, Bidadi, Basavanahalli and Kogilu villages has been presented as average of three seasons in Table1a and 1b. The degree of deposition varies from quarry to quarry depending on the magnitude of crushing and transportation activities. The volume of annual dust deposition on ground has been calculated and the same is presented in Table 1b. The data indicates that about 5 to 6 kg of dust is deposited within 50m in the downward direction, upto about 3 kg is deposited in a year in the windward direction and hence almost no

Table 1a.
Quantity of dust (gms/sq.m/yr) depositing on ground near quarries in 8 hours of operation

Place	50	100	150	200	250	300	350	400	450	500
Distance in m from the crusher point in windward direction										
Bettahalsur	14.2	8.6	5.2	3.1	1.9	0.8	0.6	0.47	0.21	0.16
Kallugopanahalli	18.5	9.6	6.5	3.6	2.5	1.2	0.9	0.51	0.20	0.14
Basavanahalli	15.1	8.1	4.9	3.2	1.6	1.0	0.5	0.23	0.19	0.16
Distance in m from the crusher point in low ward direction										
Bettahalsur	9.2	4.9	1.8	0.8	0.41	0.21	0.15	0.14	0.19	0.15
Kallugopanahalli	8.9	5.1	1.6	0.6	0.34	0.19	0.11	0.16	0.19	0.11
Basavanahalli	8.1	4.3	1.9	0.9	0.24	0.18	0.09	0.11	0.21	0.14

Table 1b.
Quantity of dust (kgs) depositing on per sq.m of ground area near quarries per year (sq.m/yr)

Place	50	100	150	200	250	300	350	400	450	500
Distance in m from the crusher point in windward direction										
Bettahalsur	5.18	3.13	1.89	1.13	0.69	0.29	0.21	0.17	0.08	0.06
Kallugopanahalli	6.75	3.50	2.37	1.31	0.91	0.43	0.32	0.18	0.07	0.17
Basavanahalli	5.51	2.69	1.79	1.16	0.58	0.36	0.18	0.08	0.07	0.06
Distance in m from the crusher point in low ward direction										
Bettahalsur	3.36	1.79	0.66	0.29	0.15	0.11	0.07	0.05	0.07	0.21
Kallugopanahalli	3.25	1.86	0.58	0.22	0.12	0.07	0.04	0.06	0.07	0.04
Basavanahalli	2.96	1.56	0.69	0.33	0.09	0.06	0.03	0.04	0.08	0.17

Table 1c.
Soil quality analysis in the study area

Place	pH	EC	OC	AN	AP	AK	ZN	CU	MN	Fe	B
Bettahalur1	5.6	50	0.35	134	18.4	162	2.10	1.87	10.18	3.86	0.32
Betthalsur2	5.8	40	0.40	128	20.6	174	2.24	1.76	10.74	3.72	0.40
Bandehosur	7.2	70	0.56	248	40.0	285	1.56	3.14	17.32	4.85	0.50
Jyothipura	5.9	50	0.60	214	25.8	230	1.84	2.54	19.15	3.85	0.56
Koyra	5.5	50	0.64	184	23.4	248	1.68	2.32	22.18	3.64	0.44
Basavanahalli	5.8	70	0.58	265	32.5	186	1.32	1.82	18.43	4018	0.65
Mahimapura	5.8	30	0.40	230	36.6	174	1.46	2.12	17.36	8.16	0.74
Kallunayakanahalli	5.5	40	0.45	315	25.0	145	2.99	1.87	26.19	10.70	0.75
Kallugopanahalli	5.9	50	0.34	154	27.6	135	1.88	2.15	14.18	12.82	0.46
Kaggalahalli	6.9	60	0.54	360	16.2	270	2.20	1.56	12.65	13.34	0.56

Note: EC-µmohs/cm, OC-Organic carbon-%, AN-Available nitrogen, AK-Available potassium are expressed in Kg/ha, Zn-Zinc, Cu-Copper, Fe-Iron, Mn-Manganese and B-Boron expressed in µg/g.

Table 2
Soil fertility ratings

	Low	Medium	High
OC%	<0.5	0.5-0.75	>0.75
AN (kg/ha)	<280	280-560	>560
AP(kg/ha)	<9	9-22	>22
AK (kg/ha)	<141	141-336	>336
Zn (µg/g)	<1.00	-	-
Cu (µg/g)	<0.40	-	-
Fe (µg/g)	<4.50	-	-
Mn (µg/g)	<2.00	-	-
Boron (µg/g)	<0.50	-	-

cultivation of annual crop is observed. During the present investigation it was noticed that practically no vegetation existed in the windward direction upto 100 m at all the quarry locations sampled.

The study and the data also indicate that the structure or particulate composition of the deposited dust varies with distance from the crushing point. The course sand size particulates remain air borne within 100m from the crusher point, and fine sand size particulates remain airborne for a relatively longer time in the air and hence spreads even upto 200m. The observations and the analytical data obtained indicated a general reduction in soil fertility characters which is mainly due to runoff, soil erosion, wind blow, land slides etc.

DISCUSSION

The laboratory analysis conducted during the present investigation indicated that quarrying/crushing activity is causing considerable degradation of soil fertility characteristics. The spent explosives and the crushed rock debris dumped in the vicinity are affecting the organic carbon and nitrogen content in the soil of near by agricultural field. The soil quality is perceptibly affected by seasonal changes. During rainy season the runoff from the dumps and waste material flows to the surrounding agricultural fields resulting in the degradation of soil fertility. As a consequence of the addition of large amount of dust arising from quarry operations the soil in few of the sampled villages is found to become deficient in NPK ratios in addition to reduction water holding capacity which results in decrease in crop yield over a period of time. The chemistry and biology of the soil around the quarry area in several cases is found to be affected considerably because of dust emission and deposition which effects soil texture affecting the pore size. The damages caused due to surface mining are not confined to the immediate site only, but also spread over a vast area around the operation sites (Adhikari *et al.* 1993). These disturbances influence the availability of water and nutrient uptake by plants besides leaching and direct impact on the water holding capacity and mobility of solution in the soil medium.

CONCLUSION

1. Fertility of the soil samples collected near the quarries and crushers are found to be of low and moderate ratings, which may be mainly attributed to the deposition of the quarry dust generated and chemicals used for blasting.
2. Soil texture has undergone remarkable changes within 250m from the crusher points. Substantial amount of coarse and fine sand is getting added to soil.
3. More than 3 kgs of dust is added per sq.m of land annually, no growth of plants has been observed within first 150 mts.
4. Soil fertility parameters are not affected near manual type of quarrying where crushing is not being carried out.
5. Soil properties around Semi-Mechanized and Mechanized quarries are affected to a considerable degree.
6. It is the crusher operation, which is generally more responsible for degradation of soil quality.

Suggestion

1. Reclamation of dumped areas
2. Soil reclamation should be done frequently
3. Adequate soil conservation methods like provision of garland, drains, bunds, plantations have to be done.
4. Plantations have to be made mandatory in the quarry area.

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