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Physico-Chemical Quality of Soil of Agro-Fields Along Side Heavy Transportation Burdened Barakar Road, Bongabari, Purulia, WB, India

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Abstract Present study was undertaken to observe the physico-chemical characteristics of soil collected from agro-fields adjacent to the highly traffic burdened Barakar Road, Bongabari, Purulia. These fields ,most of the time, are exposed to the heavy automobile emission. Simultaneously, for control study, soil samples were collected from agro-field near Purana Kali Mandir, Ketika, Purulia where fields are far away from heavy automobile emissions. Soil samples were collected from both of the agro-field surface areas within the depth 0-10 cm. Parameters like bulk density, particle density, organic carbon, pH, EC, soil moisture, available nitrogen, phosphorus, potassium, Cu, Zn, Pb and Cd of soil samples were estimated. pH of Bongabari area is less acidic ($p<0.01$) than that of control area ; Cu and Pb concentration were significantly enhanced in the road side field ($p <0.01$) than in interior region, soil moisture, available nitrogen, available potassium, Zn and Cd concentration were reduced significantly ($p<0.01$) in the road side area. Study guesses that the changes in physico-chemical characteristics and comparatively elevated concentration of Pb and Cu in Bongabari area may be due to the impact of automobile emission. In the second part of the investigation, the changing pattern in soil physico-chemical characteristics was investigated between two zones of the same agro-field. A set of 5 soil samples were collected from 0-10 m horizontal range from Barakar Road whereas another set of similar number of soil samples were collected from the 25—35 m range horizontally from the said road. Analytical data revealed that soil density, organic carbon, pH, available nitrogen, available potassium and Zn concentration were significantly higher ($p<0.01$, $p<0.05$) in the range 0-10 m from the road and soil moisture, phosphorus, Cu, Pb and Cd concentration were found significantly higher ($p<0.01$, $p<0.05$) in the range 25—35m. It was observed that changes in soil characteristics were more prominent in the range 25—35 m than the other one; Pb, Cu and Zn concentration were also found significantly ($p<0.01$) higher in this range.

Keywords Soil density, NPK, Soil pH, Soil organic carbon, Soil Pb.

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Introduction

Automobile emission produces impact on soil system. Oil and fuel spill from vehicles seep into soil alongside highways. Particulate matters, compound of Hydrocarbons and some other pollutants from motor vehicles are important pollution source to road side agro-ecosystem. Accumulation of heavy metals and Hydrocarbons in soil system affects vegetation growth and crop yield badly and also accumulates in plant tissues. Heavy metal contamination of soil may pose risk and hazard to human and the ecosystem through the food chain, reduces plant growth, crop yield as well as food quality, contaminate ground water. Generally the risk of lead poisoning increases from direct intake of lead contaminated soil or dust deposit on the plants or plant parts. Hussain et al. (2018) found that people especially dwelling in motorized and urban environment suffers from the toxic effect of lead. Alloway (2012) observed that soils in all urban areas are generally contaminated with Pb, Zn, Cd and Cu from traffic, paint and many other non-specific urban sources. Popescu (2011) found relation between traffic and heavy metals content like Pb,Cd from SPM (Suspended Particulate Matter). Lead content was higher during the working days while Cd content was found as constant.

Present study was undertaken to investigate the changes, if any in physico-chemical qualities of heavy transportation burdened road side agro-field soil in comparison to the control area agro-field soil. Besides, the pattern of changes was also observed between two distinct distances from road side, within 0-10 m and 25-35 m horizontally from the road. In both the control and study area, soils samples were collected within 0-10 cm depth from the surface.

Materials and Methods

Representative soil samples were collected randomly with the help of a khupri from different spots of the agro-field of the Bongabari region of Purulia, in close proximity to Barakar Road. The soil of these fields is always exposed to the automobile emissions. Simultaneously, soil samples were also collected from agro-fields near Purana Kali Mandir, Ketika, Purulia which is far away from heavy traffic burdened road. Samples were collected in a bright sunny day of the month of August, 2017. Then just after collection, soil samples were brought into the laboratory and taking suitable portion of prepared soil samples, soil parameters like bulk density, particle density (Saxena 1998), pH (Jackson 1972), soil moisture (Gupta 1967), organic carbon (Walkley 1947) were analyzed in laboratory following mentioned methods; EC was estimated in Soil Testing Laboratory of Bongabari, Purulia; N,P,K, Pb, Cd, Cu, Zn were analyzed in Soil Cares Lab in Manpada, Thanewest, Thane 400610, Mumbai.

Results and Discussion

Analytical results as well as the required statistical

Table 1. Analytical results and t -test of soil parameters of agro-fields of Bongabari area and control area. *$t_{0.05, 13}$ =2.160, **$t_{0.01,13}$=3.012, NS-No significant difference.

Parameters	Bongabari area Mean ± SD	Min	Max	Control area Mean ± SD	Min	Max	t-test value	
BD (g/cc)	1.37 ± 0.12	1.23	1.59	1.55 ± 0.28	1.17	1.93	1.80	NS
PD (g/cc)	2.33 ± 0.07	2.21	2.43	2.36 ± 0.04	2.31	2.42	0.83	NS
OC (%)	0.88 ± 0.29	0.52	1.27	1.18 ± 0.26	0.86	1.57	1.99	NS
pH	6.26 ± 0.35	5.8	6.8	5.56 ± 0.05	5.5	5.6	4.40	**
EC	0.30 ± 0.38	0.1	1.17	0.10 ± 0.01	0.1	0.11	1.13	NS
Moisture	8.57 ± 4.25	3.37	15.36	14.69 ± 1.82	12.5	16.66	3.03	**
N (kg/ha)	99.51 ± 30.56	69.8	156.9	173.54 ± 8.24	164.9	187.2	5.23	**
P (kg/ha)	12.32 ± 1.54	10.27	14.6	13.74 ± 0.53	13.11	14.26	1.98	NS
K (kg/ha)	161.23 ± 10.77	149.8	180.9	198.88 ± 4.76	190.72	202.3	7.36	**
Cu (mg/kg)	240.49 ± 57.59	187.2	317.8	151.24 ± 19.17	124.8	178.7	3.32	**
Zn (mg/kg)	37.12 ± 6.47	27.6	44.7	45.68 ± 3.63	41.2	50.1	2.72	*
Pb (mg/kg)	80.57 ± 15.04	57.9	99.4	43.02 ± 4.07	38.7	49.6	5.39	**
Cd (mg/kg)	10.60 ± 2.79	4.9	13.7	14.70 ± 0.71	13.8	15.6	3.18	**

analysis of the soil parameters are represented in respective tables. These analytical data help to recognize if there are any significant or remarkable differences in soil physico-chemical parameters between two different places i.e., the road side zone and the interior zone. Besides, this comparative discussion, another investigation was performed simultaneously to assess the pattern of changes with changing distance from the road side. Observation revealed (Table 1) that there was no significant difference in the particle density, bulk density, organic carbon, electrical conductivity and available phosphorus level between both the study and control area. PH of study area is less acidic ($p<0.01$) than that of control area, while soil moisture, available nitrogen, available potassium, Zn,Cd level were remarkably reduced ($p<0.01$) in the road side agro-field soil. Besides lead and Cu accumulation in soil were enhanced significantly ($p<0.01$) in the study area in comparison to the control area. Elevated level of Zn and Cd in the control area field soil may be due to seepage as the field was in a depressed land, while the comparatively higher accumulation of Pb, Cu in road side soil indicates deposition of particulates or gaseous emission from automobiles.

Low supply of nitrogen produces poor growth of plants; leaves become pale green or yellow. Zhao et al. (2005) noticed that nitrogen deficiency significantly reduces leaf area, chlorophyll content as well as photosynthetic rate resulting in lower biomass production. Potassium deficiency results in stunted growth and reduced yields in crop.

Secondly, comparison between two sets of analytical and statistical data (Table 2) of 2 different zones i.e., 0-10 m and 25-35 m range from road in the study area revealed that there was no remarkable changes in EC between the said two zones, but bulk density, particle density, organic carbon, pH, available nitrogen level, available potassium and Zn were significantly reduced in the 25-35 m range from Barakar Road, whereas soil moisture level, available phosphorus, Cu, Pb and Cd concentration enhanced in that zone noticeably. This reduction in available nitrogen and potassium, pH and Zn level and simultaneous elevation of Pb, Cd and Cu may be due to aerial deposition of emission from moving vehicles.

Table 2. Analytical results and t-test of soil parameters of two different distances from road in Bongabari area agro-field. *$t_{0.05, 8}$=2.306, ** $t_{0.01, 8}$=3.355, NS-No significant difference.

Distance from road Parameters	0-10 m Mean ±SD	25-35 m Mean ± SD	t-test value	
BD (g/cc)	1.45 ± 0.12	1.29 ± 0.03	3.0	*
PD (g/cc)	2.39 ± 0.04	2.28 ± 0..05	3.82	**
OC (%)	1.13 ± 0.15	0.63 ± 0.12	5.77	**
pH	6.56 ± 0.18	5.96 ± 0.11	6.26	**
EC	0.49 ± 0.48	0.11 ± 0.01	1.80	NS
Moisture (%)	5.24 ± 1.65	11.90 ± 3.20	4.13	**
N (kg/ha)	123.98 ± 24.31	75.04 ± 3.72	4.45	**
P (kg/ha)	11.25 ± 0.97	13.38 ± 1.24	3.02	*
K (kg/ha)	168.42 ± 10.88	154.04 ± 3.66	2.80	*
Cu (mg/kg)	188.08 ± 0.91	292.90 ± 24.38	9.61	**
Zn (mg/kg)	41.8 ± 2.52	32.44 ± 5.76	3.33	*
Pb (mg/kg)	68.48 ± 11.22	92.66 ± 4.18	4.51	**
Cd (mg/kg)	8.52 ± 2.48	12.68 ± 0.78	3.58	**

Probably the emission just after its discharge from point source of moving vehicles follow the velocity of that source and then was deposited on the distant site from the road to some extent higher amount than that of the site every adjacent to the road and produce subsequent changes in physico-chemical characteristics of soil. Deposition of emission from vehicles depend on various factors i.e. speed of the vehicle, dispersion factors of the surrounding atmosphere like wind velocity, direction, precipitation, atmospheric instability, humidity, air pressure gradient, atmospheric temperature. All these factors cumulatively dominate or regulate the deposition patterns of gaseous and particulate emission from vehicles on to the bare ground surface.

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