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GIS evaluation for the effect of vehicles on the pollution of Fayoum soils, Egypt.

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ABSTRACT

The effect of automobile exhausts on soil pollution with Pb and Cd was tested in three sample areas in El Fayoum Governorate. The roads network were overlayed first over the soil-map of Sinnuris Districts to specify the soil mapping units that have roads with different construction ages and with different types of side trees wind barriers. The tested soils are classified mainly as Typic Haplotorrerts.

Three sample areas were taken surrounding 3 roads, each of them has 3 sampling tracks with 100 m apart. Mini-pits were sampled in each track at distances of 10 , 20 ,50 ,100 and 200 m east of the roadside. All soil samples were tested for total and available Pb and Cd. Interpolation was done to create sample areas maps using ILWIS GIS. The study indicated that effect of automobile exhausts on soil pollution with Pb and Cd is recognizable. Correlation models were calculated to represent the relationship between the total Pb and Cd contents and distance from the tested roads.

Key Words:
GIS, Environmental impacts, automobile exhausts , pollution, Fayoum soils.

1. INTRODUCTION

Urban air pollution is a major environmental problem which jeopardizes Egypt's economic development and its citizens health. Urban air quality is seriously degraded as a result of industrial emissions, vehicles, constructions, garbage burning, and natural dust from surrounding deserts. The vehicles emissions constitute one of the major soil pollution source, especially along highways and different roads. The roads traffic density is considered a major factor for soil pollution usually along roads. The emitted pollutant particles travel on the air for a specific distance, then precipitate on soil and plant surface. The present study aimed mainly to investigate the effect of automobile exhausts on soil pollution with Pb and Cd around some selected highway roads at Sinnuris District, Fayoum .

1.1 Research objectives

The work aimed to achieve the following objectives;

a) To test the effect of automobile exhausts on soil pollution beside El-Fayoum highway roads.

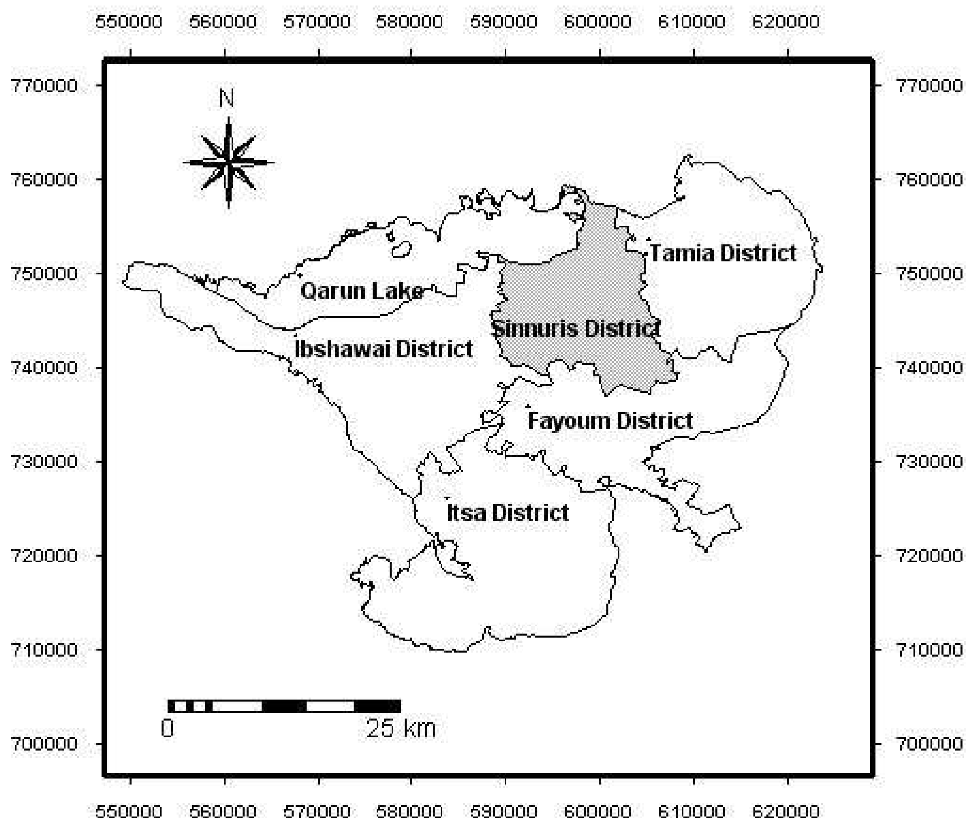
b) To investigate the effect of side roads trees on reducing traffic pollution.

c) To investigate the contribution of GIS in studying such environmental problem.

1.2 General description of the studied area

An area located in Sinnuris District, Fayoum Governorate, Map (1) is selected for the present study. The annual mean of wind speed is 4.46 knots with a North West main direction. El-Khamaseen wind blows over the area during February - June period, from the western direction across the Western desert. The annual mean temperature is 22 C° and the annual mean rainfall is only 8 mm, whereas the mean daily evaporation is 6.75 mm/day.

Map 1. Location of the studied Sinnuris District area.



A part of the fluvio-lacustrine gently sloping terrace tread mapping unit (Pl1211*<.05%) from the soil-map of Sinnuris district, Abdelfattah (2002), is selected for the present study. The area have deep well drained soils, with low to moderate contents of calcium carbonate, clayey texture, none saline, non alkaline with high CEC values, neutral pH and classified as Typic Haplotorrerts.

2. MATERIALS AND METHODS

With the help of ILWIS GIS, (ITC, 2002). the roads network were overlayed first over the soil map of Sinnuris District that previously studied by Abdelfattah (2002), to decide the locations selected to investigate the effect of traffic pollution on soils.

A reconnaissance soil survey was made first, then three locations were selected . The selection was governed to test the effect of both the age of the road construction and the side roads trees as wind barriers to soil pollution.

The first location was selected to represent the pollution condition adjacent to the recent El-Fayoum- Cairo highway road that functioned on 1993.

The second and third locations were carried out beside the old Fayoum- Cairo highway road that constructed since more than fifty years ago.

The effect of side road trees were tested in locations 2 and 3.

Three tracks each of them 100 meter apart are sampled where five mini-pits were made at distances of, 10, 20, 50, 100 and 200 at east of the roadside. The exact location of the investigated points were digitized to ILWIS GIS, Map 2.

A total of 90 disturbed soil samples were collected, i.e.30 per each location, for laboratory analysis where texture, the main chemical characteristics and the total and available Pb and Cd were determined, (Black 1965 & 1982),Tables 1,2,3,4,5 &6.

The analysis results were stored as geographic attributes for the digitized points. Moving Average GIS Interpolation is made to create the elements contents maps, Maps 3,4,5 6,7 & 8.

Total contents of Pb and Cd in soil samples were extracted by wet digestion with HF / $HClO_4$ mixture (Jackson , 1967). The extract was kept for their determinations using Atomic absorption apparatus.

Available heavy metals were extracted by DTPA method according to Lindsay and Norvell (1978) and determined using Atomic absorption .

3. RESULTS AND DISCUSSIONS

The main soil characteristics of the investigated soils are indicated in Tables 1,2, and 3. Data indicate that all the investigated soils have clayey texture where clay contents ranged between 40.4 and 48.3 %. Assadian (1998) reported that relative metal concentrations are highly correlated with clay content within the plough zone.

Low to moderate CaCO3% contents are recoded and ranged between 4.63 to 6.88 %. Swelling and shrinking cracks and silkensides were recoded during the field work, therefore, the soils were classified as Typic Haplotorrerts, Soil Survey Staff (2003).

No signs of soil salinity are recoded and relatively high CEC values are obtained reflecting the smectites rich soil minerals reported in the area by Shendi (1990). It is expected that such soil texture and clay mineralogy with high sorption capacity will elevate the traffic pollution hazard in the area.

Data of Pb and Cd contents for the investigated soils are presented in Tables (4, 5 and 6). Lead accumulation in the road side soil depends upon distance from the motorway, density of traffic and atmospheric conditions; concentration of Pb in the arable layer of soils. According to the obtained results, it is clearly obvious that the contents of the total and available Pb and Cd are higher in the surface top soil than the subsurface layer in all the observed samples. Similar results were obtained by El-Sayad (1992) and El-Mola (1980). Merry et al. (1993) , reported that Pb concentration in soils decreases exponentially with depth

Also, it is clear to conclude that concentrations values of the studied two metals are lower beside the new road than the old one.

The total lead varied in the surface layers between 22.94 and 38.65, ppm . Aubert and Pinta (1977) reported that the average lead concentration in soils are 15- 25 ppm. By comparing this average with the obtained results, we can conclude that lead concentrations in top soils are slightly much higher than the international lead levels and indicating the pollution problem. Lead content in the subsurface layers were 4.65 - 14.72 , 7.15 - 19.81 and 11.01 - 20.11 ppm for the locations 1,2 and 3, respectively. The clearly pronounced accumulation of total lead in the top soil may suggest that the lead deposits are relatively immobile and tend to accumulate in the soil surface. Furthermore, the lead content in the subsurface layers can be due to the management practices such as cultivation, ploughing and green manure additions, which in turn aid to the redistributing of the soil constituents between the surface and the subsurface layers, Chow (1969).

Map 2. Location map of observation points.

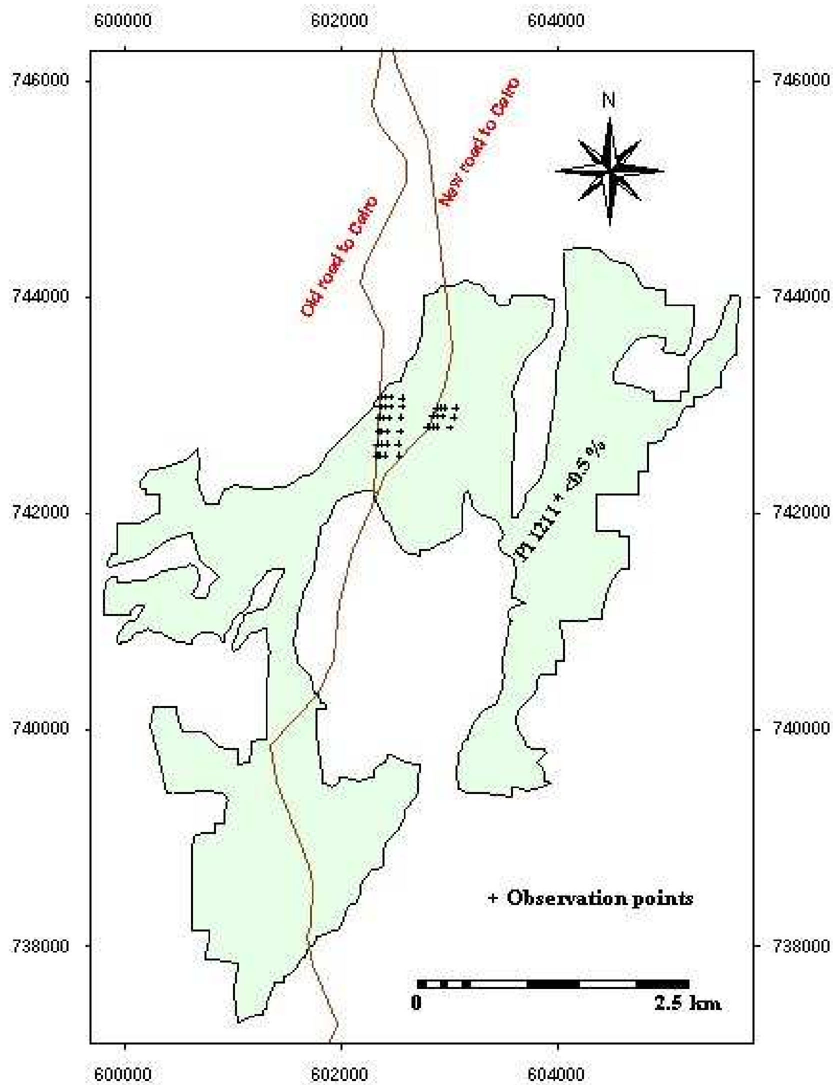


Table 1. Particle size distribution and $CaCO_3$ % of the main investigated soils.

Location	Distance from the main road (m.)	Depth (cm)	Sand %		Silt %	Clay %	Texture class	$CaCO_3$ %
			Coarse	Fine				
1	10	0-20	2.0	35.2	15.1	47.7	C.	6.38
		20-40	1.8	37.6	18.7	42.0	C.	6.84
	20	0-20	2.1	38.3	15.7	44.0	C.	6.70
		20-40	1.9	38.0	17.0	43.1	C.	5.76
	50	0-20	1.6	35.4	22.6	40.4	C.	6.22
		20-40	1.3	33.0	25.1	40.6	C.	6.47
	100	0-20	1.8	33.1	23.6	41.6	C.	6.57
		20-40	1.7	25.8	29.7	42.9	C.	6.56
	200	0-20	1.4	28.7	24.1	45.8	C.	5.86
		20-40	1.6	26.3	25.3	46.8	C.	6.53
2	10	0-20	2.1	28.1	26.1	43.7	C.	5.56
		20-40	1.9	28.0	28.2	42.0	C.	5.61
	20	0-20	1.9	39.2	12.7	46.2	C.	5.17
		20-40	1.2	41.2	15.1	42.5	C.	5.81
	50	0-20	1.7	36.5	18.1	43.7	C.	5.00
		20-40	1.2	41.0	13.2	44.6	C.	5.71
	100	0-20	1.7	39.0	16.3	42.9	C.	6.16
		20-40	1.6	36.0	14.1	48.3	C.	6.88
	200	0-20	1.6	35.2	18.1	45.1	C.	6.31
		20-40	1.5	37.6	17.3	43.5	C.	6.36
3	10	0-20	1.5	36.8	18.7	43.1	C.	5.42
		20-40	2.0	36.1	21.0	40.9	C.	5.57
	20	0-20	1.7	39.2	12.3	46.8	C.	5.67
		20-40	1.6	44.2	13.4	40.9	C.	5.95
	50	0-20	2.0	36.6	14.2	47.2	C.	5.56
		20-40	1.7	34.0	21.5	42.8	C.	5.33
	100	0-20	2.1	36.6	19.5	41.8	C.	4.63
		20-40	1.7	37.8	16.3	44.2	C.	4.93
	200	0-20	1.9	38.1	13.7	46.4	C.	4.72
		20-40	1.4	39.2	16.2	43.2	C.	4.68

Location	Distance from the main road (m)	Depth (cm)	pH (soil paste)	ECe (dS/m)	Cations (meq/l)				Anions (meq/l)			SAR
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	SO_4^{--}	HCO_3^{-}	Cl^{-}	
1	10	0-20	7.42	1.83	5.75	2.11	10.28	0.46	2.76	2.04	13.80	5.18
		20-40	7.80	0.98	3.60	1.44	4.58	0.10	1.04	2.26	6.42	2.88
	20	0-20	7.76	0.84	2.92	0.56	4.85	0.15	1.43	2.40	4.65	3.67
		20-40	7.78	0.94	3.15	0.48	5.92	0.12	1.88	2.37	5.42	4.39
	50	0-20	7.68	1.01	3.94	1.10	4.81	0.13	2.05	2.31	5.62	3.03
		20-40	7.83	1.00	3.54	1.55	4.65	0.11	2.26	2.22	5.37	2.92
	100	0-20	7.93	0.94	4.65	1.12	4.02	0.12	0.09	2.92	6.90	2.37
		20-40	8.04	0.97	3.07	0.64	6.12	0.09	0.69	2.81	6.42	4.50
	200	0-20	7.86	1.10	3.43	1.57	5.76	0.11	1.96	2.35	6.56	3.64
		20-40	7.94	1.16	3.37	1.64	6.26	0.12	2.03	2.41	6.87	3.95
2	10	0-20	7.37	2.52	6.64	2.18	16.52	0.21	9.03	2.31	14.21	7.86
		20-40	7.73	2.36	7.07	2.60	13.52	0.45	8.12	2.15	13.37	6.14
	20	0-20	7.12	1.44	5.22	1.65	7.45	0.13	5.44	2.06	6.95	4.02
		20-40	7.60	1.67	4.82	1.93	9.87	0.14	5.46	2.88	8.42	5.37
	50	0-20	7.40	1.43	5.47	1.91	6.97	0.11	1.91	2.65	9.90	3.63
		20-40	7.63	1.42	4.49	1.27	8.55	0.12	3.03	2.51	8.90	5.04
	100	0-20	7.66	2.72	7.19	2.52	16.77	0.19	8.89	2.41	15.37	7.61
		20-40	8.09	2.54	8.07	2.05	15.44	0.20	8.33	2.36	14.87	6.86
	200	0-20	7.73	2.42	6.35	2.32	15.01	0.32	8.09	2.21	13.61	7.24
		20-40	7.82	2.51	6.81	2.18	15.63	0.38	8.48	2.31	14.21	7.37
3	10	0-20	7.28	2.54	7.54	2.28	15.62	0.23	9.37	2.70	13.24	7.05
		20-40	7.74	2.36	5.00	2.12	16.35	0.35	8.77	2.58	12.47	8.66
	20	0-20	7.15	1.48	4.35	1.64	8.64	0.12	3.37	2.45	8.93	5.00
		20-40	7.58	1.69	5.67	1.78	9.42	0.13	4.99	2.68	9.33	4.88
	50	0-20	7.38	1.40	5.45	1.89	6.87	0.11	2.05	2.25	10.02	3.60
		20-40	7.59	1.39	4.51	1.25	8.45	0.13	1.71	2.11	10.52	4.98
	100	0-20	7.67	2.69	8.20	2.51	16.15	0.19	10.21	2.36	14.48	6.97
		20-40	8.10	2.49	6.10	2.06	16.73	0.18	9.54	2.48	13.05	8.28
	200	0-20	7.78	2.49	5.97	2.10	16.72	0.21	8.57	2.51	13.92	8.32
		20-40	8.11	2.56	6.03	2.25	16.98	0.24	8.83	2.36	14.31	8.34

Table 2. Chemical characteristics of the investigated soils for traffic pollution.

Location	Distance from the main road (m)	Depth (cm)	pH (soil paste	ECe (dS/m)	Cations (meq/l)				Anions (meq/l)			SAR
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	SO_4^{--}	HCO_3^{-}	Cl^{-}	
1	10	0-20	7.42	1.83	5.75	2.11	10.28	0.46	2.76	2.04	13.80	5.18
		20-40	7.80	0.98	3.60	1.44	4.58	0.10	1.04	2.26	6.42	2.88
	20	0-20	7.76	0.84	2.92	0.56	4.85	0.15	1.43	2.40	4.65	3.67
		20-40	7.78	0.94	3.15	0.48	5.92	0.12	1.88	2.37	5.42	4.39
	50	0-20	7.68	1.01	3.94	1.10	4.81	0.13	2.05	2.31	5.62	3.03
		20-40	7.83	1.00	3.54	1.55	4.65	0.11	2.26	2.22	5.37	2.92
	100	0-20	7.93	0.94	4.65	1.12	4.02	0.12	0.09	2.92	6.90	2.37
		20-40	8.04	0.97	3.07	0.64	6.12	0.09	0.69	2.81	6.42	4.50
	200	0-20	7.86	1.10	3.43	1.57	5.76	0.11	1.96	2.35	6.56	3.64
		20-40	7.94	1.16	3.37	1.64	6.26	0.12	2.03	2.41	6.87	3.95
2	10	0-20	7.37	2.52	6.64	2.18	16.52	0.21	9.03	2.31	14.21	7.86
		20-40	7.73	2.36	7.07	2.60	13.52	0.45	8.12	2.15	13.37	6.14
	20	0-20	7.12	1.44	5.22	1.65	7.45	0.13	5.44	2.06	6.95	4.02
		20-40	7.60	1.67	4.82	1.93	9.87	0.14	5.46	2.88	8.42	5.37
	50	0-20	7.40	1.43	5.47	1.91	6.97	0.11	1.91	2.65	9.90	3.63
		20-40	7.63	1.42	4.49	1.27	8.55	0.12	3.03	2.51	8.90	5.04
	100	0-20	7.66	2.72	7.19	2.52	16.77	0.19	8.89	2.41	15.37	7.61
		20-40	8.09	2.54	8.07	2.05	15.44	0.20	8.33	2.36	14.87	6.86
	200	0-20	7.73	2.42	6.35	2.32	15.01	0.32	8.09	2.21	13.61	7.24
		20-40	7.82	2.51	6.81	2.18	15.63	0.38	8.48	2.31	14.21	7.37
3	10	0-20	7.28	2.54	7.54	2.28	15.62	0.23	9.37	2.70	13.24	7.05
		20-40	7.74	2.36	5.00	2.12	16.35	0.35	8.77	2.58	12.47	8.66
	20	0-20	7.15	1.48	4.35	1.64	8.64	0.12	3.37	2.45	8.93	5.00
		20-40	7.58	1.69	5.67	1.78	9.42	0.13	4.99	2.68	9.33	4.88
	50	0-20	7.38	1.40	5.45	1.89	6.87	0.11	2.05	2.25	10.02	3.60
		20-40	7.59	1.39	4.51	1.25	8.45	0.13	1.71	2.11	10.52	4.98
	100	0-20	7.67	2.69	8.20	2.51	16.15	0.19	10.21	2.36	14.48	6.97
		20-40	8.10	2.49	6.10	2.06	16.73	0.18	9.54	2.48	13.05	8.28
	200	0-20	7.78	2.49	5.97	2.10	16.72	0.21	8.57	2.51	13.92	8.32
		20-40	8.11	2.56	6.03	2.25	16.98	0.24	8.83	2.36	14.31	8.34

Table 3. Cations exchange capacity and exchangeable cations, of the investigated soils.

Location	Distance from the main road (m)	Depth (cm)	CEC ($cmol_{c/Kg}$ soil)	Exchangeable Cation ($cmol_{c/Kg}$ soil)				ESP
				Ca	Mg	Na	K	
1	10	0-20	40.51	22.59	12.95	4.74	0.40	11.70
		20-40	36.67	19.54	11.78	4.82	0.23	13.15
	20	0-20	39.12	22.11	13.60	2.93	0.36	7.51
		20-40	36.11	18.98	13.07	3.68	0.25	10.21
	50	0-20	36.51	19.86	13.30	2.94	0.22	8.07
		20-40	39.05	20.96	13.02	4.61	0.33	11.81
	100	0-20	34.51	20.53	10.03	3.46	0.19	10.05
		20-40	37.62	21.23	10.98	4.98	0.28	13.26
	200	0-20	37.25	21.53	10.22	5.02	0.22	13.50
		20-40	39.41	23.22	10.25	5.32	0.31	13.49
2	10	0-20	36.11	19.66	13.55	2.57	0.20	7.13
		20-40	33.23	18.96	10.11	3.74	0.22	11.25
	20	0-20	41.52	23.02	12.91	5.02	0.39	12.08
		20-40	37.31	20.22	11.39	5.28	0.29	14.16
	50	0-20	35.67	18.96	14.17	2.11	0.22	5.91
		20-40	37.86	20.21	13.86	3.43	0.27	9.06
	100	0-20	39.42	22.61	13.18	3.20	0.32	8.12
		20-40	43.62	23.25	14.95	4.50	0.42	10.30
	200	0-20	36.86	20.31	11.89	4.10	0.28	11.12
		20-40	37.96	20.25	11.95	5.30	0.35	13.96
3	10	0-20	37.41	22.65	12.51	1.90	0.29	5.07
		20-40	33.24	20.24	10.19	2.41	0.21	7.25
	20	0-20	39.54	22.80	12.40	3.82	0.33	9.66
		20-40	33.79	19.66	10.01	3.77	0.18	11.15
	50	0-20	41.00	22.97	13.46	3.40	0.37	8.23
		20-40	37.21	20.80	11.91	4.12	0.32	11.06
	100	0-20	36.12	19.24	14.30	2.25	0.21	6.23
		20-40	38.33	20.91	13.57	3.47	0.30	9.05
	200	0-20	39.21	21.98	13.21	3.50	0.31	8.92
		20-40	37.51	20.15	11.95	4.91	0.29	13.08

Table 4. Total (T.) and extractable (Av.) Pb and Cd (mg/kg) in the first sample area as influenced by distance from the new El-Fayoum – Cairo highway (without side road trees).

Location 1	Distance from the main road (m)	Depth (cm)	Pb		Cd	
			T.	Av.	T.	Av
Track 1	10	0 - 20	23.21	4.12	2.52	0.10
		20 - 40	9.86	2.82	1.46	0.06
	20	0 – 20	17.92	3.52	2.21	0.07
		20 - 40	8.52	1.61	1.30	0.04
	50	0 - 20	17.89	2.93	1.96	0.01
		20 - 40	7.66	1.51	0.91	0.005
	100	0 - 20	14.46	2.03	1.38	0.008
		20 - 40	6.31	0.92	0.72	0.003
	200	0 - 20	10.06	1.77	1.25	0.002
		20 - 40	5.40	0.32	0.35	0.001
Track 2	10	0 - 20	22.94	4.21	2.61	0.12
		20 - 40	13.96	2.61	1.31	0.05
	20	0 - 20	18.01	3.31	2.15	0.09
		20 - 40	10.85	1.55	1.23	0.05
	50	0 - 20	17.87	2.96	2.11	0.03
		20 - 40	8.21	1.34	1.01	0.006
	100	0 - 20	13.95	1.94	1.36	0.007
		20 - 40	7.12	0.81	0.69	0.004
	200	0 - 20	9.86	1.66	1.18	0.003
		20 - 40	4.65	0.43	0.25	0.001
Track 3	10	0 - 20	23.02	4.34	2.45	0.15
		20 - 40	14.72	2.31	1.28	0.06
	20	0 - 20	17.90	3.41	2.33	0.08
		20 - 40	9.11	1.42	1.15	0.04
	50	0 - 20	17.86	3.00	1.95	0.02
		20 - 40	8.55	1.39	0.87	0.005
	100	0 - 20	14.35	1.90	1.28	0.008
		20 - 40	6.96	0.79	0.58	0.003
	200	0 - 20	9.91	1.59	0.85	0.002
		20 - 40	5.21	0.29	0.31	0.001

Table 5. Total (T.) and extractable (Av.) Pb and Cd, (mg/kg) in the second sample area as influenced by distance from the old El- Fayoum – Cairo.road (with side road trees)

Location 2	Distance from the main road (m)	Depth (cm)	Pb		Cd	
			T.	Av.	T.	Av
Track 1	10	0 - 20	32.08	6.02	4.02	0.42
		20 - 40	19.81	3.56	2.00	0.23
	20	0 – 20	29.07	4.95	3.82	0.31
		20 - 40	14.64	2.68	1.91	0.16
	50	0 - 20	26.34	2.71	3.15	0.20
		20 - 40	13.97	1.95	1.23	0.09
	100	0 - 20	22.16	2.58	2.84	0.11
		20 - 40	9.96	1.31	1.08	0.06
	200	0 - 20	14.05	2.10	1.29	0.07
		20 - 40	7.87	0.87	0.97	0.02
Track 2	10	0 - 20	31.17	5.91	3.91	0.39
		20 - 40	19.25	2.76	2.05	0.21
	20	0 - 20	28.13	4.68	3.62	0.27
		20 - 40	15.06	2.12	1.85	0.17
	50	0 - 20	26.49	3.96	3.16	0.18
		20 - 40	14.12	1.65	1.62	0.10
	100	0 - 20	21.23	2.61	2.71	0.07
		20 - 40	10.23	1.29	1.28	0.04
	200	0 - 20	15.17	2.23	1.48	0.05
		20 - 40	8.65	0.96	1.09	0.02
Track 3	10	0 - 20	30.86	6.12	3.84	0.41
		20 - 40	19.67	2.61	1.94	0.19
	20	0 - 20	28.34	4.26	3.65	0.28
		20 - 40	16.11	2.26	1.87	0.15
	50	0 - 20	27.11	3.96	3.04	0.20
		20 - 40	13.95	2.12	1.54	0.09
	100	0 - 20	20.52	2.83	2.68	0.07
		20 - 40	9.48	1.65	1.20	0.05
	200	0 - 20	14.11	2.13	1.31	0.06
		20 - 40	7.15	0.61	0.87	0.02

Table 6. Total (T.) and extractable (Av.) Pb and Cd, (mg/kg) in the third sample area as influenced by distance from the old El- Fayoum – Cairo.road (Without side road trees).

Location 3	Distance from the main road (m)	Depth (cm)	Pb		Cd	
			T.	Av.	T.	Av
Track 1	10	0 - 20	38.65	8.05	6.45	0.81
		20 - 40	20.11	4.11	3.32	0.50
	20	0 – 20	35.94	6.48	5.18	0.57
		20 - 40	17.55	3.76	2.81	0.31
	50	0 - 20	29.68	4.87	4.67	0.51
		20 - 40	15.98	2.33	2.48	0.21
	100	0 - 20	29.06	3.68	4.35	0.37
		20 - 40	15.50	1.84	2.27	0.12
	200	0 - 20	20.14	2.98	3.70	0.27
		20 - 40	11.01	1.31	1.71	0.11
Track 2	10	0 - 20	37.54	8.00	5.94	0.85
		20 - 40	19.87	3.91	3.37	0.48
	20	0 - 20	34.93	6.65	5.54	0.55
		20 - 40	16.97	2.82	2.77	0.26
	50	0 - 20	29.76	5.08	4.87	0.50
		20 - 40	16.45	2.25	2.59	0.20
	100	0 - 20	28.68	3.96	4.24	0.34
		20 - 40	16.10	1.96	2.18	0.11
	200	0 - 20	19.89	3.07	3.58	0.25
		20 - 40	12.45	1.55	1.68	0.10
Track 3	10	0 - 20	38.42	7.92	6.33	0.75
		20 - 40	21.10	3.68	3.25	0.42
	20	0 - 20	35.48	6.36	5.20	0.51
		20 - 40	17.70	2.76	2.75	0.29
	50	0 - 20	30.51	4.96	4.95	0.47
		20 - 40	18.47	2.92	2.66	0.26
	100	0 - 20	29.15	3.82	4.12	0.32
		20 - 40	16.86	1.95	2.32	0.18
	200	0 - 20	22.30	3.13	3.73	0.26
		20 - 40	12.58	1.05	1.89	0.09

The available fraction of lead varied in the surface soil layers between 1.59 – 4.34, 2.10 – 6.12 and 2.98 – 8.05, ppm for the studied locations 1, 2 and 3, respectively. And it ranged 0.29 – 2.82, 0.61 – 3.56 and 1.05 - 4.11 ppm for the same locations, respectively in the subsurface depth .

Similar trend for , total soil Cadmium as it ranged 0.85 - 2.61 ,1.29 - 4.02 and 3.58 - 6.45, ppm for the chosen locations 1, 2 and 3, respectively, and from 0.25 - 1.46, 0.87 - 2.05 and 1.68 - 3.37 ppm for the same locations ,respectively in the surface and sub-surface soil depth ,respectively. Lahucky et al. (2001), studied Cd contamination in Slovakia soils and mentioned that the maximal allowed Cd concentration in soils is (0.8 mg.kg-1). Accordingly, the present data indicate that the determined contents of cadmium were higher in (92 % of the tested soil samples) than the maximal allowed concentration. This fact points to enhanced risk for ecosystems with a possibility of food chain contamination.

3.1. Effect of distance from roads

The obtained data indicated that there is a highly significant and negative correlations between the distance from the road and both total and extractable lead and cadmium either in the surface and subsurface soil samples.

The total lead ranged 22.94 – 38.65 ppm at 10meter distance, while it was 9.86 – 22.30 ppm at 200 meter from the studied roads.

The corresponding values for the extractable lead amounted to 4.12 – 8.05 ppm and 1.59 – 3.13 ppm for 10 and 200 m, respectively away from the studied roads. On the other hand, the total Cd averaged 2.45 – 6.45 ppm at 10m. distance, while it ranged from 0.85 - 3.73 ppm at 200m away from the studied roads.

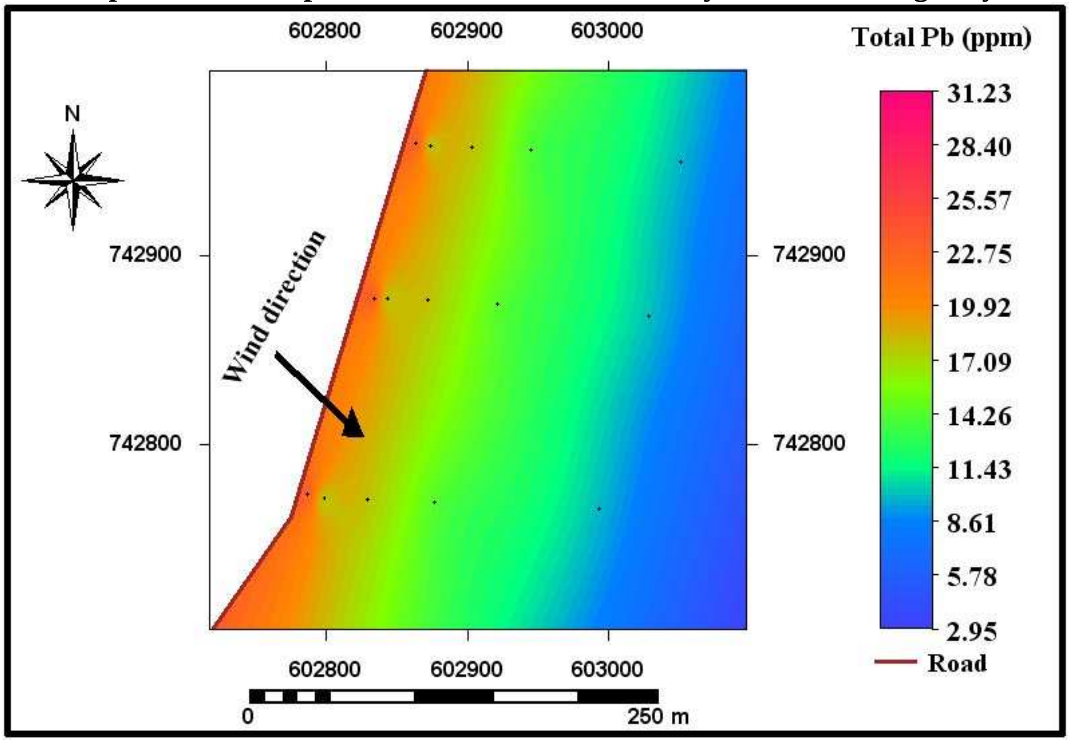
The corresponding values for soil extractable Cd being in the rang of 0.10 – 0.85 ppm and 0.002 – 0.27 ppm for 10 and 200m, respectively, from the studied roads.

To investigate the spatial distribution of pollutant, the location of the observed points were digitized into ILWIS GIS and interpolation were made , Maps (3, 4, 5, 6, 7 and 8) . The obtained maps clarify the high contents of Pb and Cd beside the road and tending to decrease with increasing the distance from east of the road with main distance of wind in the area.

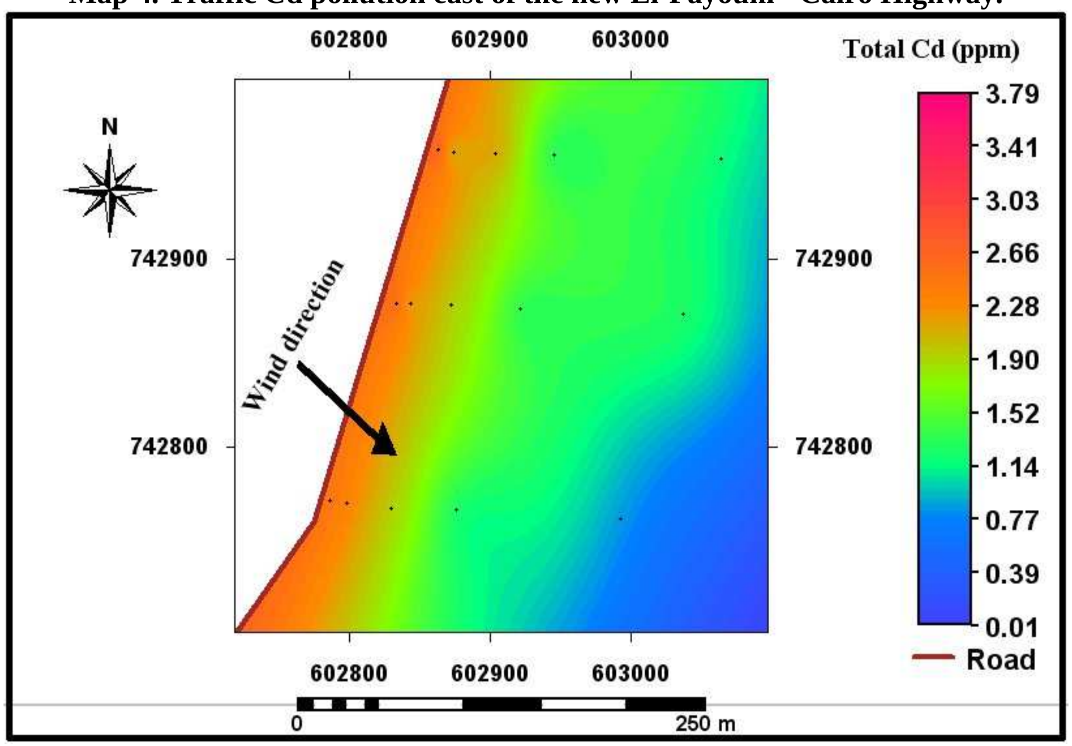
To assure the contribution of traffic pollution on increasing the Pb and Cd contents in the tested soils, the correlation was made three times i.e., in the north-south direction in west-east direction and northwest- southeast direction and the recorded correlation values were -0.871, -0.96 and -0.987 . The results indicate that the highest correlation value is obtained in the same direction of wind (northwest- southeast), which assures the role of automobile exhausts on soil pollution with Pb and Cd around the tested roads.

The obtained results were used to calculate a correlation model between the total Pb and Cd contents and distance east of the tested roads, and the following, equations, were obtained and represented by, Figures (1 and 2)

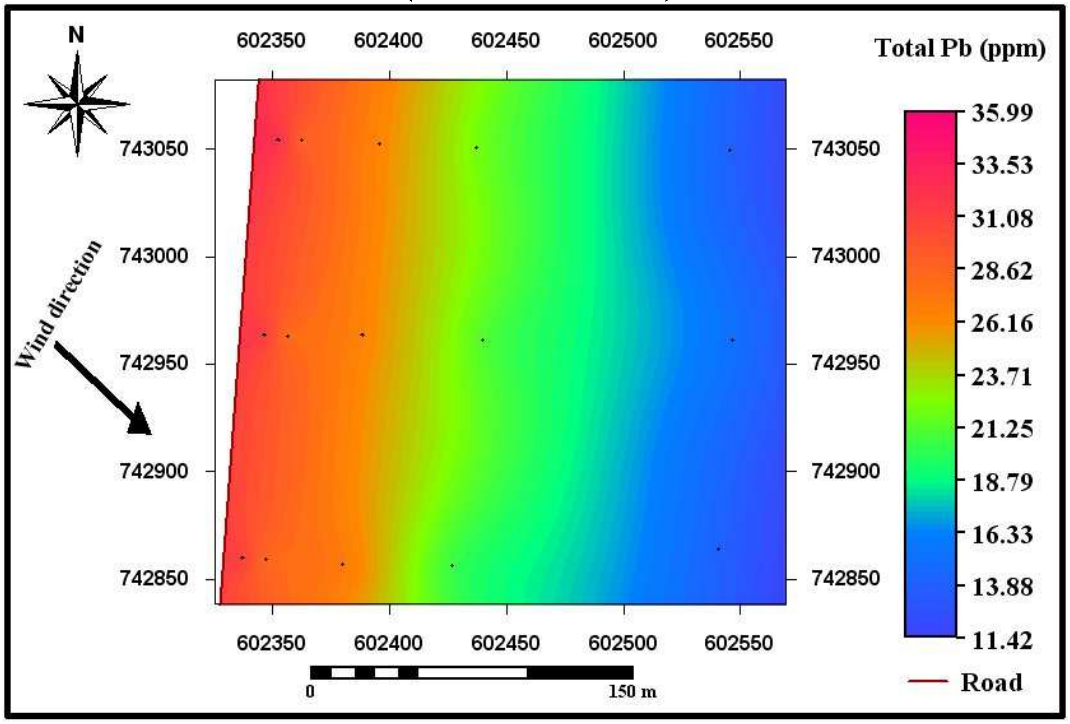
Map 3. Traffic Pb pollution east of the new El- Fayoum - Cairo Highway.



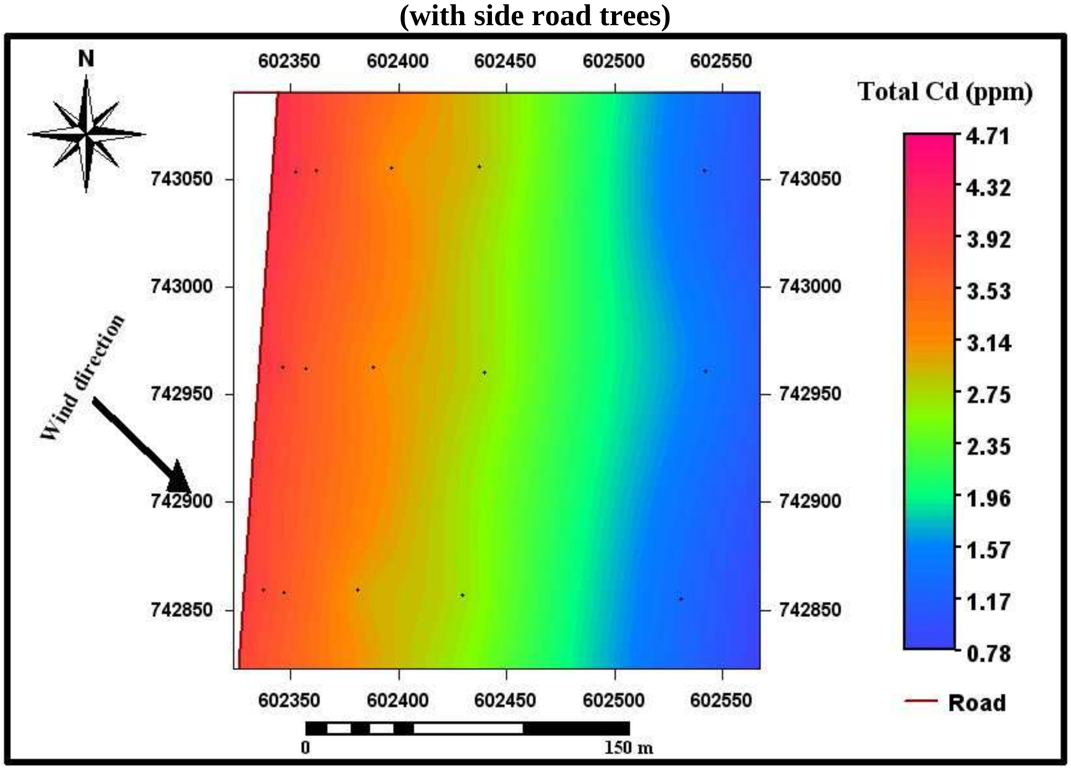
Map 4. Traffic Cd pollution east of the new El-Fayoum - Cairo Highway.



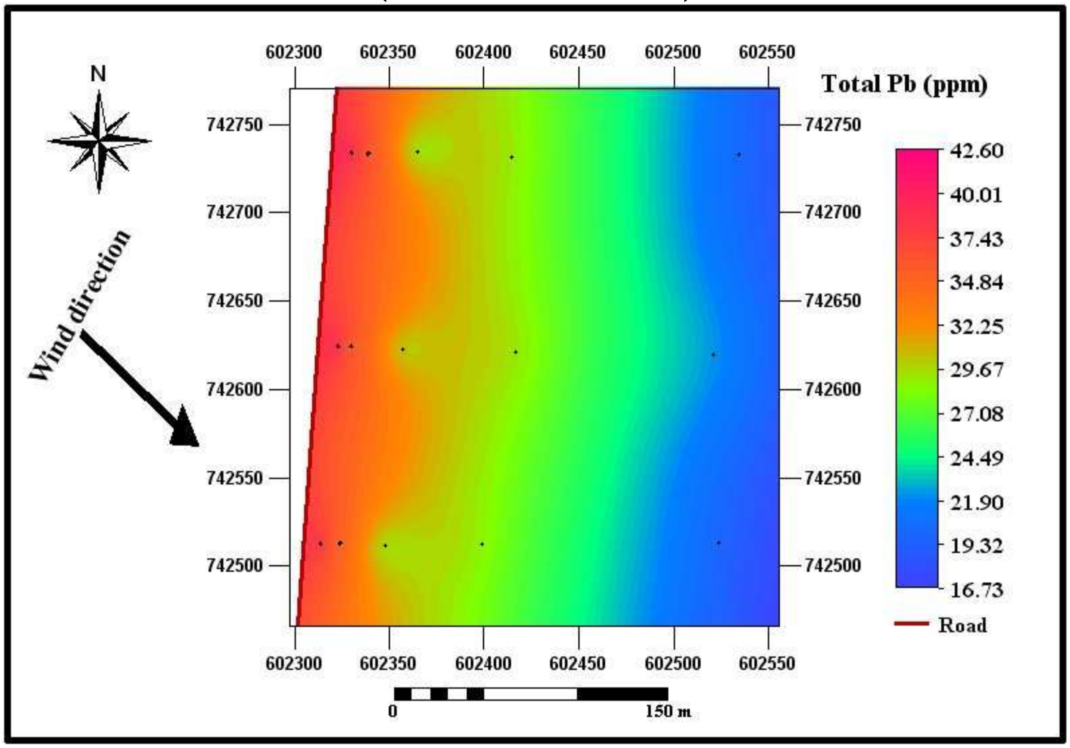
Map 5. Traffic Pb pollution east of El Fayoum – Cairo old highway. (with side road trees)



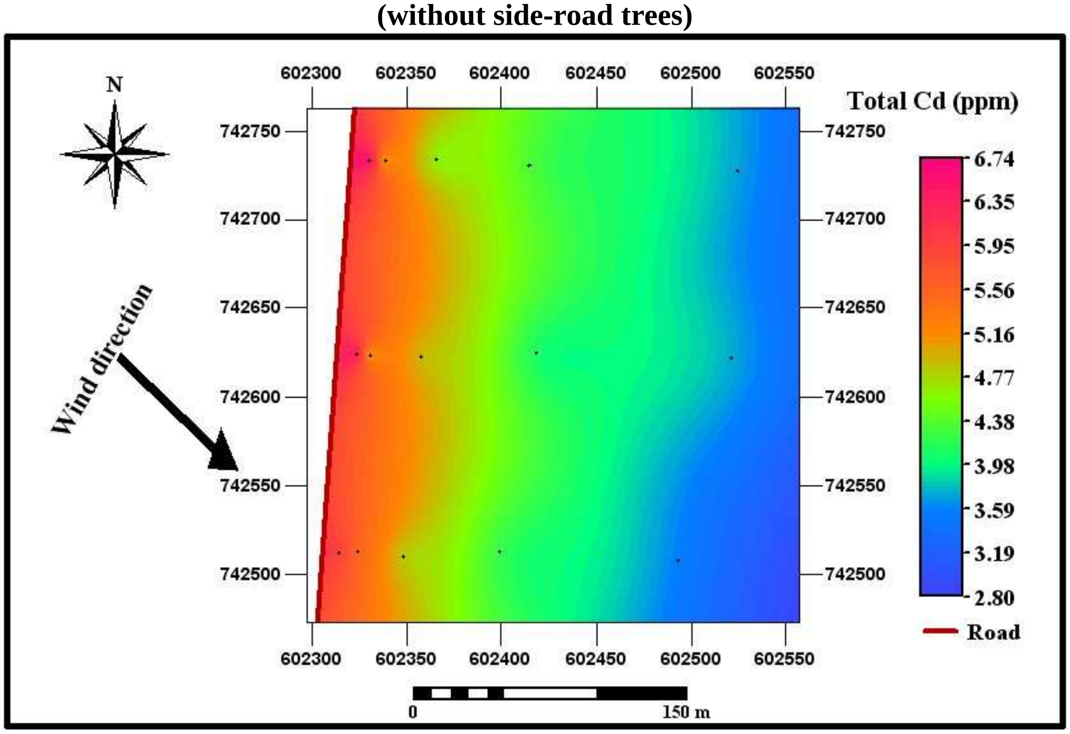
Map 6. Traffic Cd pollution east of El Fayoum – Cairo old highway. (with side road trees)



Map 7. Traffic Pb pollution east of El Fayoum - Cairo old highway. (without side-road trees)



Map 8. Traffic Cd pollution east of El Fayoum - Cairo old highway. (without side-road trees)



Location 1- new El-Fayoum – Cairo highway (without side roads trees).

1- Total Pb (ppm) = -0.0631X + 20.881 r = (-0.992)

2-Total Cd (ppm) = -0.007X + 2.3327 r = (-0.98)

Location 2- old road of El-Fayoum – Cairo (with wind break).

1-Total Pb (ppm) = -0.082X + 30.646 r = (-0.986)

2- Total Cd (ppm) = -0.013X + 3.9359 r = (-0.985)

Location 3- old road of El-Fayoum – Cairo (without side road trees).

1- Total Pb (ppm) = -0.076X + 36.537 r = (-0.987)

2- Total Cd (ppm) = -0.0121X + 5.8459 r = (-0.989)

Where: X= distance (m) east of the roads up to 300 m.

3.2. Affect of side roads trees on reducing traffic pollution.

By comparing data presented in Tables (5 & 6), it is clear that areas with side-road trees, (with the same road age approximately), possess lower contents of Pb and Cd in all tested samples in locations (2 and3). This observation spot the lights on the importance of side-roads trees on reducing soil and plants pollution.

3.3. Effect of traffic exposure time on soil pollution

Soils of the same mapping unit were sampled along the old and new highway of El-Fayoum – Cairo, (with more than 50 years difference), the obtained data are presented in Tables (4 and 6) and maps (3, 4, 7 and 8). It is clear that the contents of both Pb and Cd increased significantly around the old high way which confirm the hypothesis of accumulation of Pb and Cd with time beside roads of course such hypothesis is affected also by traffic intensity on the roads 1 and 3.

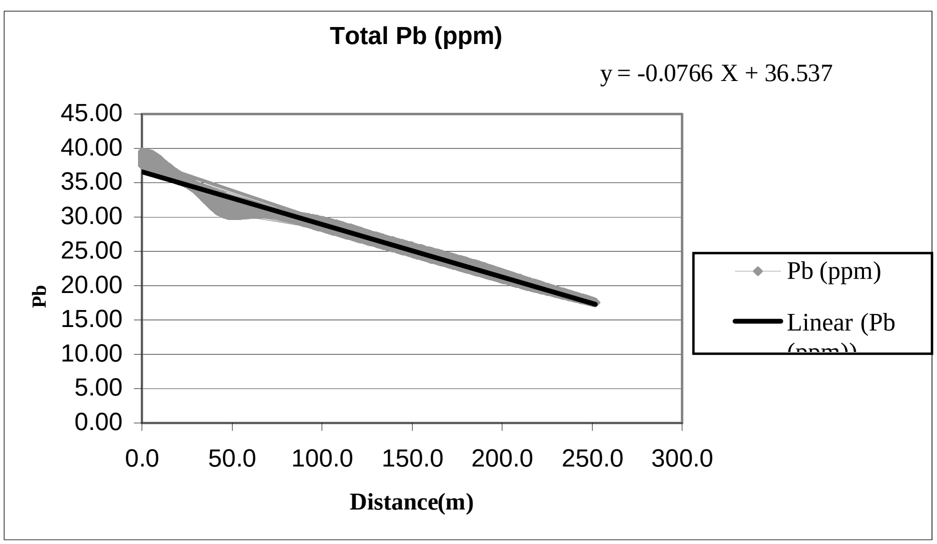


Figure 1. Relationship between total Pb content and distance from roads.

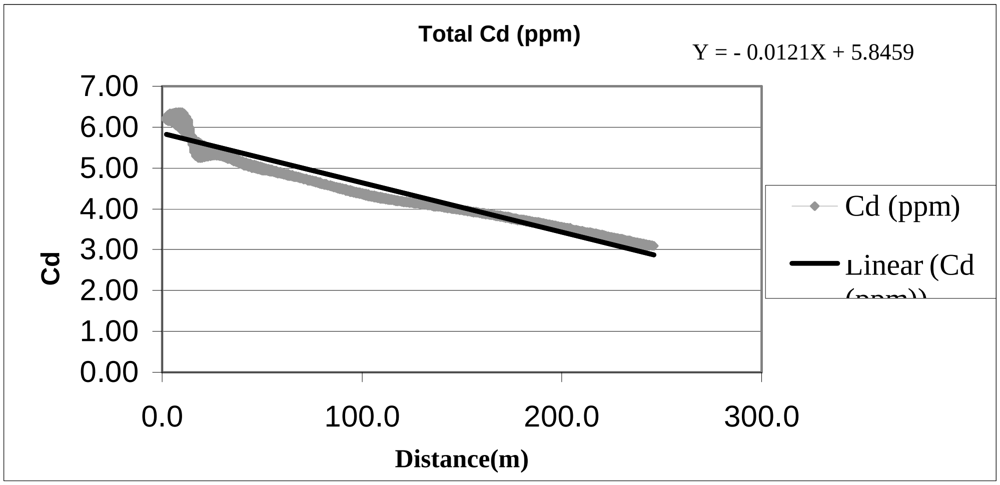


Figure 2. Relationship between total Cd content and distance from roads.

4. CONCLUSIONS

- The study reported soil pollution with Pb and Cd along Fayoum-Cairo highway and proved the contribution of vehicles on soil pollution beside roads .
- Side roads trees significantly decreased the soil pollution from vehicles.
- GIS was helpful to represent and model Pb and Cd contents.
- Future research is recommended on the fields of how to control and amend soil pollution along roads.

5. REFERENCES

Abdelfattah, M. A. 2002. A GIS evaluation of soil and water management for sustainable agriculture in El-Fayoum Governorate , Egypt. Ph. D. Thesis, Fac. of Agric. at El-Fayoum, Cairo Univ., Egypt.

Abd El_Motaleb, M.H. 2002. Contribution of Geographic Information Systems for studying some environmental problems in El Fayoum Governorate, Egypt. Ph.D. Thesis, Fac. of Agric. at Fayoum, Cairo University, Egypt.

Assadian-NW; Esparza-LC; Fenn-LB; Ali-AS; Miyamoto-S; Figueroa, 1998. Spatial variability of heavy metals in irrigated alfalfa fields in the upper Rio Grande River basin. Agricultural-Water-Management. 1998, 36: 2, 141-156

Aubert, H. and M. Pinta. 1977. Trace elements in soils. Elsevier north Holland, Inc., New York, p. 39-42.

Black, C. A. (1965). Methods of Soil Analysis. Part 1., American Society of Agronomy, Inc. Medison, Wisconsin, U.S.A.

Black, C. A. (1982). Methods of Soil Analysis. Part 2., American Society of Agronomy, Inc. Medison, Wisconsin, U.S.A.

Chow, T.J. 1969. Lead accumulation in roadside soil and grass. Nature, London., 225: 95 – 96.

El- Mola, S.H. 1980. Studies on soil and plant pollution with lead .M.Sc. Thesis, Fac. of Agric., Ain shams Univ., Egypt.

El- Sayad, E.A.E. 1992. Impact of automobile exhaust on roadside soils and plants at – Fayoum Governorate . Egypt . J. Appl. Sci., 7 : 413 – 423.

ITC. 2002. Integrated Land and Water Information System ILWIS Version 3.1, ITC, Enschede, The Netherlands.

Jackson, M. L. 1967. Soil Chemical Analysis. Prentic Hall, Ladia Private, LTD., New Delhi.

Lahucky, L., A. Vollmannova, J. Kulich, and J. Tomas, 2001 . Mobility of Cadmium in various soil Types/Subtypes. JCEA Volume 2 (2001) Number 3-4

Lindsay, W. L.; and Norvell, W. A. 1978. Development of a DTPA soil test for zinc, iron, manganese and copper . Soil Sci. Soc.Am. J., 42: 421 - 428

Merry, R. J.; Tiller, K. G. and Alston, A. M. 1993. Austr. J. Soil Sci. 21: 549 - 561 In "Heavy metals in soils"**.** (ed) Alloway, B. J. Blackie Academic & professional, New York .

Shendi, M. M. 1990. Some mineralogical aspects of soil sediments with special reference to both lithology and environmental conditions of formation in Fayoum area, Egypt. Ph. D. Thesis, Fac. of Agric. at El-Fayoum, Cairo University, Egypt.

Soil Survey Staff. 2003. Key to Soil Taxonomy. 9th edition. USDA, National Resources Conservation Services, USA.

Agriculture and Food in Middle East, 3rd Egyptian-Syrian Conf. 2006, El-Minia Univ., Egypt.
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تقييم تأثير السيارات على تلوث الأراضى بالإستعانة بأنظمة المعلومات الجغرافية، الفيوم ، مصر

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الملخص

هدف هذا البحث إلى إختبار تأثير عوادمِ السياراتِ على تلوثِ التربةِ الملاصقة للطرق بعنصرى الرصاص والكاديوم وذلك فى ثلاث مناطق بمركز سنورس بمحافظة الفيوم – مصر.

وبالإستعانة بصور الفضاء وأنظمة المعلومات الجغرافية تم أولا توقيع مسارات الطرق فوق خريطةِ التربة لمركز سنورس وذلك لتحديد وحدات التربة التى بها طرق بأعمار مختلفة وبحالات مختلفة من وجود أشجار مصدات الرياح على جانبى الطريق. وكان تقسيم التربة المختارة لهذه الدراسة هى Typic Haplotorrerts .

ثم تم دراسة 45 قطاع محدود Mini pits أخذت منها عينات تربة سطحية وتحت سطحية من ثلاث مناطق معاينة مختلفة فى عمر الطريق ومختلفة فى وجود مصدات الرياح بجانب الطريق. وفي كل منطقة معاينة تم أخذ العينات من 3 مسارات مختلفة تبعد كل منها 100 متر عن الأخرى حيث أخذت العينات من كل مسار علي أبعاد: 10 ، 20 ، 50 ، 100 ، 200 متر من الجانب الشرقي للطريق، حيث تم تقدير المحتوي الكلي والميسر لعنصري الرصاص والكادميوم وإنتاج الخرائط بالإستعانة ببرنامج ILWIS حيث أختبرت العلاقات الإحصائية ونماذج الإرتباط المكانية المدعمة بالمعادلات الرياضية والتى تمثل العلاقة بين المسافة من الطريق وتركيز كلا من الرصاص والكاديوم فى المنطقة.

الكلمات الدالة :
التأثيرات البيئية، عوادم المرور ، التلوث، أراضى الفيوم.