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# Distribution of Cadmium and Lead in Aswan Reservoir and River Nile Water at Aswan

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**Abstract:** The present study aimed to evaluate the concentrations of cadmium and lead in the water of Aswan Dam Reservoir and River Nile. Results showed a temporal variation in Cd and Pb concentrations, concurrently with the physicochemical conditions of water as Temperature, dissolved oxygen, pH and wastes discharged. The concentrations of lead in Nile water at Aswan was obviously higher than Aswan Reservoir, exceeding of permissible limits at the eastern side. Contrarily, the water quality of River Nile at Aswan was lower than the opposite values of the Aswan Reservoir. The concentration of Pb during spring is higher than the other periods, while Cd levels are higher in summer and autumn. Both Pb and Cd levels exceeded the permissible limits in most sites. Increasing the tourist ships discharging its wastes into the Nile at Aswan and wastewater input of Kema fertilizer factory through El- Sail Drain may be the main reason for elevation lead and cadmium concentrations at the studied sites. As well as, results showed that Pb and Cd levels exceeded of permissible limits in most sites during the period of study as compared with those reported before the transplantation program of grass carp fish fry since 1995.

**Key word:** Aswan Reservoir · River Nile · Cadmium and Lead · Wastewater contamination

## INTRODUCTION

Increasing the discharging of petrol derivative like benzene and solar from ships into river water and wastewater from fertilizer factory may be the main reason for elevation lead and cadmium concentrations [1, 2]. Lead and cadmium accumulated in autotrophic aquatic organisms through water and up take by macrophytes and fish and may pose a threat to human health. The increase of these heavy metal levels cause toxicity of aquatic biota [3]. Lead and cadmium are particular interest because of their toxicity and widespread presence in the environment.

The annual discharge water from Lake Nasser through High Dam to River Nile downstream is 55.5 $(10)^9$ tons. On the other side, River Nile receives wastewater about 37 main drains along the Nile of Egypt discharging municipal agriculture and industrial waste [4]. The total annual amount of wastewater contamination discharged into main stream of River Nile in Egypt has been estimated to be $2.6(10)^9$ tons every year, including about $390(10)^6$ tons industrial wastes [5]. In the meantime, the increasing number of tourist boats in Aswan Reservoir and River Nile represents a source of domestic wastes that have adverts impact on water quality. Recently, sever drop in the density of aquatic macrophytes was observed due to the transplantation program of grass carp fish fry implemented by the Ministry of Irrigations in the 1995 year. The grass carp consumed a huge amount of hydrophytes and consequently caused a severe drop in their density and bioaccumulation activities at this area. This has direct and indirect effects on the water quality at this region. In the meantime, the increasing number of fishing and tourist boats at this area, represents a major source of water contamination. The distribution of Pb and Cd in water of Aswan Reservoir and River Nile before transplantation program of grass carp fish fry since the middle of 1990s, were produced by several authors [6-9], Table 1.

Hassoun and Toufeek [10] analyzed heavy metals in El-Sail Drain canal which discharges wastes in River Nile body at Aswan City. They found that the average Cd levels at El-Sail Drain were 19, 31, 75, 15 $\mu g l^{-1}$ during winter, spring, summer and autumn, respectively.

The present study aimed to throw light on the distribution of lead and cadmium in River Nile at Aswan City and Aswan Reservoir water after the transplantation program of grass carp fish fry since the middle of 1990s, Also the effect of the environmental conditions and wastewater contamination on the distribution of these metals in Aswan Reservoir and River Nile water were investigated.

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Table 1: Average Pb and Cd values in Aswan Reservoir and River Nile µg/l before transplantation of grass carp fish 1995 year

| | | Winter | | Spring | | Summer | | Autumn | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Locations | Sampling, year | Pb | Cd | Pb | Cd | Pb | Cd | Pb | Cd | References |
| Reservoir | 1985 | 6.4 | 2.6 | 5.9 | 1.8 | 24 | 11.0 | 28.0 | 8.0 | Lasheen, 1987 [6] |
| River Nile | | 12.0 | 7.0 | 15.0 | 4.0 | 36 | 14.0 | 24.0 | 11.0 | |
| Reservoir | 1989 | 4.0 | 2.3 | 4.5 | 2.0 | 15 | 6.3 | 7.0 | 4.4 | Soltan, 1991 [7] |
| River Nile | | 11.0 | 3.1 | 6.6 | 3.6 | 21 | 8.4 | 8.0 | 7.8 | |
| Reservoir | 1991 | 14.0 | 3.7 | 11.0 | 4.0 | 32 | 6.9 | 17.2 | 3.3 | Toufeek, 1993 [8] |
| River Nile | | 19.0 | 5.3 | 17.0 | 11.3 | 79 | 7.3 | 25.8 | 9.6 | |
| Reservoir | 1993 | 19.0 | 6.2 | 11.0 | 4.5 | 16 | 9.8 | 15.0 | 7.5 | Hassoun, 1995 [9] |
| River Nile | | 32.0 | 7.8 | 18.0 | 8.0 | 77 | 11.0 | 22.0 | 8.3 | |

## MATERIALS AND METHODS

**Study Areas:** Two areas representing different habitats were selected for the present study illustrate in Figure 1.

The first lied between old Aswan Reservoir and the High Aswan Dam (H.D). It was formed after damming old Aswan Reservoir in 1934. It was built stretching from side of the valley with a total length of 9 km and 2.7 km width. The second area is the stream of the River Nile located at 25 Km north of Aswan Reservoir. Also, there is a fertilizer factory that discharges its effluents directly into the Nile through El-Sail Drain at Aswan City.

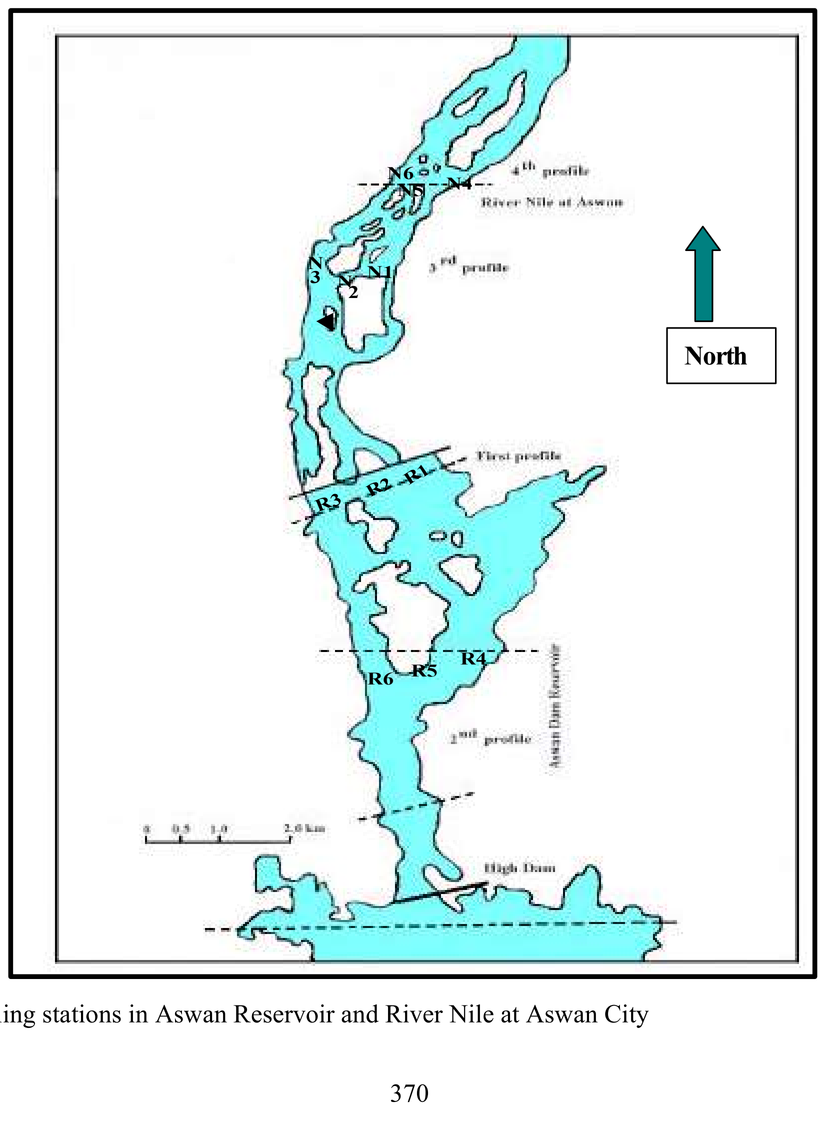


Fig. 1: Map of sampling stations in Aswan Reservoir and River Nile at Aswan City

Table 2: Some information in the sampling stations and frequencies of depths in different seasons

| Stations | Profile, No | Dist. north, H.D | Depths, m | Stations | Profile, No | Dist, north H.D | Depths, m |
|---|---|---|---|---|---|---|---|
| R1 | First | 9 Km | 4-6 | N1 | Third | 24 Km | 3-5 |
| R2 | First | 9 Km | 5-8 | N2 | Third | 24 Km | 6-8 |
| R3 | First | 9 Km | 14-18 | N3 | Third | 24 Km | 4-5 |
| R4 | Second | 3 Km | 4-5 | N4 | Fourth | 25 Km | 4-7 |
| R5 | Second | 3 Km | 6-9 | N5 | Fourth | 25 Km | 7-9 |
| R6 | Second | 3Km | 4-6 | N6 | Fourth | 25 Km | 3-5 |

Sampling was carried out on quarterly basis from winter to autumn, 2008 and covered four profiles, including 12 sampling stations recorded in Table 2. Water samples were collected from subsurface and near bottom by Van Dorn bottle and preserved in polyethylene bottle.

**Methods of Analyses:** The methods outlined in the American Public Health Association (APHA) [11] were used for determination of the studied parameters except where noted. Water temperature measured by ordinary thermometer, pH values were measured during the time of sampling using pH meter model (Jenway 3150) after calibration. Carbonate and bicarbonate were determined directly by titration with standard 0.02N $H_2SO_4$ using phenolphthalein and methyl orange as indicators. Dissolved oxygen was carried out by using the modified Winkler method. COD was determined by dichromate reflex method. Chloride was measured using Mohr's method and sulphate was estimated by terbidmeteric method. Calcium and magnesium were determined by direct titration using EDTA solution. Ammonia was determined by phenate method. Nitrite was determined using colorimetric method. Nitrate was determined by reduction method. Orthophosphate and total phosphorus were determined by using stannous chloride and acid molybdate method. Silicate was determined by molybdosilicate method. Concentrations of Pb and Cd determined using SHIMADZU Atomic Absorption Spectrophotometer Model AA-6800 with graphite furnace.

**Statistical Analysis:** The relationships between the different studied parameters were assigned by computing the correlation coefficients (r) to indicate the nature and the sources of the polluting substances.

## RESULTS

The variation in physic-chemical characteristics of Aswan Reservoir and River Nile water has been summarized in the Tables 4 and 5. While the average physicochemical parameters in same area before the transplantation of grass carp fish were recorded in Table 3.

Table 3: Average levels of physicochemical parameters in same area during 1991, before the transplantation grass carp fish [8]

| | | Aswan Dam Reservoir. | | | | River Nile at Aswan City. | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameters | | Winter | Spring | Summer | Autumn | Winter | Spring | Summer | Autumn |
| Temp. | °C | 17.10 | 19.70 | 26.80 | 23.20 | 16.80 | 17.90 | 26.70 | 22.80 |
| D.O | $mgl^{-1}$ | 7.33 | 5.24 | 3.52 | 5.40 | 6.30 | 4.70 | 3.40 | 7.30 |
| pH | | 7.67 | 8.08 | 7.81 | 7.73 | 7.80 | 8.12 | 7.52 | 7.75 |
| $CO_3$ | $mgl^{-1}$ | 8.70 | 5.30 | 3.30 | 4.70 | 1.33 | 14.66 | 10.00 | 4.00 |
| $HCO_3$ | $mgl^{-1}$ | 126.00 | 130.00 | 111.00 | 113.00 | 130.00 | 128.00 | 112.00 | 116.00 |
| Cl | $mgl^{-1}$ | 6.70 | 7.61 | 4.60 | 5.72 | 7.07 | 7.70 | 6.77 | 5.33 |
| $SO_4$ | $mgl^{-1}$ | 8.62 | 9.36 | 8.64 | 6.37 | 9.87 | 14.31 | 8.61 | 7.27 |
| $NH_3$ | $\mu gl^{-1}$ | 230.00 | 190.00 | 370.00 | 355.00 | 410.00 | 345.00 | 560.00 | 620.00 |
| $NO_2$ | $\mu gl^{-1}$ | 35.00 | 56.00 | 137.00 | 123.00 | 410.00 | 680.00 | 580.00 | 600.00 |
| $NO_3$ | $\mu gl^{-1}$ | 277.00 | 213.00 | 144.00 | 183.00 | 3100.00 | 4500.00 | 3700.00 | 2800.00 |
| $SiO_3$ | $mgl^{-1}$ | 3.77 | 5.29 | 3.20 | 4.51 | 5.70 | 5.67 | 3.36 | 4.60 |
| $PO_4$ | $\mu gl^{-1}$ | 58.00 | 96.00 | 165.00 | 99.00 | 2500.00 | 1857.00 | 2367.00 | 2667.00 |
| C Ca | $mgl^{-1}$ | 29.02 | 28.44 | 24.00 | 22.70 | 25.60 | 22.40 | 20.80 | 24.00 |
| Mg | $mgl^{-1}$ | 10.00 | 10.96 | 8.60 | 7.76 | 6.64 | 5.70 | 4.80 | 6.48 |
| TOM | $mgl^{-1}$ | 7.24 | 6.44 | 4.42 | 5.22 | 8.86 | 9.56 | 6.42 | 7.88 |
| TDS | $mgl^{-1}$ | 157.00 | 156.00 | 169.00 | 161.00 | 161.00 | 164.00 | 174.00 | 160.00 |
| Tranp | m. | 4.20 | 3.10 | 3.40 | 1.90 | 2.55 | 2.10 | 2.30 | 2.80 |
| TSS | $mgl^{-1}$ | 6.70 | 7.61 | 4.60 | 5.72 | 7.10 | 6.04 | 1.50 | 9.15 |

Table 4: Frequencies of physicochemical parameters in Aswan Reservoir water 2009

| Variable | | Winter | Aver. | Spring | Aver. | Summer | Aver. | Autumn | Aver. |
|---|---|---|---|---|---|---|---|---|---|
| Temp. | °C | 17.0-18.1 | 17.600 | 20.2-21.8 | 20.500 | 21.8-27 | 24.100 | 21.-23.2 | 22.200 |
| D.O | $mgl^{-1}$ | 7.3-10.70 | 8.850 | 6.2-8.3 | 7.150 | 2.2-3.7 | 2.850 | 3.0-6.6 | 5.120 |
| pH | | 8.45-8.7 | 8.550 | 8.37-8.62 | 8.470 | 7.4-8.2 | 7.840 | 7.58-8.3 | 7.750 |
| $CO_3$ | $mgl^{-1}$ | 14-36 | 21.400 | 10-16 | 11.600 | 2.0-10.0 | 5.100 | 0.0-4.0 | 2.250 |
| $HCO_3$ | $mgl^{-1}$ | 140-152 | 149.600 | 118-132 | 127.800 | 120-136 | 133.100 | 136-156 | 148.300 |
| Cl | $mgl^{-1}$ | 8.0-10 | 9.200 | 8.5-10.0 | 8.900 | 9.5-11.0 | 10.700 | 6.0-8.0 | 7.200 |
| $SO_4$ | $mgl^{-1}$ | 13.8-21.3 | 16.400 | 10.5-15.6 | 12.500 | 4.8-5.52 | 5.020 | 9.2-12.1 | 10.300 |
| $NH_3$ | $\mu gl^{-1}$ | 70-250 | 145.000 | 50-170 | 112.000 | 110-470 | 295.000 | 80-260 | 158.000 |
| $NO_2$ | $\mu gl^{-1}$ | 44-140 | 81.000 | 90-180 | 118.000 | 40-360 | 176.000 | 135-178 | 154.000 |
| $NO_3$ | $mgl^{-1}$ | 0.50-1.35 | 0.755 | 0.12-0. 53 | 0.324 | 0.88-2.6 | 1.425 | 0.5-1.55 | 0.805 |
| $SiO_3$ | $mgl^{-1}$ | 2.05-2.41 | 2.240 | 3.75-5.63 | 4.750 | 5.0-6.20 | 5.720 | 3.18-5.40 | 4.240 |
| $PO_4$ | $\mu gl^{-1}$ | 30-200 | 147.000 | 25-125 | 92.000 | 250-620 | 462.000 | 125-225 | 178.000 |
| Ca | $mgl^{-1}$ | 26.4-28.8 | 27.400 | 25.6-30 | 28.500 | 22.-25.2 | 23.400 | 21.6-24 | 22.600 |
| Mg | $mgl^{-1}$ | 6.4-7.42 | 7.050 | 5.28-8.2 | 7.240 | 9.6-11.2 | 10.150 | 4.8-7.2 | 6.200 |
| TOM | $mgl^{-1}$ | 4.48-8.82 | 6.220 | 6.88-12.6 | 9.520 | 3.4-5.28 | 4.200 | 4.64-7.4 | 5.240 |
| TDS | $mgl^{-1}$ | 142-162 | 156.000 | 138-159 | 149.000 | 154-172 | 161.000 | 143-162 | 154.000 |
| Transp. | m. | 6.25 7.50 | 7.050 | 4.75- 5.50 | 5.120 | 3.5-4.25 | 4.050 | 3.25- 4.5 | 3.850 |
| MSL | m. | 105. 8-106 | 105.900 | 106-106.9 | 106.640 | 109.3-111 | 110.400 | 108.2-109 | 108.700 |

Table 5: Frequencies of physicochemical parameters in River Nile water during 2009

| Variable | | Winter | Aver. | Spring | Aver. | Summer | Aver. | Autumn | Aver. |
|---|---|---|---|---|---|---|---|---|---|
| Temp. | °C | 17.0-18.1 | 17.50 | 20.2-21.3 | 20.60 | 24.4-28.2 | 25.70 | 22.3-24.5 | 23.40 |
| D.O | $mgl^{-1}$ | 7.7-8.1 | 7.92 | 5.3-5.9 | 5.60 | 1.3-3.2 | 1.80 | 4.0-5.4 | 4.45 |
| pH | | 8.05-8.4 | 8.12 | 8.3-8.52 | 8.41 | 7.5-8.25 | 7.94 | 7.65-7.95 | 7.72 |
| $CO_3$ | $mgl^{-1}$ | 12-20 | 15.80 | 4.0-24.0 | 12.00 | 2.0-10.0 | 4.20 | 0.0-2.0 | 0.80 |
| $HCO_3$ | $mgl^{-1}$ | 124-132 | 127.40 | 126-136 | 131.60 | 112-122 | 117.80 | 114-116 | 114.80 |
| Cl | $mgl^{-1}$ | 8.08-9.35 | 9.15 | 9.55-11.9 | 10.45 | 13.6-18.2 | 16.52 | 9.3-11.2 | 10.05 |
| $SO_4$ | $mgl^{-1}$ | 9.9-14.46 | 12.25 | 12.8-22.8 | 18.54 | 3.8-6.12 | 4.56 | 7.2-11.2 | 8.74 |
| $NH_3$ | $\mu gl^{-1}$ | 480- 710 | 625.00 | 370-480 | 426.00 | 480-730 | 615.00 | 675-980 | 806.00 |
| $NO_2$ | $\mu gl^{-1}$ | 2170- 650 | 486.00 | 507-1060 | 852.00 | 292-659 | 454.00 | 630-1205 | 938.00 |
| $NO_3$ | $mgl^{-1}$ | 2.16-3.30 | 3.15 | 1.20-6.20 | 5.25 | 3.57-8.63 | 6.16 | 1.80-15.10 | 10.20 |
| $SiO_3$ | $mgl^{-1}$ | 2.5-3.0 | 2.65 | 4.80-5.31 | 5.23 | 6.85-10.3 | 8.02 | 5.22-5.93 | 5.56 |
| $PO_4$ | $\mu gl^{-1}$ | 345- 455 | 410.00 | 568-942 | 845.00 | 78-110 | 91.00 | 40-125 | 86.00 |
| Ca | $mgl^{-1}$ | 26.2- 2 8.8 | 27.02 | 25.8-30.8 | 28.74 | 19.2-22.4 | 21.20 | 21.0-23.8 | 21.60 |
| Mg | $mgl^{-1}$ | 7.2-8.2 | 7.71 | 5.68-9.60 | 7.82 | 8.6-14.4 | 11.25 | 7.2-10.56 | 8.87 |
| TOM | $mgl^{-1}$ | 8.8- 12.4 | 10.42 | 7.4-18.42 | 14.58 | 7.4-11.24 | 8.56 | 96.3-19.3 | 13.20 |
| TDS | $mgl^{-1}$ | 140-144 | 142.60 | 159-162 | 161.50 | 174-181 | 176.40 | 158-161 | 159.00 |
| Transp. | m. | 4.75- 6.50 | 5.75 | 4.0- 5.5 | 4.53 | 3.5- 4.5 | 3.85 | 3.5-4.25 | 4.05 |
| MSL | m. | 80.24-81.4 | 80.52 | 80.9-81.85 | 80.82 | 81.2- 83.3 | 82.75 | 81.06- 82.0 | 81.90 |

Table 6: Seasonal variations of lead (Pb) in Aswan Reservoir (R) and River Nile (N) µg/l during 2009

| | Winter | | Spring | | Summer | | Autumn | |
|---|---|---|---|---|---|---|---|---|
| Stations | Surface | Bottom | Surface | Bottom | Surface | Bottom | Surface | Bottom |
| R1 | 82.8 | 92.2 | 278.8 | 298.50 | 211.0 | 196.7 | 239.7 | 236.8 |
| R2 | 124.8 | 81.5 | 273.3 | 281.60 | 197.2 | 129.8 | 233.8 | 286.6 |
| R3 | 93.2 | 84.8 | 287.2 | 286.10 | 207.5 | 115.6 | 227.0 | 227.0 |
| R4 | 95.4 | 48.8 | 254.8 | 281.50 | 110.2 | 104.6 | 221.2 | 234.8 |
| R5 | 29.9 | 111.4 | 278.1 | 282.70 | 117.6 | 108.7 | 231.4 | 246.5 |
| R6 | 87.0 | 50.0 | 280.4 | 273.40 | 114.0 | 42.5 | 227.0 | 214.0 |
| Average | 85.5 | 78.1 | 275.4 | 284.00 | 159.6 | 116.3 | 230.0 | 241.0 |
| N1 | 277.0 | 24.6 | 255.5 | 255.00 | 124.3 | 115.2 | 217.8 | 226.2 |
| N2 | 104.0 | 291.3 | 261.2 | 277.00 | 81.7 | 211.4 | 217.2 | 278.1 |
| N3 | 50.0 | 30.8 | 260.0 | 274.70 | 208.0 | 115.0 | 210.0 | 215.0 |
| N4 | 291.7 | 277.0 | 262.3 | 265.69 | 121.6 | 204.4 | 277.0 | 239.7 |
| N5 | 293.9 | 283.7 | 256.6 | 266.80 | 168.6 | 212.4 | 431.4 | 226.0 |
| N6 | 92.7 | 100.8 | 265.7 | 254.40 | 207.5 | 117.6 | 208.0 | 264.0 |
| Average | 184.9 | 168.0 | 260.2 | 265.60 | 152.0 | 162.7 | 260.2 | 241.5 |

Table 7: Seasonal variations of Cadmium in Aswan Reservoir (R) and River Nile (N) µg/l during 2009

| | Winter | | Spring | | Summer | | Autumn | |
|---|---|---|---|---|---|---|---|---|
| Stations | Surface | Bottom | Surface | Bottom | Surface | Bottom | Surface | Bottom |
| R1 | 18.8 | 9.4 | 9.84 | 10.6 | 16.7 | 15.6 | 20.4 | 19.9 |
| R2 | 10.7 | 10.2 | 9.90 | 10.1 | 16.1 | 14.2 | 19.6 | 10.6 |
| R3 | 9.0 | 18.8 | 10.30 | 10.1 | 16.2 | 15.2 | 14.8 | 10.6 |
| R4 | 8.7 | 10.3 | 10.10 | 10.3 | 14.6 | 16.2 | 18.9 | 20.2 |
| R5 | 12.4 | 19.5 | 10.30 | 10.4 | 14.2 | 12.6 | 10.6 | 20.3 |
| R6 | 9.0 | 10.2 | 10.20 | 9.4 | 14.1 | 11.5 | 18.1 | 14.2 |
| Average | 11.4 | 13.1 | 10.10 | 10.2 | 15.3 | 14.2 | 17.1 | 16.0 |
| N1 | 10.7 | 18.7 | 9.00 | 8.9 | 16.1 | 15.3 | 10.6 | 10.0 |
| N2 | 10.2 | 10.5 | 8.90 | 9.0 | 16.7 | 16.5 | 11.5 | 11.0 |
| N3 | 10.2 | 10.5 | 9.20 | 9.5 | 16.1 | 16.0 | 11.0 | 10.0 |
| N4 | 12.8 | 14.4 | 14.40 | 8.8 | 22.1 | 20.1 | 12.8 | 15.9 |
| N5 | 10.6 | 9.3 | 8.80 | 8.9 | 20.6 | 16.7 | 11.0 | 9.1 |
| N6 | 10.2 | 10.5 | 9.20 | 9.5 | 16.0 | 16.3 | 11.0 | 10.0 |
| Average | 10.8 | 12.3 | 9.90 | 9.1 | 17.9 | 16.8 | 11.3 | 11.0 |

The transparency was varied between 3.25 and 7.50 m in the present study, while the average values ranged between 1.9 to 4.20 m during 1991 (Table 3). It can observation that pH, sulfate and nutrient (ammonia, nitrite, nitrate and soluble phosphate) are higher than that those reported in the previous studied before the transplantation of grass carp fish in 1995.

The River Nile water at Aswan has inferior quality as compare with reservoir water, whereas many physical and chemical parameters were higher than corresponding values such as nitrate, nitrite, ammonia, phosphate and organic matter content (Tables 4, 5).

The seasonal distribution of lead and cadmium of the Aswan Reservoir and River Nile water during 2009 is shown in Tables 6, 7. The concentration of Pb in the reservoir water varied from a minimum of 29.9 $\mu gl^{-1}$ recorded at R5 site and a maximum of 298.5 $\mu gl^{-1}$ at R1 site in the eastern site of reservoir. It was found that the concentrations of lead is the highest during spring and autumn as compared with those values recorded during winter and summer seasons at different areas under investigation.

Table 7, shows that the concentrations of cadmium at Aswan Reservoir area were 8.7 and 19.52, 9.84 and 10.66, 12.61 and 16.7, 10.5 and 20.42 $\mu gl^{-1}$ during winter, spring, summer and autumn, respectively. The highest levels were recorded during autumn with a maximum value of 20.42 $\mu gl^{-1}$ and a minimum level 8.7 $\mu gl^{-1}$ detected at R4 during winter. Where the average concentrations of Cd recorded in the 1st profile (R1, R2, R3) were higher than those reported in the 2nd profile (R4, R5, R6) sites in different seasons.

In the River Nile, the absolute highest value of Cd was 22.14 $\mu gl^{-1}$ recorded in the surface water layer during summer as compare it's the absolute lowest value 8.8 $\mu gl^{-1}$ was measured in the bottom layer during spring. In general, the average concentrations in eastern sites in River Nile at Aswan area (N1 and N4) were higher than the value found in western sites (N3 and N6) during the period of study. While the highest Cd levels were detected during summer and autumn comparing with the lowest values occurred during spring and winter. The correlation coefficient matrix estimated between different physicochemical parameters showed that Pb is positively correlated with Ca (r=0.841, 0.714), DO (r=0.648, 0.655), $NH_3$(r=0.725, 0.668), COD (r=0. 647, 0.619) and sulfate (r= 0.734, 0.698). Also, Pb has a strong positive correlation with $NO_2$ (r= 0.825, 0.719), $NO_3$ (r= 0.628, 0.719) in Aswan Reservoir and River Nile, respectively. On the contrary, Pb has negative significant relationships with temperature (r= -0.669, -0.782), pH (r=-0.79, -0. 741) as well as, with silicate (r=-0.707, -0.813) and $PO_4$ (r=-0.747, -0.771) in the same areas, respectively.

Cd was positively correlated with temperature (r= 0.633, 0.883), Sulfate (r= 0.655, 0.647) and chloride (r= 0.668, 0.673), $NO_3$ (r= 0.706, 0.803) and negatively significantly correlated with DO (r= -0.628, -0.705), pH (r=-0.609, -0. 642), silicate (r=-0.612, -0.609 ) and $PO_4$ (r=-0.759, -0.773) in Aswan Reservoir and River Nile, respectively.

## DISCUSSION

The toxicity of lead and cadmium depends on their relative distribution between water and sediment [12]. Cadmium toxicity affects fish and aquatic organism and cause kidney damage. While, lead is potentially hazardous for most form of life. In addition, it causes kidney problems; high blood pressure and death of most organisms following exposure to high level. It also has a bad effect on infant and children. Exposed children could show slight deficits in attention span and learning abilities [13]. The World Health Organization limits of drinking water are 5&50 μg $l^{-1}$ for Cd &Pb, respectively [14].

The great seasonal changes in cadmium and lead result in changes of physical and chemical conditions after the transplantation of grass carp fish (Tables 6, 7). The concentrations of Cd and Pb in the current studies were higher than previous data reported by several authors illustrate in Table 1 [6-9]. This is mainly due to consume a huge amount of hydrophytes by grass carp fish at the Aswan Reservoir since 1995. This has direct and indirect effects on the water quality at this area.

The levels of different physicochemical parameters in Aswan Reservoir are lie bellow the permissible limits. While the concentrations of Pb and Cd of the studied areas exceeded the reported permissible limits [14, 15].

The increase of concentrations of nitrate, nitrite and ammonia in the Nile water at Aswan City, may be probably due to sewage and industrial effluents from Kema fertilizer factory input in Nile body at Aswan City through El-Sail Drain, whereas more than 756 ton/ hr of different type of wastewater contamination containing about 30 $mgl^{-1}$ $NO_3$ and 10 $mgl^{-1}$ $NO_2$ $mgl^{-1}$ [16].

High Pb level can be occurred from increasing the number of fishing boats activities and from combustion of plastic pollutes and fossil fuels as benzene and solar [17]. Also, the increasing number of tourist boats discharges their wastes to the water without any treatment.

The highest Pb values recorded during spring and winter in Aswan Reservoir and River Nile is mainly due to decrease the sorption of lead ions on the surface of suspended particles resulted to the drop of water levels during these periods. Also, it resulted in formation of a soluble complexes as $Pb(NO_2)_2$ and $Pb(NH_3)_4SO_4$ [18]. In contrast, the low Pb levels in water during summer may probably ascribe to increasing of water levels in Nile water. This leads to increasing of sorption of Pb ions on the surface of suspended particles and settled to sediment.

The highest Pb and Cd levels at the eastern side of Aswan Reservoir (R1 site) is probably due to the increasing number of floating tourist boats discharged contaminates products at this area whereas the Villa temple is localized at this area.

While the highest Cd and Pb were found in the River Nile water at N1 site mainly due to increasing number of tourist ships discharged wastes and sewage at this site that contain significant values from nutrients and organic complexes and this was in agreement with several literature [19, 20].

The lowest Pb concentrations recorded in River Nile and Aswan Reservoir areas during summer may probably due the increase of total dissolved solids (TDS) recorded during this period. This is also, was in good agreement with other published results [21].

In addition, the high cadmium level recorded during summer and autumn, especially in the N4 site may be probably related to the decomposition of organic wastes like silage and liquid manure discharged from El-Sail Drain. [22].

The lowest Cd level recorded during spring may be due to the increased pH value, where this metal is reversibly correlated with pH value. This is due to the increase of sorption of metals on suspended particles and removed as fine colloidal at high pH value. This is in a good agreement with several literatures [23-25].

The negative correlation coefficient relationships between metal ions were mainly ascribed to the exchangeable reactions occurs between different metal salts as the following equations:

$$MeCl_2 + CaCO_3 \longrightarrow CaCl_2 + MeCO_3$$

$$Me(NO_3)_2 + MgSiO_3 \longrightarrow Mg(NO_3)_2 + MeSiO_3$$

Where Me is Cd or Pb or ...Alc

It was concluded that,

Pb and Cd concentrations in the examined areas are higher than permissible limits (WHO). This is probably resulted to waste water contamination from Kema fertilizer factory and domestics input in the Nile body through El-Sail Drain. The concentration of Pb during spring is too higher than other periods while the Cd levels are higher in the summer and autumn than those reported in other season. Pb content in Nile River at Aswan is higher than those found in Aswan Reservoir water. Results showed that Pb and Cd levels are exceeded of permissible limits in most sites during the period of study as compared with those reported before the transplantation program of grass carp fish fry since 1995.

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