Ecology, Pollution and Environmental science: Open Access (EEO)

Review Article

Environmental pollution in the River Nile, Egypt: Overview

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Water Pollution is considered to be one of the most dangerous hazards affecting Egypt.

The River Nile is the principal fresh water resource in Egypt, supplying Egypt with about 98 percent of its fresh water [1,2].Pollution in the Nile River System (main stem Nile, drains and canals) has increased in the past few decades because of increases in population; several new irrigated agriculture projects, and other activities along the Nile. The River Nile receives wastewater discharges from 124 sources points between Aswan and El-kanater Barrage, of which 67 are agricultural drains and the rest are industrial sources [3]. The Egyptian Environmental Affairs Agency reports that the pollution of the surface water in greater Cairo and the province of Beni Suef is a major hazard to all biological systems [4]. As the program to expand irrigated agriculture moves forward, the dilution capacity of the Nile River system will diminish at the same time that the growth in industrial capacity is likely to increase the volume of pollutants discharged to the Nile.

Egypt faces a rapidly increasing deterioration of its surface and groundwater due to increasing discharges of heavily polluted domestic and industrial effluents into its waterways. Excessive use of pesticides and fertilizers in agriculture also causes water pollution problems. Egyptian industry uses 638 M. m3/yr. of water, of which 549 M. m3/ yr. is discharged to the drainage system. Industrial activities in the Greater Cairo and Alexandria regions use 40% of the total. The River Nile supplies 65% of the industrial water needs and receives more than 57% of its effluents (Table1) [5]. Agricultural is the major non-point source pollution, with a number of potential impacts on the environmental and human health. In many agricultural areas, local surface and groundwater contamination has resulted from leaching of nitrates from fertilizers, and bacteria from livestock and feed (Table 2). The way domestic pollution affects water quality heavily depends on the way of disposal of this pollution. Approximately 65 percent of Egypt's population is connected to drinking water supply and only 24 percent to sewerage services, although the latter percentage is expected to grow rapidly, due to works under construction. The population not connected to sewerage systems relies on individual means of excreta and wastewater disposal such as latrines and septic tanks [6].

In the last decades nanomaterials (NMs) have attracted a great deal of attention due to their many technologically interesting properties. Nanotechnology applications advanced very quickly while very little has been done to measure and assess the risks of nanoparticles (NPs) to biological systems and to the ecosystems. The small size of nanoparticles and their properties can become easily a vehicle for binding and transport of toxic chemical pollutants. There are concerns among scientists and environmentalists that manufactured nanoparticles (NPs) will be released in the environment from these products over their life use through their erosion. Also, these products could generate wastes containing nanomaterials (domestic or industrial waste). There is an uncertainty whether or not the sewage treatment works could remove the released nanomaterials from the effluents. At present there are not many studies on the environmental problems, risks to human health and Eco toxicological issues of nanomaterials. The exposure can be divided into three wide categories: Occupational exposure, Consumer exposure and Environmental exposure. Longer term, there is an opportunity for a much wider exposure of the entire ecosystem to engineered nanomaterials through the water and soil. Due to expanding use of nanoparticles (NPs) and commercialization of nanotechnology products, exposure of the environment and humans to NPs is bound to increase and an evaluation of their potential toxicity is highly essential. Although high numbers of water-borne diseases are reported, it is believed that many more people suffer from diseases related to other forms of water pollution. Toxins such as pesticides and heavy metals in drinking water and food products can affect human health. Regular controls of drinking water quality and contamination of fish products must be achieved in the short-term, together with adequate actions to prevent further exposure of the population to harmful contaminants.

Table 1: Industrial Wastewater Discharge to the River Nile System

Total	Ultimate Sink (M.m^3/yr.)*				District
	Lakes	Drains	Canals	Nile	
204	5	2	5	192	Upper Egypt
128	7	20	21	80	Greater Cairo
126	1	13	85	27	Delta
88	35	33	7	13	Alexandria
4	1	3	0	0	Others
550	49	71	118	312	Total

Table 2: Amounts of Pesticides and Chemical Fertilizers Used in Egypt.

Year	Pesticides (tons)	Chemical Fertilizer (1000 tons)
1952	2 100	730
1960	16 300	1 400
1965	25 100	2 150
1970	25 600	2 450
1975	27 400	5 750
1980	20 500	4 500
1985	18 400	5 900
1990	17 200	6 240

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Received: June 09, 2018; **Accepted:** June 25, 2018; **Published:** June 29, 2018

In the last few years there is a wide debate about the benefits of nanotechnologies for humans and the technological society from the diverse applications of new products, but also about the risks of many manufactured nanomaterials (NMs) and consumer products to human health and the environment [7,8]. It is a well-known fact that most of the industrial waste and all urban water sewage end up in waterways (rivers, lakes, coastal waters, etc). It is inevitable that industrial nanoscale products and by-products to enter the aquatic environment [9].

Environmental release of NPs into aquatic environment poses new environmental problems that need to be studied in the near future [10]. Micro pollutants contaminants are released into environment mainly as a result of the manufacturing processes, the disposal of unused or expired products, and the excreta, mostly through urban wastewater and many of them can further spread through the water cycle, even reaching drinking water, due to their hydrophilic character and low removal at wastewater treatment plants (WWTPs) and drinking water treatment plants (DWTPs) [11,12]. Studies showed that in various aquatic environments suspended sediment particles play an important role in sequestering and transporting chemical pollutants over significant distances and the hydrodynamic and morphological characteristics of rivers and coastal zones will determine the distribution of bound NPs [13].Potential routes for the uptake of NPs by aquatic organisms include direct ingestion, entry through gills, olfactory organs and body wall (through the skin). Eukaryotic organisms, such as protists and metazoans, have highly developed processes for the cellular internalization ofnanoscale (<100 nm) and microscale (100 nm-100.000 nm) particles which are called endocytosis and phagocytosis [14,15].

They can also enter into the environment due to surface-water runoffs and soil leaching after the agricultural applications of manure. Once released into the environment, micropollutants are subject to different processes, such as biodegradation and chemical and photochemical degradation, which contribute to their elimination. When these transformations take place, degradation products can differ in the environmental behavior and toxicity. However, they are often more persistent than their corresponding parent compounds [11].

These compounds are present to very low concentrations and due to the high complexity of some environmental samples; very specific and sensitive analytical procedures are needed for their determination. However, screening techniques commonly used for toxicity testing of macro-scale substances like gas chromatography (GC)-mass spectrometry (MS) for air, sewage, fish, and animal tissues; GC/ electron capture detector (ECD) for water and sediment samples; GC/ high resolution MS (HRMS) for fish tissue; and liquid chromatography (LC)/GC-MS-flame ionization detector (FID) for sediments may not be appropriate for nanoparticles hazard characterization, but may have to be adapted or modified with regard to their nanospecific properties [12]. Although these compounds are not currently covered by the existing regulations, the possibility of adverse effects on humans and animals and their extensive environmental distribution has recently attracted an increasing interest [16]. Overall, the available literature on nanomaterials toxicology and its distribution in the Egyptian environment and its environmental hazards is incomplete.

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