Water quality and health in Egypt

“A ticking time bomb threatening the life of the Egyptians”

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Topics covered

- Definition of Water quality
- Sources of water pollution
- Safe drinking water standards
- Sources of water supply
- Current state of water quality and health in Egypt
- Examples of disaster in Nile river
- Approaches for solutions
- Conclusion
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-**Water quality** refers to the chemical, physical and biological characteristics of water.

-The parameters for water quality are determined by the intended use:

- Human consumption,
- Industrial use, or
- Fishing or agriculture

Water Pollution

According to the WHO 2010 Water pollution is - defined as the contamination of natural water bodies by chemical (organic and inorganic), physical, pathogenic microbial (as bacteria, viruses and parasites) or radioactive substances.

Sources of pollution

- Industrial pollution
- Agricultural pollution
- Domestic pollution
- Tourism is a main source of marine pollution
- Dumping wastes

Safe Drinking Water Standards

Primary standards regulate substances that potentially affect human health, and *Secondary standards* prescribe aesthetic qualities, those that affect taste, odor, or appearance.

Safe drinking-water, does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.

The EPA standard for drinking water, stated the **Maximum Contaminant Level (MCL)**, which is the highest amount of a contaminant allowed in drinking water supplied by public water system.

Safe Drinking Water Standards

Although MCLs are set primarily to protect health, they also take into consideration the feasibility and cost of analysis and treatment of the regulated contaminants.

Those at greatest risk of waterborne disease are infants and young children, people who are debilitated or living under unsanitary conditions and the elderly

What's the Quality of Our Drinking Water?

- Sodium
- Hardness
- Mineral content (TDS)
- pH
- Chlorine
- Pathogens: Bacteria, Viruses, parasites
- Other contaminations

Industrial waste water

The industrial sector is an important user of natural resources and a major contributor to pollution of water and soil. There are about 24,000 industrial enterprises, about 700 of which are major.

In Egypt, manufacturing facilities are often located within the boundaries of major cities, in areas with readily available utilities, supporting services and workers. In general the majority of heavy industry is concentrated in Greater Cairo and Alexandria.

Industrial waste water

Industrial use of water in the year 2000 is estimated to be 7.6 billion cubic meters (BCM). By the year 2017, it is expected to reach 10.6 BCM. Consequently, an increase in the volume of industrial wastewater is expected.

The increase in water usage without proper controls (i.e. enforcement of laws regarding discharge, improved recycling of water in plants, etc.), will lead to increased pollution loading to receiving waters as well as groundwater. This increased loading places the current reuse of drain water strategy increase risks to human health and the environment.

Municipal Wastewater

Currently there are 59 primary or secondary treatment plants operating with a total capacity of 6.2 mcm/day (or 2.3 bcm/year). These sewage treatment plants in 1997 served 18 million of the 60 million people of Egypt or 30% of the population. By the year 2017, coverage is expected to increase to serve 39 million or 47% of the population.

This is not sufficient to cope with the future increase in wastewater production from municipal sources. Therefore, the untreated loads reaching water bodies will not decline in the coming years. Because of shortage of wastewater treatment infrastructure, widespread contamination of drinking water supplies, and in turn significant episodes of illness

In Greater Cairo, the sewerage systems also serve industrial and commercial activities. So toxic substances as heavy metals & organic micro-pollutants, are mainly attached to suspended material, most accumulate in the sludge.

Improper sludge disposal and/or reuse may therefore lead to contamination of surface and ground water

In general, the bulk of treated and untreated domestic wastewater is discharged into agricultural drains. Total coliform bacteria are generally higher than the Egyptian standard of 5000 MPN/100. It is important to mention that all drains in Upper Egypt flow back into the Nile.

There is a national policy to maximize the reuse of drainage water by mixing it with canal water resulting in contamination of many irrigation canals from domestic sources.

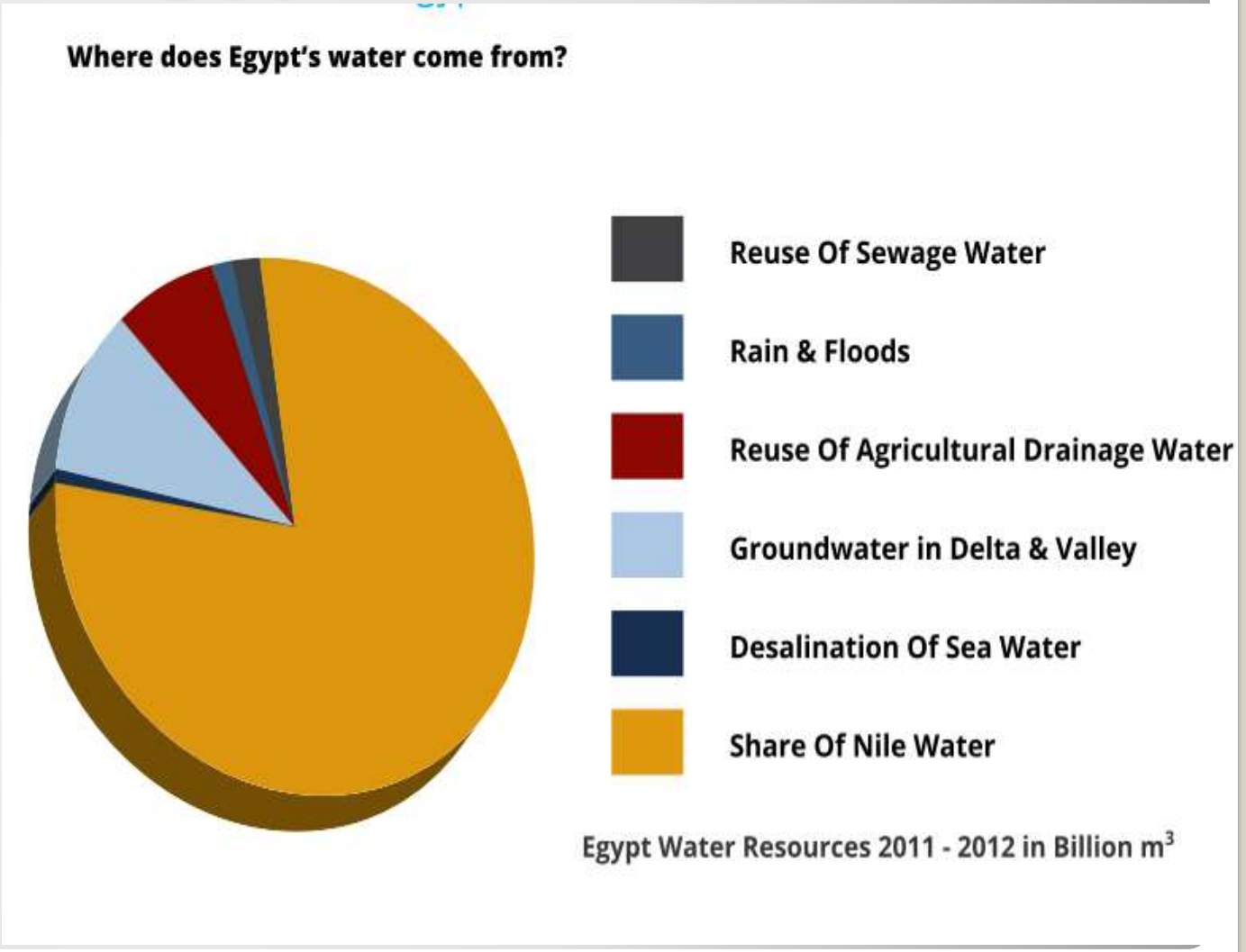
Dissolved minerals may affect suitability of water for a range of industrial and domestic purposes. The most familiar of these is the presence of ions of calcium and magnesium which interfere with the cleaning action of soap, and can form hard sulfate and soft carbonate deposits in water heaters or boilers.

Hard water may be softened to remove these ions. The softening process often substitutes sodium cations.

Hard water may be preferable to soft water for human consumption, since health problems have been associated with excess sodium and with calcium and magnesium deficiencies. Softening decreases nutrition but increases cleaning effectiveness

Sources of water in Egypt

- Nile River and Groundwater in Delta and Valley
- Deep Groundwater, Drainage water reuse, agriculture wastewater reuse
- Rainfall and flash floods
- Unconventional sources of water: Wastewater reuse and Desalination



The Nile river has long been a crucial component of both the identity and the vitality of Egypt

Drinking water supply and sanitation in Egypt

Among the achievements are an increase of piped water supply between 1990 and 2010 from 89% to 100% in urban areas and from 39% to 93% in rural areas despite rapid population growth; the elimination of open latrines in rural areas during the same period; and in general a relatively high level of investment in infrastructure.

Access to an improved water source in Egypt is now practically universal with a rate of 99%. On the institutional side, the regulation and service provision have been separated to some extent through the creation of a national Holding Company for Water and Wastewater in 2004, and of an economic regulator, the Egyptian Water Regulatory Agency (EWRA), in 2006

Current state of water quality in Egypt

- 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 added to water pollution problems.

Examples of Disasters occurring in Nile River during the last few years

- Emergence of an oil slick along the 6 km in the city of **Edfu in Aswan**, the inefficient control of industrial wastewater plants located on both sides of the Nile River was the cause the disaster.
- Another time in 2014, repeated incident of oil slick in the south of **Isna**, in which oil leaks from an old ship that store petroleum products ,standing near the shore. With winter blockage, and the lack of water level ship tilted to its side before sinking, leaving an oil slick with a length of about 1.5 km, and width of 700 meters.

Current situation in Delta and Valley

El Bouraie et al, (2010), studied the Rosetta Branch of the River Nile. Heavy metals (Al, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) were high in surface river water and the bed sediments specially during closure of winter period.

Gaber et al; (2013) conducted a study to assess water quality of El-Rahawy drain, Reference samples were collected from Delta in front of El-Kanater El-Khayria City. Results, indicated high levels of heavy metals (Cu, Fe, Pb, Cd, Mn and Zn) in fish from El-Rahawy site that receives greater agricultural, industrial and domestic wastes than El-Kanater El-Khayria site.

El-Sadaawy et al; .(2013) reported the accumulation of some heavy metals (Cr, Co, Cu, Ni, Zn, Pb and Cd) in different tissues in farms' fish (muscle, gills, heart, liver, brain, bone and skin) of Tilapia nilotica.

Authman et al; (2012) clarified the hazard of consuming fishes from illegal fish farms to human and the public health (Nile tilapia)

He also measured some heavy metals ((Al, Cd, Pb, Hg and Ni)) in Tilapia nilotica.

Ibrahim (2013) **studied** the effect of water quality in Kafr El-Zyat, Tamalay on Rosetta branch of the River Nile and Shanawan drainage canal on histology of gill and kidney obtained from *Oreochromis niloticus* fish. The signs includes Necrosis, hemorrhage, hemolysis, fibrosis and hyperplasia.

Current situation in Delta and Valley (cont.)

Elnimr (2011) reported concentrations of cadmium, mercury, manganese, phosphorus, lead and zinc in samples of Basa fish and some fresh water fish (*Tilapia nilotica*, named Bolti and Karmout) collected from Kafer-El-Zayat , that are higher than the permissible safety level of human use (0.1 ppm).

- Mandour (2013) in **El-Mansoura**; showed high values of Ni and Pb in Talkha district;

- **Mit-antar** and **Demera** compact units showed high values of Cd and Pb.

- In **Sherbin** district; Network of main station showed high values of Cd and Ni.

Aswan and Lake Nasser

- Toufeek (2011) evaluated the concentrations of cadmium and lead in the water of Aswan Dam Reservoir and River Nile
- The concentration of Pb. during spring is higher than the other periods, Cd levels are higher in summer and autumn and exceeded the permissible limits.

Red Sea (Hurghada) Mansour et al; (2013) studied texture of marine surface-sediments in Hurghada. High total concentrations of Fe, Mn, Pb, and Zn at Desert Rose Resort (avg. 0.43%, 77.14, 5.00, and 19.70 ppm respectively).

Cd at El-Samaka Village and Abu-Shaar (avg. 0.15 ppm), Cu at Tourist Harbor (avg. 8.80 ppm), Ni at Abu-Shaar (avg. 20.80 ppm), and Hg at El-Samaka Village (avg. 0.07)

Greater Cairo

- Abdel-Sabour et al; (2001) studied areas of (Shoubra El-Khima, Bahteem and Mostorod)

- Shebin El-Qanater collector drain samples exhibited the highest levels of Cd, Co, Pb and Ni compared to other tested water bodies. Mostorod collector drain samples showed the highest levels of Zn and Cu.

Greater Cairo

The highest copper concentration is found in El-Salam and the lowest in Heliopolice

Highest lead concentration is reported in Heliopolice and El-Salam areas

The highest nickel concentrations is reported in El-Salam and El-Marg

The concentration of cadmium slightly exceeded the standard limit (0.01 ppm) from El-Zaitoon, El-Marg and El-Salam

The highest molybdenum concentrations is reported by Heliopolice and El-Salam areas

Red sea and Mediterranean sea (cont.)

Khalaf et al; (2002) studied certain ecological aspects of the fringing reef of Ras Shukeir

Since 1960s, this fringing reef has been chronically polluted, where Ras Shukeir area was used by Gulf of Suez Oil Company for oil production.

The reef was seriously degraded where about 99% of its coral cover was destroyed along the whole investigated shore

The river supplies 65% of the industrial water needs and receives more than 57% of its effluents.

Among other pollutants reaching the river is the persistent organic pollutants (POPs). Polychlorinated biphenyls (PCBs) are one of the 12 groups of POPs originally included in the Stockholm Convention on POPs and they were banned worldwide in the 1990s because there high toxicity.

PCBs have been used in a wide variety of manufacturing processes in Egypt, especially as plasticizers and insulators, and are widely distributed in the environment.

In 2007, the Egyptian Environmental Affairs Agency published the framework of the National Implementation Plans (NIPs) about the pollution hazard of POPs in Egypt media. In this context, they concluded that PCBs are still under investigation and information about PCBs in environmental media is limited.

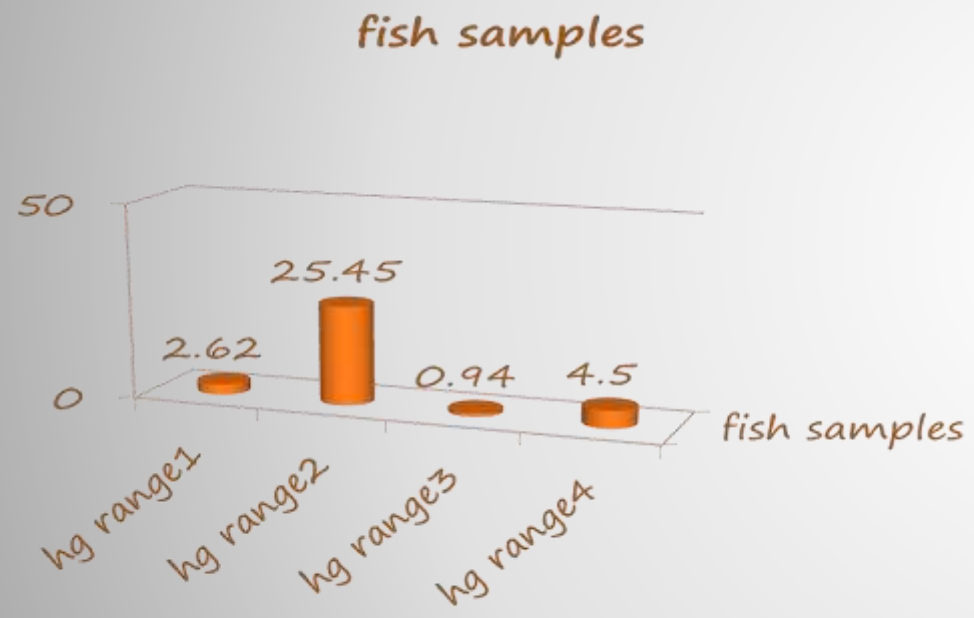
Current situation of pollution of aquatic life (Suez Canal Area)

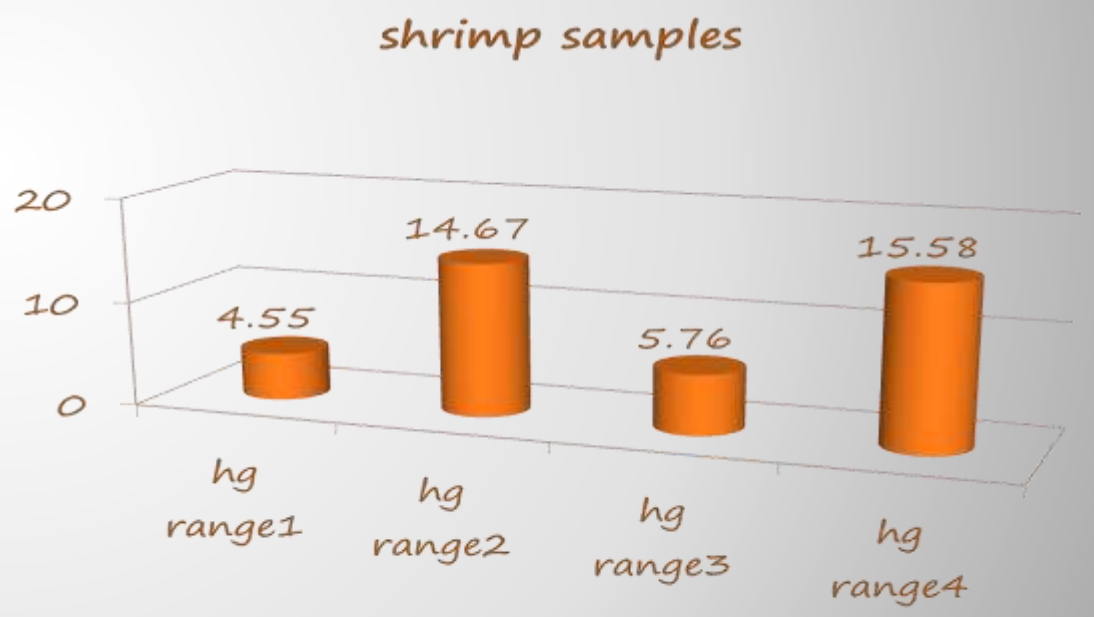
High levels of 17 β- estradiol (E2) residues in Egyptian aquatic ecosystem is found in three water bodies located in the Suez Canal region

Ahmed et al; (2013) Residues of aliphatic and (PAHs) in Aquatic life in lake Temsaha, Ismailia.

Lake Temsah and Bitter lakes

In 2006 El-Moselhy measured levels of Hg in the edible parts of the investigated organisms (ng/g wet weight of fish)





(Suez Canal Area)

Ahmed et al., (2001) investigated the pollution in Lake Temsah, where Mullet, crab and a bivalve were selected as representatives of various strata of the lake ecosystem

- Endosulfan had the highest detected concentration of all organochlorines

- Fluorine and anthracene were the most frequently detected (PAH)

The most recent publication by Megahed et al 2015 studied the flux of PCBs from the river Nile to the Mediterranean Sea which was estimated to be about 6.8 Ton/year.

They stated that There are no criteria for the maximum allowable concentration of PCBs in water in Egypt, but the USEPA set this value for PCBs in drinking water to be 500 ng L^{-1}. The total PCBs along the River Nile selected regions were all above the specified values.

Red sea and Mediterranean sea (cont.)

Khairy et al; (2011) reported polychlorinated biphenyls (PCBs), organochlorine pesticides, and chlorpyrifos in sediments and mussels of Abu Qir Bay.

Accumulation and biomagnification of PCBs residues in the aquatic ecosystems were found to be above the acceptable levels indicating the hazard of carcinogenicity for all age Groups.

- Along the Rosetta branch of the Nile, Kafr al-Sheikh recently in 2014 suffered a “mass fish die-off.“ Many speculated cause are : industrial pollution of the Nile, fish-farming polluting the water, lack of oxygen in the water , and untreated sewage.

- Testing the dead fish found that the cause of death is ammonia poisoning, along with dangerously high concentrations of lead and other solids in the water.

- Kafr al-Sheikh Governorate is home to 26,964 hectares of commercial fish farms which (if unproperly managed) can lead to an ammonia overload in the body of water housing the fish. -Ammonia is also associated with dyeing processes and chemical factories producing pesticides (as Kafr El Zayat Pesticides factory), fertilizers, plastics and detergents.

The overall result is caused by relatively unabated pollution by industrial facilities, and bad control of agricultural and domestic sources of polluted waste water.

In 2008, the Egyptian Environmental Affairs Agency officially recorded that there was 50 percent more wastewater being discharged into the Nile that is polluted beyond the legal levels than there is discharged within the legal levels.

These mass fish die-offs will continue to happen until the monitoring of the sources of water pollution up and down the Nile are carried out regularly, and feed into a regulatory system that consistently enforces the violations to prevent repetition of such incidents.

Health Effects

Untreated sewage usually contains large numbers of pathogenic microorganisms such as schistosomial ova cercaria and ova of parasitic flukes and worms; hepatitis A, bacterial dysentery, infectious diarrhea, para-cholera, and typhoid are also common.

The average annual typhoid incidence rate was estimated in Egypt to be 13/100,000 persons and the annual brucellosis incidence rate as 18/100,000 persons (Crump et al., 2003). Any incidence greater than 10 per 100,000 is considered high by the WHO.

Hundreds of people had contacted typhoid during July-August 2009; the infections have been blamed on sewage contaminating water supplies.

Childhood diarrhoea, are often caused by a multitude of factors. Numerous studies have revealed a strong connection between childhood diarrhoea and water quality and sanitation services.

Salem et al. (2000) studied the relationship between chronic diseases and geologic environment, such as renal failure, liver cirrhosis, hair loss, and chronic anemia.

These diseases are apparently related to contaminant in drinking water as heavy metals such as Pb, Cd, Cu, Mo, Ni, and Cr.

Human exposure to POPs - can lead, to increased cancer risk, reproductive disorders, alteration of the immune system, neurobehavioural impairment, endocrine disruption, genotoxicity and increased birth defects.

Renal failure which is roughly affecting 500 in every one million people in Egypt, is related to contaminated drinking water with lead and cadmium, pesticides.

Liver cirrhosis to copper and molybdenum.

Variety of cancers to chromium , asbestos and organic pollutants.

Hair loss to nickel and chromium, and

Chronic anemia to lead, copper and cadmium

In 2008 the World Health Organization found that 5.1 percent of all deaths and 6.5 percent of all annual diseases and injuries in Egypt are attributable to unsafe drinking water, inadequate sanitation, insufficient hygiene and inadequate management of water resources.

Approaches to solutions

- Scientific approaches:
- Biological
- Mechanical
- Administrative approaches
- Legislative approaches
- Preventive approaches

Approaches for solutions (scientific approaches)

- Biological safe farming of the Fish

- Use of aquatic plants as hyacinth, reeds and woven that - have the ability to absorb heavy metals (cadmium chromium , iron , copper, lead, zinc)

- Establishment of sanitary drainage stations equipped with means of water treatment in places deprived of that service

Other approaches for water pollution solutions

- Enforce laws to maintain water resources

- Attention to wastewater treatment, including possible re-usage for irrigation and in the fish farms in order to increase water resources.

- Ensure safe burring of waste in the deserts as it might leak thus threatening ground water and health.

Laws and Regulations of Water Resources

قوانين وتشريعات الموراد المائية

قانون 43 لسنة 1979	فى شأن نظام الأدارة المحلية – وزارةالتنمية المحلية
قانون 93 لسنة 1962	فى شأن صرف المخلفات السائلة فى المجارى المائية - وزارة الاسكان
قانون 53 لسنة1966 قانون116 سنة 1983 قانون 2لسنة 1985	فى شان الزراعة وتعديلاته - وزارة الزراعة
قانون 38 لسنة 1967 قانون 31 لسنة 1976 قانون 10لسنة 2005	فى شان النظافة العامة وتعديلاته - وزارة الاسكان
قانون 27 لسنة 1978	فى شأن الموارد العامة للمياه اللازمة للشرب والاستعمال الآدمى - وزارة الصحة
- قانون 123 لسنة 1983 - قانون 124 لسنة 1983	- فى شأن الثروة المائية ولائحته التنفيذية -فى شأن صيدالاسماك وتنظيم المزارع السمكية - وزارة الزراعة
قانون 48 لسنة 1982	حماية نهر النيل والمجارى المائية من التلوث - وزارة الموارد المائية والرى
قانون 12 لسنة 1984	الرى والصرف - وزارة الموارد المائية والرى
قانون 4 لسنة 1994 قانون 9 لسنة 2009	فى شأن حماية البيئة وتعديلاته – وزارة البيئة

Conclusion

Allowing industrial facilities to pollute for driving Egypt’s economic growth and development, fundamentally undercuts the ability of the poorest parts of society to survive whilst providing economic gains to the upper echelons of society profiting from not being forced to internalize the cost of pollution.

This vicious cycle contributes to the maintenance of the gap between rich and poor in Egypt.

Water pollution negatively affects the poorest’s ability to live more healthily and develop their communities, making being poor more expensive.

The poor exposed to polluted water and air, must pay the treatment costs of pollution related diseases, or in some cases, pay the ultimate price: death.

Death of the working man or woman in the family, grinds down their ability to lift themselves out of poverty and raise their standard of life.

Recommendations

- Constant monitoring of the Nile river water quality is needed to record any alteration in the quality and mitigate outbreak of health disorders and the detrimental impacts on the aquatic ecosystem and human health.
- Attention should be paid to mitigate element mobilization from sediments as their effects may become significant during seasons and years of low water flow in the river

Recommendations

- Effective implementation of laws and regulations
- Monitoring and periodic assessment of water resources
- Raise awareness of the general population
- Preparation of Cadres and capacity development

Safe and clean drinking water and sanitation is a human right

THANK YOU