

Original Paper

Trend in Global Environmental Pollution

Dr. M. A. Quader¹

¹ Distinguished Faculty, AIT

Received: November 5, 2022 Accepted: November 27, 2022 Online Published: December 24, 2022

doi:10.22158/uspa.v5n2p66 URL: <http://dx.doi.org/10.22158/uspa.v5n2p66>

Abstract

The context of environmental pollution especially economic development being associated to each other studied. Time series data for several years are studied, analyzed and used to develop statistical models and inferred for helping the planners. The models for environmental problem areas of greenhouse gas emission, noise pollution, plastic pollution, municipal waste, fertilizer pollution and industrial process pollution show consistent increasing. The models of environmental problem areas of the aspects of safe drinking water, safe sanitation, life expectancy and death rate show consistent improvement. It is recommended that the measures to prevent the environmental problems must be mad as inbuilt into the relevant project body and must be implemented.

1. Research Objective

The following are the research objectives:

- (i) To study, analyze and infer on the major environmental problems
- (ii) Quantify and model the environmental pollution problems
- (iii) Suggest the application area in planning.

2. Introduction and Review of Literature

As per the content in <http://ourworldindata.org>, the world data has observed environmental pollution as the greatest problems that the world is facing today. This is causing grave and irreparable damage to the natural world and human society with about 40% of deaths worldwide being caused by water, air and soil pollution and coupled with human overpopulation.

It is also observed that globally, 91% of the world population is exposed to unhealthy levels of pollution. For each country, this indicator shows the portion of the country's population living in places where the mean annual concentrations of PM_{2.5} are greater than 10 micrograms per cubic meter.

The core theme of this concern is the damages being caused by pollution. The details are studied and analyzed and presented in this paper.

Everyone and every country are running for development such as economic development. This is understandable. But nobody is for everything needed. There is a shortcoming. Many times everything needed overlooked in time. One important thing is not taken care of beforehand. This is environmental aspect. Environmental aspect is intricately associated to environment. This is identified and considered only at a later stage when some damage has already occurred. GDP per capita of the World is increasing (Note 1). Environmental pollution is expected to increase also.

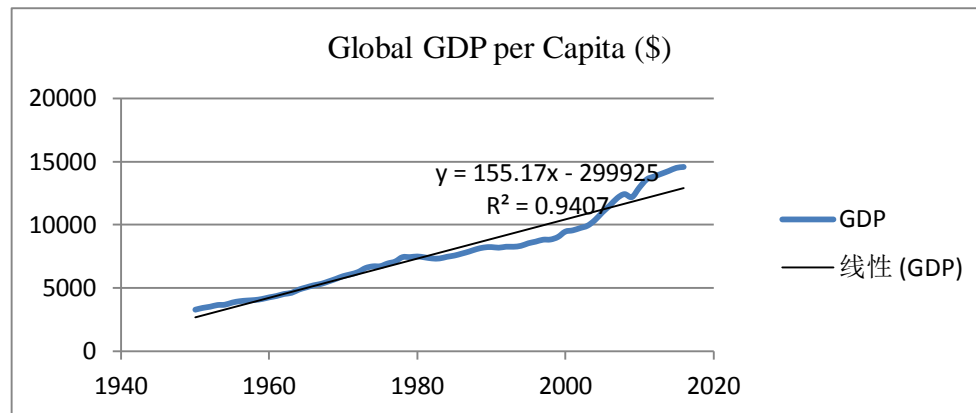


Figure 1. Global GDP per Capita

Primarily, environmental pollutions are of three types as shown in the following table. Each has been shown with subcomponents and associated remarks.

Table 1. Types of Environmental Pollutions

Environmental Pollution	Components	Subcomponents	Remark
Air Pollution	Greenhouse Emission	Carbon Dioxide (81%) Methane (10%) Nitrous Dioxide (7%) Fluorinated Gases (3%)	Global CO2 emission forecast to increase to 43.08 billion m tons in 2050.
Water Pollution	Surface Water Ground Water Waste Water Storm Water	1.8 million people die annually. 1 billion people become sick	Forecast: Accessibility to safe drinking water to 100% people by 2073. Forecast: Accessibility to safe sanitation to 100% people by 2043.
Land Pollution	Municipal Waste Plastic	2.01 billion tons municipal waste is	Soil is a “treasure beneath our feet”

Soil Erosion	generated annually. 0.39 million people die annually.	UNFPO: Annually, 75 billion tons of soil (about 25 million acres, of arable land is lost to erosion, water-logging and salivation.
--------------	---	---

Some important literatures reviewed are data sets, especially time series data from Worldometer, WHO, EPA, WB.

3. The Problem of Environmental Pollution

Annual deaths due to environmental pollution world over are shown in the following table. More than three fourths deaths occur due to air pollution. One fifth of the deaths occur due to water pollution. About 4% deaths occur due to land pollution. For better visualization, this is also shown in figure also (Figure 2).

Table 2. Type of Pollution

Item	Global (million)	Deaths	Percent
Air Pollution	7.00		76.17
Water Pollution	1.80		19.59
Land Pollution	0.39		4.24
Total	9.19		100.00

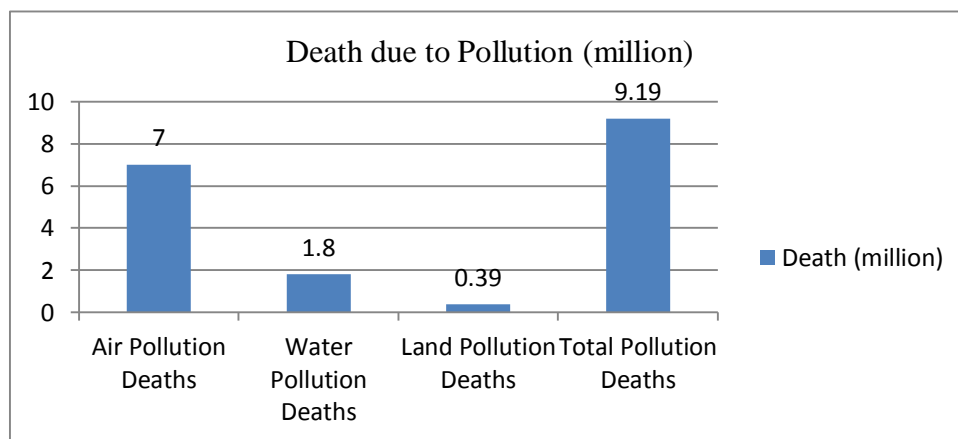


Figure 2. Death due to Pollution

3.1 Air Pollution

The composition and sources of air pollution are shown in the following table. In the components, the dominant component is carbon Dioxide (81.8%) followed by methane 10.10%, nitrous oxide 7.7% and fluorinated gases 3.3%. It is further noted that major part comes from energy sector about three quarters. This is followed by industry sector, waste sector about 3% and agriculture, forestry and land use sector 18.4%.

Table 3. Components and Sources of Air Pollutions

Components	Percent	Sources	Percent
Carbon Dioxide	81.80	Energy (electricity, heat and transport)	73.2
Methane	10.10	Direct Industrial Processes	05.2
Nitrous Oxide	07.70	Waste	03.2
Fluorinated Gases	03.30	Agriculture, Forestry and Land Use	18.4
Total	100.00	Total	100.0

3.1.1 World Death Rates due Air Pollution

3.1.1.1 Regression Model

World population death rate due to Air Pollution = $3896.82 - 1.8272 * \text{year}$

The model is drawn with population death rates due to air pollution of the world from 1990 to 2017 ($R^2 = 0.995$, $\alpha = 0.000$). (basic data source: Our World in Data: Air Pollution by Hannah Ritche and Max Rose)

World Population death rate is consistently decreasing. From the established statistical model (shown above), it can be shown that death rate is decreasing by 1.8272 every year per 100,000 of world population. The trend of decreasing death rate can be seen from the following figure. It is heartening news for the world.

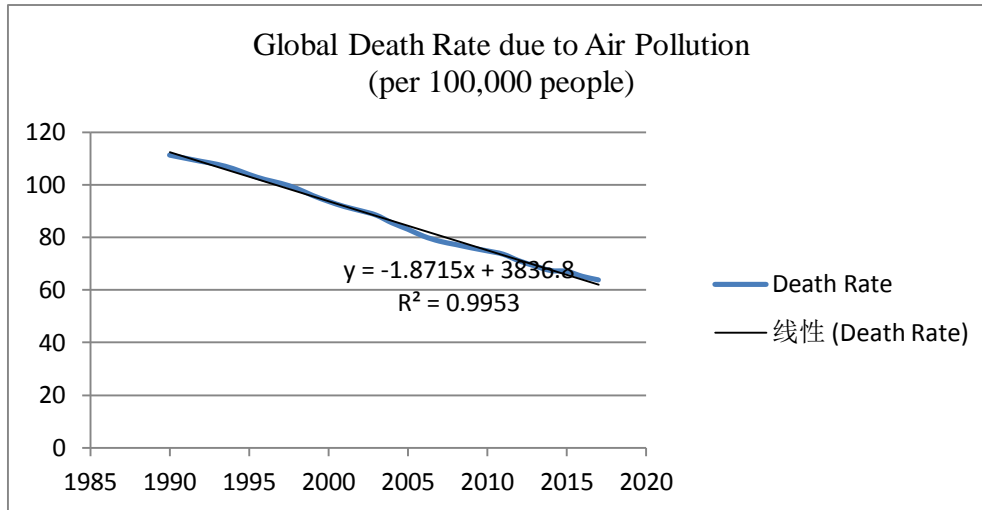


Figure 3. Global Death Rates due to Air Pollution

Source: Basic data from; World Health Organization; model and figure by author

3.1.2 Greenhouse Gas Emission

The composition and source of greenhouse has been shown above. The statistical model for emission of greenhouse gas is

$$\text{Greenhouse Gas Emission (million ton)} = - 37,430 + 19,357 * \text{year}$$

$$R^2 = 0.9817; n = 7; 1990 - 2020$$

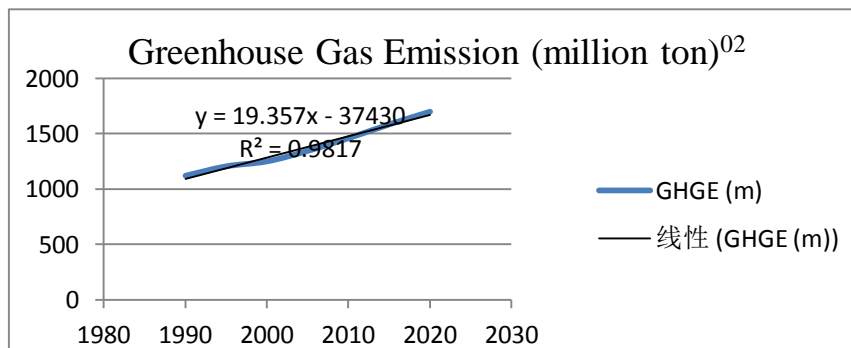


Figure 4. Greenhouse Gas Emission

Source: Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Greenhouse Gas Emission, Statistical Model by author (Note 2)

The model is highly fit, R^2 is very high. If other things are unaffected, 19.357 tons of greenhouse gas will be emitted per year.

3.1.3 Life Expectancy

The situation of the life expectancy for the world is drawn. The statistical model is as follows

$$\text{Life Expectancy} = - 702.32 + 0.3847 * \text{year}$$

$R^2 = 0.9696$; $n = 70$; 1950 – 2019

It is noted according to the model, life expectancy for the world people is increase by 0.3847 year on average. The message is heartening. It may be predicted that on average world people will have a life expectancy of 100 years.

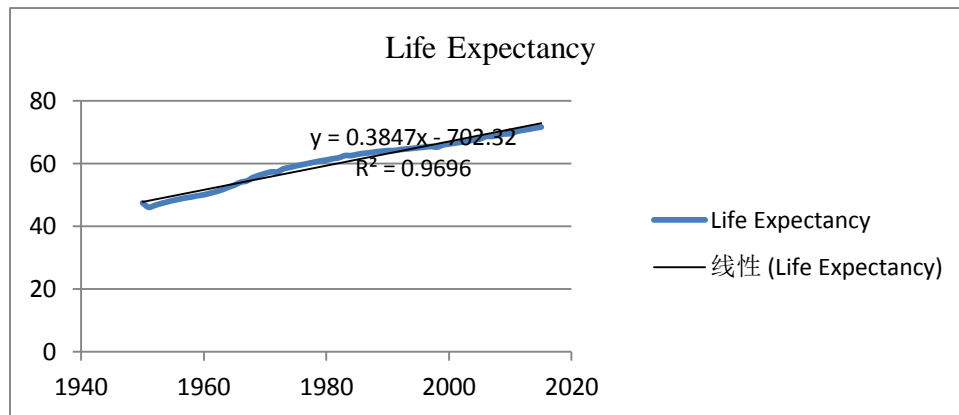


Figure 5. Life Expectancy

Source: Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Life Expectancy, Statistical Model by author (Note 3)

3.1.4 Noise Pollution

The technical information in this write is according to World Health Organization. Noise is an underestimated threat that can cause a number of short- and long-term health problems, such as for example sleep disturbance, cardiovascular effects, poorer work and school performance, hearing impairment, etc.

Noise has emerged as a leading environmental nuisance in the WHO European Region, and the public complains about excessive noise more and more often.

According to WHO, community noise recommend is less than 30 A-weighted decibels (dB(A)) in bedrooms during the night for a sleep of good quality and less than 35 dB(A) in classrooms to allow good teaching and learning conditions.

The WHO guidelines for night noise recommend less than 40 dB(A) of annual average (Light) outside of bedrooms to prevent adverse health effects from night noise.

According to a European Union (EU) publication:

- about 40% of the population in EU countries is exposed to road traffic noise at levels exceeding 55 db(A);
- 20% is exposed to levels exceeding 65 dB(A) during the daytime; and
- more than 30% is exposed to levels exceeding 55 dB(A) at night.

This is most often not followed causing pollution. Noise beyond these limits is a pollution and detrimental to health.

3.2 Water Pollution

In an article On human health, <https://www.thelancet.com> (Ref: NRDC Natural Resources Defense Council, Inc.), is reported that water pollution caused 1.8 million deaths in 2015. Contaminated water can also make people ill. Every year, unsafe water sickens about 1 billion people. And low-income communities are disproportionately at risk because their homes are often closest to the most polluting industries.

Waterborne pathogens, in the form of disease-causing bacteria and viruses from human and animal waste, are a major cause of illness from contaminated drinking water. Diseases spread by unsafe water include cholera, giardia, and typhoid.

3.2.1 Safe Drinking Water

The statistical model for safe drinking water is

$$\text{Percent of people having access to safe drinking water} = -1004.8 + 0.5331 * \text{year}$$

$$R^2 = 0.9898; n = 18; 2000 - 2017$$

Every year 0.5331 percent of people will have access to safe drinking water. It may be predicted that by 2071, about 100% people will have access to safe drinking water.

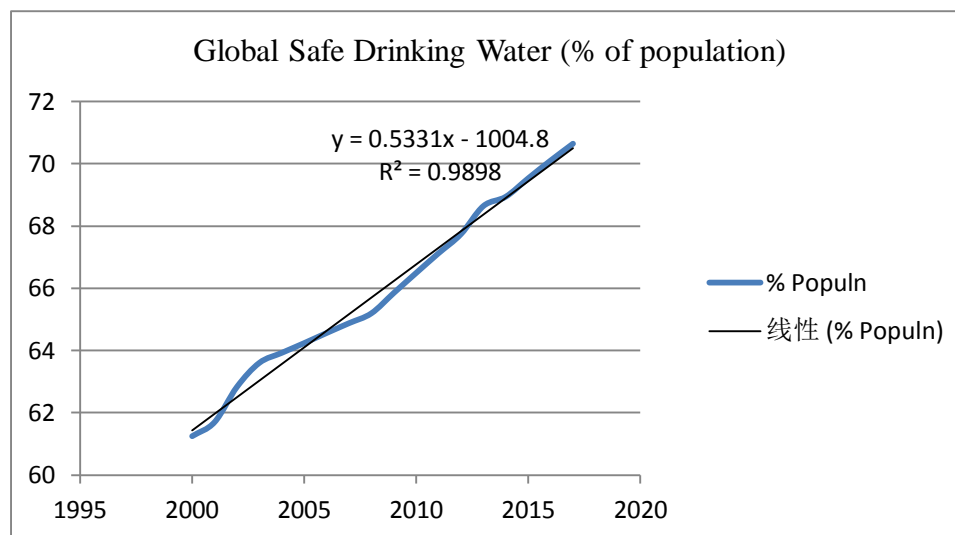


Figure 6. Global Safe Drinking Water

Source: The World Bank, Data Bank Microdata Catalog, People using safely managed drinking water services (% of population) (Note 4)

3.2.2 Safe Sanitation

The statistical model for safe drinking water is

$$\text{Percent of people having access to safe sanitation} = -747.45 + 0.4124 * \text{year}$$

$$R^2 = 0.9987; n = 18; 2000 - 2017$$

Every year 0.4124 percent of people will have access to safe sanitation. It may be predicted that by 2043, about 100% people will have access to safe drinking water.

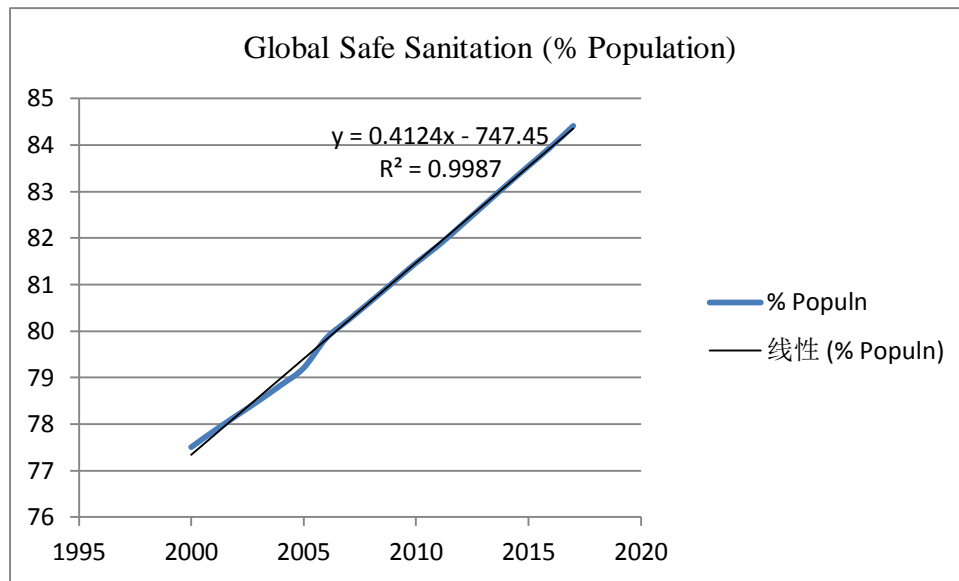


Figure 7. Global Safe Sanitation

Source: The World Bank, Data Bank Microdata Catalog, People using safely managed sanitation services (% of population) (Note 5)

3.3 Land Pollution

Land pollution is a heavy topic. With its direct impact on the environment and consequently on the health of humans, animals, and plants, soil pollution is a real problem that involves both political powers and citizens.

Soil pollution comes from different sources including agriculture and animal husbandry. Some of the agricultural practices lead to soil pollution. They are animal wastes, use of long lived pesticides, herbicides, fungicides, nematocides, etc. fertilizers and some agricultural practices.

Soil pollution comes from different sources including agriculture and animal husbandry. Some of the agricultural practices lead to soil pollution. They are animal wastes, use of long lived pesticides, herbicides, fungicides, nematocides, etc. fertilizers and some agricultural practices.

3.3.1 Plastic Pollution

China contributes the highest share of mismanaged plastic waste with around 28 percent of the global total, followed by 10 percent in Indonesia.

An estimated 20 percent of all plastic waste in the oceans comes from marine sources. In some regions, marine sources dominate: More than half of plastics in the Great Pacific Garbage Patch (GPGP) come from fishing nets, ropes and lines.

It is important to keep in mind that plastic is a unique material with many benefits: it's cheap, versatile, lightweight, and resistant. This makes it a valuable material for many functions. It can also provide environmental benefits: it plays a critical role in maintaining food quality, safety and reducing food waste. The trade-offs between plastics and substitutes (or complete bans) are therefore complex and could create negative knock-on in.

Plastic has the biggest problem that it takes very high amount of BOD to breakdown. So is the environmental problem. It takes the ocean 450 years to break down the plastic. Plastic shopping bags will take up to 20 years to break down, while styrofoam takeaway coffee cups take 50 years, and cigarette butts take 10. Some plastic products take hundreds of years to break down.

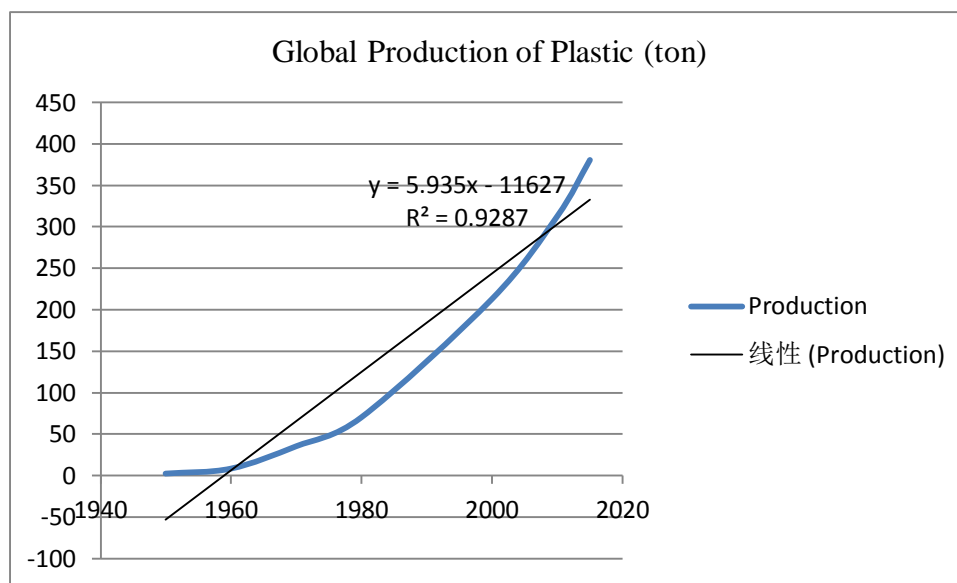


Figure 8. Global Production of Plastic

Source: Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Plastic, Statistical Model by author. (Note 7)

The statistical model is

$$\text{Plastic production} = -11,627 + 5.935 * \text{year}$$

$$R^2 = 0.9287; n = 7; 1950 - 2015$$

Every year 5.935 ton of plastic is produced.

3.3.2 Municipal Waste

Postconsumer waste, through its production and management, affects air quality, water quality, and public health, and it contributes to climate change (8). Improperly managed waste can affect the environment at different scales.

Some of the catastrophic effects of today's poor waste management systems are listed below:

- Soil Contamination. ...

- Water Contamination. ...
- Extreme Weather Caused By Climate Change. ...
- Air Contamination. ...
- Harm Towards Animal and Marine Life. ...
- Human Damage.

Irresponsible disposal of waste can cause many different environmental problems. It can result in air **pollution**, land **pollution** and could also cause numerous different health conditions.

Statistical model for production of municipal wastes is as follows:

$$\text{Global Municipal Wastes} = -80,115 + 41.74 * \text{year}$$

$$R^2 = 1; n = 7; 2010 - 2050$$

Every year 41.74 million tons of municipal waste is collected.

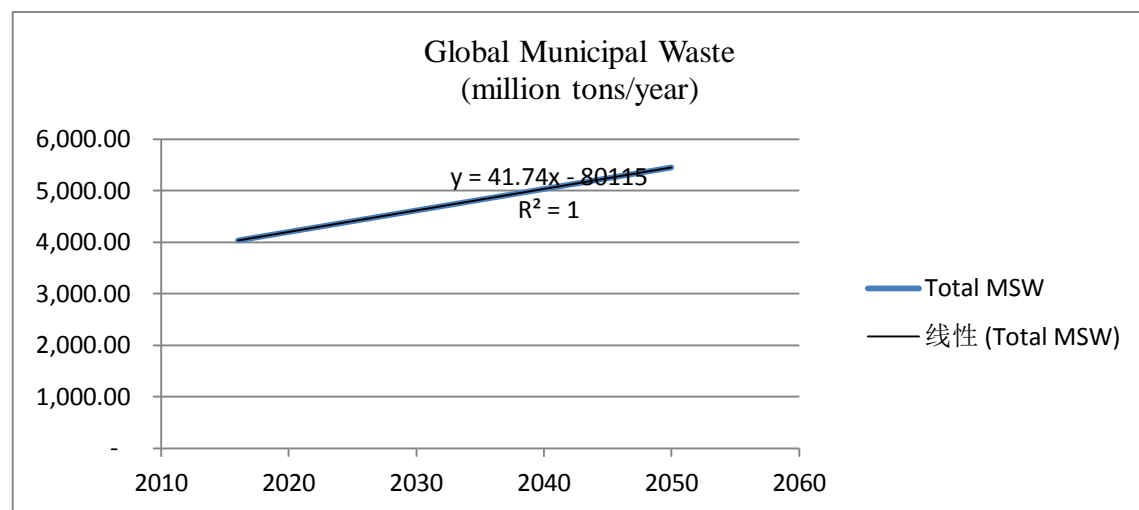


Figure 9. Global Municipal Waste

Source: Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Global Municipal Waste, Statistical Model by author. (Note 8)

3.4 Fertilizer Pollution

The Production of fertilizer in the world follows the trend shown in the following figure. The statistic model is

$$\text{Global Fertilizer Production} = -5,529.4 + 2.8459 * \text{year}$$

$$R^2 = 0.923; n = 54; 1961 - 2014$$

Every year 2.8459 million tons of fertilizer is produced.

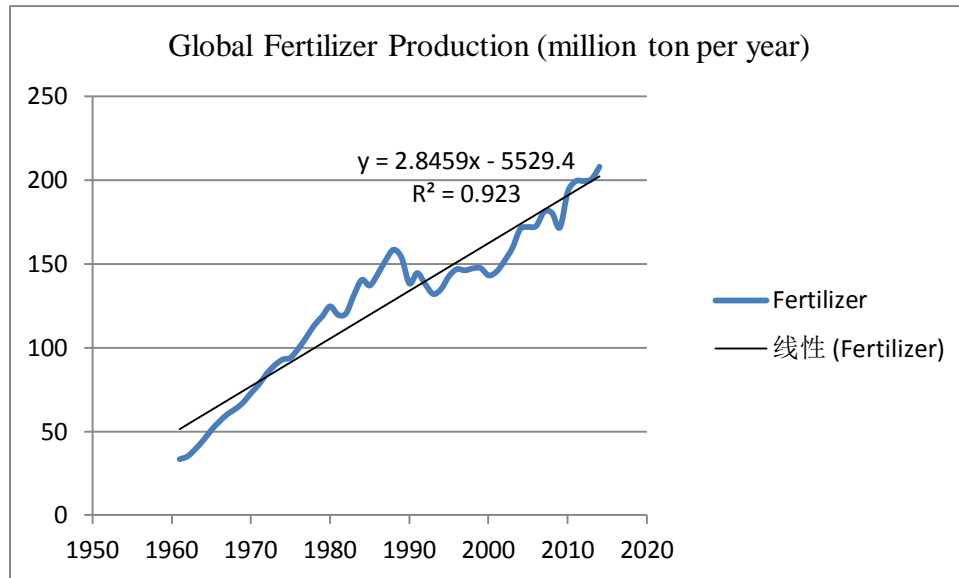


Figure 10. Global Fertilizer Production

Source: Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Fertilizer, Statistical Model by author. (Note 9)

Fertilizers, whether they are artificial or organic, can cause serious problems if they contaminate freshwater and marine ecosystems. The same nutrients

Plants absorb the fertilizers through the soil, they can enter the food chain. Thus, fertilization leads to water, soil and air pollution. ... Problems caused by too much fertilizer: The amount of nitrate may increase in drinking water and rivers as a result of high levels of nitrogen fertilizer use.

3.4.1 Industrial Process Pollution

The common forms of industrial pollution from heavy industries or large-scale manufacturing include high loads of heavy metals (particularly lead, mercury, and cadmium), oil and grease, biological oxygen demand (BOD), and suspended solid, which affect all components of the river and marine environments (Yusoff et al., ...) Industries pollute the environment through: 1). Air Pollution: It happens due to the high proportion of poisonous gases in the air like carbon monoxide. 2). Water Pollution: Organic and inorganic industrial wastes and affluent that are dumped into water bodies cause water pollution. Sep 15, 2563 BE.

4. Some Encouraging Results

Most of the environmental problems are getting worse. But fortunately, there are some results which have been showing improvement over the time. One item is number of people having access to safe drinking water. It is noticed that more and more people are getting access to safe drinking water. In 2000 percent of population having access to safe drinking water was 61.25%. In 2017, this percentage rose to 70.65%. The trend is evident from Figure 10.

Another item is safe sanitation. In 2000, about 77.51% of the population had access to safe sanitation. In 2017 we see 84.41% of the population to have access to safe sanitation. The trend is clear in Figure 10 also.

The most hilarious item is life expectancy. The life expectancy of the world is increasing consistently over the years. See Figure 5. In 1950 life expectancy was 47.5 years. In 2019 it has become 72.6. In 70 years, it has increased by 53%. The associated item is death rate. The world death rate is decreasing. In 1990, the death rate was 111.28 per 100,000 people. In 2017, it is reduced to 63.82 which is 57.35% of 1990 level, in just 27 years.

5. Conclusion and Recommendation

Development activities especially economic activities are taking place. As intricately associated related, environmental problems are cropping up. Several statistical models have been developed using SPSS and Excel software and time series data. These help in planning apart from meeting academic interest. The following pollution items show consistent increasing trend. For these items, measures to control the adverse effects of environment must be taken up and ensure implementation.

The models show worsening trend for the following pollution problems:

Greenhouse gas emission,
Noise pollution,
Plastic pollution,
Municipal waste,
Fertilizer pollution and
Industrial process pollution

The following pollution items are showing consistent improving trend. Commendable appreciation is due to the people in general and the international organizations for the untiring efforts in this regard.

Safe drinking water,
Safe sanitation,
Life expectancy and death rate

Notes

Note 1. Our World in Data: Average Real GDP per Capita across regions.

Note 2. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Greenhouse Gas Emission, Statistical Model by author

Note 3. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Life Expectancy, Statistical Model by author

Note 4. The World Bank, Data Bank Microdata Catalog, People using safely managed drinking water services (% of population)

Note 5. The World Bank, Data Bank Microdata Catalog, People using safely managed sanitation services (% of population)

Note 6. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Plastic, Statistical Model by author

Note 7. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, PLastic, Statistical Model by author.

Note 8. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Global Municipal Waste, Trend in Solid Waste Management, Statistical Model by author.

Note 9. Basic Data from Hannah Ritchie and Max Roser, Our World in Data, Fertilizer, Statistical Model by author

Note 10. Global Environmental Pollution and Coronavirus, International Journal of Scientific and Engineering Research, IJSER Volume 11, Issue 9, September 2020 Edition.