Global Environmental Pollution and Its Effect on Life Expectancy

By Dr. M. A. Quader

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Strictly as per the compliance and regulations of:

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Terms

LE Life Expectancy (years)
LEB Life expectancy at birth(years)
LLE Loss of life expectancy (years)
YLL Years of life lost
CD Communicable disease
NCD Non communicable disease
DALY Disability Adjusted Life Years

I. Environmental Pollution

Environment problem is a very big issue and problem for the human society. More than 7 million people die each year from air pollution, according to a new study. It is far more than the estimated 2.6 million people who have died from Covid-19 since it was detected more than a year ago.

Pollution is the world's largest environmental threat to health, responsible in 2020 for an estimated 10 million premature deaths, or 15% of all deaths globally, and 275 million Disability-Adjusted Life Years. This is equal to 0.035 year life expectancy lost on global basis.

Annual deaths due to environmental pollution world over are shown in the following table (Table 1.1). 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 (Fig 1.1).

Table 1.1: Global Deaths due to Pollution[01]

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

As can be seen from the table, 76.17% of the deaths occur due to air pollution followed by water pollution. Long-term health effects from air pollution include heart disease, lung cancer, and respiratory diseases such as emphysema. Air pollution can also cause long-term damage to people's nerves, brain, kidneys, liver, and other organs. Some scientists suspect air pollutants cause birth defects.

Water pollution causes typhoid, cholera, hepatitis and various other diseases and destruction of Ecosystems: Ecosystems are extremely dynamic and respond to even small changes in the environment. Water pollution can cause an entire ecosystem to collapse if left unchecked.

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Global Deaths due to Pollution (million)

Air Pollution: 7.00
Water Pollution: 1.80
Land Pollution: 0.39

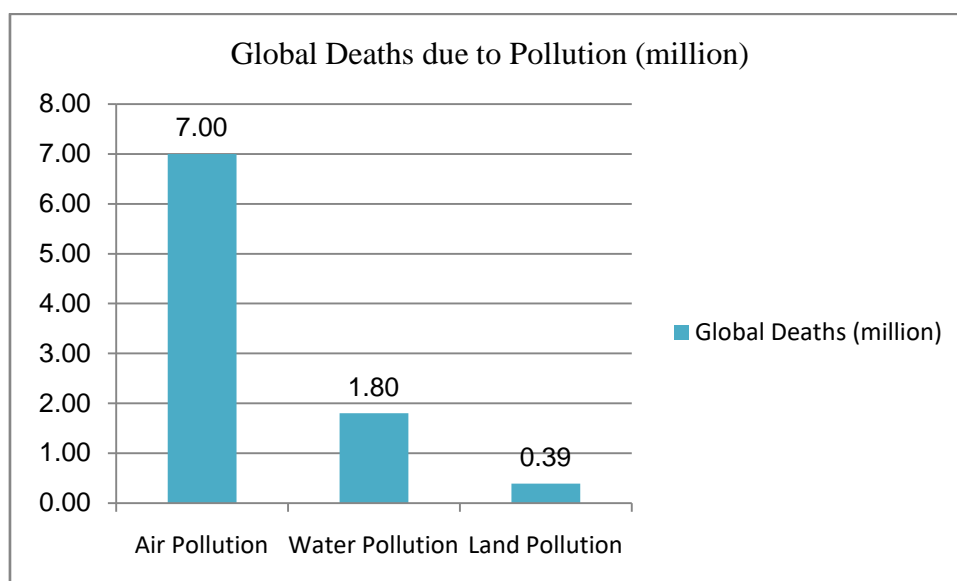Legend: Global Deaths (million)

Fig. 1.1: Global Deaths due to Pollution

Within the pollution sector, air pollution is the most damaging one. Worldwide it causes 76.17% of all the pollution deaths. The Premature deaths attributable to the components of air pollution are shown in Table 2. See also Fig. 1.2.

Table 1.2: World Air Pollutants Yearly Premature Deaths

Sl No.	Air Pollutant	World Yearly Deaths
1	Particulate Matter	4,200,000
2	Carbon Monoxide	1,062,161
3	Lead	853,000
4	Nitrogen Oxides	10,000
5	Ozone	6,000
6	Sulfur Dioxide. Notsignificant	
7	Other Air Pollutants. Not significant	
	Total	6,131,161

World Yearly Air Pollution Deaths

Particulate Matter: 42,00,000
Carbon Monoxide: 10,62,161
Lead: 8,53,000
Nitrogen Oxides: 10,000
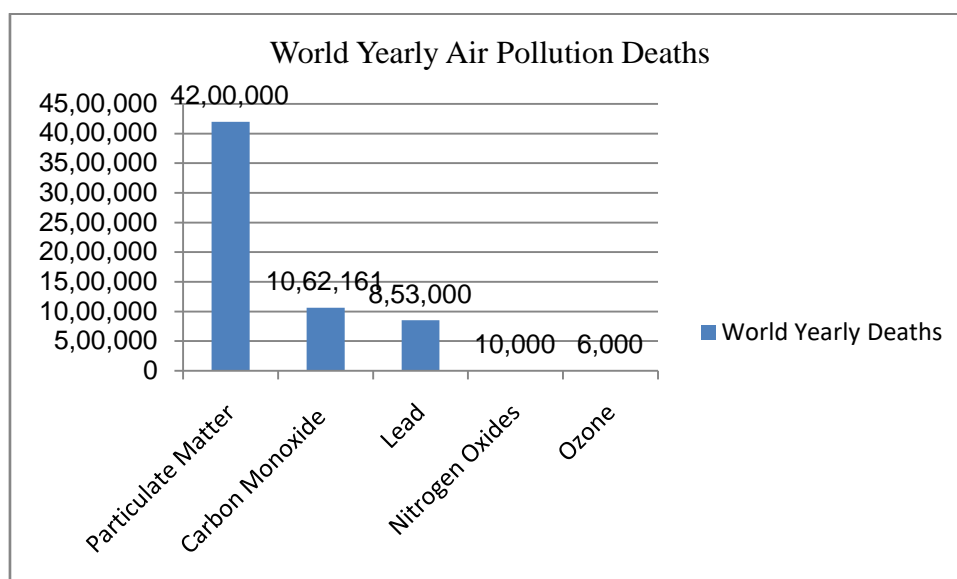Ozone: 6,000

Legend: World Yearly Deaths

Fig. 1.2: World Yearly Air Pollution Deaths

Trend of air pollution in the world is shown in figure 1.3. It is good to see that world deaths are consistently decreasing. The decreasing rate is 1.87 per 100,000 people per year.
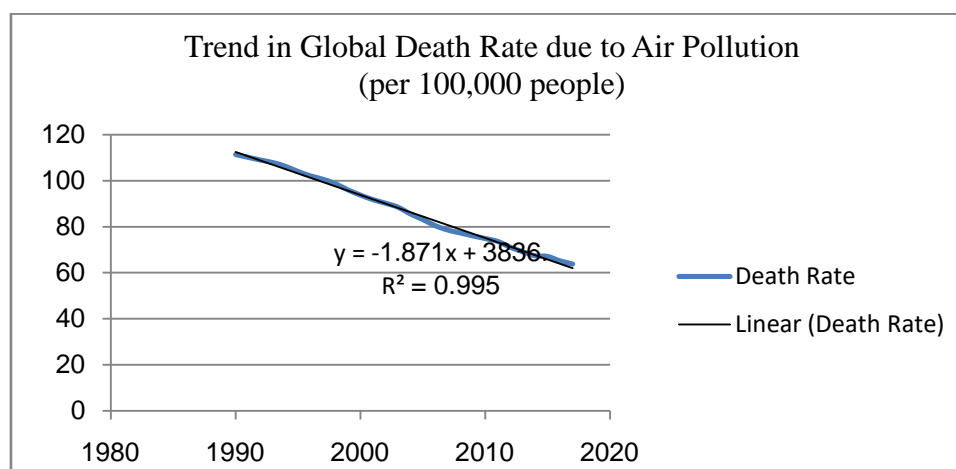
Trend in Global Death Rate due to Air Pollution
(per 100,000 people)

$$y = -1.871x + 3836.$$
$$R^2 = 0.995$$

Fig. 1.3: Global Death Rate due to Air Pollution

According to World Health Organization, Air Pollution causes 7 million premature deaths a year[02]. The World Health Organization (WHO) said air pollution was now one of the biggest environmental threats to human life, leading to seven million premature deaths a year.

a) Life Expectancy

Life expectancy is a statistical measure of the average time the human are expected to live, based on the year of its birth, its current age, and other demographic factors including sex. The most commonly used measure is life expectancy at birth (LEB).

The factors that help increase human life expectancy are better health care and hygiene, healthier life styles, sufficient food and improved medical care and reduced child mortality mean that people can expect to live much longer than our ancestors just a few generations ago.

Despite some odds, especially in the pollution sector, world death rate is declining. As a result, world life expectancy is increasing. This is depicted in Table 2.1 and Figure 2.1.

Table 2.1: World Crude Death Rate

Crude Rateper 1000 people							
Year	1960	1970	1980	1990	2000	2010	2020
Rate	17.712	11.994	10.272	9.226	8.592	7.888	6.09

World Death Rate (per 1000 people)

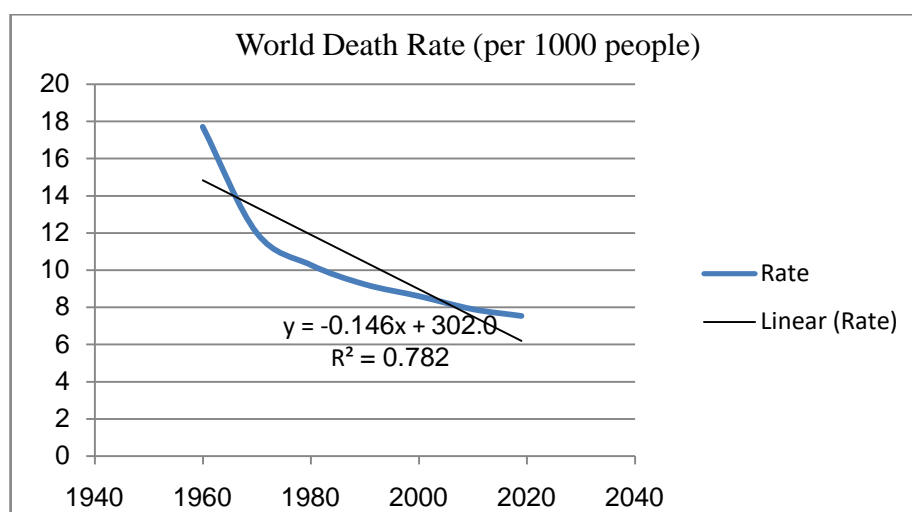$$y = -0.146x + 302.0$$
$$R^2 = 0.782$$

Fig. 2.1: Trend in World Death Rate

Another odd is increase in the life year losses due to non - communicable diseases (NCD). This is evident from figure 2.2.
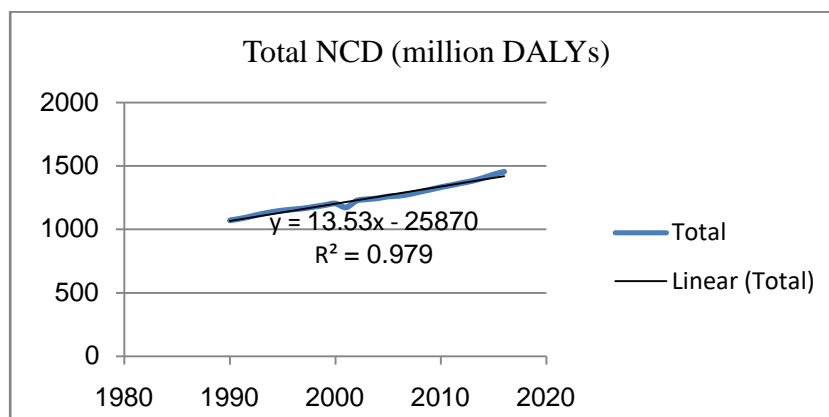

Fig. 2.2: Trend in the NCD

The average Life expectancy data of world population for several years is plotted and presented in Fig 2.3. The trend line is also shown. The statistical model with parameters is shown.
Statistical model is

Life Expectancy (years) = 0.3205 * years – 573.23

R^2 = 0.9671; time period 960 – 2016.

However the average life expectancy is consistently increasing. Every year, 0.3205 year is increasing in the world population life expectancy on average. This means every three years, one year life expectancy is increasing on the average life expectancy of the world population meaning 4 months in every year. See Fig. 2.3
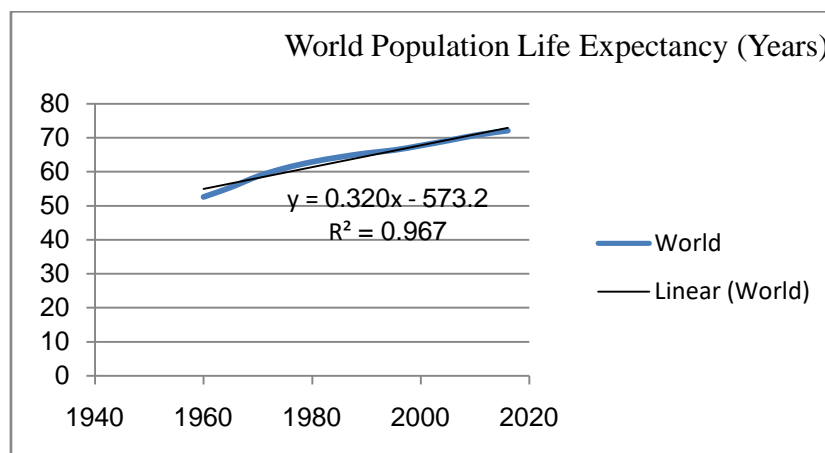

Fig. 2.3: Trend of Life Expectancy of World Population

Since the world countries are much heterogeneous in characters, there are also variations in the life expectancies between different countries, regions and level of economic development. In the table and figure here the variations in life expectancy based on the World Bank Income Groups are depicted. See the Table 2.4 and Fig. 2.4.

Table 2.4: Life Expectancy by World Bank Income Group

SI no.	WB Income Group	Life Expectancy (years) 2020
1	High Income	81.84
2	World	74.18
3	Middle income	74.28
4	Low & Middle income	73.13
05	Lower Middle income	70.21
6	Low Income	63.43

High income group has the highest life expectancy (81.84 years). Placed in order, the low income group has the lowest life expectancy (63.43 years). The trend of the life expectancies of the WB income groups is shown in figure 2.4.
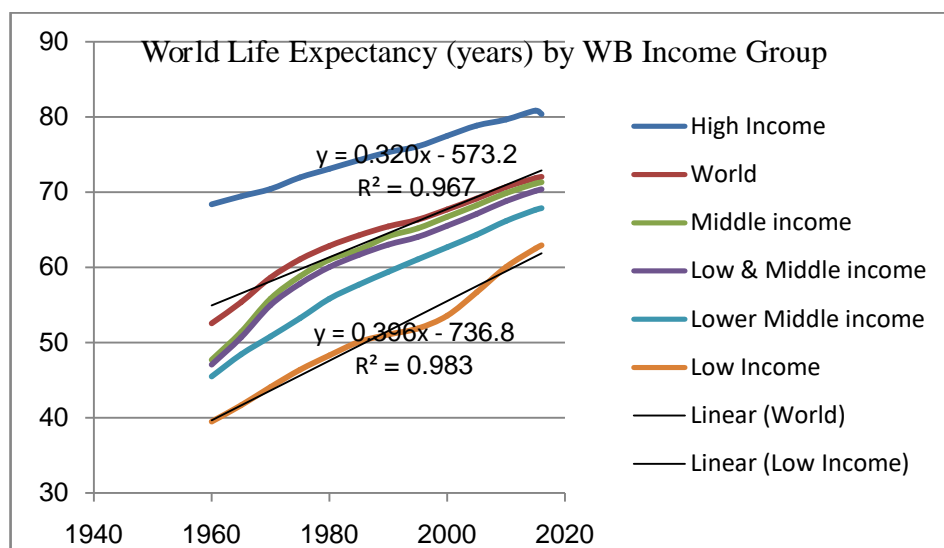

World Life Expectancy (years) by WB Income Group

$y = 0.320x - 573.2$
$R^2 = 0.967$

$y = 0.306x - 736.8$
$R^2 = 0.983$

Legend:
- High Income
- World
- Middle income
- Low & Middle income
- Lower Middle income
- Low Income
- Linear (World)
- Linear (Low Income)

Fig. 2.4: World Life Expectancy (years) by WB Income Groups

Relationship between Life Expectancy and Income Groups is shown in this figure. The trend line of low income group runs at the bottom of all lines indicating lowest level of life expectancy.

Life Expectancy by WB Income Groups 2020 (yeaars)

Legend: Life expectancy (years) 2020

Categories: High Income, World, Middle income, Low & Middle income, Lower Middle income, Low Income
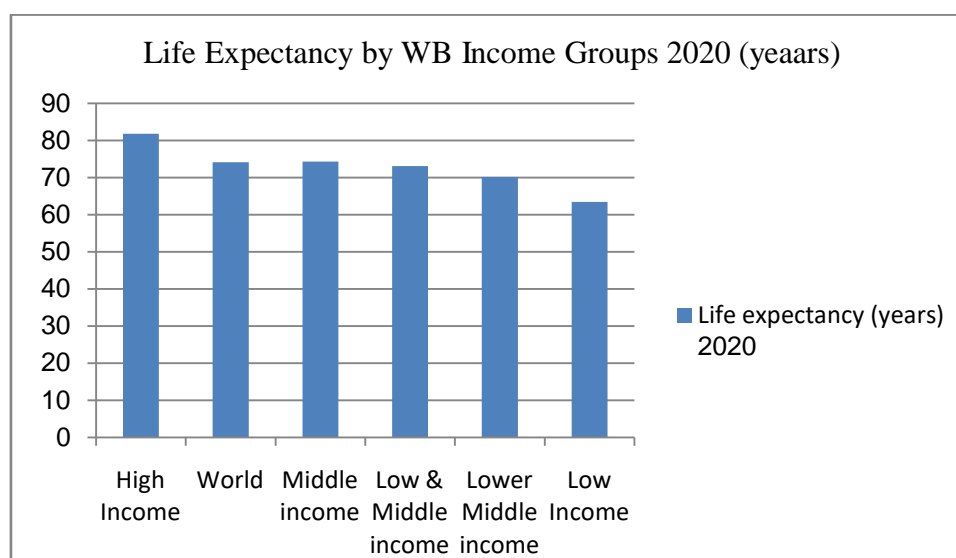
Fig. 2.5: Life Expectancy by WB Income Group 2020 (years)

II. EFFECT OF ENVIRONMENTAL POLLUTION ON LIFE EXPECTANCY

a) Life Expectancy Loss

Life year loss to the world is the most important effect pollution inflicts on the world people. In this connection, Disability Adjusted Life Years Lost in the world in 2020 in NCD is shown in the following table (Table 3.1).

Here it can be seen that the maximum loss (19.22%) occurs due to cardiovascular disease followed by cancer (12.27%). These two diseases burden together account for 31.49% of all the diseases.

The life year losses on account of these diseases are shown in Table 3.1.

Table 3.1: DALY – Disability Adjusted Life Years Lost and Life Expectancy Lost in 2020 (Burden of Diseases – NCD, 2020)

Sl No.	Disease	DALY lost (million)	Percent	Life Expectancy Lost (Year)
1	Cardiovascular Disease	365.87	19.22	0.04720
2	Cancer	233.51	12.27	0.03012
3	Neonatal Disorders	185.78	9.76	0.02397
4	Musculoskeletal disorders	138.72	7.29	0.01789
5	Mental and substance use disorders	122.76	6.45	0.01584
6	Other NCDs	121.89	6.40	0.01572
7	Respiratory diseases	112.32	5.90	0.01449
8	Neurological disorders	111.17	5.84	0.01434
9	Unintentional injuries	105.94	5.57	0.01367
10	Digestive diseases	85.29	4.48	0.01100
11	Transport injuries	75.33	3.96	0.00972
12	Malaria & neglected tropical diseases	62.28	3.27	0.00803
13	Nutrition Deficiencies	58.03	3.05	0.00749
14	Liver Disease	41.40	2.18	0.00534
15	Self Harm	34.01	1.79	0.00439
16	Interpersonal Violence	26.00	1.37	0.00335
17	Maternal Disorders	11.80	0.62	0.00152
18	Conflict and Terrorism	10.10	0.53	0.00130
19	Natural Disaster	1.20	0.06	0.00015
	Total	1903.4	100.00	0.24554

The total DALY (disability adjusted life year lost) is equivalent to 0.25 year life expectancy loss on world average.

For the Communicable diseases, see the following table (Table 3.2) and the figure(Fig 5).

Table 3.2: DALYs Lost (million) in Communicable Diseases (CD)

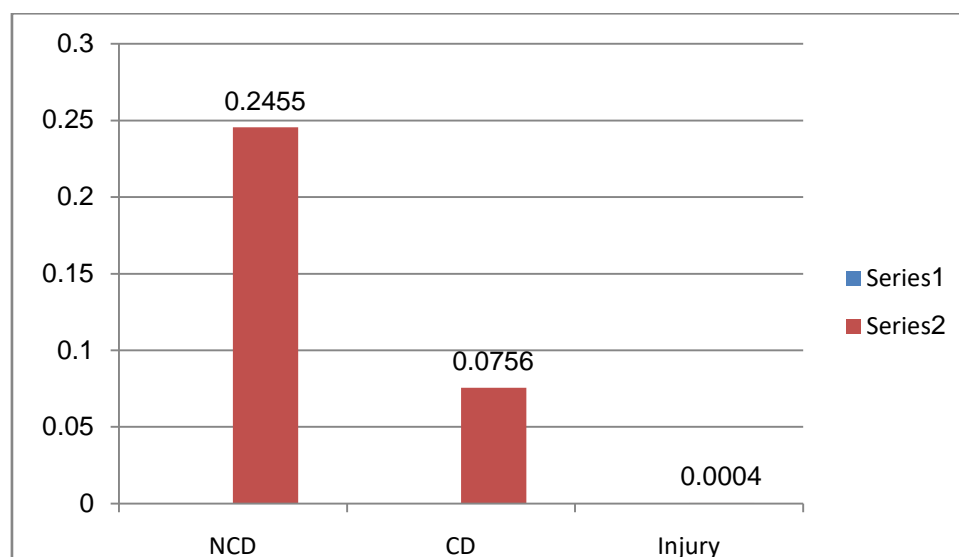| Year	DALY Lost (million) 2020	Percent	Life Expectancy Lost (Years)
Maternal Disorders	11.26	1.92	0.00145
Other Communicable	22.67	3.87	0.00292
Tuberculosis	42.26	7.21	0.00545
HIV/AIDs	41.04	7.01	0.00529
Nutritional Deficiencies	52.84	9.02	0.00682
Malaria & Tropical	60.26	10.29	0.00777
Neonatal Disorders	185.78	31.72	0.02397
Diarrhea etc	169.66	28.96	0.02189
Total CD	585.77	100.00	0.07556
Injuries (including violence, conflict, and self-harm)			0.00042

Fig. 3.1: Life Expectancy Lost (Year) by Burden of Diseases

The total loss per year on account of CD is equivalent to 0.076 year life expectancy loss on the whole world. The life year loss due to CD is 30.77% of that of NCD.

b) *Shortening of Life Expectancy*

Environmental pollution has adverse effect on human life. It shortens the life expectancy. World picture of shortening of life expectancy by pollution is shown in Table 3.2.

Table 3.2: Life Expectancy Shortened in the World by Pollution (2020)

SI no.	Factor	Life Expectancy Shortened (Years)	No People in World (million)	Life Years Each Factor (million)
1	Air Pollution	1.90	5200	9,880.00
2	Smoking	1.80	1,100	1,980.00
3	Alcohol, Drug Use	0.92	2,000	1,833.33
4	Unsafe Water	0.50	144	72.00
5	Road Injuries	0.42	55	22.92
6	HIV/AIDS	0.33	38	12.63
7	Malaria	0.50	229	114.50
8	Diabetes	6.50	463	3,009.50
9	Heavy Stress	2.80	2,714	7,599.20

Life expectancy is shortened maximum by air pollution (1.90 years) resulting a loss of life years of 9,880.00 million life years followed by heavy stress 7,599.20 life years. Overall, the picture of world life year losses (2020) is shown in figure 3.1.

The life expectancy shortening and losses of life years are shown graphically in figures 3.2 and 3.2,

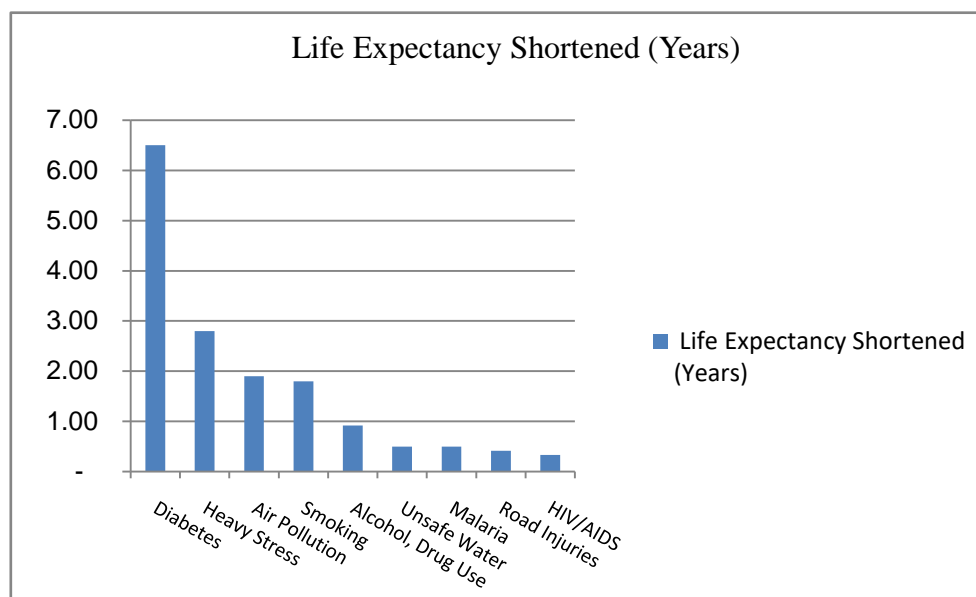Fig. 3.2: Life Expectancy (years) Shortened

Fig. 3.2: Life Years Shortened by Each Factor (million)

In this connection it may be noted that in total, 20,507,518 years of life have been lost to COVID-19 among the studied 81 countries, due to 1,279,866 deaths from the disease. The average years of life lost per death is 16 years. Feb 18, 2564 BE. This is equivalent to shortening of 0.0026 year of life expectancy loss of the entire world on average.

c) Potential Gains in Life Expectancy

It is noted that if the measures can be taken to stop the losses in full, the losses can be recovered in full and the life expectancy can be increased to the extent shown. But it is really difficult to achieve this. So, two scenarios are prepared for potential gains in the average expected life years.

Scenario A: Elimination of all deaths from specific diseases in people aged 30–70 years

Scenario B: Reduction in deaths from specific disease in people aged 30–70 years by a third.

Both the scenarios are shown in Table 3.3. The Sustainable Development Goal is set by the United Nations.

(The Lancet GlobalHealth) estimated in the Sustainable Development Goal two scenarios of potential gains.

The potential gains in life expectancy from the diseases according to World Bank Income Group are shown in Table 3.3.

Table 3.3: Potential Gain in Average Expected Years Lived between Ages 30 and 70 Yearsin 2015 by Cause of Death

Factors	Scenario A (years)	Scenario B (years)
All NCDs	2·22	0·80
Major NCDs	1·78	0·64
(1) Cardiovascular diseases	0·87	0·32
(2) Cancer	0·69	0·26
(3) Chronic respiratory diseases	0·17	0·09
(4) Diabetes	0·14	0·08
All other NCDs	0·44	0·18
Injuries	0·52	0·20
All other causes	0·62	0·24
All CDs	0.15	0.06

Scenario A: Elimination of all deaths from specific diseases in people aged 30–70 years
Scenario B: Reduction in deaths from specific disease in people aged 30–70 years by a third
(Sustainable Development Goal).
Source: The Lancet Global Health

The potential gains in average expected life years and other related information are shown in Table 3.4([04]).

Table 3.4: Potential Gain in Average Expected Life Years Lived between Ages 30 and 70 Years in 2015 by cause of Death and World Bank Economic Groups

Cause of Death	Low-income countries		Lower-middle-income countries		Upper-middle-income countries		High-income countries	
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A	Scenario B
All NCDs	2·75	1·01	2·82	1·03	1·98	0·72	1·46	0·52
Major NCDs	2·18	0·80	2·20	0·81	1·66	0·61	1·11	0·40
(1)Cardiovascular diseases	1·01	0·39	1·20	0·45	0·78	0·30	0·40	0·15
(2) Cancer	0·85	0·33	0·65	0·26	0·72	0·27	0·61	0·22
(3) Chronic respiratory diseases	0·23	0·12	0·26	0·13	0·14	0·08	0·09	0·05
(4) Diabetes	0·17	0·10	0·19	0·10	0·12	0·07	0·07	0·04
All other NCDs	0·58	0·24	0·59	0·24	0·34	0·14	0·36	0·14
Injuries	0·76	0·30	0·59	0·24	0·50	0·20	0·31	0·12
All other causes	2·22	0·80	0·94	0·36	0·32	0·14	0·10	0·05

Scenario A: Elimination of all deaths from specific diseases in people aged 30–70 years
Scenario B: Reduction in deaths from specific disease in people aged 30–70 years by a third
(Sustainable Development Goal)
Source: The Lancet Global Health

Differences can better be visualized from the figure 3.4. Maximum and almost the same value of life expectancy are achieved in low income countries and lower middle income countries.
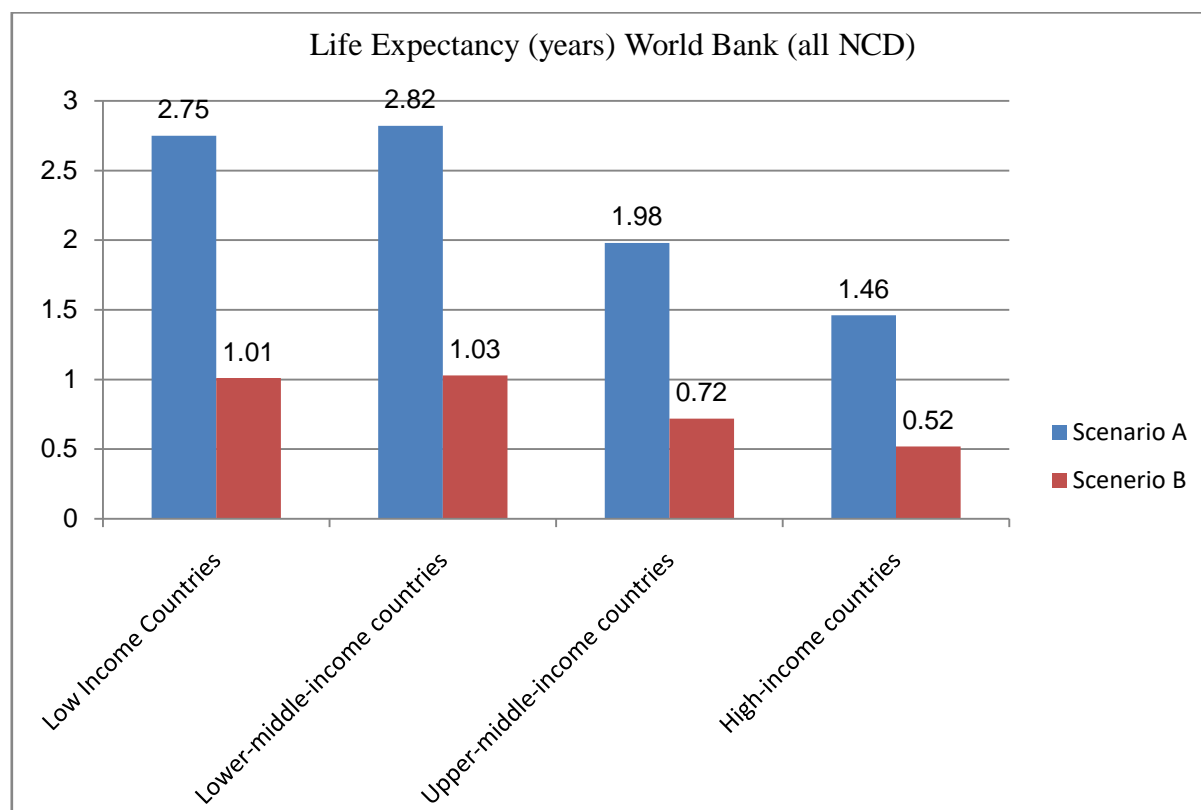

Figure 3.4: Potential Gains in Life Expectancy (years) according to World Bank (all NCD)

Regional Life Year Loss and Life Expectancy Loss are shown in Table 3.5[02]. The variations in life year loss and life expectancy loss may be marked region wise. The avoidable life expectancy loss is in East Asia 3.0 years.

Table 3.5: Regional Life Year Loss and Life Expectancy Loss

SI no.	Region	Mortality ($\times 10^3$/year)	Deaths per 100 000/year	YLL ($\times 10^6$/year)	LLE (years)	Avoidable LLE (years)
1	Africa	957	81	40.0	3.1	0.7
2	East Asia	3112	196	67.4	3.9	3.0
3	South Asia	2809	119	83.6	3.3	1.9
4	West Asia	544	94	14.6	2.3	1.0
5	Europe	790	133	14.3	2.2	1.7
6	Australia	14	47	0.3	0.8	0.2
7	North America	360	74	7.5	1.4	1.1
8	South America	207	42	5.3	1.0	0.5
9	World	8793	120	233	2.9	1.7

YLL Years of life lost
LLE loss of life expectancy

REFERENCES RÉFÉRENCES REFERENCIAS

1. M. A. Quader, Global Environmental Pollution and Coronavirus, International Journal of Scientific and Engineering Research, IJSER Volume 11, Issue 9, September 2020 Edition.
2. http//www.dw.com>who.air.pollution-causes-7-million.., 22/10/2021.
3. Jos Lelieveld, Andrea Pozzer, Ulrich Pöschl, Mohammed Fnais, Andy Haines, Thomas Münzel, Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective, Cardiovascular Research, Volume 116, Issue 11, 1 September 2020, Pages 1910–1917, https://doi.org/10.1093/cv/aa025, published 3 March 2020.
4. The Lancet Global Health, Effect on longevity of one-third reduction in premature mortality from non-communicable diseases by 2030: a global analysis of the Sustainable Development Goal health target, Lancet Global Health, Volume 6, Issue 12, December 2018.