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Environmental Pollution and its Effects on Human Health

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Abstract

Environmental pollution poses a widespread issue with significant implications for the well-being of individuals and populations worldwide. The escalating utilization of fossil fuels, improper sewage disposal practices, and indiscriminate use of agricultural pesticides contribute to the pervasive presence of environmental pollution across the globe. To assess the state of environmental pollution and its impact on human health on a global scale, a comprehensive review of relevant scholarly articles was undertaken. The deleterious effects of pollution manifest in elevated rates of cancer, cardiovascular disease, respiratory ailments, mental disorders, and diarrhea. Each year, approximately 7 million individuals succumb to air pollution-related causes, while an additional 1.6 million people perish due to diseases stemming from water pollution. Environmental pollution emerges as a principal determinant of human morbidity and mortality worldwide, with low-income nations displaying heightened vulnerability. Given the escalating burden of pollution in the modern era, concerted and collaborative efforts by all relevant entities and nations are imperative to mitigate the extent and consequences of pollution on the global environment and human health.

Introduction

Environmental pollution is a global problem that has attracted the attention of human beings for its severe long-term consequences and it is likely to highly influence in human health. Simply, environmental pollution is addition of any substance (solid, liquid, or gas) or any form of energy (such as heat, sound, or radioactivity) to the environment at a rate faster than it can be dispersed, diluted, decomposed, recycled, or stored in some harmless form (Nathamson. 2022). The World Health Organization (WHO) defines pollution as "the presence in or introduction into the environment of substances or agents (including microorganisms), which may cause harm to human health or the living environment" (WHO, 2016). In other words, it is departure toward disequilibrium condition from equilibrium condition in any system. Over the past couple of decades, various sources of pollution are altering the composition of water, air, and soil of the environment. Different chemical substances like toxic metal, organophosphorus compounds, gases; geochemical substance such as dust, sediment; biological organism or product, and physical substance like heat, radiation, sound wave etc are common pollutant that has released intentionally or unintentionally by man into the environment. Depending on the nature of pollutants air pollution, water pollution and soil/ land pollution are the main types threatening the environment, humans, plants, animals, and all living organisms.

Pollution is not a new phenomenon yet it is the world's greatest problem facing humanity and a major cause of human morbidity and mortality and around 9 million people every year die from pollution (Global alliance on health and pollution [GAHP], 2019) which is one in six death worldwide (Fuller et al., 2022). Additionally, low-income countries have been found more vulnerable to environmental pollution. Acording to GBD 2019 Risk Factors Collaborators [GBDRFC], (2020), about 92% of pollution related death and the greasteconomis losses occurs in low income and middle income countries andSouth East Asia is in the worse situation and has the highest mortality due to pollution-related diseases. In Nepal, around 54000 annual death has been reported only due to airpollution (WHO, 2017a). On the other hand, agriculture is the livelihood of half of the population, the use of agricultural chemicals (pesticide, fertilizer, herbicides) is increasing tremendously and along with this incensement of such chemical uses, it has also increased the burden on the environment and human health (GC & Neupane, 2019; Gyawali, 2018).

In this context, the effects of different pollution and its negative health impact is still not well perceived by all stakeholder. Due to a lack of awareness among the citizen,the pollution level is increasing day by day and becoming a serious threat to human health. Hence this study is intended to explore the situation of different types of environmental pollution and their negative consequences on human health based on the available research article and information and finding might be useful to concern authorities to take necessary action to minimize it's the losses that originated from degraded environment.

Methodology

This article is a narrative review of the existing literature on environmental pollution and its effect on human health especially reverence to air pollution, water pollution, and pollution from pesticides. A search of the Elsevier database, Science direct, Google scholars, were undertaken using the search terms

"environment pollution", "air pollution", "water pollution", "pesticide", "health effect", "mortality" "Nepal" in various combinations. Three broad themes were identified and were used to organize the review: a) current situation of environment pollution b) Impact environment pollution on human health c) The impact of pesticide in human health. The review is based on the secondary data from different scholars and institutes and information has been discussed thematically. The article made sure to appropriately cite and acknowledge the work of the original authors, demonstrating a respectful attitude towards intellectual property rights, recognizing the efforts of the researchers involved, and fostering transparency and accountability in academic discussions.

Result and Discussion

While environmental pollution is not a recent occurrence, it continues to pose the greatest challenge to humanity and remains the primary cause of morbidity and mortality worldwide. It significantly impacts the health and well-being of populations across the globe. Environmental factors, including pollution, contribute to approximately 9 million deaths annually, accounting for 16% of all global deaths (GAHP, 2019; WHO, 2022). The majority of these fatalities are observed in low- and middle-income countries, where individuals are often exposed to higher levels of pollution and face limited access to healthcare services. Notably, countries with large populations such as India and China are prominently affected due to their rapid industrialization. Additionally, Nigeria, Indonesia, Pakistan, Bangladesh, and the United States of America also rank among the heavily populated nations grappling with the consequences of pollution (Fig. 1)

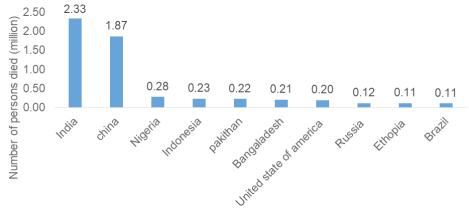

Figure 1. Top ten countries of premature pollution-related death per year

Source: Global alliance on health and pollution (GAHP, 2019)

Conversely, Chad, the Central African Republic, and North Korea stand out as the top three countries with the highest rates of pollution-related deaths per 100,000 population per year, with figures of 287, 251, and 202, respectively (GAHP, 2019). Among various types of pollution, air pollution emerges as the primary contributor to the greatest number of deaths, followed by water pollution (Fuller et al., 2022). However, it is important to note that the reported numbers may increase if all pathways of chemical exposure in the environment are identified and analyzed, as highlighted by Parvez et al. (2021). Furthermore, the impact of pollution on mortality rates and disease burden varies across genders. According to GBDRFC (2020), men are more susceptible to mortality resulting from ambient air pollution, lead pollution, and occupational pollutants, whereas women and children are at higher risk of death due to water pollution compared to men.

Air pollution as health threats

Air pollution is a prominent environmental and public health concern, influenced by factors such as economic development, urbanization, energy consumption, transportation, and population growth.

While developed countries have made significant strides in reducing air pollution levels, developing countries and those in transition continue to grapple with relatively high levels of air pollution (Chen & Kan, 2008). Among various forms of pollution, air pollution exhibits a higher mortality rate, accounting for 7 million deaths annually and ranking as the fourth leading risk factor for premature death worldwide (GAHP, 2019). Mortality rates associated with air pollution are notably higher in developing nations compared to developed ones. Regionally, East Asia accounts for 35 percent of annual air pollution-related deaths, followed by South Asia (32 percent), Africa (11 percent), Europe (9 percent), North and South America (6 percent), and Australia (1.5 percent) (GAHP, 2019).

In low-income countries, household air pollution stemming from the use of solid biomass fuels for cooking and other domestic purposes is a major health issue, whereas ambient air pollution poses a significant challenge in developed and industrialized nations. According to Fuller et al. (2022), ambient air pollution was responsible for 4.5 million deaths in 2019, a significant increase from 2.9 million deaths recorded in 2000, reflecting both rising levels of ambient air pollution and the incidence of non-communicable diseases associated with air pollution. Conversely, in developing countries, household air pollution is primarily attributed to solid biomass fuel usage and represents a significant problem, particularly in low-income nations (WHO, 2019a). Both ambient and indoor air pollutants have been linked to various fatal diseases such as cardiovascular disorders, stroke, high blood pressure, respiratory infections, and lung cancer (WHO, 2019a) (Fig. 2). Furthermore, air pollution has adverse implications for mental health and reduces global life expectancy by an average of nearly three years, leading to a loss in life expectancy (Lelieveld et al., 2020). Overall, the mortality burden associated with air pollution is higher in less developed and moderately developed nations. According to Fuller et al. (2022), annual deaths attributed to ambient and household air pollution worldwide stand at 4.14 million and 2.31 million, respectively.

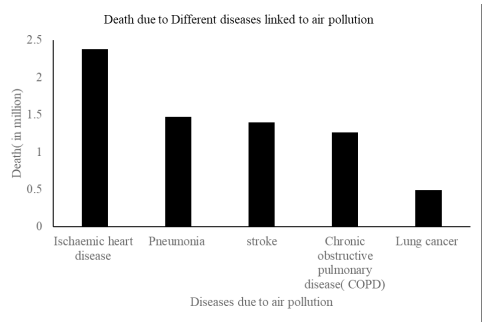

Figure 2. Death due to different diseases linked to air pollution (2019) source: WHO (2019a)

In low income countries, nearly two-thirds (64%) of the infant deaths are linked to use of household burning of solid fuels, especially hitting hardest in South Asia and Sub-Saharan Africa and 22% of all neonatal mortality is linked to air pollution, most of which is attributed to indoor pollution from kitchen fires (State of Global Air [SGA], 2020). In Nepal, also still large percentage of the population is living in rural areas where solid biomass fuel is a principal source of energy that is used for domestic purposes. Such use of biomass fuel is the major cause of household pollution. According to Dhimal et al (2014), solid biomass fuel brings acute respiratory infection (ARI), including acute lower respiratory infection (ALRI), andthat is

the leading cause of childhood morbidity and mortality level in Nepal.

Along with household air pollution, the rapid and uncontrolled urbanization and haphazard developmental projects, people are being victimized by ambient air pollution too, and other serious airborne diseases in Nepal. In 2016, Environmental Performance Index (EPI), Nepal's air quality ranked 176th out of 180 countries and, in Asia, Kathmandu is ranked one of the most polluted cities (Yale center for environmental law and policy [YCELP], 2016). Together with automobile emissions and re-suspended road dust, the brick industry's dust particles are responsible for reducing air quality substantially causing various health problems like Chronic obstructive pulmonary disease (COPD), asthma, bronchitis, silicosis, and other pulmonary complications in Nepal (Thygerson, Sanjel & Johnson, 2016). Peng and Trishna (2018) also reported that coughing, sore throat, runny nose, sneezing, headache, fever which come under mild respiratory disease are the common problem due to air pollution In Kathmandu Valley.

Water pollution and its effects on human health

Water pollution presents a significant global challenge that affects both developed and developing countries, compromising economic growth, socio-environmental sustainability, and the health of billions of people. The release of organic and inorganic water pollutants from various sources continues to escalate, with approximately 80 percent of municipal wastewater being discharged untreated into the environment, and industries dumping substantial amounts of heavy metals, solvents, toxic sludge, and other wastes into water bodies annually (WWAP, 2017). Traditional water pollutants include iron, nitrate, and trace heavy metals such as lead, cadmium, chromium, nickel, zinc, arsenic, and mercury. However, with technological advancements and urbanization, emerging water pollutants such as steroids, hormones, endocrine-disrupting compounds (EDCs), pharmaceuticals and personal care products, and surfactants are becoming more prominent.

Water pollution stands as a leading global problem, resulting in 1.8 million deaths annually and causing diseases such as diarrhea, cholera, dysentery, typhoid, and polio, with diarrhea being the major illness associated with water pollution each year. Additionally, high levels of nitrates in water can lead to the well-known blue baby syndrome, a potentially fatal condition affecting infants (WHO, 2019b). Globally, at least 2 billion people rely on drinking water sources contaminated with fecal matter, with microbial contamination from fecal contamination posing the greatest risk to drinking water safety (WHO, 2022).

Arsenic represents another significant water pollutant with profound implications for human health. According to the WHO (2018), at least 140 million people in 50 countries consume water containing arsenic above the recommended levels, leading to cancer, skin lesions, and associations with cardiovascular disease and diabetes. Contaminants in drinking water have also been identified as a major risk factor for digestive system cancers (Xu, Xing, Wang, & Xiao, 2019). Furthermore, exposure to water pollutants during pregnancy and early childhood has been linked to adverse effects on cognitive development and increased mortality in young adults (WHO, 2018). SAARC nations, including Nepal, have reported contamination of surface and groundwater sources with coliforms, harmful metals, arsenic, and

pesticides, resulting in various public health problems in the region (Azizullah, 2011).

In Nepal specifically, water pollution represents a grave environmental issue. A significant portion of the population still lacks access to basic drinking water services, relying on unreliable and unimproved sources such as ponds, unprotected wells, and streams that are susceptible to pollution from sewage, industrial effluents, agricultural residues, and chemicals (Budhathoki, 2019). Numerous cases of waterborne diseases, including cholera, dysentery, typhoid, and skin diseases, are reported annually, with nearly 30,000 children dying each year due to diarrhea (Pokhrel & Viraraghavan, 2004). Additionally, testing of deep and groundwater samples reveals elevated levels of arsenic content in the Kathmandu Valley and Terai region of Nepal, with 52% of samples exceeding WHO standards (Chapagain, 2008). Shrestha (2012) also found that deep tube wells in the Kathmandu Valley contain higher levels of ammonia, iron, and turbidity compared to WHO guideline values.

Pesticide uses and effects on human health

Along with the increasing population, it is demanding more food every year and other hands the farming land is shrinking hence modern agriculture has to mostly depends on the use of various agrochemicals to bridge the gap between food production and consumption. For this purpose, the use of different agrochemicals (fertilizers, plant-protection chemicals or pesticides, and plant-growth hormones) are increasing throughout the world. Among different agro chemical, pesticide is one of the major input which is used to decrease crop output losses caused by pests and diseases and maintain healthy crops. These are mainly classified into pesticides, insecticides, and herbicides and can be formed by both synthetic and biological compounds. According FAO (2022) there are more than 1000 pesticides used around the world to ensure food is not damaged or destroyed by pests and global use of pesticide is increasing annualy at a rate of 4.1%. Along with agricultural purpose, pesticide also used in private gardens, golf field and other public areas too.

The use of pesticides has increased agricultural production, but on the other hand,it has tremendous negative effects on the environment and human health. Bioaccumulation through the food chain can eventually become a risk to mammals because pesticides induce certain negative effects for a long time from generation to generation (Gerber, et al. 2016; FAO, 2017).The effects of pesticides are not limited to farms but they are affecting the different sectors as they are dispersed through the air, leach into the soil and groundwater, and also run-off into surface water (Gil & Sinfort, 2005; Chopra, Sharma & Chamoli 2011).

Exposure to pesticides and synthetic chemicals was reported related to cancer, obesity, endocrine disruption, and other diseases in human beings (George & Shukla 2011; Araújo et al. 2016; WHO 2017). The misuse and pesticide poising is higher in developing nations and according to Jeyaratnam, there were approximately 2.9 million cases of acute pesticide poisoning, resulting in about 220 000 deaths each year in the developing world. Moreover, the risk of contamination can persist for decades as many pesticides remain in the environment over long periods (Ozkara, Akyil & Konuk, 2016). Similarly, unintentional pesticide poisonings is another burden of pesticed and 385 million people each year suffered from unintentional pesticide poising with around 11000 fatalities cases occure. Likewise 25

million agricultural workers had experience unintentional pesticide poisonings each year (Alavanja & Bonner 2012; FAO, 2017).

Pesticide exposure has shown different short and long terms effects. Diarrhea, abdominal pain, vomiting, nausea, etc. are the short-term effects, whereas skin diseases, cancer, asthma, depression, diabetes, genetic disorders, and death are reported as the long-term effects of pesticides exposure(Tago, Andersson & Treich 2014). Similarly, the effect of pesticide on human may cause acute health problems like allergy, skin irritation, dizziness, lethargy, swelling of the body, development of respiratory diseases like asthma and reduction of sperm quality and sperm count (Ozkara, Akyil & Konuk, 2016; Bhandari, 2014). It is well known now that a significant fraction of pesticides is carcinogenic; for instance, 18% of all insecticides and 90% of all fungicides were found to be carcinogenic (National Academy of Sciences [NAS], 1987). Epidemiologic studies suggest that exposure to some herbicides(2,4-D and MCPA) may be associated with increased risk non-Hodgkins lymphoma (NHL), Hodgkin's disease (HD), leukemia, and soft-tissue sarcoma (STS) (Stackelberg, 2013). Researchers have elucidated the more adverse effect of pesticides in pregnant women, with a 5-9% increase in adverse birth outcomes, decrease in birth weight of a child with gestational length, pre term birth, and birth abnormalities (Larsen, Gaines & Deschenes, 2017).

In the Nepalese context also pesticides are considered a powerful weapon to enhance agriculture productivity and their uses are increasing day by day. In Nepal, within 20 years (from 1998 to 2019) the import of pesticides has increased 12 times that is from 56.17 mt active ingredients (ai) in 1998 to 681.7mt ai in 2019 (Fig.3).

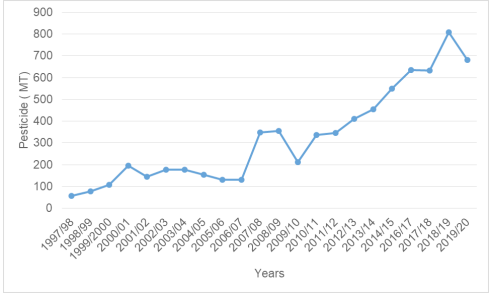

Figure 3. Total pesticide imported in Nepal

Source: Plant quarantine and pesticide management centre [PQPMC], 2021

Though the average use of pesticides in Nepal is comparatively lower as compared to other developed countries but their haphazard use is a big problem in our context. Vegetable crops are the major crops in which farmers use pesticides and 93% of eggplant and 100% of tomato and chili samples had found contained pesticide residues (Bhandari et al, 2019). Along with the huge use of pesticides, it has been administered that farmers in the developing countries do not use safety masks, gloves, and other protective gears during the spraying of pesticides which results in the access of pesticides in the bloodstream through inhalation and dermal exposure which can adversely affect their eyes, skin and the respiratory system and causes serious health hazards (Shrama & Singhvi, 2017). There are no nationwide data on the incidence of acute pesticide poisoning or of the pesticides causing deaths in Nepal but some studies revealed that with the use of pesticides 31% of the farmers complained of headache, 24% complained of skin burning, 27% complained of eye irritation, 10% and 9% of farmers complained about nausea and dizziness respectively in Nepal and India (Bhatta, 2013; Rao et al, 2009).

Conclusions

Pollution remains a significant contributor to human mortality worldwide, with low-income countries being disproportionately affected. The ongoing processes of industrialization, urbanization, and construction activities continue to exacerbate the issue on a daily basis. In addition, countries like Nepal also contend with indoor air pollution and contamination of water sources. The indiscriminate use of pesticides by Nepalese farmers, driven by the demand for increased food production per unit of land, poses a long-term threat to both the environment and human health.

Efforts must be made to raise mass awareness about the detrimental effects of air and water pollution. Programs should be initiated to support impoverished families in replacing traditional cooking stoves with cleaner alternatives, thereby reducing household air pollution. It is crucial to foster coordination among various agencies and provide assistance and incentives for the adoption of plant-based and biological pesticides. Supporting integrated pest management practices and promoting organic farming can help minimize pesticide usage in agriculture. Furthermore, a comprehensive national and international approach should be devised and implemented collaboratively to address pollution effectively, leading to a reduction in associated healthcare costs.

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