Scientific Research Publishing

Atmospheric and Climate Sciences, 2024, 14, 287-298
https://www.scirp.org/journal/acs
ISSN Online: 2160-0422
ISSN Print: 2160-0414

Preserving the Ozone Layers: Battling Illegal Trade in Ozone-Depleting Substances

Ibrahim Badawi

Seattle Law School, Seattle University, Seattle, USA
Email: hema_law@hotmail.com

How to cite this paper: Badawi, I. (2024) Preserving the Ozone Layers: Battling Illegal Trade in Ozone-Depleting Substances. *Atmospheric and Climate Sciences*, **14**, 287-298.
https://doi.org/10.4236/acs.2024.143018

Received: April 20, 2024
Accepted: June 25, 2024
Published: June 28, 2024

Abstract

The depletion of the ozone layer, a vital shield protecting the Earth from harmful ultraviolet (UV) radiation, is now a worldwide environmental concern. Human activities, particularly the release of ozone depleting substances (ODS), have led to the thinning of this protective layer over recent decades. Simultaneously, illegal trade has emerged as a global challenge, giving rise to economic issues, losses of tax revenue, heightened criminal activities, health risks, and environmental hazards. The depletion of the ozone layer, a critical shield protecting the Earth from harmful ultraviolet (UV) radiation, has become a global environmental concern. This paper delves into the legal dimensions surrounding ozone-depleting substances (ODS), their impact on the ozone layer, and the subsequent risk of skin cancer. As countries navigate international agreements, domestic regulations, and enforcement mechanisms, the intricate interplay between legal frameworks and the health implications of ozone layer depletion comes to the forefront. The paper highlights particular instances of illegal trade in ozone depleting substances, drawing from data reported by the parties to the Montreal Protocol. Notably, there are several significant sources of contraband ODS, with countries such as Bulgaria, Lithuania, Poland, and France reporting numerous cases. Analyzing these case instances offers insights into the efficacy of legal frameworks and enforcement measures. The paper offers a comprehensive set of recommendations to strengthen global control and enforcement against the illegal trade of ozone depleting substances. These recommendations span diverse aspects such as production monitoring, customs collaboration, mutual verification, cross-border agreements, public-private partnerships, international cooperation, detection equipment, global regulatory standards, resource allocation, public awareness campaigns, alternative substance development, and controlling the trade at its source. By applying these recommendations and enhancing enforcement measures, we aim to protect the ozone layer and create a healthier and safer world for future generations and achieve sustainable development goals.

Keywords

Ozone-Depleting Substances, Illegal Trade, Montreal Protocol, Environmental Protection, Ozone Layers, Climate Change

1. Introduction

The story of ozone depleting began in 1985 when Joe Farman, Brian Gardiner and Jonathan Shanklin discovered a hole in the invisible shield that protects us from solar radiation, Jonathan Shanklin said "The Discovery had a worldwide impact. It's still having that impact. Because even the smallest changes in ozone readings can reveal interesting things".

To understand this issue, it's crucial to recognize that the Earth's atmosphere consists of several layers. The lowest layer, the troposphere, extends from the Earth's surface up to about 6 miles or 10 kilometers. The next layer, the stratosphere, goes from 6 miles to around 31 miles in altitude. Most commercial airplanes fly in the lower stratosphere [1].

In the stratosphere, found between 9 to 18 miles (15 to 30 km) above the Earth's surface, there is a significant concentration of ozone, a molecule with three oxygen atoms. According to the UN, the ozone layer is a thin shield of gas in the Earth's atmosphere that protects the planet, absorbing the sun's ultraviolet (UV) rays and helping to preserve all life on the planet [2]. While we understand the beneficial role of the ozone layer for humans, the consequence of decades of human misconduct, particularly after the industrial revolution, has led to the depletion of the ozone layers. But how did this happen?

Ozone-depleting substances (ODS), a group of synthetic greenhouse gases, which include chlorofluorocarbons commonly present in everyday items like air conditioners, refrigerators, and aerosol cans, have been causing harm to the ozone layer [3].

The Kigali Amendment to the Montreal Protocol, focusing on substance depleting the Ozone layer, marks a significant milestone in our efforts to control Ozone-depleting substances. It urges leading nations to expedite their commitments to rapidly phasing down these substances. According to this Amendment, all parties must reduce their production and consumption of HFCs by more than 80 the equivalent of more than 70 billion metric tonnes of CO_2 emissions by 2050 [4].

Swiftly reducing CO_2 emission, along with emission of HFCs and other climate superpollutants, is crucial. One effective strategy, among several, involves regulating and controlling the illegal trade of ozone depleting substances. The Kigali Amendment emphasizes the global commitment to combat climate change and protect the environment by addressing not only the legal but also the illegal sources of ozone-depleting substances.

Illegal trade poses a significant challenge for governments worldwide in their

efforts to combat ozone depleting substances, giving rise to various risks and complexities. These risks include economic distortions, tax revenue losses, increased criminal activities, especially along borders, threats to public health and safety, environmental hazards, and development goals. Addressing and understanding these risks and challenges requires the involvement of law enforcement agencies, international cooperation, regulatory measures, public awareness campaigns, and increasing people's awareness.

Illegal trade, which has various definitions, both common and specific, is often referred to as black market or underground economy. It involves the exchange of goods, services, or commodities that violate the laws and regulations of a particular country or jurisdiction [5]. This trade happens outside the formal, government-regulated market named channels such as smuggling, counterfeiting, tax evasion, and the sale of prohibited or controlled substances. The major faced by the parties under Montreal Protocol is that the illegal trade doesn't have a specific definition and it requires further clarification. In recent times, countries worldwide have been grappling with the depletion of the ozone layer, a process that began several decades ago. Illegal trade significantly contributes to the depletion of the ozone layer.

This paper's purpose is to address global concerns regarding the depletion of the ozone layer, as well as the need to confront the illegal trade of ozone depleting substances (ODS). It highlights the legal dimensions surrounding ODS, and how it severely affects the ozone layer. This paper provides comprehensive recommendations to strengthen global controls and enforcement needed to overcome this illegal trade and protect the ozone layer for future generations, fulfilling sustainable development goals.

Furthermore, this paper sheds light on the implications of the recorded cases reported by Montreal Protocol Parties. After analyzing their findings, this paper argues for the necessity of stronger national and international regulations, under the umbrella of the United Nations, to ensure the flow of legal trade in ozone-depleting substances (ODS).

2. How Do the Ozone-Depleting Effects Impact Our Planet?

In simple terms, when ozone levels decrease, it leads to intensified sunlight and greater exposure to UVB radiation at the earth's surface. This results in reduced protection from the sun's harmful effects. For example, consider the Antarctic, where the amount of the UVB radiation at the surface can double during annual ozone hole [6].

The increased UVB radiation has various adverse effects on human health, the environment, and marine life. Firstly, it can elevate the risk of skin cancer and impact the production of essential vitamin D in the skin, crucial for overall health. UVB exposure is also linked to conditions responsible for approximately half of the world's blindness cases, affecting around 20 million people in 2010 [7].

Secondly, in terms of the environment, diseases linked to climate change are significantly influenced by ozone depletion. Unchecked ozone depletion puts

plants, animals, and microbes in natural ecosystems in risk in addition to food production. Essential services that these ecosystems offer include clean water, clean air, and the removal of carbon dioxide from the atmosphere.

Moreover, in terms of marine life, ozone depletion can have a direct and several harmful impacts on crustaceans, fish eggs, and corals. Consequently, uncontrolled ozone depletion would pose a threat to fish and other aquatic resources that play a substantial role in the global food supply [8].

3. The Montreal Protocol: A Milestone in Global Environmental Protection

In 1987, the Montreal Protocol marked a critical moment in global endeavors to shield the ozone-depleting layers. This international agreement garnered signatures from 197 countries, distinguishing it as one of the inaugural treaties in United Nations history to attain universal ratification. The Protocol not only symbolized a collective commitment but also served as the vanguard for consolidating global efforts to preserve the ozone-depleting layers, underscoring the imperative of international collaboration in environmental protection.

The Montreal Protocol has implemented several measures and procedures to control and phase out the production and consumption of ozone-depleting substances (ODS). Here's what the Protocol has done to protect Ozone Layer:

1) Phasing Out ODS Production: The Protocol establishes specific phaseout schedules for different ODS, leading to a gradual reduction in their production and consumption. substances.

2) The Montreal Protocol established an essential quota system to oversee the production and use of ozone-depleting substances (ODS) by participating nations, particularly during the HCFC Phase-out Management Plan (HPMP) implementation. The quota system's core objective is to prevent countries from exceeding their allocated limits for importing and exporting specific substances, in accordance with their national legislation and the Protocol's constraints.

3) Controlled Substances Lists: The Protocol identifies and lists specific ODS, such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and others, that are subject to stringent controls and restrictions. These substances are regulated to prevent their harmful effects on the ozone layer.

4) Regulation of Trade: The Protocol controlled the import and export of new, used, recycled substances ODS through the establishment of licensing systems. Importers and exporters of ODS must obtain licenses, ensuring that their movements are tracked and controlled.

5) Data Reporting: This aspect plays a pivotal role by providing essential statistics for analyzing the efforts of the parties. Parties to the Protocol are mandated to furnish data regarding the production, consumption, trade, and illegal trade of ozone-depleting substances (ODS). This data serves as a crucial tool for monitoring compliance with the Protocol's provisions.

6) Enforcement Measures and Control of Illegal Trade: Parties are urged to take action to identify and sanction illegal activities associated with ozone-depleting

substances (ODS), including smuggling and unauthorized production. These actions may encompass the imposition of penalties for breaches and the initiation of investigative processes.

7) Research and Development: The Protocol promotes research and development efforts to find alternatives to ODS. This has led to the development of ozone-friendly technologies and substances as replacements for ODS.

8) International Cooperation: The Protocol fosters international cooperation, information exchange, and capacity-building initiatives to support the efforts of developing countries in controlling ODS and complying with the Protocol.

4. The Relationship between Illegal Trade and Ozone-Depleting Substances

The link between illegal trade of substances and ozone layer depletion is intricate and interconnected. As illegal trade escalates, there is a corresponding rise in ozone layer depletion; conversely, as illegal trade wanes, so does the reduction in ozone layer depletion. Understanding this positive relationship is of paramount significance in comprehending the measures required to regulate ozone-depleting substance.

Ozone-depleting substances (ODS) comprise a category of synthetic chemicals. Among the most renowned examples are chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrobromofluorocarbons (HBFCs), methyl bromide, carbon tetrachloride, methyl chloroform, and a range of others [9]. These substances find widespread application in various sectors, including home and air conditioning systems, commercial refrigerants, and refrigerators. Furthermore, they serve as constituents in foam blowing agents, aerosol spray propellants, certain components of electrical equipment, industrial solvents, cleaning agents (including those utilized in dry cleaning), fumigants, and fire extinguishing materials. The illegal trade in ozone-depleting substances can worsen the negative impacts in several ways:

1) Production and Distribution: Illegal trade often involves the production and distribution of substances that are banned or restricted under international agreements like the Montreal Protocol. These agreements aim to gradually reduce the production and use of ozone-depleting substances.

2) Health and Environmental Risks: The illegal trade in these substances can lead to improper handling, storage, and disposal, resulting in risks to both human health and the environment. Accidental leaks or releases can harm individuals and ecosystems.

3) Economic consequences: illegal trade, sometimes referred to as the underground economy, can undermine the legal market for more environmentally friendly alternatives to ozone-depleting substances. This not only affects the environment but also has a direct impact on the tax revenue. It counteracts stand against the economic and environmental benefits associated with transitioning to safer and more sustainable technologies, especially the shift toward a circular economy.

4) Transnational organized crime groups are often involved in the illegal trade of ozone-depleting substances, which are banned or regulated by international agreements like the Montreal Protocol, aimed at protecting the ozone layer. Criminal organizations engage in this trade to profit from the high demand for these substances especially from the developing countries, often driven by the availability of cheaper but harmful alternatives. restricted under international agreements like the Montreal Protocol.

5. How This Illegal Trade Is Trafficking?

According to reports submitted by the parties to the Montreal Protocol, as shown in Figure 1, it has been demonstrated that most ozone-depleting substances originate from Türkiye and Belarus. The figure reflects the number of reported cases involving these substances. These countries have emerged as significant sources of contraband ozone-depleting substances, contributing to the global challenge of ozone layer depletion. Understanding the primary suppliers is crucial in addressing illegal trade and implementing effective control measures. This figure reflects that the majority of cases seized by the parties indicate Türkiye, followed by Belarus, as the major sources of illegal trade in ozone-depleting substances [10].

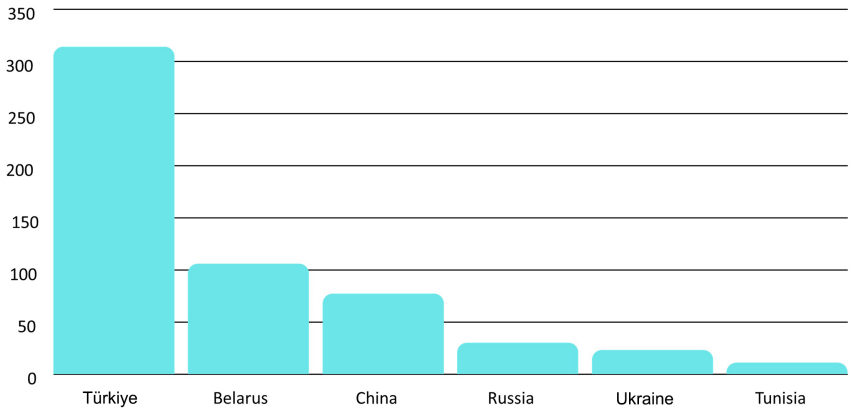

Figure 1. Major sources of illegal trade in ozone-depleting substances.

6. The Cases of Illegal Trade in Substances Controlled under the Montreal Protocol

According to reports submitted by the parties to the Montreal Protocol as shown in Figure 2, this figure reflects the number of cases reported by parties and successfully seized by the authorities. Bulgaria stands out as a country with a significant number of reported cases related to illegal imports of ozone-depleting substances. This trend began in 2007, and most of these cases fall under the category of attempted illegal imports of ozone-depleting substances. Bulgarian customs authorities successfully intercepted and halted these attempts at the Bulgarian border. The cylinders containing these substances were seized and subsequently directed for destruction in facilities recommended by the law.

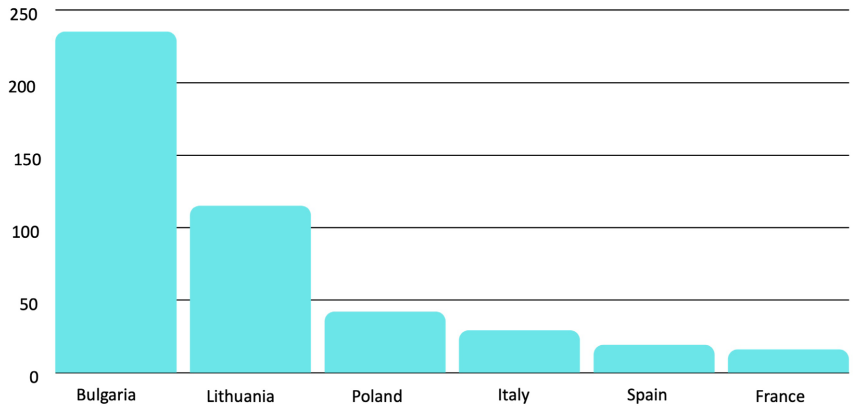

Figure 2. Illegal trade cases reported by Montreal protocol parties.

In the case of Lithuania, which ranks second in terms of the highest number of cases provided by Montreal Parties, these incidents are primarily attributed to smuggling non-refillable cylinders detected during roadside inspection, importing ozone depleting substances (ODS) outside the quote system specified in the Montreal protocol, and some of them are related to goods being mis-declared with the wrong Hs code. In response, the government imposed fines, and the goods were seized.

Similarly, Poland has reported numerous cases related to illegal ozone depleting substances. These cases encompass a wide range of infractions, including smuggling, goods not declared for customs clearance, use of non-refillable cylinders, violations of regulations 517/2014, false labeling, and imports outside the quota system.

France, too has reported several cases, also starting in 2007. These cases encompass various categories, including the illegal packaging of refrigerants in non-refillable cylinders, which is prohibited within the European Union. Additionally, cases involve the illegal import and export of air conditioning units, which were detected by French customs authorities.

7. Analysis of the Cases of Illegal Trade in Substances Controlled Under the Montreal Protocol

These figures pertain to specific instances of illegal imports of substances that deplete the ozone layer, with many of these cases attributed to various countries that are significant suppliers of such substances. It is important to acknowledge that these statistics reflect varying perspectives, shedding light on the effectiveness of legal systems and law enforcement agencies across international borders.

On one hand, a high number of cases may indicate that numerous countries lack strict and effective laws or regulations to combat and control the illegal import of these substances. This underscores the necessity for more robust legal measures and enhanced international cooperation to comprehensively address the issue. It may also highlight the challenges associated with enforcing and regulating such matters across borders.

Conversely, a high number of cases can signify a country's implementation of strong enforcement agencies capable of effectively monitoring, seizing, and apprehending those involved in such criminal activities. This underscores the necessity of law enforcement efforts and international collaborations in curbing illegal trade.

On the other hand, countries with few or no recorded cases may indict two distinct scenarios. They might have relatively weak enforcement agencies or regulatory frameworks, leading to an inability to effectively combat such criminal activity. In such cases, strengthening enforcement and regulations becomes imperative.

Conversely, countries with minimal recorded cases could have highly effective enforcement agencies successfully preventing such occurrences, in these instances, their strict measures act as a strong deterrent against illegal imports of ozone-depleting substances.

In summary, the numbers of recorded cases serve as valuable indicators of the global landscape of illegal ozone-depleting substances trade. Analyzing these figures can inform efforts to develop and enforce regulations, enhance international cooperation, and strengthen enforcement agencies to protect the ozone layer and mitigate environmental harm.

8. Challenges in Combating Illegal Trade of Ozone-Depleting Substances (ODS)

This section explores the challenges and difficulties associated with controlling illegal trade in ozone-depleting substances. These challenges encompass a wide range of factors, each contributing to the complexity of the issue. To provide a comprehensive understanding, we will give highlight the struggles and obstacles faced in regulating and combating illegal trade, through the following 12 key points:

1) Global Nature of the Trade: Illegal trade often crosses international borders, making it challenging to coordinate efforts and enforce regulations effectively.

2) Complex Supply Chains: Ozone-Depleting Substances (ODS) may pass through multiple intermediaries, making it difficult to trace the origins and destinations of these substances. Additionally, ODS come in various forms, including liquids and gases, which lack distinct odors, making it challenging for customs officers to detect them.

3) Diverse Range of Substances: ODS encompass various chemicals, each with unique characteristics, posing challenges in regulating and monitoring them. The diverse physical states of these substances, from liquids to gases, further complicate detection and seizure.

4) Inadequate Regulatory Frameworks: Some countries may lack robust legal frameworks to control ODS trade or may have weak enforcement mechanisms. The effectiveness of regulations often depends on the economic and develop-

mental status of individual countries, as well as the awareness of people.

5) Limited Resources: Insufficient funding and manpower for enforcement agencies can hinder their ability to combat illegal trade effectively. Both funding and manpower are crucial elements that work together to address this issue.

6) Lack of Adequate Inspection Equipment: most countries lack advanced equipment to detect and confirm the presence of ODS, which should be highly developed to check these distinctive materials, making it difficult to seize them.

7) Evolution of New Substances: Criminals may continually seek new substances that are not yet regulated, requiring updated regulations and monitoring mechanisms to keep pace with these distinct materials.

8) Corruption and Bribery: Inadequate government oversight can lead to corruption and bribery, undermining efforts to combat illegal trade.

9) Lack of Awareness: Some individuals and businesses may not be aware of the environmental and legal implications of ODS trade.

10) Limited Availability of Alternative Substances: Developing countries with economic constraints often struggle to transition to alternative substances due to limited technological advancements. Support in discovering and adopting alternatives is crucial in overcoming this challenge.

11) Support for Developing Countries: Providing subsidies, additional funds, and incentives can facilitate the development of regulations and laws to control illegal trade

12) Enhanced International Cooperation: Effective control of illegal trade necessitates strong international collaboration. Differing priorities among nations can present obstacles to these efforts, highlighting the need for effective coordination on a global scale.

9. Recommendations to Strengthen Control and Enforcement against Illegal Trade of Ozone-Depleting Substances

After conducting a comprehensive analysis of the challenges and complexities surrounding the illegal trade of ozone-depleting substances (ODS), as well as understanding the environmental impact of ozone depletion on our planet and its effects on various sectors of our lives, it is essential to propose a set of recommendation aimed at strengthening control, minimizing, and enforcing measure against this illegal trade. The following recommendations address the various aspects of ODS trade and aim to enhance international efforts to protect the ozone layer:

1) Production monitoring and transparency: Encourage major ozone-depleting substance-producing countries to establish transparent and accountable systems for monitoring and reporting their production levels under Montreal Protocol, involving regular reporting to international body responsible for ozone layer protection.

2) Customs Collaboration and Joint Training: Enhance collaboration between customs agencies across nations, enabling the sharing of intelligence and best

practices in detecting illegal trade. Organize joint operations and training exercises to strengthen enforcement capabilities, ultimately leading to the establishment of international customs units to oversee the illegal trade of ozone-depleting substances.

3) Cross border agreements for control: Establish bilateral or regional agreements aimed at fostering collaboration in regulating the production and trade of ozone-depleting substances. These agreements would encompass the sharing of information, coordinated inspections, and mutual enforcement support.

4) Cooperation between public and private partnership for self-regulation: it's crucial to engage the private sectors in self-regulation to assume responsibility and propose effective solutions for controlling the illegal trade for ozone-depleting substances by providing them subsidies and incentives. Through these methods, they will play an important role in addressing this issue.

5) Standardized Detection Equipment: Promote the development and distribution of standardized, and user-friendly detection equipment to help customs officers identify ozone-depleting substances effectively.

6) Global Regulatory Standards: Encourage uniform global regulatory standards for controlling ODS trade, aiding countries with inadequate regulatory frameworks in adopting best practices on how to control and minimize the ODS trade.

7) Resource Allocation for Enforcement: Provide financial and technical support to developing and resource-limited countries enabling them to strengthen their enforcement agencies and enhance their capabilities to combat illegal trade, and develop regulations and laws and transition to alternative substances.

8) Public Awareness Campaigns: Launch campaigns to educate individuals and businesses about the environmental and legal implications of ozone-depleting substance trade, thus reducing demand and involvement in illegal activities.

9) Alternative Substance Development: enhance research and development efforts to discover and promote environmentally friendly alternatives to ODS, especially in developing countries with limited technological advancements.

10) Minimizing and controlling the trade of Ozone-Depleting Substance at the source: this requires international collaborative efforts. The focus should be on identifying major (ODS) producing countries and establishing new mechanisms aimed at reducing and closing illegal trade (ODS) from the source, rather than allowing it to cross borders. This proactive approach entails close collaboration to limit production and ensure compliance with international agreements like Montreal Protocol, ultimately safeguarding the ozone layer and the environment.

10. Conclusions

In conclusion, the illegal trade of ozone depleting substances imposes challenges and risks to governments worldwide. It disrupts economic stability, diminishes tax revenues, fuels criminal enterprise, threatens public and health safety, and

poses a severe threat to the environment. As well as it contravenes the goals of sustainable development. Addressing these challenges requires a comprehensive approach including law enforcement agencies, international cooperation, stringent regulatory measures, and increased public awareness campaigns.

The crucial role of the ozone layer in safeguarding life on Earth is evident, with profound effects on human health, the environment, and marine life. Its significance lies in maintaining the delicate balance essential for life. The consequences of ozone depletion extend widely, impacting human health, ecosystems, and climate. The Montreal Protocol stands as a landmark, representing significant international cooperation in global environmental protection. This protocol plays a vital role in controlling and phasing out ozone-depleting substances, marking the onset of a new era of international collaboration to preserve and protect the ozone layer from further depletion. Ozone-depleting substances encompass skin cancer and eye disease.

To address the challenges outlined earlier, a set of recommendations is required. These suggestions center around maintaining a global grip on the illegal trade of ozone depleting substances. They encompass aspects such as production monitoring, customs collaboration, mutual verification, crossborder agreements, fostering public-private partnerships, enhancing international cooperation, adapting new detection technology, implementing global regulatory measures, allocating recourse judiciously, increasing public awareness campaigns, promoting the development of alternative substances, and curbing ozone-depleting substances trade at the sources. By implementing these recommendations and strengthening enforcement measures, governments can strive for a future where the ozone layer remains intact, ensuring a healthier and safer world for the next generation.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] UCAR SciEd. (n.d.) Layers of the Earth's Atmosphere. UCAR Center for Science Education.
https://scied.ucar.edu/learning-zone/atmosphere/layers-earths-atmosphere

[2] United Nations Environment Programme (n.d.) Ozone and You.
https://ozone.unep.org/ozone-and-you

[3] Department of the Environment and Energy, Australia (n.d.) Ozone-Depleting Substances.
https://www.dcceew.gov.au/environment/protection/ozone/ozone-science/ozone-depleting-substances

[4] Andersen, S.O., Gonzalez, M. and Rand, S., Eds. (2023). 35th Anniversary Protecting the Ozone Layer: Condensed Second Edition. 2nd Edition, United Nations Environment Programme.

[5] Investopedia Team (2021) Black Economy, Aka Black Market. Investopedia.

https://www.investopedia.com/terms/b/black-economy.asp

[6] U.S. Environmental Protection Agency (EPA). Health and Environmental Effects of Ozone Layer Depletion. https://www.epa.gov

[7] Wale, M.Z., *et al.* (2020). Cataract and Associated Factors among Adults Visiting Ophthalmic Clinic at Debre Markos Comprehensive Specialized Hospital, Northwest Ethiopia. *SAGE Open Medicine*, **9**. https://doi.org/10.1177/2050312121989636

[8] United Nations Environment Programme. "Ozone and You". https://ozone.unep.org/ozone-and-you

[9] Gutberlet, J. and Uddin, S.M.N. (2017) Household Waste and Health Risks Affecting Waste Pickers and the Environment in Low- and Middle-Income Countries. *International Journal of Occupational and Environmental Health*, **23**, 299-310. https://doi.org/10.1080/10773525.2018.1484996

[10] United Nations Office on Drugs and Crime (UNODC) (n.d.) Chapter 10. Illicit Trade in Ozone-Depleting Substances (ODS) from East Asia to the World. https://www.unodc.org/documents/toc/Reports/TOCTA-EA-Pacific/TOCTA_EAP_c10.pdf