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THE MANAGEMENT AND CONTROL OF OZONE-DEPLETING SUBSTANCES UNDER THE INTERNATIONAL TREATIES: A RE-ANALYSIS

Rilwan F. Mahmoud *
&
Omodara B. Olawumi **

Abstract

There has been a commendable surge in the global awareness of preserving the Ozone layer. The Ozone layer is responsible for shielding the Earth's surface from harmful rays of the sun but has continually been compromised by man-made chemicals commonly referred to as Ozone-depleting Substances. This paper examines the effectiveness of the regulatory efforts of international bodies to preserve and protect the ozone layer. The paper achieves this by highlighting the most relevant International treaties regulating the ozone-depleting substances with a view to determine what each of their efforts entails and how effective these treaties have been in attaining their desired goals. The paper finds that while there have been several positive results; the main challenges have been the lack of availability of substitutes for the ozone-depleting substances as well as sauntering commitments by member states. The paper then recommends that more effective countermeasures be put in place for parties that do not reach their intended goals and as well as the construction of realistic time frames to help the parties reach pragmatic goals.

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1.1 THE OZONE AND THE OZONE LAYER

The importance of ozone to the existence and survival of all life on earth cannot be overstated. This is because without the ozone, life as we know it would not have had protection from the direct rays of sunlight.² Though the first stage of single cell organism development requires an oxygen-free environment, as the primitive forms of plant life multiplied and evolved, they began to release minute amounts of oxygen through the photosynthesis reaction.³ The accumulation of oxygen through time particularly in the stratosphere is what led to the creation of what we know as the ozone layer.⁴ The primary benefits being, the filtration of destructive ultraviolet rays from the sun thus allowing for the development of advanced life forms on earth.⁵

The Ozone is a gas that is naturally present in the atmosphere which is composed of a solitary Oxygen atom (O) merging with an Oxygen Molecule (O₂) to form a Triatomic Oxygen (O₃).⁶ The term 'ozone layer' generally refers to a relatively high concentration of Ozone in the

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- 2 Sivasakthivel.T and K.K.Siva Kumar Reddy 'Ozone Layer Depletion and Its Effects: A Review' International Journal of Environmental Science and Development, Vol.2, No.1, February 2011 ISSN: 2010-0264
 - 3 Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), Washington, DC, 1995.
 - 4 Sivasakthivel.T and K.K.Siva Kumar Reddy 'Ozone Layer Depletion and Its Effects: A Review' International Journal of Environmental Science and Development, Vol.2, No.1, February 2011 ISSN: 2010-0264
 - 5 Fakhra Anwar, Fahad Nazir Chaudhry, Saiqa Nazeer, Noshila Zaman, Saba Azam Causes of Ozone Layer Depletion and Its Effects on Human: Review (Atmospheric and Climate Sciences, 2016, 6, 129-134 <<http://www.scirp.org/journal/aes><http://dx.doi.org/10.4236/aes.2016.61011>> last accessed on the 3rd of August, 2018); World Meteorological Organization (WMO), "Scientific Assessment of Ozone Depletion: Report No. 44," World Meteorological Organization, Geneva, 1998.
 - 6 F. M. Mims "What is the Ozone layer and how does it affect you" (1994) Access Research Network Volume 3, Number 1

Stratosphere, a layer of very dry air around 19 and 30 kilometers (12 to 30 miles) above the Earth's surface.⁷ Most of the ozone on earth, approximately 90% can be found in the stratosphere which extends over the entire globe with some variation in altitude and thickness while the rest of it is in the troposphere, which is the lowest region of the atmosphere (between earth's surface and the stratosphere). As earlier stated the layer contained in the stratosphere⁸ is essential for the shielding of the earth's atmosphere from damaging ultraviolet radiation emitted by the sun which can be dangerous to biological life forms on earth as well as damaging to certain inorganic entities.⁹

2.1 WHAT ARE OZONE-DEPLETING SUBSTANCES

Ozone depletion occurs when there is a disruption in the volume of ozone contained in the stratosphere by unnatural activities such as by-products in the form of chemical compounds commonly referred to as ozone-depleting substances (ODS).¹⁰ When these substances break down in the atmosphere, they release certain chemicals such as chlorine or bromine which act as catalysts breaking down tens of thousands of ozone molecules before being removed from the stratosphere. ODS¹¹

⁷ Committee on Solar Terrestrial Research, "Solar Terrestrial Research for the 1980's," A Report, National Research Council, National Academy Press, Washington DC, 1981.

⁸ F. M. Mims "What is the Ozone layer and how does it affect you" (1994) Access Research Network Volume 3, Number 1; Anjali Aggarwal and others Depletion of the Ozone Layer and Its Consequences: A Review (*American Journal of Plant Sciences*, 2013, 4, 1990-1997 <<http://dx.doi.org/10.4236/ajps.2013.410247>> last accessed on the 7th of August, 2018)

⁹ Y. Matsumi and M. Kawasaki, "Photolysis of Atmospheric Ozone in the Ultraviolet Region," *Chemical Reviews*, Vol. 103, No. 12, 2003, pp. 4767-4781. <http://dx.doi.org/10.1021/cr0205255>

¹⁰ Angell, J.K. and Korshover, J. (2005) Quasi-Biennial and Long-Term Fluctuations in Total Ozone. *Monthly Weather Review*, 101, 426-43.

¹¹ United State Environmental Protection Agency 'Ozone layer depletion' <<http://www.epa.gov/sunwise/doc/ozonedepletion.pdf>> last accessed on 5th September 2014

that contain chlorine and bromine molecules such as methyl chloroform, halons, and chlorofluorocarbons (CFCs), are stable and have atmospheric lifetimes long enough to be transported by winds into the stratosphere.¹²

In 1974, chemists F. Sherwood Rowland and Mario Molina of the University of California first proved that ultraviolet (UV) rays from the sun break up CFCs in the stratosphere and that the chlorine atoms therefrom, was a major cause of the destruction of the stratospheric ozone.¹³ CFCs are highly volatile and can evaporate quickly thus easily reaching the stratosphere.¹⁴ The rate of ozone depletion has been increasing by 0.5 percent per year since the year 2000.¹⁵ Due to depletion of Ozone, UV rays penetration into the troposphere has drastically increased leading to more ozone formation in the troposphere and has had extremely damaging effects particularly on organic life forms on the planet.¹⁶

- 12 Andersen, S. and Sarma, M. (2002) Protecting the Ozone Layer. The United Nations History, Earthscan Publications Ltd., Virginia; Ravishankara, A.R., Daniel, J.S., and Portmann, R.W. (2009) Nitrous Oxide (N₂O): The Dominant Ozone-Depleting Substance Emitted in the 21st Century. *Science*, **326**, 123-125. <<http://dx.doi.org/10.1126/science.1176985>>
- 13 Angell, J. K. "The Variations in Global Total Ozone and North Temperate Layer Mean Ozone." *Journal of Applied Meteorology*, vol.27, no. 1, pp. 91-97, 2007; Sivasakthivel.T and K.K.Siva Kumar Reddy 'Ozone Layer Depletion and Its Effects: A Review' International Journal of Environmental Science and Development, Vol.2, No.1, February 2011 ISSN: 2010-0264
- 14 Environmental Fact Sheet. New Hampshire Department of Environmental Services 'Chlorofluorocarbons (CFCs)' Health Information Summary, 2010. Fakhra Anwar, Fahad Nazir Chaudhry, Saiqa Nazeer, Noshila Zaman, Saba Azam Causes of Ozone Layer Depletion and Its Effects on Human: Review (Atmospheric and Climate Sciences, 2016, 6, 129-134 <<http://www.scirp.org/journal/acs><http://dx.doi.org/10.4236/acs.2016.61011>> last accessed on the 3rd of August, 2018)
- 15 Rozema, J., Boelen, P. and Blokker, P. Depletion of Stratospheric Ozone over the Antarctic and Arctic: Responses of Plants of Polar Terrestrial Ecosystems to Enhanced UV-B, an Overview. *Environmental Pollution*, **137**, 428-442. 2005<<http://dx.doi.org/10.1016/j.envpol.2005.01.048>>
- 16 Fears, T.R., Bird, C.C., Guerry, D., Sagebiel, R.W., Gail, M.H., Elder, D.E., Halpern, A., Holly, E.A., Hartge, P. and Tucker, M.A. (2002) Average Midrange Ultraviolet Radiation Flux and Time Outdoors Predict Melanoma Risk. *Cancer Research*, **62**, 3992-3996; B. O. Bolaji and Z. Huan, "Ozone Depletion and Global Warming: Case for the Use of Natural Refrigerant – A Review," *Renewable & Sustainable Energy Reviews*, Vol. 18, 2013, pp. 49-54.

Another cause of ozone layer depletion is global warming.¹⁷ The ozone layer depletion had for a while been treated as separate and distinct from the effect of climate change with researchers addressing them separately.¹⁸ Although climate change is concerned with how carbon dioxide, methane, and other greenhouse gases emitted by human activities are altering the climate system while ozone depletion is concerned with the effect of the breakdown of chemicals like chlorine or bromine on the ozone layer, their effects have been shown to be somewhat symbiotic.¹⁹ Scientists are now concerned that continued global warming will accelerate ozone destruction and increase stratospheric ozone depletion likewise, the use of CFC has also been shown to exacerbate global warming.²⁰ This is because global warming and greenhouse gasses trap heat in the troposphere thus making the stratosphere colder than it should be and the recovery of ozone layer requires as much heat as possible thus the depletion of ozone.²¹

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- 17 Fakhra Anwar, Fahad Nazir Chaudhry, Saiqa Nazeer, Noshila Zaman, Saba Azam "Causes of Ozone Layer Depletion and Its Effects on Human: Review" (Atmospheric and Climate Sciences, 2016, 6, 129-134)
- 18 Fergusson A, Ozone depletion and Climate change: Understanding the linkages (Minister of Public Works and Government Services Canada, 2001)
- 19 Kameshwar Sharma Yadavilli and others "Depletion of the Ozone Layer and Its Consequences: A Review" (American Journal of Plant Sciences · January 2013 DOI: 10.4236/ajps.2013.410247 last accessed on the 3rd of August, 2018)
- 20 Sivasakthivel, T and K.K. Siva Kumar Reddy 'Ozone Layer Depletion and Its Effects: A Review' International Journal of Environmental Science and Development, Vol.2, No.1, February 2011
ISSN: 2010-0264
- 21 B. O. Bolaji and Z. Huan, "Ozone Depletion and Global Warming: Case for the Use of Natural Refrigerant—A Review." *Renewable & Sustainable Energy Reviews*, Vol. 18, 2013, pp. 49-54; Fakhra Anwar, Fahad Nazir Chaudhry, Saiqa Nazeer, Noshila Zaman, Saba Azam Causes of Ozone Layer Depletion and Its Effects on Human: Review (Atmospheric and Climate Sciences, 2016, 6, 129-134)

THE EFFECT OF OZONE-DEPLETING SUBSTANCE

3.1 ON BIOLOGICAL LIFE FORMS

Ultraviolet radiation from the sun can be damaging to life on earth in many ways including countless diseases such as skin cancer, genetic mutations, stunted growth as well as damage to the eyes.²² For instance the risk of contracting cataract which is one of the major causes of blindness increases by 0.3% - 0.6% if the stratospheric ozone decreases by as little as 1%.²³ This is because the UV rays produce oxidative agents which can severely damage the cornea of the eyes and can cause Photokeratitis.²⁴ Exposure to UV radiation has also been shown to be a major cause of several skin diseases.²⁵ Breast cancer, Leukemia as well as lung diseases such as Bronchitis, Emphysema and asthma have also been heavily linked to UV radiations exposure.²⁶

- 22 Y. Matsumi and M. Kawasaki, "Photolysis of Atmospheric Ozone in the Ultraviolet Region," *Chemical Reviews*, Vol. 103, No. 12, 2003, pp. 4767-4781. <<http://dx.doi.org/10.1021/cr0205255>>; Wargent, J.J., and Jordan, B.R. From Ozone Depletion to Agriculture: Understanding the Role of UV Radiation in Sustainable Crop Production. *New Phytologist*, 197, 1058-1076, 2013. <<http://dx.doi.org/10.1111/nph.12132>>
- 23 Eaton, J.W. (1995) UV-Mediated Cataractogenesis: A Radical Perspective. *Documenta Ophthalmologica*, 88, 233-242.; United Nations Environment Programme (1994) Environmental Effects of Ozone Depletion: 1994 Assessment UNEP, Nairobi.
- 24 Christenson, L.J., Borrowman, T.A., Vachon, C.M., et al. (2005) Incidence of Basal Cell and Squamous Cell Carcinomas in a Population Younger Than 40 Years. *JAMA*, 294, 681-690. <<http://dx.doi.org/10.1001/jama.294.6.681>>; Lee, K.W., Meyer, N. and Ortwerth, B.J. (1999) Chromatographic Comparison of the UVA Sensitizers Present in Brunescant Cataracts and in Calf Lens Proteins Ascorbylated in Vitro. *Experimental Eye Research*, 69, 375-384. <<http://dx.doi.org/10.1006/exer.1999.0709>>
- 25 Tian, J. and Juan, Y. (2009) Changes in Ultrastructure and Responses of Antioxidant Systems of Algae (*Dunaliella salina*) during Acclimation to Enhanced Ultraviolet-B Radiation. *Journal of Photochemistry and Photobiology B: Biology*, 97, 152-160. <<http://dx.doi.org/10.1016/j.jphotobiol.2009.09.003>>; Andersen, S. and Sarma, M. (2002) Protecting the Ozone Layer. The United Nations History, Earthscan Publications Ltd., Virginia.
- 26 Wargent, J.J. and Jordan, B.R. From Ozone Depletion to Agriculture: Understanding the Role of UV Radiation in Sustainable Crop Production. *New Phytologist*, 197, 1058-1076, 2013. <http://dx.doi.org/10.1111/nph.12132>; M. Belkin, P. Diffy, M. Kojima, C. Roy 'Protection against exposure to ultra violet radiation' <<http://www.who.int/uv/publications/proUVrad.pdf>> Last accessed 1st September 2014

4.1 THE INTERNATIONAL TREATIES REGULATING THE ACTIVITIES IN THE OZONE REGION

The Primary treaties are: The Vienna Convention for the Protection of the Ozone Layer^{2, 7} Vienna, 1985, Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1987, United Nations Framework Convention on Climate Change, New York, 1992, Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 1997, Paris Accord to the United Nations Framework Convention on Climate Change, Paris, 2015.

4.2 VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER, VIENNA, 1985

The Vienna Convention for the Protection of the Ozone Layer was adopted with a view to protecting human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer. To this end, the Parties are enjoined to cooperate by sharing research and information to better understand the effects of human activities on the ozone layer as well as adopt appropriate legislative or administrative measures and policies to control, limit, reduce or prevent human activities within their jurisdiction.²⁸

²⁷ Article 2 of The Vienna Convention For The Protection Of The Ozone Layer 1985

²⁸ *ibid*

4.3 MONTREAL PROTOCOL ON SUBSTANCES THAT DEplete THE OZONE LAYER, MONTREAL, 1987

The Montreal Protocol focused particularly on controlling production and trade of ODS.²⁹ Since the signing of the protocol, several amendments have been made particularly on expanding the list of regulated substances and the introduction and subsequent acceleration of phase-out dates for regulated substances.³⁰ In the face of growing data on higher ozone depletion worldwide, the international community decided that the Montreal Protocol needed to be tightened considerably.³¹ The party members met in 1992 and agreed on tighter timetables for phasing out ozone-depleting chemicals.³² The signatories agreed to move forward the total ban on CFCs from the year 2000 to 1996.³³ The signatories also agreed to fund up to \$500 million over a three year period in order to facilitate the transfer of ozone-friendly technology to developing nations.³⁴ Additionally, the parties to the agreement advanced the phasing out of halons from the year 2000 to 1994.³⁵ Likewise, the parties moved the ban on methyl chloroform from 2005 to 1996.³⁶

²⁹ United Nations "Montreal Protocol On Substances That Deplete The Ozone Layer" (2008) (United Nations Audiovisual Library of International Law 2008) <legal.un.org/avl/pdf/ha/vcpol_ph_e.pdf> last accessed 27th August 2014

³⁰ European Commission 'The Montreal Protocol' Luxembourg Office for Official Publications of the European Communities, 2007; *The Montreal Protocol On Substances That Deplete The Ozone Layer, 1987*

³¹ B. Maddox, "Business and the Environment: Industry Heated Over the CFC Ban" FIN. TIMES, Nov. 25, 1992, at 15.

³² M. I. Kupferberg 'Fixin' a Hole: Recent Attempts by the European Community to Preserve the Ozone Layer' *Boston College International and Comparative Law Review* Volume 17, Issue 1, 1994

³³ *ibid*

³⁴ Paul Brown, "Denmark: 'Sell-Out' Fear" LEXIS, Europe library, AHeur File, 1992

³⁵ *ibid*

³⁶ *ibid*

4.4 THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC), 1992

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted with the ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system.³⁷ This objective was designed to be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.³⁸

4.5 THE KYOTO PROTOCOL TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The UNFCCC in 1997 produced the Kyoto Protocol with 192 Party members.³⁹ Under this protocol, 37 industrialised countries and the European Community committed to reducing their emissions by a responsible for global warming as they have contributed the most to the anthropogenic build-up of carbon dioxide in the atmosphere (around

³⁷ United Nations Framework Convention On Climate Change (UNFCCC), 1992

³⁸ Article 2 of the United Nations Framework Convention On Climate Change (UNFCCC), 1992

³⁹ M. R. Raupach, 'Global and regional drivers for accelerating CO₂ emission: Discussions' US National Academy of Sciences, 2007

77% of emissions between 1750 and 2004),⁴⁰ and that carbon dioxide emissions per person in developing countries (2.9 tonnes in 2010)⁴¹ are, on average, lower than emissions per person in developed countries (10.4 tonnes in 2010). Developing countries do not have binding targets under the Kyoto Protocol, but have committed under the treaty to reduce some of their emissions on a voluntary basis. Actions taken by developed and developing countries to reduce emissions include support for renewable energy, improving energy efficiency, and reducing deforestation. Under the Protocol, emissions of developing countries are allowed to grow in accordance with their development needs.⁴² Under the Protocol, parties shall individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases which the Protocol seeks to regulate do not exceed their assigned amounts and also show demonstrable progress in achieving its commitments under the Protocol.⁴³

4.6 THE PARIS AGREEMENT TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

In 2015 following the success of the Kyoto Protocol, 196 Parties to the UNFCCC adopted the Paris Agreement which is slated to come into force in the year 2020.⁴⁴ In contrast to the Kyoto Protocol, the Paris

⁴⁰ Ibid

⁴¹ The Kyoto Protocol To The United Nations Framework Convention On Climate Change, 1997

⁴² Ibid

⁴³ Article 3 of the Kyoto Protocol To The United Nations Framework Convention On Climate Change, 1997

⁴⁴ The Paris Agreement To The United Nations Framework Convention On Climate Change, 2015

agreement does not establish emission reduction and limitation targets for individual Parties instead, it establishes a *global warming goal of well below 2°C on pre-industrial averages* and defines a universal, legal framework to *'strengthen the global response to the threat of climate change.'*⁴⁵ The agreement leaves it up to the parties to decide how much they can contribute to meeting the goal in accordance with the *principle of common but differentiated responsibility and respective capabilities, in the light of different national circumstances.*⁴⁶ To ensure that the overall goal is being met, the Parties are enjoined to meet every five years to adapt their mitigation contributions and also to take stock of the progress with a view to reflect the highest possible ambition and to achieve the agreement's long-term goals.⁴⁷

5.1 THE ACHIEVEMENTS OF THE TREATIES REGULATING THE MANAGEMENT AND CONTROL OF OZONE-DEPLETING SUBSTANCES

The treaties have had some challenges but have also made tremendous progress over the years in their quest to reduce ODS. The most notable successes have been those of the Montreal Protocol and its amendments with the global and annual production and consumption of ODS decreased by 95% between 1989 and 2005.⁴⁸ As a result, total levels of

⁴⁵ Charlotte Streck, Paul Keenlyside, and Moritz von Unger 'The Paris Agreement: A new beginning' (Journal for European environmental & planning law 13 (2016) 3-29); Article 2 of the Paris Agreement To The United Nations Framework Convention On Climate Change, 2015

⁴⁶ Ibid

⁴⁷ Article 4 and Article 14 ibid

ODS and ODS substitutes released into the atmosphere, including hydrofluorocarbons (HFCs), also decreased during this period, declining by 81%.⁴⁹ The concentration of ozone-depleting substances in the atmosphere has also decreased since the enactment of the Protocol. Effective equivalent troposphere chlorine (EETC), a common measure of the concentration of ozone-depleting substances in the atmosphere, has also decreased by 14% from a peak of 2,700 parts per trillion in the mid-1990s.⁵¹ Organisations such as United Nations industrial development organisation (UNIDO), the Global environmental facility (GEF) as well as the European Union (EU) have been in the forefront of ODS reduction on a global scale. The Global Environment Facility (GEF) unites 180 countries in partnership with International institutions, civil society organizations (CSOs), and the private sector to address global environmental issues while supporting national sustainable development initiatives.⁵² Since 1991, the GEF has achieved a strong track record with developing countries and countries with economies in transition, providing \$12.5 billion in grants and leveraging \$58 billion in co-financing for over 3,690 projects in over 165 countries.⁵³ The GEF has also made more than 20,000 small grants directly to civil society and community-based organizations, totalling \$653.2 million.⁵⁴

48 Global Environmental Facility 'Investing in the phase-out of ozone-depleting substances: The GEF experience' (Professional Graphics printing Co) 2010

49 *ibid*

50 *ibid*

51 *ibid*

52 *ibid*

53 The Global Environmental Facility 'GEF projects funding' http://www.thegef.org/gef/gef_projects_funding last accessed, 7th September 2014

54 *ibid*

The European Commission has also had a substantial part to play in the Ozone depletion regulation as well. After the enactment of the Montreal Protocol, the European Commission agreed on a proposed new regulation that vastly accelerated the elimination of ozone-depleting substances as compared with the timetables established by the Montreal Protocol and its 1992 amendments.⁵⁵ Its provisions are stricter than those of the Montreal Protocol as they set out controls for the production, trade, use, and recovery of ozone-depleting substances and include detailed reporting requirements.⁵⁶ The regulation also sets a legal basis for inspections and penalties while making way for new substances to be included into the control scheme and creates an electronic licensing system for importing and exporting ozone-depleting substances (ODS) into and out of all EU Member States and also serves to prevent the illegal trade in ozone-depleting chemicals.⁵⁷ The most recent changes to the regulation aim at improving co-operation between environmental and customs and health authorities and at encouraging the Member States to find cost-effective sanctions for non-compliance.⁵⁸

The EU legislation has been very effective in controlling ozone-depleting substances and also acted as a driver for the development of

55 European Commission 'EEC Proposes Earlier Phase-Out Date For HCFO: Than Montreal Protocol Set' Int'l Env't. Daily (BNA), LEXIS, Europe library, AHeur File, 1993

56 Ibid

57 Ibid

58 European Commission 'The Montreal Protocol' Luxembourg Office for Official Publications of the European Communities, 2007 <https://ec.europa.eu/clima/sites/clima/files/docs/montreal_prot_en.pdf> last access on the 6th of August, 2018

innovative technologies such as the development of methyl bromide alternatives, new insulation foam blowing agents, CFC-free metered dose inhalers for the treatment of asthma, and the creation of innovative firefighting systems on board ships and airplanes which do not use halons.⁵⁹ Although chlorofluorocarbons (CFCs) and many of the other original ozone-depleting substances of concern are no longer produced and used in new equipment, thousands of tons of these substances are contained in existing equipment and buildings.⁶⁰ The United Nations industrial development organisation has also been active in the reduction of ozone-depleting substances as well as controlling greenhouse gas emissions. An example of such effort can be seen in Gambia where the government the United Nations Industrial Development Organization (UNIDO) agreed to implement a demonstration project to reduce greenhouse gases and ozone-depleting substances in the country's industrial refrigeration and air-conditioning sector.⁶¹ Also in Morocco where large numbers of farmers earn their livelihood by growing fresh fruits and vegetables, methyl bromide which is being used by Moroccan farmers as a pesticide needed to be phased out due to its high ozone-depleting potential in line with Morocco's commitments under the Montreal Protocol.⁶² Thus, a major UNIDO environmental project was

59 Ibid

60 Ibid

61 United Nations Industrial Development organisation 'UNIDO project to help green Gambia's refrigeration and air-conditioning sector' <http://www.unido.org/news/press/unido-sector-4.html>

62 United Nations Industrial Development Organisation 'Phase-out of Methyl Bromide used for soil fumigation for Moroccan tomato production' https://www.unido.org/fileadmin/user_media_upgrade/Worldwide/Projects/Phaseout_of_Methyl_Bromide_used_for_soil_fumigation_for_Moroccan_tomato_production.pdf last accessed, 7th September 2014

carried out over the past decade in Morocco helping the country to be in compliance with the Protocol.⁶³ The project was implemented by UNIDO in close cooperation with the Moroccan Government and the Moroccan Association of Fruit and Vegetable Producers and Exporters (APEFEL) and helped set up an applied research and demonstration centre run by APEFEL with a view to educating Moroccan farmers to more effective and sustainable farming techniques.⁶⁴

6.1 CHALLENGES OF THE REGULATION OF OZONE-DEPLETING SUBSTANCES

The biggest challenge for the international treaties regulating ozone-depleting substances like many international treaties is the lack of compliance by member states. The full phase-out of CFCs in developing countries presented the most difficult compliance challenge yet for the Montreal Protocol. Illegal trade in CFCs and other ODSs is expected to increase once the complete ban on CFCs takes effect, which will exacerbate the black market operating in both developed and developing countries.⁶⁵ Illegal trade currently is estimated to represent about ten to twenty percent of all trade in ODSs, which in CFCs alone comprises 7,000 to 14,000 tons per year, with a value of U.S. \$25-60 million.⁶⁶ The

63 Ibid

64 Ibid

65 D. Kaniaru, R. Shende, S. Stone & D. Zaelke 'Strengthening the Montreal Protocol: Insurance Against Abrupt Climate Change' *Sustainable Development Law & Policy* Volume 7 Issue 2, *Climate Law Reporter*, 2007

66 *ibid*

Montreal Protocol instituted a licensing system for the trans-boundary shipments of ODSs to combat illegal trade, but compliance remains a critical issue due to the activities of the illegal traders.⁶⁷ Other compliance challenges arise from the lack of control measures for use of ODSs, such as HCFC-22 and methyl bromide, in the feedstock, process agent, and Quarantine and Pre-shipment ("QPS") applications. This makes it possible for ODSs produced for these applications to be used illegally in other applications that have been phased out.⁶⁸ Feedstock and process agent applications are not subject to control measures because, in these, the ODSs used in these applications are either converted to chemicals that do not harm the ozone layer or are destroyed in the conversion process. But this does not take into account any by-products, such as HFC-23 or CTCs, nor the possibility some will be diverted to illegal trade.⁶⁹ As regards the Kyoto protocol's contribution to regulation of ozone-depleting substances, there is no doubt that its major accomplishment has been bringing awareness to the need to reduce harmful chemicals, greenhouse substances and the protection of our environment we need to reduce greenhouse gas emissions and protect our environment.⁷⁰ While the Kyoto protocol was successful in reaching a consensus by its member states on the goals set therein, this success was only due in

⁶⁷ *ibid*

⁶⁸ *ibid*

⁶⁹ *ibid*

⁷⁰ M. Chavez 'The Kyoto Protocol Accomplishments and Failures'

<<http://www.atmos.washington.edu/2009Q1/111/ATMS111%20Presentations/Folder%201/ChavezM.pdf>>
accessed, 7th September 2014

avoidance and difference to future conferences, a number of issues that would be crucial to its operation generally, and to its ratification by the countries producing the greatest emissions.⁷¹ The goals set by the protocol to have reduced the emission by 2005 was not achieved by most of the countries involved unsurprisingly considering its impracticality and lack of adequate enforcement techniques in the protocol.⁷² Since greenhouse gases are generated mostly by burning fossil fuel, as in power plants, factories, and automobiles, it is not easy to reduce emissions in growing economies.⁷³ With the Kyoto conference, the concept of limiting emissions has become a political issue in many of the industrial countries and a success, as well as the flexibility mechanisms, proved quite practicable in achieving the primary aim of regulating the ozone depletion substances.⁷⁴

7.1 CONCLUSION AND RECOMMENDATIONS

There is no doubt that the international treaties regulating the ozone region have had tremendous successes which include the creation of awareness of the need to control ozone depletion substances to the regulation of such substances. There has also been a substantial success in the replacement of the current carbonated and chlorinated substances

71 J. W. Anderson 'The Kyoto Protocol on Climate Change' *Resource of the future*, 1998

72 S. Barrett 'Climate treaties and the imperative of enforcement' *Oxford Review of Economic Policy*, Volume 24, Number 2, 2008, pp.239-258

73 Ibid

74 Ibid

very much relied on by producers of items such as air conditioning systems and fridges and pesticides in record time. This progress has been met with several challenges like compliances and unrealistic goal as well as lack of sufficient replacement of the ozone-depleting substances globally. There have also been challenges of noncompliance as not all the countries have reached their intended goals. Regardless of the shortcomings of these regulations, there is still a lot of prospect with predictions of near complete recovery of the ozone layer by the middle of the 21st century with the steady rate of continued decline in ODS emissions are by the Environmental Protection Agency of the United States of America.⁷⁵

It is therefore recommended that more effective countermeasures should be adopted against State members who do not reach their targets in terms of economic sanctions set out international regulations. It is also recommended that moving forward, realistic time frames should be adopted to reflect each member state's capabilities and current economic status. This will help improve the recovery of the ozone layer.

⁷⁵ The United States Environmental Protection Agency 'Current State of the Ozone Layer' <<https://www.epa.gov/ozone-layer-protection/current-state-ozone-layer>> last accessed on the 1st of August, 2018