

Carbon Emissions and Their Impact on Climate Change

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Abstract- Climate change has since become one of the most significant environmental problems of our era and that has been feasible mostly because of the continuous increase in carbon emissions which humans produce in the world. This will include a discussion on the major contributors to the carbon emission and their contribution to the overall climate change in the world. The secondary data are in the form of peer-reviewed journal materials, international assessment reports, and academic publications, which are used to fully guide the study. Regarding the existing literature, numerous primary causes of carbon dioxide growth in the atmosphere such as the combustion of fossil energy, industrialization, and transport along with changes in land use (IPCC, 2021; Friedlingstein et al., 2023) were suggested. As a result of the global warming caused by rising atmospheric temperatures and the growth of extreme weather, which has severely damaged ecosystems, emissions are taking center stage in global warming with disastrous results (Le Quéré et al., 2020). Even though the international tools (e.g., Paris Agreement) are designed to put a stop to the increasing global temperature, the current state of emissions indicates that the target mitigation measures have much to be desired (Shukla et al., 2022). Thus, the conclusion on carbon emissions reduction is policy based and organized in terms of global effects on policies, effective policies implementation and transition to the sustainable systems of energy to reduce long term climatic and socio-economic effects.

Index Terms- Carbon Emissions, Climate Change, Greenhouse Gasses, Global Warming, Sustainability, Environmental Impact, Carbon Neutrality

I. INTRODUCTION

Climate change is considered to be the long-term change in temperature pattern, precipitation and other climatic changes which take long periods of time. Climate change has gained momentum over the last few decades particularly due to the impact of the anthropogenic greenhouse gases as well the production of the Carbon dioxide especially through the combustion of fossil fuels. It is already

scientifically established that we are the most significant source of global warming because of its greenhouse gas emissions as a result of human activities and contributes to increasing an existing natural greenhouse on the planet (IPCC, 2021). The high rate of industrialisation, urbanization and population explosion has led to high energy consumption in the world. Most of this demand has been based on non-renewable sources of energy like coal, oil and natural gas. Consequently, carbon dioxide levels in the atmosphere have significantly increased and record highs have been attained as Friedlingstein et al. observe. These levels trap more heat in the atmosphere causing slow warming in the world average temperatures. The latter view is supported by the fact that the last decade has been among the hottest in the history of the world, and the proximity between climate change and carbon emissions is closely linked with the latter (Le Quéré et al., 2020). Climate change has numerous and diverse effects. The melting of glaciers and polar ice caps has led to the rise of the sea level, and thus posing threats to the coast and the low lying areas because of global warming. The alteration of the precipitation pattern and such extreme weather conditions like heatwaves, cyclones, and wildfires are more frequent and worse. These transitions are ecological perturbatory processes that disturb ecosystems, decrease biodiversity and distort natural habitats causing immense pressure to the land and sea ecosystems (Rockström et al., 2009). Climate change is a significant social and economic burden besides its effect on the environment. The world food security has been of concern because of the unpredictability of the weather and water shortage that has impacted crops. Concomitant to this is an increasing danger to the health of everyone in the society i.e., heat stress, atmospheric pollution and transmission of climatic sensitive diseases. This kind of hit is especially susceptible to the developing world because some economic and technological

factors to its application are relatively lower in the world as being comparatively low carbon emitters (Stern, 2007).

In the context of rapidly implemented climate change, a number of international initiatives are doing so to reduce carbon emissions and towards sustainable development. Paris Agreement is an international accord to curb an increase in temperature and promote arrangements to cut emissions. Nevertheless, in recent research, the level of national sustainability action falls short of the national prospects in the long-run of the future (Shukla et al., 2022), which suggests that the policies articulate but the happenings of the policy fall short of the promises that they are intended to perform. This essay discusses the concept of carbon emission and its contribution in the world climate scenario. The study of the results of the scholarly articles and international evaluation reports will help improve the trend of the emissions, their impact on the climatic conditions, and the significance of the effective global mitigation strategies.

Importance of the Study

The build-up of the carbon gases in the atmosphere has caused climatic change around the world and is a key research area, which is of utmost importance both academically and in the policy front. It is also believed that carbon emission is the primary cause of global warming that may affect increase in temperature, sea level and extreme weather. The global volume of emissions is increasing all over the world, though such a discussion is widely debated globally and has policies, which also prove the necessity of new and stronger research in this field (IPCC, 2021). Among the key factors that explain why there is an escalating need to conduct research on the topic is that there is a change in the sources of carbon emission. The trend has been altered by the process of rapid urbanization, industrialization, and the rise in the consumption of energy by the regions and sectors. Although studies have been conducted extensively aimed at the industrialised economies, recent studies using the statistical analysis prove that the newly arising and developing economies may be the origin of increasing emissions, as a result of financial growth and the increasing volumes of population (Friedlingstein et al., 2023). To bring this

change, it is necessary that there should be more worldwide analysis that is to be conducted as to know the modern-day dynamics of emissions and their climatic counterparts. The other significant implication of the current research is the increasing gap between the words of the climate policy and the reality of the reduction of carbon emission.

Treaties like the Paris Agreement in a global environment put more emphasis on curbing increasing global temperatures. However, this evaluation shows that the present commitments are not enough to assist countries in the long-run effectively fight climate change (Shukla et al., 2022). When the carbon emissions, and their effects are studied as a whole, it may become a revelation of when the attempts have not been good to the future. Better policy interventions will be proposed in this regard. One of the strengths of the study as an academic work is that it is a summary of what other researchers, and even international evaluation reports, intended to say. By focusing on the effects of increasingly warming the environment on the ecosystem, human livelihood, and economic performance, it helps to bridge the gap in knowledge between scientifically supported facts and the socioeconomic consequences by highlighting the effects. The research depicts a synoptic view on the change in emissions and climatic riskiness to educate policy-makers on the present levels of evidence-based policies. Moreover, the study can be serving also to students and researchers who must review in systematic and comprehensive the carbon emissions and climate change, in a general way, and by giving them a systematic review of the phenomenon in general should it not only stimulate the topic but also encourage students and researchers to conduct more research on it.

Objectives of the Study:

- To explore the concepts and the origin of carbon emission. As the aim of the analysis is to understand the impact of carbon emissions on the global climate change.
- . To take into account carbon emission sector-wise contributions to carbon cycle.

- . To approximate the environmental and social-economic impact of global warming.
- To examine global efforts to decrease carbon emissions.
- To study issues of challenges of reduction of emission efforts.

II. REVIEW OF LITERATURE

The scientific knowledge of climate change and carbon emissions has been reinforced by comprehensive research all around the world with significant assessment reports and empirical studies all finding human activity as the leading cause of increasing greenhouse gas concentrations. One of the most authoritative syntheses of climate science is presented by the Intergovernmental Panel on Climate Change (IPCC), which states that the rapid warming that has been observed over the last several decades is closely associated with man-made carbon emissions, which are primarily considered as a result of fossil fuel burning, industrial and land-use change (IPCC, 2021). Although the report provides solid evidence on the physical science foundations of climate change, it provides fairly few discourses on the practical effectiveness of individual climate policies, which is how further research may be conducted to determine the performance of individual climate policies and its results (IPCC, 2021). Besides long-term scientific tests, scientists have investigated short-term changes in emissions to learn the way the global systems react to the disruption and reaction of emissions. An important one is the work by Le Quéré et al. (2020) who studied the provisional decrease in global CO₂ emissions during the COVID-19 pandemic. The results indicate that the emission decreases in the period of lockdown were temporary and regained quickly as the economic and industrial activities reappeared (Le Quéré et al., 2020). It means that temporary emissions reduction will not always lead to the reduction of emissions in the long term unless it is supported by structural changes in energy systems, transportation, and consumption patterns. Nevertheless, the research concentrates mainly on short-term tendencies and does not extensively discuss long-lasting strategies that may support the long-run mitigation planning, leaving a gap in the

research (Le Quéré et al., 2020). The recurring datasets will also observe and provide approximate results of the global carbon emission trends to identify whether the effort of the climate action is adequate. The Global Carbon Budget 2023 by Friedlingstein et al. (2023) provides updated scales and projections of carbon emissions, which prove that the CO₂ emissions to the world are continuously growing despite the increased mitigation efforts. The research paper points out the ongoing reliance of economies on carbon-intensive regimes and suggests that the emission patterns are not in line with the targets required to preclude significant risks of climate change (Friedlingstein et al., 2023). Although it has a global evaluation, the study has not conducted much regional adaptation assessment; that is, localized analysis on climate preparedness and resilience strategies has not been explored much within the piece of work (Friedlingstein et al., 2023). The greater environmental applicability of the process of climate change has been contextualized as well in the setting of the planetary stability and sustainability. Rockström et al. (2009) proposed the idea of a safe operating space of humanity and determined planetary boundaries and climate change being one of the most important boundaries that should not be crossed to ensure the environmental stability. Their study focuses on the fact that climate change is not only a local environmental problem, but a global threat to the planet in the form of a system that is interacting with the destruction of biodiversity, degradation of the land, and the ecological imbalance (Rockström et al., 2009). Nevertheless, although the framework goes a long way in explaining global thresholds and urgency, it does not present much sector specific-solutions to global emission cuts across industries like transport, manufacturing, agriculture and energy, implying that more applied studies are required to convert planetary limits into sector-based action plans (Rockström et al., 2009). The interdependence between carbon emission and climate change has also been effectively explored on economic aspect particularly on long term costs and risks. Stern (2007) asserts that climate change is one of the biggest market failures in the contemporary times and that delaying action to curb the phenomenon would result in even greater economic losses than the costs of acting now.

III. RESEARCH METHODOLOGY

Descriptive and analytical research design has been selected in the analysis done in this study with the focus being on the carbon emissions and climate change on a global scale. The significance of the given idea is that it is possible to map up the existing tendencies of emissions in a systematic manner; also, it is possible to give significant explanation on environment and socio-economic impacts. The study is exclusively secondary due to the inability to conduct primary data collection, which is not suitable research on the global climate. The peer-reviewed journal articles, international assessment reports, and scholarly publications related to the climate change and carbon emission have been used as the secondary literature on the study. Among the key sources of information used in the report, the Intergovernmental panel on climate change, Global carbon budget research and papers in the academic journals of the world that focus on climate science, environmental economics and sustainability will be referred to. The sources are popular within the academic literature, and, therefore, may be considered true in terms of learning about the global trends of emissions and climate effects (IPCC, 2021; Friedlingstein et al., 2023). The data acquired are the past and current trends of carbon emissions, contribution of each sector to the global emissions, regional pattern of emissions and the changes in climate that have been observed. Qualitative data that has been addressed includes policy appraisals and mitigation systems which have aided in comprehending the manner in which the global disaster responses are carried out. Analysis and synthesis of information, derived through different sources has been systematically carried out through a content analysis. The strategy will entail the determination of the overlapping themes, patterns and links in carbon emissions and climate change. Since the studies are carried out at the global level, one is able to come up with an integrated comprehension of the effects of emissions on climatic systems in different parts of the world. Such a plan is to determine the general cause of emissions and the combined effect of these causes on global warming and environmental degradation including: fossil fuel dependencies, industrialization and land-use change. The comparison of emission behavior between developed and developing areas is

now being highlighted through the comparative analysis. Nevertheless, the research also has weaknesses in addition to strengths. You are using more secondary data and hence can only model small regional/on-the-fly differences in emissions. Also, the criteria used to report data in various countries can have an impact on comparability.

The Stern Review proves that climate effects may destabilize the global economy by disrupting agriculture, health, infrastructure, productivity and development, and proposes climate mitigation as a cost-effective investment in the world economy, as opposed to an environmental necessity (Stern, 2007). However, the review lacks incorporation of more recent emission data and current carbon budgets, and this implies that a current study is necessary to capture the integration of economic analysis and the current trends of carbon emission in the world (Stern, 2007).

IV. ANALYSIS

The fact analysis proves the existence of a highly publicized correlation between carbon emission and global warming with the increase in atmospheric carbon dioxide levels that are caused by human activity as the most critical factor (IPCC, 2021). The rise of use of fossil fuels as energy source, means of transportation, and industrial production since the industrial age has contributed to the accelerated greenhouse effect and contributed significantly to global warming (Friedlingstein et al., 2023). Energy has been the biggest contributor of carbon emissions with countries still depending on coal, oil, and natural gas especially in the fast growing industrializing economies (Friedlingstein et al., 2023). The level of emissions is higher when it comes to the transport and industrial sectors because of the combustion of funds and energy-demanding production processes (Le Quéré et al., 2020; IPCC, 2022). Moreover, land use and deforestation reduce the ability to absorb carbon and enhance global warming and net emissions (IPCC, 2021). Such emissions have an impact on the environment, leading to an increase in global temperatures, melting ice caps, rising sea level, and an increase in extreme weather (IPCC, 2021). These alterations brought to the ecosystems a disturbance, reduction in biodiversity, and heightened the vulnerability (Rockström et al., 2009), and climate change is also one of the principal problems

in social and economic matters. The erratic weather patterns endanger the agricultural and food production, and the water stress and heat stress pose more threat to the health of the population (Stern, 2007). This also affects developing countries more than the developed countries because they have low adaptive capacity which increases global inequality (Stern, 2007). Although there are already international mitigation frameworks, policies and promises are not sustainable enough at the moment to empower long-term climate goals (Shukla et al., 2022).

The significance of this analysis is that it is necessary to build international strategies to enhance the adoption of renewable energy, energy performance (efficient energy use), sustainable land management, international collaboration in the field of climate change reduction, and scaling up the work to minimize carbon emissions (IPCC, 2021; Shukla et al., 2022).

V. DISCUSSION

Through the literature that was examined, it is evident that climate change on the world is largely due to carbon emissions. It has been demonstrated through numerous researches that the CO₂ emission that is caused by people, and especially the one that is generated by burning fossil fuels that are composed primarily of the carbon dioxide gas, made the Earth climate system radically different (IPCC, 2021). In addition, it is factual in numerous scientific experiments that the abrupt decrease of the greenhouse gas emissions, which have been observed during global economic downturns, could not culminate to permanent climate enhancement absent altering the organization of the energy system (Le Quere et al., 2020). With increasing understanding of the subject and the policy task to undertake, recent studies of the carbon budget indicate that emissions are still increasing worldwide (Friedlingstein et al., 2023). The trend shows the failure of the existing mitigation policies and the necessity of more efficient practices. The planetary boundaries model puts forward that climate change has already reached the risky ecological phase (Rockström et al., 2009), and the Earth system is no longer safe. Research indicates that the expenses of inaction in relation to climate

change, in the long term, are significantly greater compared to mitigation measures and this is a case in favor of immediacy to reduce emissions (Stern, 2007). Moreover, to reduce the growth of world temperature in the upcoming years, according to the research based on mitigation, the carbon emission must be reduced at all areas both immediately and globally (Shukla et al., 2022). Although general trends on emissions and climatic change have been researched, scientific, economic and policy aspect has not been excluded in either of the researches.

Here is where the lack of studies that tie together the presence of emissions and the socio-economic and political factors can be noticed. This gap is what we hope to fill in this article to a certain extent in creating a consensus on the issue of carbon emission and its contribution to global climate change.

VI. FINDINGS

The findings of the present study are structured in terms of the study goals and which are substantiated by peer-reviewed articles in global journals and international assessment reports. Findings that will support Objective 1: Learn the meaning and origin of carbon emissions. According to the study, most carbon emissions are anthropogenic, and they consist primarily of the combustion of fossil fuels to produce power, transportation, and industry (IPCC, 2021). The biggest contributor to the global carbon emissions is electricity and heat produced through the use of fossil fuels, and the second highest sources are gas emissions produced by transportation systems and manufacturing processes in industries (Friedlingstein et al., 2023). Altering land use, particularly deforestation is another cause of the emission level rise in that it reduces natural carbon sinks and leads to carbon emission in the atmosphere. The research findings of this work comply with the objective 2, which is to quantify the impacts of carbon emissions on global climate change. It establishes a scientifically defined and robust correlation between the increase of the emission of carbon dioxide and global warming.

The carbon dioxide concentration in the atmosphere has been driving the greenhouse effect up, and the continuous rise of the global mean temperature (IPCC, 2021). Such a warming trend transformed the

climatic systems, disrupted the rain patterns, and increased the incidence and intensity of extreme weather events such as heatwaves, floods, droughts, and wildfires (Le Quéré et al., 2020; Rockström et al., 2009).

In this paper the climate change in recent times shows that it is not natural climate variability that causes the trends that are being reported but are human-made actions (IPCC, 2021). Related Results to Objective 3: Research sector-related emissions of carbon. In another sectorally determined work, the energy sector is identified to be the highest contributor of carbon emissions worldwide by still relying on coal, oil and natural gas as a source of power generation and energy (Friedlingstein et al., 2023).

It was noted that the second-highest emissions sector is the transport sector that primarily leads to an increase in cars, aviation, and the international transport (Le Quéré et al., 2020). The industrial sectors that are powerful cement, steel and chemical manufacturing also serve the economic purpose by being energy intensive and the chemical reactions often occurring in the production process (IPCC, 2022). All these industries are full of technology and financial obstacles to decarbonization. Findings connected with Goal 4: Determine the environmental and socio-economic consequences of climate change. Studies indicate that climate change has environmental issues that are beginning to manifest themselves and expand. The melting of ice in the glaciers and polar ice poles due to global warming has been one of the significant causes of rising sea level and increased risks in coastal regions (IPCC, 2021). Collapse of ecosystems, extinction of species, coral bleaching and natural habitat destruction are becoming a more common occurrence at both terrestrial and marine ecosystems (Rockström et al., 2009). Considering the socio-economic perspective, climate change poses an immediate risk to food security, water resources, and citizen health. Higher changes of temperature and precipitation have negatively affected the yield of agricultural products, and water insecurity and extreme heat have exacerbated the health risks of the population (Stern, 2007). Although they relatively contribute less to global emissions, their impacts are even more

deplorable in the developing economies that possess relatively low adaptive capacity which represent a case of climate inequality and environmental injustice (Stern, 2007). Objective 5 and its Findings To take a look back at some of the international attempts to minimize carbon emission. Findings indicate that global treaties like the Paris Agreement are an impressive endeavor towards global warming by curbing the rising temperature and promoting a decline in emissions (Shukla et al., 2022). However, the current national commitments and current policy implementation failures suffice to the realization of sustainable climate stabilization goals today. The data about world emissions depicts increasing regardless of mitigation pledges and a vast disparity between the aims of the policies and the actual implementation (Friedlingstein et al., 2023; Shukla et al., 2022). Findings of objective 6: To take into account problems of emission-reduction. Results of this research underscore a number of obstacles that impede successful implementation of emission reduction. The dependency on fossil energy, economic price of switching to clean energy solutions, technology barriers in hard-to-abate markets and weak systems of enforcing policies remain significant drawbacks (IPCC, 2022).

Furthermore, the inequality in access to financing and technological input in developed and developing states enhances the difficulties faced in the mitigation efforts across the world (Shukla et al., 2022). Even though temporary short-run emission cuts during low economic periods have been attained, it seems that they are temporary and thus, long-term structural change, not intervention strategies are needed (Le Quéré et al., 2020).

VII. SUGGESTION

According to the results of the research, carbon emission mitigation will require concerted efforts on the international level that can combine policy change, technological progress, and changes in behavior. The burning of fossil fuels is the biggest contributor of global warming through carbon emission (Friedlingstein et al., 2023). Thus, there is a necessity to hasten the world movement towards the use of renewable energy sources including solar electricity, wind energy, and hydro-power. According

to the Intergovernmental Panel on Climate Change (IPCC, 2022), the global temperature increase needs to be limited to 1.5 °C with swift and sustained cuts in greenhouse gas emission amounts in all the areas. Governments will be thus forced to impose harsher standards of emission and to eliminate coal-based power production by organized energy transitions schemes. Secondly, the globalization of carbon pricing systems like carbon taxes and carbon emissions trading system ought to be reinforced. Economic tools establish a financial incentive to the industries to deal with emission cuts and invest in cleaner technologies (Rogelj et al., 2016). Research reveals that when carbon pricing systems are well formulated, countries will have a visible reduction in emissions without necessarily negatively affecting the economy (IPCC, 2022). The development of such mechanisms, particularly in the developing economies, has the potential of encouraging accountability and decarbonizing. Third, the low-carbon technologies should be implemented in the industrial and transportation sectors. The process of electrification of transport systems, creation of green hydrogen, and carbon capture and storage (CCS) technologies are the primary avenues to enabling the net-zero emission state (Shukla et al., 2022). Moreover, the energy efficiency of buildings and manufacturing can be enhanced to significantly reduce the overall carbon intensity. The Global Carbon Budget says that in recent years, the growth rate of emissions has already slowed due to improvement in energy efficiency (Friedlingstein et al., 2023). Fourth, there should be increased international climate cooperation and climate finance.

Developed countries need to assist developing countries by transfer of technology and giving them financial support in order to create sustainable development channels. The system of the Paris Agreement supports the significance of shared responsibility and open systems of monitoring (IPCC, 2022). Mitigation activities in vulnerable areas could not be adequate unless there is proper climate finance. Finally, the level of awareness among the population and sustainable consumption patterns are also significant. As Ripple et al. (2020) state, to tackle the climate crisis, the society needs systemic change, such as less reliance on fossil fuel and responsible consumption habits. The long-term

behavioral changes towards sustainability can be promoted through educational programs and climate literacy. To sum up, the reduction of carbon emission requires multifaceted measures that involve the growth of renewable energy sources, reforms of the economic policies, technological advancement, international collaboration, and social change. The negative effects of the climate change can be properly managed only by combined and long-term actions.

VIII. CONCLUSION

This paper reiterates the fact that the contribution of human made carbon emissions has become the largest contributor to the current day climatic change that bears a very high degree of effects on the environment, ecology and socioeconomics. The results indicate that the release of power, transport, and industrial development and land-use systems such as deforestation through burning of fossil fuels has significantly contributed to the level of carbon dioxide in the atmosphere, and has enhanced the greenhouse effect and resulted in global warming (IPCC, 2021; Friedlingstein et al., 2023). It can already be seen that the effects of the increasing carbon emissions on the environment include increasing global temperatures, faster melting of ice glaciers and polar ice caps, rise of the sea level, and the intensifying frequency and intensity of extreme weather events (Le Quéré et al., 2020; Rockström et al., 2009). These have impacted the ecosystems, led to loss or displacement of natural habitat pointing out that the current climatic change is not a thing in the future but is actually the present. Climate change is a socio-economic disproportionate issue in the fact that carbon emission enhancement strengthens the already susceptible populace, specifically, in the underdeveloped countries in regions such as food security, water supplies and human health (Stern, 2007). The current gap between the international work of mitigation and the extent of work that is necessary to stabilize the global temperatures, as the results indicate, remain intact, and it demonstrates that the current global policies including the agreements of the Paris Agreement are not sufficient to reach the long term climate goals (Shukla et al., 2022). Finally, a global approach composed of renewable energy, energy efficiency, land-use, technological change and

responsible policy can be used to manage carbon emissions well. To protect the ecosystems and secure the environmental justice, it is crucial to integrate sound science with the economic and policy intervention so that the risks of the future can be reduced (IPCC, 2021; Friedlingstein et al., 2023; Shukla et al., 2022). Nevertheless, until long-term and active work, none of the long-term consequences of carbon emissions will stop causing a threat to the planet and humankind.

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