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Impact of Climate Change on Income Inequality

Pragya Kapoor

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I. Abstract

Climate-change is the pervasive reality of the world today. This research paper explores the relationship between climate change and income inequality, highlighting how these two global challenges amplify one another. It examines the disproportionate contributions of wealthy nations and individuals to greenhouse gas emissions and the severe impacts of climate change on low-income communities and vulnerable economies. The paper discusses solutions such as climate finance, carbon pricing, and investments in sustainable technologies, and emphasises their potential to address both environmental and economic disparities. This study advocates for inclusive approaches that prioritise social justice to achieve a more sustainable and equitable future.

Keywords: Climate Change, Income Inequality, Carbon Emissions, Economic Disparities

II. Introduction

Climate change is no longer a threat in the distant future - it is now the reality of today's world and has serious impacts on the planet's ecosystems and economy. Manifesting in the form of a drastic rise in occurrence of natural disasters and seen in the changing patterns of agriculture, climate change impacts those the most who are least prepared to deal with its consequences.

Post the pre-industrial era, the Earth's average temperature has increased by around 1.2°C, and this has had a direct impact on global economic stability and inequality. It is estimated that by 2100 in India and Saudi Arabia, the **cost of climate change could reach upto 9%-13% of their respective GDPs**, and the number of children who die annually due to losses in income, could increase by 165,000 and 250,000, respectively. By the same year, the number of **people living on less than \$2 a day could increase by 145-220 million**.¹ To prevent such a dire state of events would require **investments amounting to only 1% of global GDP annually**.²

This disparity is not limited to financial aspects, but extends to environmental and social ones too. While wealthy individuals and nations have relatively easy access to resources for adaptation, developing countries are often to get such access without taking on debt. According to a 2020 Oxfam report, carbon emissions of the top 10% are more than double those of the bottom 50%.³

Carbon-pricing mechanisms also reflect inequality - until redistributive policies are implemented in an effective manner, they end up burdening low-income households disproportionately more. Similarly, fossil fuel subsidies, which, according to the IMF, were \$5.9 trillion in 2020, also distort energy markets and divert resources which could have been used for making investments in renewable energy.

Another challenge is the **disproportionately high influence that high-income groups wield**. These groups tend to lobby for their own financial interests and oppose measures which pose a threat to their profit-making activities. This makes it difficult to effectively implement policies for promotion of renewable energy and carbon-pricing.

Behavioural economics tells us that income inequality makes it difficult for certain sections of the population to adopt sustainable practices. While **the wealthy can assimilate electric vehicles and solar panels into their lifestyles**, low-income households are prevented from realising such practices due to the financial barrier associated with them. However, it is possible to work towards making green practices accessible to all, through subsidies and tax credits.

Models are used to assess the distributional impacts of policies on income inequality. Integrated Assessment Models (IAM) are an example of the same. Poorly designed policies can worsen income inequality. To reduce income gaps while reducing emissions, carbon-pricing mechanisms can be implemented alongside policies which aim at progressive redistribution of revenue.

Climate change and income inequality are deeply interconnected phenomena. It is imperative to use the tools given by Economics to quantify the impacts of climate change and design comprehensive policies to protect the most vulnerable communities from bearing the brunt of climate change.

III. Climate Change as an Economic Phenomenon

Climate change is one of the gravest examples of negative externalities seen in the modern history period, and has been made worse by **market failure**. Its impacts are not limited by borders, industries, or generations, and have an umbrella effect, regardless of the unequal contribution of different sections to the problem.

In economic terms, an ‘externality’ refers to the impact an action by an entity has on other entities, when these impacts are not accounted for in the price of the commodity. The reason why climate change represents a classic **negative externality** is because greenhouse gas emissions impact the present and future generations and impose heavy social costs on them, and yet, the emitters of these GHGs are not liable to appropriate financial penalty.

Social cost of carbon (SCC) is a measure which quantifies such externalities. According to a 2022 study, the mean value of global SCC is \$185 per tonne of CO₂, which is much more than the actual prices of carbon.⁴ This gap is a testament to the statement that markets do not always internalise the true cost of emissions, which leads to exacerbation of inefficiency and inequalities.

The trans-boundary nature of emissions worsens the problem, since CO₂ emitted by a country contributes to warming on a global level, irrespective of the origin of the emissions. This makes climate change a good example of the ‘**tragedy of the commons**’ problem, since individual nations do not have sufficient incentive to reduce emissions, leading to a sub-optimal outcome on the global level.

Climate change has not spared any sector or region from being economically impacted. Studies say that by 2050, global agricultural yields can fall by 3%-12%, and by 11%-25% by 2100, due to rising temperatures.⁵ Regions where agriculture forms a major part of GDP and employment, such as Sub-Saharan Africa and South Asia, are prone to greater impact. Health costs are also expected to be extremely high. According to a 2020 World Bank study, till 2030, an additional 132 million people would fall into extreme poverty, out of which, 44 million can be attributed to only health-related costs.⁶

Infrastructure is also susceptible to climate change impact. Between 2000 and 2019, climate related disasters were responsible for \$2.97 trillion worth of damage, 1.23 million lives and impacting 4.2 billion people.⁷ Hurricane Harvey (2017) alone inflicted damage worth \$125 billion in infrastructure and housing.⁸

According to a 2019 study, if mitigation measures are not adopted, a sustained rise in average temperature of 0.04°C can lead to a **reduction in global GDP per capita by more than 7%, till 2100**. If the Paris agreement is followed, this loss can be limited to only 1% and the annual rise in

temperature can be limited to 0.01°C.⁹ These numbers highlight that it is important to make climate the central focus of economic policy.

In the absence of policy interventions, markets do not account for external costs of emissions, which leads to an **over-production of carbon-intensive goods and under-investment in clean technology**. Such factors of externalities, public goods, and information asymmetries, lead to market failure. Government intervention is necessary to finance initiatives such as renewable energy and coastal defences, to prevent under-supply of such public goods. Carbon-pricing mechanisms such as carbon taxes and cap-and-trade systems are also important tools. Sweden's carbon tax, which was set at \$130.29 per tonne in 2024,¹⁰ has helped reduce emissions by 27% in 1990-2018.¹¹

Information asymmetry is caused due to complexity of climate science and delayed impacts. Consumers and businesses underestimate risks. According to the IEA, to achieve net-zero emissions by 2050, clean energy requires \$4 trillion in annual investments. However, the current global investment level is less than one-third of this requirement, in developing economies.¹²

Green bonds are a financial instrument, and are also an important part of climate finance. Since 2007, cumulative issuance of green bonds has crossed \$1 trillion, which is used to fund renewable energy and sustainable transportation projects.¹³ Developed nations have pledged \$100 billion in annual climate finance under the Green Climate Fund, however disbursements are not at par with the targets.¹⁴

Private investments are equally important. Incentives such as tax credits and public private partnerships have the power to boost private investment. For example, Glasgow Financial Alliance for Net Zero has raised more than \$130 trillion private capital for net-zero goals.¹⁵

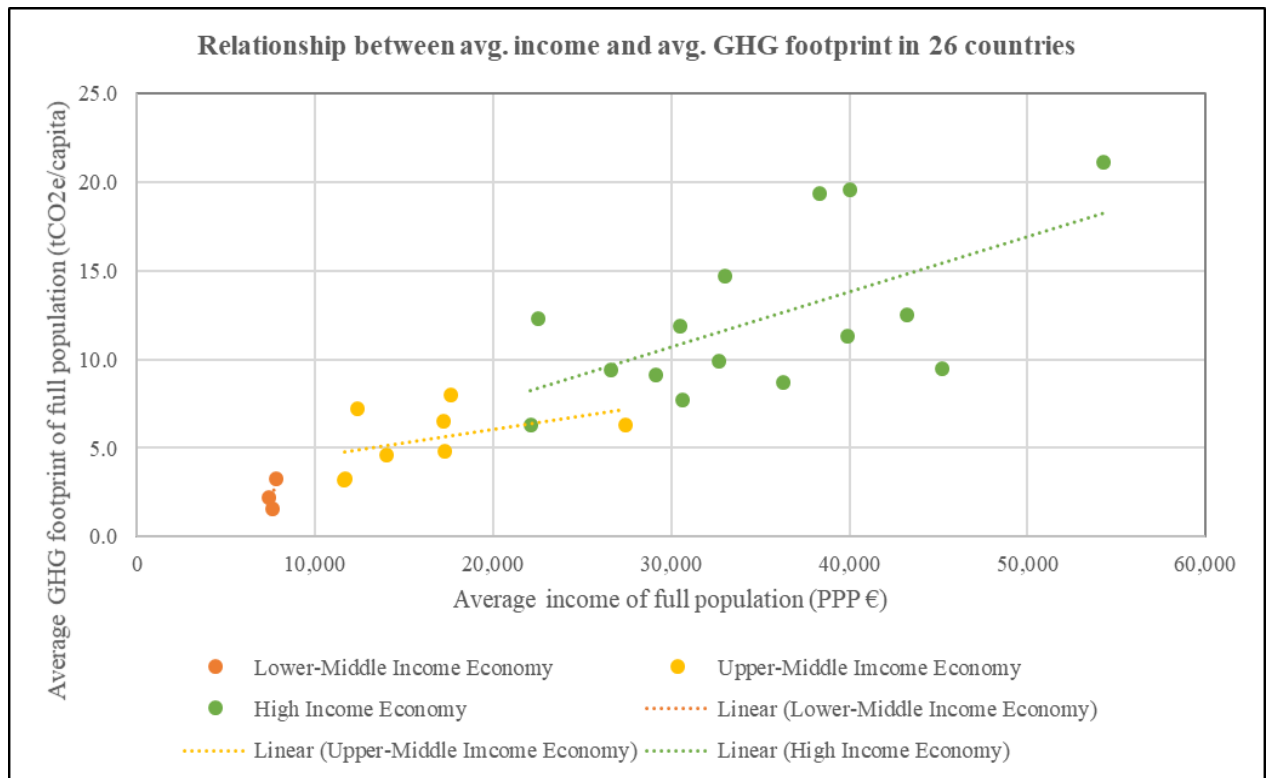
All these factors show that it is urgently required to align economic policy with climate goals. Until effective action is taken. The burden would have to be borne most by the vulnerable communities.

IV. Interlinkages Between Climate Change, Poverty, and Income Inequality

The relationship between poverty, inequality and climate change creates a vicious cycle. Pre-existing socio-economic inequalities make certain sections of the population more vulnerable to the effects of climate change.

Income inequality and carbon emissions are intricately linked. **Wealthy households consume energy-intensive goods and services, due to which their per-capita emissions are quite high.** The top 10% of global income earners are responsible for 48% of the total carbon emissions, whereas the bottom 50% are responsible for only 12% of total carbon emissions.¹⁶ This disparity highlights that there is a direct correlation between income and equality and a carbon-intensive lifestyle.

The distribution of global emissions and climate effects is also unequal. **Even though developing countries contribute less to global emissions, they face disproportionately higher effects of climate change.**



Data source: World Inequality Report 2022.¹⁷ Data table in Appendix.

The graph clearly depicts a **positive correlation between average greenhouse gas emissions and average income of a country**. An average individual belonging to a richer nation has higher carbon emissions than an average individual living in a poorer nation. Poorer countries have lower per capita carbon emissions. Further, variance in average GHG emissions also seems to increase as average income among countries increases, perhaps due to some countries making use of their high-income status to invest in cleaner production processes and other practices, which leads to lower emissions; an option entirely unavailable for low-income and lower-middle income economies. As per World Bank classification, lower-middle income economies have the least average emissions and high-income economies have the highest.

There is also evident disparity in energy access. Affluent populations prioritise their own convenience and consumption, while low-income groups are devoid of equitable access to basic clean energy infrastructure. According to a 2021 IEA study, 770 million people, most of them from Africa and South Asia, do not have access to electricity.¹⁸

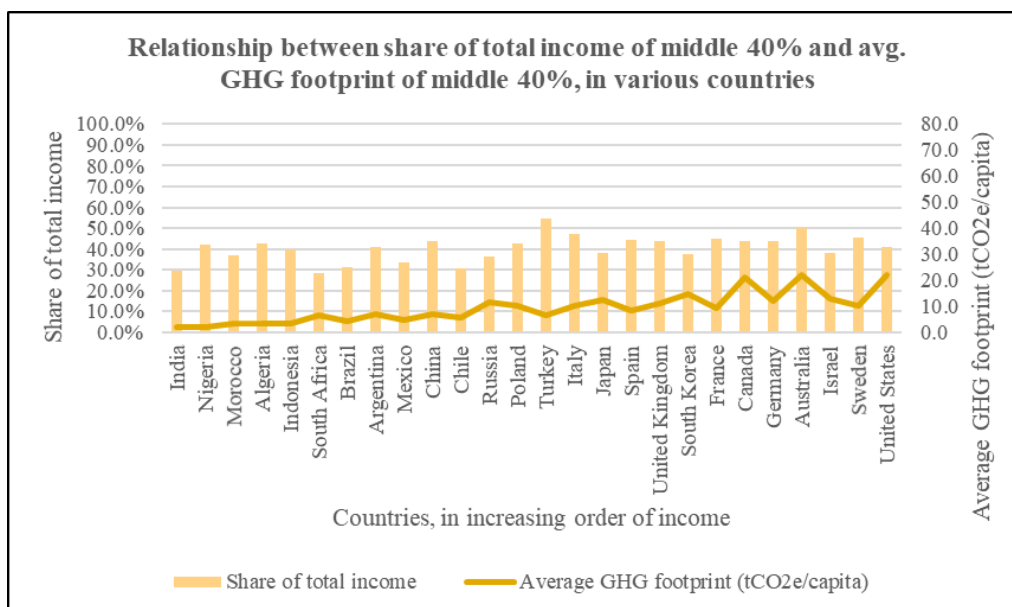
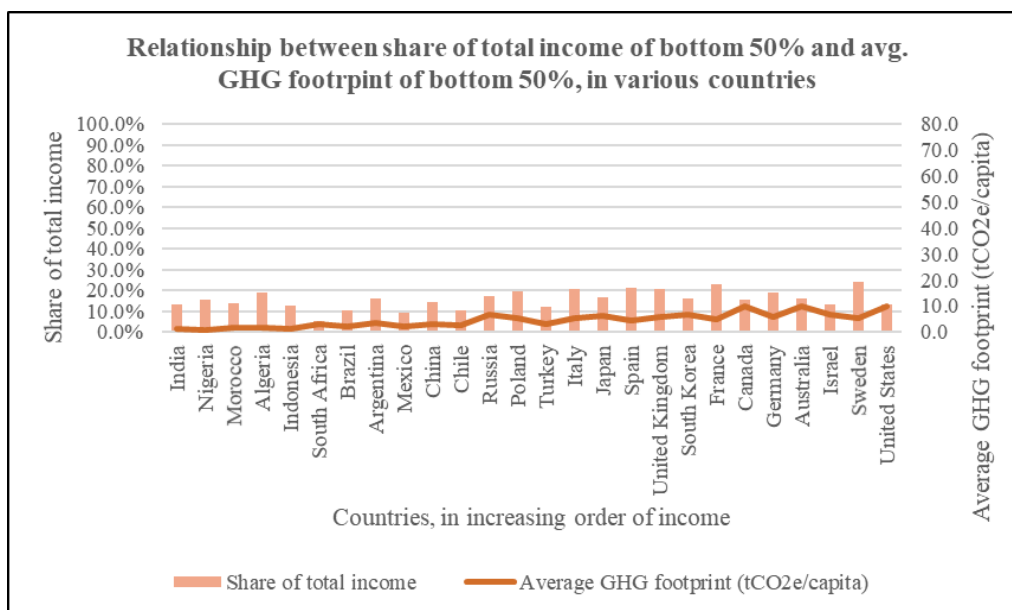
Poorer people face the most and worst impacts of climate change, since their **adaptive capacity is limited**. Low-income households in areas prone to extreme weather events such as floods or droughts do not have adequate financial resources or social safety nets, making their recovery difficult. Among the urban poor, the most susceptible populations to climate related disasters are **informal settlements**. According to a 2020 World Bank report, if climate has a high impact on health, then by 2030, 44 million people can be pushed into extreme poverty. If this impact is low, the number is still estimated to be 25 million.¹⁹

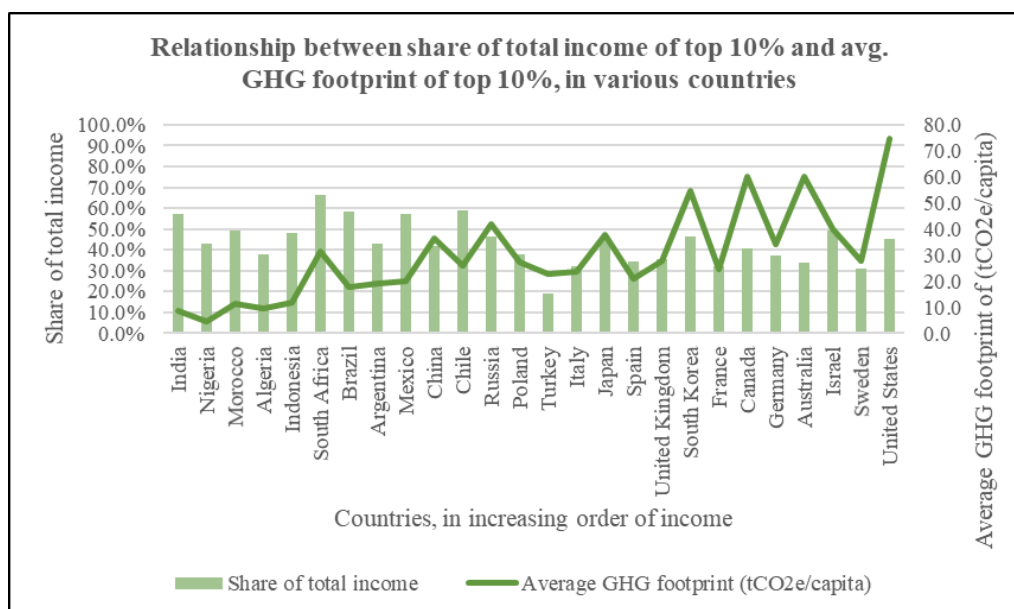
Poor communities are the ones most impacted by **decline in agricultural productivity** and rising temperatures and associated increase in vector-borne diseases. According to a 2019 study, low-income neighbourhoods are more affected by heatwaves in Delhi than wealthy neighbourhoods.²⁰

The cost of **adaptation to rising sea-level** is also a major consideration for poor economies. For the three most vulnerable regions in the Pacific atoll nations, sea-level rise of 0.5 meters is expected to cost \$10 billion, which is equivalent to 20 years of their current GDP being entirely spent on physical adaptation efforts.²¹ Also, every year, rural families in Bangladesh spend 158 billion taka (around \$2 billion) in repairing damage incurred due to climate change and in preventing such damage.²²

The carbon-intensive lifestyles, including air travel, large housing and high levels of consumerism, of affluent populations in wealthy nations magnify climate-related income inequalities. The annual carbon footprint of a working-class Nigerian is 0.67-0.80 tonnes of CO₂, while that of a middle-class Nigerian is approximately double that amount. Compared to these figures, an average American emits a minimum of 15 tonnes of carbon a year and a Brit emits 10 tonnes.²³

The **export of carbon-intensive industries to developing nations** magnifies these disparities. Due to this, poorer economies have to shoulder a major portion of the environmental costs of production, which worsens their vulnerabilities.





Data source: World Inequality Report 2022.²⁴ Data table in Appendix.

The three graphs above show the relationship between total income and average GHG footprint of each - the bottom 50%, middle 40% and top 10%. Since the countries are arranged in increasing order of average income, we can see that while there does not seem to be much overall difference between the share of total income of the bottom 50% in richer nations and that in poorer nations, this difference is slight but perceptible in the case of the middle 40% (overall slightly lower in poorer nations than in richer nations), and perceptible in the case of the top 10% (overall higher in poorer nations than in richer nations). The country with the highest share of total income for its bottom 50% falls at the richer end of the income spectrum, and the country with the lowest share of total income for its bottom 50% falls at the poorer end. The country with the highest share of total income for its middle 40% falls in the middle of the income spectrum, and the country with the lowest share of total income for its middle 40% falls at the poorer end. The country with the highest share of total income for its top 10% falls at the poorer end of the income spectrum, and the country with the lowest share of total income for its top 10% falls in the middle of the income spectrum. This points to lower disparity between the rich and the poor in rich and developed nations.

Average GHG footprint is higher in richer nations than in poorer nations for all income classes. However, it is interesting to note that the variation in average GHG footprint is much higher among richer countries than in poorer ones, for the top 10%. This variation is slight but perceptible for the middle 40%, and extremely slight for the bottom 50%. Overall, average GHG emissions are highest for the top 10%, followed by the middle 40%, and least for the bottom 50%, and higher in richer nations than in poorer ones, for all income classes.

V. Impact of Climate Change on Vulnerable Economies

It is the vulnerable economies that are most impacted by climate change, since it deepens existing inequalities. A few characteristics differentiate vulnerable economies from others.

1. **Agriculture forms a significant portion of GDP** in low-income countries. In Sub-Saharan Africa, the contribution of agriculture to GDP is more than 20%, and more than 60% of the labour force is employed in agriculture.²⁵ However, erratic weather patterns make the

agricultural sector especially susceptible to erratic weather patterns, since it relies on specific climatic conditions.

2. Vulnerable economies are often rife with problems of **limited financial resources, weak governance structures, and inadequate infrastructure**, which become a hurdle in their ability to implement strong adaptation measures. According to Notre Dame Global Adaptation Initiative (ND-GAIN), countries like Chad, Haiti and Eritrea are least prepared for climate risks.²⁶
3. Further, such economies also have poor resilience to climate shocks, since a **large section of their population lives below the poverty line**. In 2022, 40% of total consumer spending in low-income countries of Africa and South Asia was spent on food.²⁷

The most vulnerable sector in climate-sensitive economies is agriculture. Crop yields and livestock productivity are directly impacted by rising temperatures, changing precipitation patterns and extreme weather events. According to a 2017 paper, an increase in global mean mean temperature by 1°C leads to a decline in the yields of staple crops such as wheat, rice and maize, by 6%, 3.2% and 7.4%, respectively.²⁸ With more prevalent and sophisticated crop insurance and irrigation systems, wealthier nations are less impacted by such climate events. This highlights the differences in adaptive capacities between poorer and richer nations.

Energy infrastructure is also vulnerable to climate change. The Coca Codo Sinclair hydroelectric dam in Ecuador, which was designed to cater to 90% of the country's energy requirements, operated at merely 30% of its capacity due to climate change-induced droughts and construction faults. This led to power cuts of as much as 14 hours, which posed severe disruptions to economic activities and daily life.²⁹

Weak infrastructure exacerbates the impacts of climate-related disasters. Coastal areas in low-income countries are at risk due to sea-level rise and storm surges. According to studies, developing countries suffer infrastructural damages of upto \$18 billion due to natural disasters every year, and households and businesses suffer losses of upto \$390 billion attributable to disruptions and inadequate maintenance due to natural disasters. High-income countries are able to mitigate their losses by investing in climate-resilient infrastructure.³⁰

Climate-induced migration is an emerging concern for vulnerable economies. According to the World Bank's Groundswell report, till 2050, climate change would force 216 million people to migrate internally, especially in Africa, Asia and Latin America.³¹ In Bangladesh, sea-level rise and river-erosion have displaced millions, and Dhaka absorbs 300,000-400,000 million climate migrants every year. It is estimated that by 2050, rise in sea-level would cause 17% of the country to drown and would force 20 million individuals to relocate.³² Lack of strong urban planning and rural development strategies make the cycles of poverty and economic instability worse in the face of migration. Wealthier nations are better able to manage such displacement by making use of their advanced planning and resources.

The stark difference between the preparedness of rich and poor nations is quite evident. High-income nations such as Denmark and Netherlands are top performers on the Climate Change Performance Index (CCPI) due to their widespread use of strong climate regulations and large R&D expenditures.³³ On the other hand, nations such as Iran are unable to adeptly adopt mitigation and adaptation measures.

Vulnerable economies face disproportionately higher economic losses. Global average losses reach up to 10% of GDP at 3 degrees celsius of warming, while low-latitude poor nations face losses of up to 17% of GDP.³⁴ In 2017 Hurricane Maria was responsible for damages equivalent to 226% of GDP in Dominica,³⁵ while Hurricane Harvey caused losses equivalent to less than 1% of the GDP of the USA.³⁶

VI. Challenges

Efforts in the context of addressing income inequalities and climate change face several challenges which are often intertwined with the complex socio-economic and political structures of the globalised world.

A major issue is the **lack of coordination** between the global, national and local levels in matters of governance. By its nature, climate change is not limited by national boundaries, but the response to its impact on income inequality varies from nation to nation. Wealthier nations, which have historically been the largest contributors to GHG emissions, often focus only on reducing their own domestic emissions, while vulnerable economies do not receive sufficient support for adaptation. This poses a challenge to poorer nations in securing financial and technological resources to protect their populations.

Dearth of climate finance and inequity adds to this problem. While it is widely recognised that large investments are required to address climate-induced inequalities, the flow of climate finance is still inadequate. Bureaucratic mechanisms make it difficult for low-income countries and marginalised groups to access resources. The populations which are already at risk have to bear a disproportionate effect, making it harder for them to recover from, or adapt to, climate-related disruptions.

Another challenge faced by developing countries is their **competing priorities**. For such countries, balancing immediate needs like poverty-alleviation, healthcare and education, with long-term investments for climate-change, is a concern. Owing to limited budgets, governments often prioritise short-term solutions, which reinforce systemic inequalities and become a hindrance in the process of reduction of income inequalities.

Aside from this, **resistance from powerful vested interests** is also a challenge. Influential economic players such as Fossil-fuel-reliant industries and large-scale agribusinesses often resist policies which aim to reduce income inequalities caused by climate change. Such entities make use of their political and economic power to lobby against reforms and regulations that have the possibility of impacting their profits. This creates a pressure on policymakers to maintain the status-quo, which undermines efforts to promote equitability. Consequently, implementation of important policies gets delayed and effectiveness of initiatives gets weakened.

Technical and logistical challenges also present an important concern. To design effective policies, governments require reliable data and analytical tools to identify the most at-risk populations and sectors. However, developing nations lack the institutional and technological infrastructure required to gather accurate data and conduct analyses. Without correct data, poorly targeted interventions may be implemented, which are not able to deliver the expected benefits to beneficiaries and end up wasting resources.

Behavioural and cultural factors also create hurdles. Redistributive measures such as carbon pricing or progressive taxation see significant variation in public support, especially in societies with severe economic stratification and weak solidarity between income groups.

The global economic system amplifies these challenges. Wealthier countries and corporations are able to extract resources and labour from poorer nations without adequate compensation, thanks to **trade liberalisation and capital mobility**. Developing nations dependent on climate-sensitive industries such as agriculture and tourism face a disproportionately high negative impact of climate change. International cooperation and systemic reforms are the need of the hour, but conflicting national interests and entrenched global economic structures slow the progress.

The **barrier to marginalised groups from decision-making processes** presents another barrier - women, indigenous populations and low-income communities are not adequately represented in policy dialogues and planning processes, leading to a lack of alignment of policies with local needs and circumstances, leading to ineffective solutions.

To overcome these barriers, it is necessary to align climate action with social justice goals, and to prioritise the needs of the most vulnerable populations. Policymakers should not buckle under influence from vested interests and focus on long-term strategies to integrate climate resilience and economic equity. To ensure that resources reach those most in need of them, it is essential to make climate finance systems inclusive. Governments and international organisations need to be proactive about empowering marginalised groups, include them in decision-making processes, and tailor policies according to their specific contexts.

VII. Recommendations

To address the intertwined challenges of climate change and income inequality, a series of clear and well thought-out recommendations are required. These ideas are not merely theoretical but are inspired by our pressing reality and the need to face the dual crises with determination and innovative thinking. Following are proposals which aim to address the root causes of inequality, which have worsened due to climate change, and to help make communities and economies more resilient and adaptable.

Firstly, to ensure that climate finance is fairly distributed, **reform is needed in global financial systems**. By stepping up and developing mechanisms to help vulnerable economies access resources required to combat climate-impacts and reduce income disparities, the international community can step up to this global issue. Whether for adaptation or mitigation, funding models would benefit from a new perspective. An increase in the contribution of wealthy nations, which have historically been the major contributors of greenhouse gas emissions, in initiatives like the Green Climate Fund is required. However, these contributions should not be accompanied by overly strict conditions which make it difficult for low-income nations to access support. Greater transparency and simplicity in the distribution process of funds, and encouraging grants over loans can help decrease the financial burden of already struggling countries.

Secondly, encouraging **economic diversification in low-income countries** would go a long way, since many low-income countries depend on climate-sensitive sectors such as agriculture, which makes them more vulnerable to climate change and extreme weather events. Economies can be made more resilient by investing in sectors like renewable energy, technology and sustainable manufacturing, since this can create new jobs and reduce income inequalities. Governments and

international organisations can together promote private sector investments by giving subsidies, tax breaks and incentivising public-private partnerships. Along with this, introducing skill-development programmes for workers can help assimilation of labour into new industries.

Thirdly, **strengthening social protection systems** is also an important step to reduce the impact of climate change on income inequality. The communities most affected by climate related disruptions are marginalised groups such as low-income households, women and indigenous communities. Governments can help cushion associated economic shocks by introducing strong social safety nets such as cash-transfer programmes, unemployment benefits, and affordable healthcare and education. These systems have to be designed in a manner that they withstand effectively even in the face of climate crises like floods and hurricanes. Digitalising welfare programmes and linking them to early warning systems can make dissemination faster to affected populations.

Fourthly, **tax reforms such as carbon pricing** are also a powerful tool to address income inequality due to climate change. If carbon taxes and cap-and-trade systems are designed carefully, then emissions can be reduced alongside measures to reduce inequality. However, these policies should be formulated in a manner such that low-income households do not face unfair burden. The revenue generated from carbon pricing should be used to subsidise clean energy for disadvantaged communities and to fund public transportation systems. Transparent management of funds and taking input from the public in decision-making helps build trust.

Other essential aspects include **education and climate literacy programmes** and **policy alignment**. These recommendations cannot be effective individually. To tackle the intersection of climate change and income-inequality, a comprehensive approach is required to combine financial, social and institutional efforts.

VIII. Conclusion

Climate change and income-inequality are interconnected and form a mutually reinforcing cycle. When impacts of climate change intensify, they affect those most who have the least resources available to adapt. This deepens economic disparities. Along with this, the unequal contributions to greenhouse gas emissions highlight the role of consumption patterns.

To address these intertwined challenges, a multi-dimensional approach is required to lessen environmental damage and promote economic equity. A broad range of strategies exist to bridge the gap between the poor and the rich, such as equitable climate finance, progressive carbon pricing, and investment in clean energy and social protections.

It is vital that the solutions implemented balance immediate needs with long term sustainability. Understanding climate action and the associated economic unfairness, and aligning policies to these goals, is a top priority in current times.

IX. References

- [1] Stern, N. (2006). Stern Review: The Economics of Climate Change. Cambridge University Press.
- [2] UNEP, WEF, ELD, Vivid Economics. State of Finance for Nature 2021. (2021). United Nations Environment Programme.

- <https://www.weforum.org/press/2021/05/investing-less-than-1-of-world-gdp-into-nature-based-solutions-can-tackle-climate-change-and-biodiversity-crisis/>.
- [3] Ratcliff, A. (2020). Carbon emissions of richest 1 percent more than double the emissions of the poorest half of humanity. Oxfam International.
- <https://www.oxfam.org/en/press-releases/carbon-emissions-richest-1-percent-more-double-emissions-poorest-half-humanity>.
- [4] Rennert, K., Errickson, F., Prest, B.C., Rennels, L., Newell, R. G., Pizer, W., Kingdon, C., Wingenroth, J., Cooke, R., Parthum, B., Smith, D., Cromar, K., Diaz, D., Moore, F. C., Müller, U. K. Plevin, R. J. Raftery, A. E., Ševčíková, H., Sheets, H., Stock, J. H. Tan, T., Watson, M., Wong, T. E., Anthoff, D. (2022). Comprehensive evidence implies a higher social cost of CO₂. *Nature*. <https://doi.org/10.1038/s41586-022-05224-9>.
- [5] Wing, I. S., De Cian, E., Mistry, M. N. (2021) Global vulnerability of crop yields to climate change. *Journal of Environmental Economics and Management*.
- <https://doi.org/10.1016/j.jeem.2021.102462>.
- [6], [19] Jafino, B. A., Walsh, B., Rozenberg, J., Hallegatte S. (2020). Revised Estimates of the Impact of Climate Change on Extreme Poverty by 2030. World Bank Group Working Paper.
- <https://openknowledge.worldbank.org/server/api/core/bitstreams/ad7eeab7-d3d8-567d-b804-59d620c3ab37/content>.
- [7] McClean, D. (2020). #DRRday: UN Report charts huge rise in climate disasters. United Nations Office for Disaster Risk Reduction. <https://www.undrr.org/quick/13070>.
- [8] Frame, D.J., Wehner, M.F., Noy, I., Rosier, S. M. (2020) The economic costs of Hurricane Harvey attributable to climate change. *Climatic Change*. <https://doi.org/10.1007/s10584-020-02692-8>.
- [9] Kahn, M. E., Mohaddes, K., Ng, R. N. C., Pesaran, M. H., Raissi, M., Yang, J. C. (2019). Long-Term Macroeconomic Effects of Climate Change: A Cross-Country Analysis. International Monetary Fund Working Paper.
- [10] Sweden's carbon tax. Government Offices of Sweden.
- <https://www.government.se/government-policy/taxes-and-tariffs/swedens-carbon-tax/#:~:text=The%20carbon%20tax%20was%20introduced,rate%20of%20SEK%2011.58%20per.>
- [11] Jonsson, S., Ydstedt, A., Asen, E. (2020). Looking Back on 30 Years of Carbon Taxes in Sweden. Tax Foundation Europe.
- <https://taxfoundation.org/research/all/eu/sweden-carbon-tax-revenue-greenhouse-gas-emissions/#:~:text=rate%20of%20SEK%2011.58%20per.>
- ,Sweden%20levies%20the%20highest%20carbon%20tax%20rate%20in%20the%20world, gas%20emissions%20by%2027%20percent.

- [12] International Energy Agency (2021), Net Zero by 2050, IEA, <https://www.iea.org/reports/net-zero-by-2050>.
- [13] Climate Bonds Initiative, \$1Trillion Mark Reached in Global Cumulative Green Issuance: Climate Bonds Data Intelligence Reports: Latest Figures. (2020). CBI. <https://www.climatebonds.net/2020/12/1trillion-mark-reached-global-cumulative-green-issuance-climate-bonds-data-intelligence>.
- [14] Colenbrander, S., Pettinotti, L., Cao, Y. (2022). A fair share of climate finance? An appraisal of past performance, future pledges and prospective contributors. Overseas Development Institute Working Paper. <https://odi.org/en/publications/a-fairshare-of-climate-finance-an-appraisal-of-past-performance-future-pledges-andprospective-contributors/>.
- [15] Glasgow Financial Alliance for Net Zero. Amount of finance committed to achieving 1.5°C now at scale needed to deliver the transition. (2021). GFANZ. <https://www.gfanzero.com/press/amount-of-finance-committed-to-achieving-1-5c-now-at-scale-needed-to-deliver-the-transition/>.
- [16] United Nations Environment Programme (2023). Executive summary. Emissions Gap Report 2023: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again). UNEP. https://www.unep.org/interactives/emissions-gap-report/2023/#section_-1.
- [17], [24] Chancel, L., Piketty, T., Saez, E., Zucman, G. et al. World Inequality Report 2022. World Inequality Lab. <https://wir2022.wid.world/download/>.
- [18] International Energy Agency (2021). Recommendations of the Global Commission on People-Centred Clean Energy Transitions. IEA. <https://www.iea.org/reports/recommendations-of-the-global-commission-on-people-centred-clean-energy-transitions>.
- [20] Jacobs, C., Singh, T., Gorti, G., Iftikhar, U., Saeed, S., Syed, A., Abbas, F., Ahmad, B., Bhadwal, S., Siderius, C. (2019). Patterns of outdoor exposure to heat in three South Asian cities. Science of The Total Environment. <https://doi.org/10.1016/j.scitotenv.2019.04.087>.
- [21] Reuters. (2024). Pacific atolls face \$10 billion cost of rising sea, says World Bank. The Economic Times. <https://economictimes.indiatimes.com/news/international/world-news/pacific-atolls-face-10-billion-cost-of-rising-sea-says-world-bank/articleshow/115291827.cms?from=mdr>.
- [22] Hossain, M. (2021). 'Silent financier': How Bangladesh's poor are paying the costs of climate damage. Reuters. <https://www.reuters.com/markets/commodities/silent-financier-how-bangladeshs-poor-are-paying-costs-climate-damage-2021-12-10/>.

- [23] Agbo Jr., M. (2022). Nigeria's Ambitious Climate Agenda and Its Misplaced Fixation on Carbon Footprint. Common Edge.
- <https://commonedge.org/nigerias-ambitious-climate-agenda-and-its-misplaced-fixation-on-carbon-footprint/#:~:text=Using%20an%20open%2Dsource%20carbon,Nigerian%20is%20likely%20twice%20that.>
- [25] Muchoki, A. (2024). Why Agriculture Matters in Africa: The Continent's Number One Employer. Agrilinks. <https://agrilinks.org/post/why-agriculture-matters-africa-continents-number-one-employer>.
- [26] Notre Dame Global Adaptation Initiative. (2024). ND-GAIN Country Index. NDGAIN.
- <https://gain.nd.edu/our-work/country-index/rankings/>.
- [27] Economic Research Service, United States Department of Agriculture. (2023). Lower income countries spend much higher share of expenditures on food than higher income countries.
- <https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=107494>.
- [28] Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D.B., Huang, Y., Huang, M., Yao, Y., Bassu, S., Ciais, P., Durand, J., Elliott, J., Ewert, F., Janssens, I.A., Li, T., Lin, E., Liu, Q., Martre, P., Müller, C., Peng, S., Peñuelas, J., Ruane, A.C., Wallach, D., Wang, T., Wu, D., Liu, Z., Zhu, Y., Zhu, Z., Asseng, S. (2017). Temperature increase reduces global yields of major crops in four independent estimates, Proc. Natl. Acad. Sci.
- <https://doi.org/10.1073/pnas>.
- [29] Michael Stott. (2024). Latin America's hydro power bet suffers effects of climate change. Financial Times.
- <https://www.ft.com/content/059a0657-d508-4c34-a517-57e5cca0ee4c?utm>.
- [30] World Bank Group. (2019). \$4.2 Trillion Can Be Saved by Investing in More Resilient Infrastructure, New World Bank Report Finds. World Bank Group.
- <https://www.worldbank.org/en/news/press-release/2019/06/19/42-trillion-can-be-saved-by-investing-in-more-resilient-infrastructure-new-world-bank-report-finds>.
- [31] World Bank Group. (2021). Climate Change Could Force 216 Million People to Migrate Within Their Own Countries by 2050. World Bank Group.
- <https://www.worldbank.org/en/news/press-release/2021/09/13/climate-change-could-force-216-million-people-to-migrate-within-their-own-countries-by-2050>.
- [32] Shalant, J. (2018). Bangladesh: A Country Underwater, a Culture on the Move. Natural Resources Defense Council. <https://www.nrdc.org/stories/bangladesh-country-underwater-culture-move>.

- [33] Burck, J., Uhlich, T., Bals, C., Höhne, N., Nascrimiento, L. (2024). Climate Change Performance Index 2025. Climate Change Performance Index.
<https://ccpi.org/download/climate-change-performance-index-2025/>.
- [34] Waidelich, P., Batibeniz, F., Rising, J., Kikstra, J. S., Seneviratne, S. I. Climate damage projections beyond annual temperature. *Nature*. <https://doi.org/10.1038/s41558-024-01990-8>.
- [35] Dominica Ministry of Finance, Climate Resilient Execution Agency of Dominica, International Monetary Fund. (2021). Dominica Disaster Resilience Strategy. IMF Country Report. <https://doi.org/10.5089/9781513588469.002>.
- [36] Merler, S. (2017). Hurricane Harvey's economic impact. Bruegel.
<https://www.bruegel.org/blog-post/hurricane-harveys-economic-impact>.

IX. Appendix

S. No.	Country	WB income classification	Average income (PPP €)				Average GHG footprint (tCO2e/capita)				Share of total income		
			Bottom 50%	Middle 40%	Top 10%	Full population	Bottom 50%	Middle 40%	Top 10%	Full population	Bottom 50%	Middle 40%	Top 10%
1	India	Lower-Middle Income Economy	2,000	5,500	42,500	7,400	1.0	2.0	8.8	2.2	13.1%	29.7%	57.1%
2	Nigeria	Lower-Middle Income Economy	2,400	8,000	32,700	7,500	0.9	1.8	4.4	1.6	15.5%	41.8%	42.7%
3	Morocco	Lower-Middle Income Economy	2,100	7,200	38,700	7,800	1.7	3.5	11.2	3.3	13.6%	37.0%	49.4%
4	Algeria	Upper-Middle Income Economy	4,424	12,473	44,287	11,630	1.7	3.5	9.4	3.2	19.0%	42.9%	38.0%
5	Indonesia	Upper-Middle Income Economy	2,900	11,600	56,100	11,700	1.4	3.5	11.8	3.3	12.4%	39.6%	48.0%
6	South Africa	Upper-Middle Income Economy	1,300	8,700	82,500	12,400	3.0	6.5	31.3	7.2	5.3%	28.2%	66.5%
7	Brazil	Upper-Middle Income Economy	2,800	11,000	81,900	14,000	2.2	4.3	17.7	4.6	10.1%	31.4%	58.6%
8	Argentina	Upper-Middle Income Economy	5,600	17,600	73,500	17,200	3.5	7.0	19.0	6.5	16.2%	41.0%	42.8%
9	Mexico	Upper-Middle Income Economy	3,200	14,500	99,400	17,300	1.9	4.5	20.0	4.8	9.2%	33.5%	57.4%
10	China	Upper-Middle Income Economy	5,100	19,400	73,400	17,500	3.0	7.2	36.4	8.0	14.4%	44.0%	41.7%
11	Chile	High Income Economy	4,500	17,100	130,200	22,100	2.7	5.8	26.1	6.3	10.2%	30.9%	58.9%
12	Russia	High Income Economy	7,700	20,600	104,600	22,500	6.8	11.7	41.7	12.3	17.0%	36.6%	46.4%
13	Poland	High Income Economy	10,400	28,500	100,400	26,600	5.3	10.2	27.2	9.4	19.5%	42.8%	37.8%
14	Turkey	Upper-Middle Income Economy	6,500	23,100	149,400	27,400	3.1	6.3	22.6	6.3	11.9%	54.5%	18.8%
15	Italy	High Income Economy	12,100	34,300	93,900	29,100	5.2	10.3	23.8	9.1	20.7%	47.1%	32.2%
16	Japan	High Income Economy	10,200	29,200	137,000	30,500	6.3	12.4	37.9	11.9	16.8%	38.3%	44.9%
17	Spain	High Income Economy	12,900	34,000	105,500	30,600	4.6	8.3	20.8	7.7	21.1%	44.4%	34.5%
18	United Kingdom	High Income Economy	13,300	36,000	116,700	32,700	5.6	10.9	27.7	9.9	20.4%	44.0%	35.7%
19	South Korea	High Income Economy	10,600	30,900	153,200	33,000	6.6	14.9	54.5	14.7	16.0%	37.5%	46.5%
20	France	High Income Economy	16,500	40,900	116,900	36,300	5.0	9.3	24.7	8.7	22.7%	45.1%	32.2%
21	Canada	High Income Economy	11,900	41,900	156,000	38,300	10.0	20.9	60.3	19.4	15.6%	43.7%	40.7%
22	Germany	High Income Economy	15,200	43,900	148,000	39,900	5.9	12.2	34.1	11.3	19.0%	43.9%	37.1%
23	Australia	High Income Economy	12,900	50,200	134,200	40,000	9.7	21.8	60.2	19.6	16.2%	50.2%	33.6%
24	Israel	High Income Economy	11,200	40,800	211,900	43,200	6.7	13.0	40.3	12.5	13.0%	37.9%	49.2%
25	Sweden	High Income Economy	21,500	51,400	139,200	45,200	5.4	10.1	27.9	9.5	23.8%	45.4%	30.8%
26	United States	High Income Economy	14,500	56,000	246,800	54,300	9.7	22.0	74.7	21.1	13.3%	41.2%	45.5%

Data source: World Inequality Report 2022.