P-ISSN: 2790-6795	Annals of Human and Social Sciences	October-Dec 2024,Vol. 5, No. 4
O-ISSN:2790-6809	http://doi.org/10.35484/ahss.2024(5-IV)45	[499-508]

Annals of Human and Social Sciences
www.ahss.org.pk

RESEARCH PAPER

Climate change and Paris Agreement: A Case Study of Lahore

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ABSTRACT

This research examines the climate change as a political problem in Lahore, Pakistan, where environmental degradation and urban challenges worsen with poor governance and socioeconomic inequalities. Consequently, increasing temperatures, air pollution, and heavy metal contamination result from industrial emissions, vehicular pollution, and agricultural burning, bringing about health crises that affect marginalized communities disproportionately and increase inequalities. While international climate frameworks like the Paris Agreement provide a global context, their implementation is minuscule given the lack of political commitment and geopolitical differences. This work employs quantitative methods such as case studies to identify governance deficits and disjointed policy implementation requiring interventions whose focus must be community-specific, localized, and transformational. Therefore, this study would advise applying environmental justice and redistributive policy reforms for sustainable climate resilience strategies that, albeit developed, are fit for other growing urban centers in South Asia.

Keywords: Air Pollution, Climate Change, Environmental Justice, Lahore, Sustainable Development, Urbanization

Introduction

Climate change is a pressing global issue that affects nearly every aspect of life on Earth, from natural ecosystems to human societies. The burning of fossil fuels, deforestation, and industrial pollution have increased greenhouse gas emissions, causing temperatures to rise and weather patterns to become more extreme. As a result, we see more frequent and intense heatwaves, storms, droughts, and floods. These changes threaten food and water supplies, increase the spread of diseases, and exacerbate social and economic inequalities worldwide, making climate change one of the most significant challenges of our time. Climate change has intensified environmental and social issues in Lahore, Pakistan, making the city especially vulnerable to extreme weather and pollution. Rising temperatures have contributed to longer, more intense heatwaves, while shifting rainfall patterns have led to unpredictable monsoon seasons, causing flash floods that damage infrastructure and displace communities (Nadeem, et. al., 2023).

The significance of tackling climate change in Lahore cannot be overemphasized, given that the city's deleterious effects on the environment pose risks to the health, economy, and social wellbeing of the city's dwellers. More often than not, Lahore finds itself among the most traffic-congested cities in the world. This is attributed to the high levels of air pollution often recorded in the city owing to, among many other factors, high levels of industrial emissions, fossil fuel combustion, and agricultural burning in the surrounding regions. This poor quality of air, in addition to the rising temperatures, increases incidences of respiratory diseases and other heat-induced illnesses among the prone groups. Climate changes will also stress the water and agriculture further with a knock-on effect on time

exactly when the people already facing challenges with agriculture progress illogically wet monsoon rains.

Climate change as a political matter within Lahore is significant in analyzing the challenges and prospects of mitigating the environmental problems associated with developing cities. As demonstrated in this case study, it is imperative to suggest appropriate political strategies that solve the problem of urbanization without compromising the environment. This is important, as such considerations are necessary to formulate suitable climate action strategies that fit the particular political setting of the likes of Lahore. Additionally, this case study can be applied to other similar cities in South Asia, where the issue of climate change mitigation is beginning to overshadow the development agenda (Ali, 2022). Use only sur name check and revise all, all references in text needs revision

Literature Review

Adeel (2020) examines the environmental rights and climate justice have mushroomed significantly, especially in developing countries. In Pakistan, which is highly vulnerable to acute climatic shocks, environmental degradation has been blamed for a host of socio-economic and health crises. Studies suggest that climate change aggravates inequality and that poor people and marginalized communities-the least culprits are its victims. Talk about Pakistan's geographical vulnerability concerning glaciers on the northern side and coastal areas in the south. This results in increased sensitivity to flooding, glacial melts, and drought. On the policy front, the role of such environmental considerations is clear. However, how woefully those policies are ineffectually implemented and imposed is quite evident on most counts since it is subject to many governance issues and resource scarcity besides lack of public concern. Environmental rights in Pakistan emerge as a legal and ethical imperative within climate justice to urge policymakers to address climate impacts and equitable resource access.

Although there is a vast literature on the impacts of climate change in Pakistan, still there is a lack of exploration on the interlinkage between environmental rights and climate justice. There are very few studies that focus on the role of environmental justice in protecting the rights of vulnerable populations affected by climate change. In particular, scholarship is largely lacking as far as the in-depth exploration of how the existing environmental policies can be transformed towards greater involvement in inequality concerns and human rights in the climate agenda of Pakistan. Moreover, the role of community participation and how grassroots movements can shape environmental policy in Pakistan remains largely unprobed within rigorous scholarly inquiry. Therefore, it is imperative to dive deeper into environmental rights as a dimension of climate justice.

This becomes important due to climate change and many other socio-economic issues Pakistan is exposed to. Dealing with environmental rights through the climate justice framework becomes important in such a country. This case study may be a source that can enlighten the way environmental rights can be used in holding governmental as well as corporate actors responsible while being fair and equitable climate policies. This study, focusing on Pakistan, fills gaps in climate justice literature and supports practical steps toward enabling local communities to be strengthened and resilience enhanced. Analyzing the case of Pakistan will also be of value to other developing nations that face similar climate threats in their efforts toward using the principles of climate justice in the environmental policy-making process. One very relevant article talking about climate change as a global political issue is:

Smith (2019) Climate change is increasingly recognized not only as an environmental crisis but as a multifaceted global political problem. Climate change politics involve complex interplays among countries, where geopolitical interests, economic goals, and social pressures converge. His studies highlight how international climate negotiations

often reflect broader political conflicts, such as those between developed and developing nations. It's in this context that the developing world, as one of the largest emitters, demands equal resource utilization against climate impacts. In so doing, Smith has revealed that the literature reveals that climate change is indeed a politicized phenomenon brought about by factors such as dependence on fossil fuel sources and multinational corporations and a divided opinion on the aspects of climate justice and responsibility. International frames, like the one in Paris, are attempts at harmonizing international efforts; however, these will most likely be frustrated by political interests and a lack of mechanisms that bite, and climate change will persistently remain an intractable political problem.

Despite numerous studies on international frameworks and negotiations, national level political agendas remain a significantly underappreciated factor in global climate action. Most studies ignore the fact that the domestic politics of the powerful nations are a barrier to the integrated global effort. In particular, there is very little study of how lobbying from fossil fuel industries, for example, or a government's changing priorities affect the country's position at international climate negotiations. The contribution of political ideology in changing public perception and policy uptake is under-explored, though it is also a critical influence on climate initiatives at both national and international levels.

This would offer additional assistance in recognizing the existing divisions of the awkward response within the global setting and the degree of difficulty in aligning climate targets with policy objectives. The present study attempts to locate some of these barriers and difficulties as well as possibilities for adequate global cooperation by studying those intersections of global climate politics with national political processes. These can serve to modify certain policies to reflect the political realities more accurately, which would enable to achievement of a stricter and more legally binding climate change commitment. The perspective enhances the conceptualization of climate change as a political matter and assists in the development of policies where environmental targets and social objectives conflict.

Shouping, (2019) Examine Climate change has created an elaborate network of international environmental laws and agreements to be designed to combat global warming, preserve biodiversity, and support sustainable development. The most critical international frameworks include the Paris Agreement, the Kyoto Protocol, and the United Nations Framework Convention on Climate Change (UNFCCC), which act as the legal underpinning of these efforts. The frameworks have been well researched by scholars regarding their roles in coordinating global climate action while keeping in view national interests and global responsibilities. For example, the Paris Agreement has illustrated how countries can present ambitious carbon reduction targets known as Nationally Determined Contributions in a flexible, nonbinding framework that may suit different political and economic capacities of countries. However such agreements are not matched by any binding mechanism that ensures uneven responsibility, best captured by the principle of Common but Differentiated Responsibilities. The tension therefore embodies the persistent strive towards the creation of effective, comprehensive, and practical international environmental law.

While there has been extensive research on the political aspects of international environmental law, it is quite puzzling that there is a scant understanding of how accountability and compliance among member countries can be enhanced. The majority of arguments center on the existing shortcomings of current agreements as a call for stricter and legally binding commitments from the worst carbon-emitting countries. There is also little attention on alternative models or additional legal regimes that would seek to achieve compliance or provide incentives without infringing sovereignty. This silence in the literature is quite salient as it begs the answer on how the international laws will develop to enhance the compliance levels with the climate change goals that have a global outreach. So too, little is addressed on how newer frameworks may fit the requirements of the

developing countries who may not have the requisite capability to meet global environmental criteria.

Strengthening global action on climate change requires that the gaps in international environmental law literature be adequately addressed. As climate change accelerates, the need to have enforceable, fair, and adaptable international frameworks for the same becomes more urgent by the day. A study of mechanisms to ensure that accountability and fairness are preserved within these laws could prove to be more resilient and capable of addressing both local and global challenges. Future research in this space will provide insight for policymakers looking to improve global cooperation, cut emissions, and bridge the gap between law theory and effective climate action. Studying alternatives of the traditional environmental agreements will, at the same time add more to the academic discussion while guiding practice in setting a fair and enforceable framework for international climate governance. Air pollution in the urban density of South Asian region is becoming an extreme issue of public health and environmental concern. Pakistani cities especially Lahore is on the top of this list. This persistent haze was primarily caused by the growing industrial revolution, the rising number of vehicles, the burning of crop residues at specific times, and the overreliance on fossil fuels. In the existing literature, air pollution studies conducted in and around the Lahore city area focus most of the attention on PM2.5 and PM10, SO_2, NO_x, and other toxic emissions originating from traffic, industries, and a cyclical burning of farms. Emission sources in Lahore are highly localized and unregulated causing acute health effects and environmental decline. Action plans for pollution and smog control in Lahore have come up with the experience learned from other cities facing similar pollution problems. This entails reinforcing environmental regulation policies, raising the level of public education and awareness, and providing facilities necessary for green energy and clean urbanization. Yet, as is always the case, social and political factors remain barriers to its successful application.

Although there are increasingly more studies aimed at analyzing air pollution in Lahore, there are hardly any studies directed toward the localized data and the specific sources' contributions to the daily and seasonal pollution level. Existing studies that assess the pollution levels and the pollution sources do and up to the recent levels, lack detailed real-time information which can assist in implementing focused measures. There is also minimal literature on the effectiveness of actions that have been proposed in eliminating residues and smog out of the context of Lahore's complex setting of industries and agriculture. The analysis of how adaptation actions work in the urban and rural parts of… around Lahore is crucial in developing action plans that are more realistic to the context. Further, the relationship of policy enforcement with local governance as well as environmental issues has not been well addressed and therefore poses a question of how the given measures can be taken to ensure that there is a reduction in pollution levels.

It is important to fill these research voids to formulate relevant, practical, and efficient strategies for pollution control in Lahore. Further investigation on real-time quantification of the specific emission sources about its spatial accuracy will help enhance the capabilities of policymakers on the resource allocation needed to combat pollution and smog. Moreover, lessons on feasible actions for Lahore could also be drawn from the assessment of the success of adaptation plans implemented elsewhere with similar conditions. This kind of research would not only enhance the framework for the management of air quality in the region but also provide a blueprint that other regions in South Asia with similar air quality issues will use. To develop climate-sensitive and regulatory measures to curb pollution, addressing these issues is very pertinent in the context of pollution in Lahore.

Iqbal, (2016) examines the problem of heavy metal pollution in cities has become a global issue due to its threat to natural systems and people's health. Many scholars have studied the influence of industrialization, traffic, and poor waste disposal on the high

contents of heavy metals in the soils and water bodies of urban settlements. For instance, the areas of a city such as Lahore, Pakistan, where the industry is rapidly increasing, usually have African levels of heavy metals like lead, cadmium, mercury, and arsenic that contaminate the soil and the water. These, in turn, get concentrated in the food chain causing health effects such as respiratory diseases, neurological impairment, and even cancers in people. Other studies also show that urban soil contamination increases the risk of health problems, especially in already at-risk groups such as children who may ingest contaminated dust through hand contact with their mouth. To this end, the authors underline that metal pollution issues in cities are also very important in context of the public health management strategies, and urban planning.

While there is already a lot of literature on heavy metals pollution in the urban centers of the world over, such studies are few and far between for Lahore Pakistan especially in terms of the ecological and medical effects of metal pollutants. Previous studies have indicated that industry and traffic are sources of heavy metals, however, there are few pathways to explain how these metals accumulate in the local living organisms and turn affect the human beings in Lahore. Also, most of the previous studies are more often generalized in that they do not provide preliminary surveys of heavy metal pollution from more specific sources, like industries, geologic conditions, or even rainfall patterns in Lahore. This shortcoming also weakens the present measures and strategies geared at dealing with the problem as many of the available data are general.

It is vitally important to address this link to develop localized policies and measures to alleviate the health risks posed by metal pollution in Lahore. Recognizing the specific sources and pathways of heavy metal contamination in Lahore will help us understand how best to monitor and control pollution burdens relative to the city's unique industrial and environmental settings. In addition, such research would have practical benefits by supporting community interventions and educating people on the dangers of metal pollutants. Finally, considering all these aspects, the current research is bound to provide useful information on urban metalliferous pollution of which Lahore is a part, as it can be useful in other cities with similar environmental problems.

Material and Methods

Qualitative research methodology in the context of climate change and pollution in Lahore could include secondary sources such as report analysis, research papers, and policy documents from relevant environmental agencies, academia, and NGOs. Uploaded secondary media sources may include news articles, online forums, and social media channels emanating from the public to see their concerns. This could be followed by a case studies from other regions that face similar environmental issues. This methodology could also yield secondary data analysis for expert opinions and understanding of community level concerns. Overall, this methodology would provide an overview picture of the impacts of climate change in Lahore while revealing policy gaps around it.

Results and Discussions

The findings of the research proved that in Lahore, the factors of environmental degradation have become worse primarily as a result of global warming. One of the international trends that has been shown to result from increased Greenhouse gas emissions is the increase in both the frequency and the strength of heat waves. These extreme heat waves are a health threat to most of the population, especially the young and aged, overweight, sick people, and children. They also put lots of pressure on the hardware in Lahore.

The air quality data for the city of Lahore indicates that there are very high recorded levels of pollutants like PM2.5, PM10, SO2, and NOx which are all well above and beyond the

levels recommended by the World Health Organization (WHO). The major sources of pollution include waste from factories, smoke from vehicles, and burning of crops in nearby farmland during off harvest seasons. Recorded levels of pollution tend to be highest in the late spring and winter periods as a result of thermal inversion, especially the part that prevents pollutants from dispersing into the air thus creating a haze that worsens respiratory diaseases and impairs vision.

Observation and previous research indicate that the levels of heavy metals, including lead, cadmium, and mercury, are alarming in the soils and waters of Lahore, especially in the areas close to industries. The sources of this contamination are industrial effluents, disorganization in the management of solid wastes, and exhaust from cars. The food chain is a concern for communities since these metals can also be found in local delicacies causing serious health implications such as respiratory and brain ailments in people living close to the industries.

The adverse effects of climate change and pollution are more felt in low-income families as they tend to widen the existing social and economic gaps. Majorly, these low-income families do not have access to social services, particularly health facilities, and live in areas that are heavily populated and near industries. This triggers an upsurge of health loss associated with pollution, decreased economic activity, and escalation of healthcare expenses further increasing the societal disparities in Lahore.

The research paper underlines in particular the problems of low governance and poor implementation in solving Lahore's pollution and climate change problems. Environmental policies have been formed in some way or the other; however, their enforcement is often lacking due to budgetary constraints, political disinclination, and competing social development priorities. This is not an isolated case as it can be seen in most Asian countries that development takes precedence over environmental protection. It has also reported governance issues as one of the main reasons for increased environmental challenges in the country and therefore the political focus and funding should be improved (Keohane, R.O. 2015).

There are local climate challenges within the city of Lahore, however, these challenges are also systemic. Countries are required to meet all proposed percentages because of other agreements such as the Paris Agreement. However, it is nearly impossible for Pakistan because of her current political as well as economic status. Because of the lack of punitive mechanisms in those treaties, there is less willingness to punish countries like Pakistan which do not have in them to control the pollution. This research supports Smith (2019) who states that many international treaties are skewed towards the developed nations geopolitically which defeats the purpose of the treaty about climate change.

The study highlights the importance of environmental justice concerning the marginalized groups in Lahore, as they bear the brunt of pollution and climate change's adverse effects. Climate justice, as explained by means that looking towards the future, policies have to be made in ways that ensure everyone has access to resources held and more so protect those most at risk. This may encompass providing more clean water, limiting exposure to air pollution, and enhancing medical facilities in poor regions.

Although community participation in environmental decision-making should be the bedrock for every country in ensuring long-term positive outcomes, it is minimal in the context of Lahore. Here, such movements could serve to create a consciousness, encourage compliance with policy, and demand that those in power be responsive. According to the study, additional investigation is necessary to determine the extent to which such community practices could reshape policy or generate greater support for policies that adapt to such climate changes.

This study analyze pollution data on a localized scale with a specific emphasis on time day and season wise, to grasp the contributors of pollutants and their spread. Besides, reading about the beneficial practices of other cities that have fought and won against the heightened levels of pollution, could be of use to Lahore as well. To enhance the urban resilience and health security of the people of Lahore, it is essential to design a pollution control and climate change framework targeted to the region.

Due to the combined problems of smog and climate change, Lahore, a city renowned for its history and dynamic culture, is currently dealing with a serious environmental problem that endangers the health and well being of its citizens. This urban landscape has seen a concerning increase in smog over time, which has been directly related to climate change. A serious issue that needs to be addressed right away is the haze that has now covered Lahore's once clear skies. Lahore is now the third most polluted city in the world, with air quality having deteriorated to 97.4 micrograms of PM 2.5 particles per cubic meter, up from 86.5 in 2021, according to IQAir. In addition to impairing air quality, smog's ongoing deterioration feeds a destructive cycle that has wider ramifications for climate change. Their effects on the economy, public health, and general quality of life in this ancient city serve as further evidence of how urgent it is to solve these issues. Given these dangers, it is becoming more and clearer that coordinated actions and all encompassing solutions are required as Lahore works to recover the sky and safeguard the welfare of its thriving populace.

The increasing smog problem in Lahore has been linked to climate change, according to recent meteorological assessments. The increasing frequency of temperature inversions, a characteristic that exacerbates smog generation, makes this relationship clear. This occurs when pollutants are trapped close to the surface by a layer of warm air, which hinders their ability to disperse and raises the concentration of airborne particles. The periods of poor air quality that are frequently encountered in Lahore are largely caused by these meteorological factors.

Moreover, alterations in weather patterns that may be brought on by climate change exacerbate the problems caused by smog. Smog is more pervasive and persistent due to the changing dynamics of the climate. The confluence of these elements creates a scenario for Lahore that emphasizes the intricate relationship between pollution deterioration and climate change. Recognizing these connections is essential to putting policies into place that tackle both regional pollution sources and more general climate-related issues.

One factor contributing to Lahore's pollution problem is the combined effect of greenhouse gas emissions on climate change and smog formation. Major components of the greenhouse effect, carbon dioxide (CO2) and methane (CH4) are released by Lahore's industrial and automotive sources. By trapping heat and changing the climate, these emissions not only raise the atmospheric concentrations of greenhouse gases but also amplify the greenhouse effect (Fahad, & Wang, 2020).

This complex link creates a loop whereby a stronger greenhouse effect causes climatic change, which in turn creates the conditions for the creation of smog. The intensity and persistence of smog are influenced by altering climatic circumstances, such as temperature inversions, and shifting weather patterns. The air quality in Lahore is in jeopardy because of these interrelated relationships. Addressing this issue becomes vitally crucial as the city copes with the effects of rising greenhouse gas emissions.

Conclusion

All these factors, both internal and external, such as global warming and lack of greenhouse gas emissions control, contribute towards Lahore’s extreme climatic conditions, more particularly heat, air quality, and the rising instance of heat waves. This constitutes a health hazard for the people living in this city, particularly the vulnerable communities,

especially with current levels of air pollution and systemic rise in diesel particulate matter (PM2.5). In addition to these toxic pollutants, notably heavy metals heavily present in soil and water, which are commonplace even in cities with higher resources further threaten the health of communities including the food supply. To bring about change the report underlines improvement in governance, more respect for the existing environmental laws, and an organizational approach that involves the public. To these, while there are global target commitments that constrain all sovereign states through instruments like the Paris Accord, Lahore still has these targets difficult to achieve because of factors such as politics and finances. Strategies that are focused, comprehensive, and aim at the recovery of Lahore, increasing especially the capacity to deal with adverse effects of climate change in the future, such as improved air quality monitoring and management framework, increase of enforcement, and provision for community activities are imperative.

Recommendations

The study offers some helpful strategies and recommendation:

Strengthen Environmental Governance and Enforcement:

The most critical issue is that there are existing environmental laws but they are not being enforced. As such, it is imperative to build the capacity of the enforcement agencies through improved funding, training, and providing effective deterrent measures against violations. This study posits that the government should embed environmental protection at the top of the policy hierarchy to counter rapid environmental degradation and pollution challenges facing Lahore.

Invest in Public Awareness and Education Campaigns:

It is very important to make them aware of climate change and pollution and the impacts of both on society. Such Community involvement initiatives must address the causative agents of pollution and the danger it poses to healthy acceptable ways of living in society. An understanding of the pollution problem can create a proactive community that motivates people to fight for cleaner air and help monitor the operational conduct of industries in the area.

Sustainable Solutions to Urban Planning and Transportation

Solutions to Traffic Congestion and Pollution Problems in Cities are Possible with the Development of Infrastructure. Widening the scope of projects aimed at building eco-friendly vehicles including the development of efficient public transport systems bikeways, and walkable access zones can cut down emissions from cars. Governing authorities must formulate restrictions on oil usage and promote vehicles powered by environmentally friendly energy sources.

Enforce Pollution Control Strategies on Selected Sources

Lahore of late has been experiencing a decline in air quality due to the action of certain pollutants e.g. PM2.5, PM10, SO_2, NO_x, industrial emissions, crop residue burning, and vehicular emissions. To this end, the government needs to go over and above the compliant factory emissions levels which allow factories, to impose a complete ban on the burning of crop residues and propose other uses for the wasted agricultural produce.

Enhance Monitoring and Data Collection

For effective and timely policy implementation, and in this case, sounding the alarm of the pollution management, there is a need for real-time gathering of pollution levels, and

climate indicators. Installing additional air pollution monitoring stations within Lahore and extensively researching emission sources will help formulate specific solutions. The Upgrade of the data facilities may result in the issues being addressed being more tackled.

Encourage The Construction of Infrastructure that is Stronger and More Reliable to Climate Change

Urban plans need to incorporate climate change infrastructure such as better drainage systems to avoid cases of flooding after the rains and more prevalence of cooling shelters to mitigate against high temperatures. Upgrading the existing facilities in Lahore will curb the effects of climate change that will affect the vulnerable section of society.

Promote Climate Justice Actions for Vulnerable Communities

Since climate impacts are more pronounced on low-income households, policies should address measures that include the provision of safe water supply systems, better healthcare services, and access to cheap clean energy sources in these vulnerable zones. Integrating equity into policymaking will contribute to strengthening the resilience of these groups.

Maximize the Benefits of International Climate Policies

Economically and politically, Pakistan is not an exception from such countries, however, it still has comparative advantages for most international collaboration – for instance, the Paris Agreement. Moreover, engaging in international climate finance mechanisms and technical assistance will create ways of tackling local climate issues in a coordinated manner with the country's development agenda.

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