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Pakistan's Air Pollution Conundrum: The Challenge of Inconsistent Policy Implementation

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Pakistan's Air Pollution Conundrum: The Challenge of Inconsistent Policy Implementation

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Contents

List of Tables, Boxes and Charts Pages

Acronyms

AATHP	ASEAN Agreement on Transboundary Haze Pollution
AQI	Air Quality Index
ASEAN	Association of Southeast Asian Nations
BCCP	Balochistan Climate Change Policy
CCP	Climate Change Policy
CO	Carbon Monoxide
CSOs	Civil Society Organizations
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
GHG	Greenhouse Gas Emissions
IEE	Initial Environmental Examination
KP	Khyber Pakhtunkhwa
MCC&EC	Ministry of Climate Change and Environmental Coordination
NAAQS	National Ambient Air Quality Standards
NCAP	National Clean Air Policy
NCCP	National Climate Change Policy
NDCs	Nationally Determined Contributions
NEQS	National Environmental Quality Standards
NGOs	Non-Governmental Organizations
NOx	Nitrogen Oxides
NSC	National Conservation Strategy
Pak-EPA	Pakistan Environmental Protection Agency
PBS	Pakistan Bureau of Statistics
PCCP&AP	Punjab Climate Change Policy and Action Plan
PEPC	Pakistan Environmental Protection Council
PEPO	Pakistan Environmental Protection Ordinance
PM10	Particulate Matter 10
PM2.5	Particulate Matter 2.5
PuCAP	Punjab Clean Air Policy
SAARC	South Asian Association for Regional Cooperation
SCCP	Sindh Climate Change Policy
SDGs	Sustainable Development Goals
SLCP	Short-Lived Climate Pollutants
SO2	Sulfur Dioxide
UN	United Nations
VOCs	Volatile Organic Compounds

Executive Summary

For the past 30 years, smog has plagued millions of urban residents in Pakistan, particularly in Punjab, where air quality levels reach hazardous levels from October to March. The Air Quality Index (AQI) of Lahore surpassed 1,000 in November 2024, largely due to burning rice stubble transport and industrial pollution. Lack of source apportionment hinders effective policy design.

Various factors contribute to smog, including increased vehicle numbers, rapid industrialization, agricultural waste, and the burning of rice stubble. The energy sector also plays a significant role in urban heat production. A comprehensive approach is needed to combat the air pollution challenge by understanding the contribution of gaseous pollutants and seasonal patterns.

Hourly analysis of air pollution data offers more precise insights compared to 24-hour averages. Weekly, monthly, and yearly data often misrepresent air quality, especially during peak pollution hours. Yearly averages can be highly deceptive. For a nuanced understanding of air pollution, detailed data on sources and timing are essential for developing impactful policies.

In Pakistan, yearly data snapshots show moderately clean air quality, which contradicts known issues. For instance, the yearly average data shows that Lahore's AQI was unhealthy for sensitive groups in 2017-2018 but moderate from 2019-2023. However, disaggregated data reveals that Lahore ranks among the world's top 5 most polluted cities. The inconsistencies in data highlight the need for standardized definitions and methodologies to ensure authenticity, reliability, and consistency of air quality data, with stakeholder participation in data collection and verification.

Public awareness about poor air quality and its severe health consequences, such as cardiovascular arrests, respiratory and lung diseases, cancer, asthma, eye infections, chronic bronchitis, and mental illnesses, is lacking in Pakistan. Awareness of the harmful effects of pollutants is limited. Effective policy design and public participation require extensive education and awareness campaigns.

The institutional response to air pollution in Pakistan is fragmented due to the 18th Constitutional Amendment, which grants autonomy to provincial governments over environmental matters. This has led to weak inter-departmental coordination, complicating efforts to combat smog. Provincial governments are responsible for implementing air pollution reduction policies, while national institutions set agendas, formulate policies, and coordinate with international agencies.

The review of national and provincial policies highlights significant gaps in addressing air quality issues. The National Climate Change Policy lacks targeted mechanisms for improving air quality, while the National Clean Air Policy emphasizes provincial roles but lacks technological integration and legal clarity. Punjab's Clean Air Policy is marked by an absence of decentralized structures and coordination mechanisms for data collection and sharing. Provincial Climate Change Policies vary in their focus and effectiveness, with some lacking specific air quality strategies.

Ironically, climate change in Pakistan is often viewed through the lens of Disaster Risk Reduction rather than as atmospheric pollution contributing to global climate change. A holistic policy framework for air pollution should integrate climate change objectives and ensure strict compliance with environmental laws through robust administrative enforcement. Policy coherence is essential, requiring mechanisms for quarterly emission data exchange between national and provincial policies. The Pakistan Environmental Protection Agency (Pak-EPA) should effectively enforce its legislative and punitive powers, with provincial EPAs acting as extensions, ensuring coordination, data collection, dissemination, and monitoring.

Policy Recommendations

- Determine pollutant sources based on time, frequency, location, and characteristics before creating a dynamic, real-time data-driven policy framework.
- Use yearly data to assess overall air quality and establish baseline rather than relying solely on it.
- Integrate all communication resources to enhance awareness of air pollution impacts in government and non-government strategies.
- Adopt an inclusive data-sharing policy for air quality monitoring that ensures standardized definitions, consistency, accuracy, and stakeholder verification.
- Address air pollution as both an environmental and institutional issue by improving district-level administrative enforcement of existing laws and empowering Pak-EPA with augmented powers for compliance and penalties.
- Incorporate an air pollution reduction strategy with 15-year targets into the National Climate Change Policy, aligning with the National Clean Air Policy and Nationally Determined Contributions.
- Formulate provincial clean air policies with specific emission reduction targets and integrate them into provincial climate change policies.

The Context

The economic and social progress in many developing countries over the last forty years has been widely acknowledged by policymakers, researchers, academia, international development partners, and residents alike. Rapid urbanization has also been seen as a symbol and step forward towards modernity and advancement. However, motorization and industrial emissions have become prominent sources of urban air pollution. Consequently, the concentration of pollutants has been increasing regularly, which violates the guidelines of the National Environmental Quality Standards (NEQS) and National Ambient Air Quality Standards (NAAQS) (Tabinda et al., 2020). While this transformation was necessary and significantly contributed to economic progress and improved living conditions for millions of people, the associated costs were knowingly neglected, resulting in extremely hazardous air quality in most developing countries' cities.

Pakistan is also grappling with this transformational challenge. Many cities in the country have experienced severe environmental degradation to the point where they are now considered uninhabitable. These cities face issues such as population bulge, unplanned housing, traffic congestion, lack of waste management, overflowing sewerage pipes, and hazardous air quality. The most critical factor threatening the future of these cities and their populations is the 'invisible killer,' i.e. air pollution. The policy response to address smog and poor air quality in major cities of Pakistan is inadequate due to various factors, requiring a holistic approach to fully understand the problem. Enum and Ahmad (2023) argued that 'the way air pollution is framed as a sustainability challenge has implications on how policy responds. Air pollution is an environmental crisis as much as it is a health crisis.' Therefore, addressing this issue requires integrated strategies that consider both environmental sustainability and public health.

In 2015, Pakistan became a signatory to the United Nations (UN) global development framework, known as the Sustainable Development Goals (SDGs). This agenda includes 17 goals, 169 targets, and 231 unique indicators applicable to all countries. The SDGs framework has three goals directly linked to the health impacts of air and waste pollution: Goal 3 (Health and Wellbeing) with Target 3.9, Goal 6 (Clean Water and Sanitation) with Target 6.3, and Goal 11 (Sustainable Cities and Communities) with Target 11.6. These targets specifically aim to improve air quality at both community and household levels.

This policy paper examines the cascading factors responsible for air pollution in major cities of Pakistan and identifies strategies to address the most pressing issue of poor air quality.

The Air Pollution/Smog Conundrum

Smog is now dominating the lives of millions of urban residents in Pakistan. Recently, the severity of the air pollution problem forced the Government of Punjab to impose restrictions or bans on educational, recreational, business, and economic activities, particularly in four districts: Lahore, Multan, Faisalabad and Gujranwala[1]. Educational institutions from primary to university level in Lahore and Multan districts were either shifted to online mode or closed for a week [2].

There is no single solution to this chronic problem, as all the efforts of the government and other stakeholders have been unsuccessful due to the increasing magnitude of the factors contributing to smog. Notably, there is no consensus in the literature on the definitive causes of smog in cities, with various studies identifying multiple contributing factors. Some reports cite the increased number of vehicles over the years, while others highlight the rapid industrialization in the peripheries of city limits. Additionally, agricultural waste and the burning of rice stubble have been linked to chronic smog conditions, particularly in Punjab province. The literature also highlights the energy sector's role as a major source of heat production in cities. This lack of consensus on the primary sources of poor air quality has further complicated efforts to combat the smog problem, which is particularly pronounced in Punjab province during the last quarter and the first three months of each year.

Goheer et al. (2024) argued that a comprehensive approach clarifies the roles pollutants play in smog formation and offers valuable insights into seasonal patterns. This contributes to a more nuanced understanding of the region's air quality management strategies. Air quality is often perceived as an urban issue due to a priori assumption that rural areas are pollution-free and clean. Consequently, no efforts have been made to collect air pollution data for rural areas despite the presence of sugar, rice, and wheat flour industries in rural areas of Sindh, Punjab, and Khyber Pakhtunkhwa. Oil and gas exploration in Sindh and Balochistan, along with cement industries in rural areas of all four provinces, also necessitate air pollution data and

[1] EPA restriction order due to smog in Punjab, chrome, dated November 16, 2024- https://epd.punjab.gov.pk/system/files/Circular%20Restrictions%20Smog%2016-11-2024.pdf

[2] https://epd.punjab.gov.pk/system/files/Smog%20Restrictions%20Lhr%20Multan%2015-11-2024-2%20%281%29.pdf

compliance with emission standards. The lack of institutional arrangements and enforcement of laws and regulations in rural areas are mainly responsible for the limited understanding of rural air pollution and gaseous emissions.

For the past 30 years, the air quality in major cities of Punjab province has typically reached hazardous levels from October to March. For example, the AQI of Lahore district in November 2024 surpassed 1,000 for the first time[3]. The burning of rice stubble in both Indian and Pakistani Punjab provinces are held responsible for the worsening of air quality in both countries (Maryam et al., 2019). However, some studies indicate that transport and industrial pollution are the leading sources of air pollution in major cities throughout the year. Habib et al. (2021) argued that the lack of source apportionment is a significant cause of air pollution policy failure. There is insufficient knowledge about the spatial and temporal dynamics of emission sources, which compromises policy design to target the composition, location, and contribution of overall emissions.

Most research studies on air pollution have focused on Punjab province due to the increasing severity of air quality issues over the last 30 years. The First Air Pollution Inventory of Punjab, covering data from 1990 to 2020, shows that the transport sector contributes 36% to air pollution, followed by the industrial sector (24%) and the agriculture sector (15%). The energy sector and other sectors contributed 13% and 12%, respectively. However, the only comprehensive study on the source contribution of air pollutants was conducted by the Food and Agriculture Organization (FAO) in 2018. The FAO findings somewhat differ from the Air Pollution Inventory study on source apportionment. According to FAO (2018), the transport sector contributes 43%, followed by the industrial sector (25%), the agriculture sector (20%), and the power sector (12%). Further research is needed to account for the concentration of air pollutants in relation to vicinity and time period. Identification of air pollutants is also crucial from a policy perspective. It has been observed that among major air pollutants, carbon monoxide (CO) has the highest share in overall emissions, followed by nitrogen oxides (NOx), sulfur dioxide (SO2), volatile organic compounds (VOCs), particulate matter 2.5 (PM2.5), and particulate matter 10 (PM10).

[3] https://www.nytimes.com/2024/11/07/world/asia/pakistan-air-pollution-punjab.html

The Choice of Data Periodicity

Air pollution data is more meaningful when analyzed on an hourly basis rather than a 24-hour average. Weekly, monthly, and yearly data can portray misleading scenarios of air quality, especially when the severity of pollution occurs at specific times of the day. Yearly averages can be deceptive; without disaggregated data on pollution sources, precise timings of the day or week, and specific months of the year, policy formulation or revision will not effectively address air pollution issues. This is particularly true in Pakistan, where yearly data snapshots of major cities show moderately clean air quality, which contradicts the known issues of air quality in the country.

Table 1 shows that the Air Quality Index (AQI) of Lahore in 2017 and 2018 was unhealthy for the sensitive groups if analyzed on a yearly average basis. In the following years, from 2019 to 2023, the AQI of Lahore remained moderate. However, when this data is disaggregated on a monthly, weekly, daily, and hourly basis, Lahore ranks among the world's top 5 most polluted cities. According to yearly average data, Karachi's air quality deteriorated from "Good" to "Moderate" in 2023. Meanwhile, Islamabad has maintained "Good" air quality from 2017 to 2023, making it the only city in Pakistan with consistently good air quality during this period.

Table 1: Yearly Average Air Quality of Major Cities of Pakistan

S. No.	Cities	2017	2018	2019	2020	2021	2022	2023
1	Lahore	133	115	90	79	87	97	100
2	Faisalabad	-	130	105	73	94	85	88
3	Peshawar	-	-	64	-	90	92	77
4	Rawalpindi	-	-	41	42	51	49	60
5	Karachi	39	34	40	44	46	51	56
6	Islamabad	39	39	35	39	41	41	42

Air Quality and Pollution Measurement Scale:

0-50	Good	51-100	Moderate	101-150	Unhealthy for Sensitive Groups
151-200	Unhealthy	201-300	Very Unhealthy	300 Plus	Hazardous

Source: http://www.iqair.com

The analysis based on different data periods may provide a distorted perspective on the problem. An analysis of monthly air quality is presented in the following paragraphs using two different data sources for selected cities in Pakistan. Table 2 presents monthly air quality data for 2023, while Table 3 shows monthly air quality data for 2019 and 2020. The yearly average of air quality is categorized as “moderate”

for Lahore, Faisalabad, Peshawar, Rawalpindi, and Karachi. Islamabad is the only city in Pakistan with a yearly average of "good" air quality.

Table 2 shows that November and December are particularly problematic months for air pollution in Lahore, Faisalabad, and Peshawar, where the air quality is unhealthy for all population groups. Sensitive groups are at higher risk in these two months in Rawalpindi and Karachi. According to the data, air quality is not an issue from April to September in the six major cities of Pakistan. Lahore, however, experiences varying levels of air quality throughout the year, except from June to August. Faisalabad and Peshawar exhibit similar air quality trends from September to March each year, but both cities have comparatively good air quality from April to August. In contrast, Rawalpindi, Karachi, and Islamabad enjoy longer periods of good air quality throughout the year.

Table 2: Monthly Average Air Quality of Four Cities of Pakistan – Year 2023

	Months	Lahore	Faisalabad	Peshawar	Rawalpindi	Karachi	Islamabad
1	January	143	92	136	88	99	70
2	February	117	107	79	73	65	48
3	March	74	67	53	44	54	32
4	April	53	45	34	26	28	21
5	May	52	43	39	27	27	22
6	June	46	44	43	31	30	28
7	July	40	--	36	30	32	23
8	August	42	39	44	42	30	32
9	September	54	46	53	48	43	31
10	October	126	70	83	62	38	41
11	November	251	197	156	107	121	67
12	December	198	204	166	140	109	94
		100	87	77	60	56	42

Air Quality and Pollution Measurement Scale:

0-50	Good	51-100	Moderate	101-150	Unhealthy for Sensitive Groups
151-200	Unhealthy	201-300	Very Unhealthy	300 Plus	Hazardous

Source: http://www.iqair.com

Table 3 shows a completely different scenario of air quality in the four major cities of Pakistan. From May 2019 to April 2020, no city experienced air quality that could be termed as "Good." For most of the year, air quality remained "unhealthy for sensitive groups" in all four major cities. Lahore and Peshawar were the most polluted cities, with "unhealthy" air quality for six and four months, respectively. Karachi and Islamabad experienced "moderate" air pollution for five and six months, while Lahore and Peshawar experienced it for only one month.

Table 3: Monthly Average Air Quality of Four Cities of Pakistan

		Lahore	Karachi	Islamabad	Peshawar
1	May 2019	179	103	88	149
2	June 2019	164	87	90	124
3	July 2019	136	90	98	126
4	August 2019	126	81	86	111
5	September 2019	147	92	113	142
6	October 2019	210	115	117	147
7	November 2019	260	138	129	159
8	December 2019	296	156	172	213
9	January 2020	244	th	147	176
10	February 2020	128	148	139	160
11	March 2020	134	111	93	114
12	April 2020	96	87	86	90
	Twelve Months Air Quality	6 Months	0 Months	1 Month	4 Month
		5 Months	7 Months	5 Months	7 Months
		1 Month	5 Months	6 Months	1 Month

Air Quality and Pollution Measurement Scale:

0-50	Good	51-100	Moderate	101-150: Unhealthy for Sensitive Groups	
151-200	Unhealthy	201-300	Very Unhealthy	300 Plus	Hazardous

Source: https://opendata.com.pk/dataset/air-quality-index-may-2019-april-2020/resource/decb72cb-1d47-4c2b-8414-33fb01f763d5

The analysis of monthly air quality data from two different sources highlights the inconsistency and inaccuracy of data. Comparing two different years may be questioned, as policies and implementation in 2019-2020 may differ from those in 2023. This can be true as federal and provincial governments have constantly tried different options to combat air quality issues; however, Table 2 shows “Good” air quality months from April to August, except in Lahore, which Table 3 lacks. The above

analysis suggests the need for standardized definitions and methodologies to ensure the authenticity, reliability, consistency, and frequency of air quality data, with the participation of all relevant stakeholders in data collection and verification. The use of technology and scientific methods should be ensured to strengthen technical capacity and maintain long-term consistency and quality of data.

Lack of Credible Environmental Data and Awareness

Pakistan has a general lack of public awareness regarding poor air quality and the severe consequences of rising air pollution. The higher concentrations of PM2.5 and PM10 (particulate matter) and gaseous pollutants in the air are 'invisible killers' responsible for cardiovascular arrests, respiratory and lung diseases, and cancer. Additionally, asthma, eye infections, chronic bronchitis, reduced attention spans, and mental illnesses are among the serious consequences of elevated levels of PM2.5, PM10, and gaseous pollutants. Public awareness of the hazardous effects of gaseous pollutants such as nitrogen oxides, carbon monoxide, sulfur dioxide, and volatile organic compounds is also very limited.

Moreover, there is a dearth of credible evidence about air quality in major cities over different time periods. Zaeem et al. (2024) state that a significant portion of the population remains unaware of climate change and its harmful consequences, particularly those without access to educational and media resources. This indicates a substantial gap in the dissemination of environmental knowledge. While international sources regularly report air quality data for major cities, government data sources are scarce and insufficient for making forward-looking decisions.

The chronic issue of air pollution in Pakistan necessitates extensive education and awareness campaigns by government and non-government stakeholders. Public awareness of climate change and its disproportionate devastating impact, particularly evident from the floods in 2010 and 2022, has been largely communicated through TV and newspaper ads, visuals in TV news, climate change documentaries, and development partners' dissemination strategies. Recently, the severity of the air pollution problem compelled the Government of Punjab to launch education and awareness campaigns to ensure public participation in combating high emissions, particularly in smog-affected cities and towns. A positive aspect of the current education system, irrespective of the education boards, is including climate change and air pollution topics in the syllabus from Grade I onwards. This has helped create awareness and knowledge about these issues from the early stages of education.

Although climate change is one of the most pressing global issues, air pollution and emissions are conceptually closely related to it. Air pollution or excessive gaseous emission is the combination of various activities, while climate change is the culmination of these detrimental atmospheric activities. By highlighting the deep-rooted interconnections between air pollution/high emissions and climate change, it becomes easier to develop dissemination plans and mass awareness strategies.

The air quality monitoring mechanisms are insufficient, and the lack of technological upgrades has hampered the consistent collection of air quality data. Environmental data has generally not been collected and published by federal and provincial statistical departments. Pakistan Bureau of Statistics (PBS), the country's central data collection agency, has only managed to publish four environmental compendiums[4] in the last 20 years. Only the Punjab province has recently collected and published provincial environmental statistics. The first publication of 'Punjab State of Environment' was released in June 2023. The report acknowledges data limitations and challenges confronted in the absence of data on core environment indicators.

The credibility and authenticity of data are crucial for evidence-based decision-making and policy formulation. Unfortunately, no data-sharing protocol exists among federal ministries and departments, apart from a lengthy and cumbersome bureaucratic approval process. Air pollution data differs from other developmental and environmental indicators in that it requires both aggregate and temporal analysis. Real-time air quality monitoring demands real-time data collection and dissemination, which would help the government and the public mitigate adverse impacts. This requires strong coordination among all stakeholders (public and private) involved in the air quality data collection. It has been observed that there are considerable discrepancies in the air quality data among stakeholders. The absence of technical capacity and the use of information technology could be responsible for these differences and inconsistencies.

Institutional Domain, Accountability and Implementation

The institutional response to air pollution is fragmented and dispersed. Following the 18th Constitutional Amendment, environmental matters fell under the jurisdiction of provincial governments, leaving very limited space for national-level decision-making. Provincial governments have the autonomy to pass legislation, develop policies, and conduct monitoring and implementation. Within provincial governments, different

[4] *Compendium of Environmental Statistics, 2004, 2010, 2015 & 2020.*

departments work in isolation to address the problem of smog, relying on their existing capacities and knowledge. Inter-departmental coordination is either weak or non-existent, adding another layer of complexity to developing a comprehensive strategy to combat smog.

The responsibility for implementing air pollution reduction policies and laws lies with the ministries and local departments at the provincial level. These departments typically operate independently, even on common issues such as air pollution, which affects everyone equally. National institutions are responsible for setting national agendas, formulating policies, and implementing monitoring and oversight mechanisms. They also coordinate with international agencies and ratify international laws, regulations, protocols, and covenants on behalf of the Government of Pakistan. In this way, national institutions act as custodians of international laws and covenants, providing technical support and guidance to their provincial counterparts.

Environmental Institutional Evolution in Pakistan

Environmental governance is particularly complex and challenging for a developing country like Pakistan. This is due to the weakness of institutions, which struggle to implement laws and regulations in their true and literal spirit. Despite the promulgation of environmental laws and the establishment of designated environmental institutions in the early 1980s, the success of environmental governance at the national level has been neither prominent nor satisfactory. For instance, the Motor Vehicle Ordinance 1965 contains provisions for vehicle emissions standards, vehicle fitness and certification, and measures to control noise pollution. However, these provisions were not implemented in any district or province, leading to an increased contribution of the transportation sector to air pollution. Similar issues are found in the industrial and agriculture sectors, where compliance with emissions standards has been negligible.

A timeline of establishing institutions, laws and regulations to combat air quality and emission abatement over the past 40 years is shown in Box 1. The establishment and role of the Pakistan Environmental Protection Agency (Pak-EPA) have been crucial since its inception, primarily commanding environmental governance in the country. Pak-EPA was established to strengthen institutional capacity by creating similar bodies at the provincial level, with Provincial Environmental Protection Agencies being established at different times in all four provinces. Additionally, laws and regulations were enacted, and environmental standards were set. The National Environmental Quality Standards (NEQS) is a landmark achievement of Pak-EPA, comprehensively providing thresholds for various substance emissions. Pak-EPA is also a central coordination forum, overseeing compliance and enforcement functions both at federal and provincial levels.

At the federal level, the Ministry of Climate Change and Environmental Coordination (MCC&EC) serves as the focal ministry, providing the national policy framework and guidelines for the conservation and protection of natural ecosystems. It has a critical role in ecosystem monitoring, ensuring the performance and accountability of ministries and departments, and overseeing compliance with and implementation of national and international environmental laws and regulations.

Box 1: Environmental Legislation, Laws, Regulations and Institutions

Pakistan Environmental Protection Ordinance (PEPO) 1983

In 1983, Pakistan was among the region's leading countries that gave deserving attention and importance to the looming environmental threats such as biodiversity degradation, high emissions and fast deterioration of air quality. Under section 8 of PEPO, all development projects must carry out an Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE). This aligns the development planning with the environmental protection strategy envisioned in the PEPO.

Pakistan Environmental Protection Council (PEPC)

Under PEPO, the Pakistan Environmental Protection Council (PEPC) was established. PEPC functions as an advisory body to the ministries. With the participation of government and non-government stakeholders, a comprehensive plan was prepared to address the air pollution issue in the country.

National Conservation Strategy (NCS)

In 1992, NCS was formulated and emerged as a policy document that formed the basis for institutionalizing environmental units in federal ministries and provincial line departments.

National Environmental Quality Standards (NEQS)

In 1993, National Environmental Quality Standards (NEQS) set emission and effluent targets for ambient air quality, noise and motor vehicle exhaust. Later, NEQS were revised in 2000 to include drinking water, municipal and liquid effluents and gaseous emissions.

Pakistan Environmental Protection Agency (Pak-EPA)

In 1997, an institutional setup was established at federal and provincial levels with implementing and regulatory responsibilities. Pak-EPA was mandated to control atmospheric pollution both at national and provincial levels.

Pakistan Environmental Protection Act, 1997

In 1997, the government repealed the Pakistan Environmental Ordinance (1983) and enacted the Pakistan Environmental Protection Act to implement all the provisions of PEPO with the addition of the establishment of Provincial Sustainable Funds, Protection and Conservation of species and renewable resources, and the establishment of environmental tribunals. Pakistan Environmental Protection Act, 1997 (Act No. XXXIV of 1997) is defined in Gazette notification as *"an Act to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development."*

Air Pollution provisions through legislation

a. Prohibition of Emission Discharge in excess of NEQS (PEPA Act 1997, Section 11)
b. Motor vehicle emission regulation (PEPA Act 1997, Section 15)
c. Import of hazardous waste and handling of hazardous substances (PEPA Act 1997, Section 13 & Section 14)

Air Pollution as a Transboundary Issue

There is a strong argument that transboundary air pollution results from burning agricultural residue in Punjab in India (Maryam et al., 2019). Due to the proximity of major cities in the Punjab province of Pakistan, these cities experience smog issues from October to February each year. Major cities in India, such as New Delhi, Lucknow, and Kanpur are also affected by smog, like Lahore, Gujranwala, and Faisalabad. Despite the persistent smog issues in both countries, more efforts are needed to improve the administrative control of agricultural residue burning and enhance education and awareness campaigns to encourage farmers to abandon this damaging traditional practice. Both countries have not engaged in environmental diplomacy due to longstanding issues and rivalry. Also, no progress has been made to utilize the Male Declaration of 1998, an intergovernmental agreement under the South Asian Association for Regional Cooperation (SAARC), to control and prevent air pollution and its likely transboundary effects for South Asian countries[5].

However, the fact of the matter is that there are examples of transboundary air pollution agreements among countries with unsettled and unresolved issues. All ten countries in the Association of Southeast Asian Nations (ASEAN) do not have cordial diplomatic relations with each other but agreed to adopt the ASEAN Agreement on Transboundary Haze Pollution (AATHP) in 2002 after lengthy deliberations and discussions that began in 1981. The AATHP primarily aimed to prevent and monitor cross-border air pollution from forest and land fires, particularly in Indonesia. Hence, Indonesia abstained from ratifying the agreement until 2014, but eventually, it had to sign the agreement as it was gradually losing its powers over the transboundary air pollution issues[6]. Article 2 of the AATHP is also relevant for transboundary agreement between Pakistan and India, stating:

> *"The objective of this Agreement is to prevent and monitor transboundary haze pollution as a result of land and/or forest fires which should be mitigated, through concerted national efforts and intensified regional and international co-operation. This should be pursued in the overall context of sustainable development and in accordance with the provisions of this Agreement."*

Review of National & Provincial Policies to Contextualize Air Pollution Issue

The uniqueness of environmental issues and the distinct economic, social, and spatial dimensions present challenges in devising specific policies. For instance, a climate

[5] https://www.sei.org/perspectives/reinvigorating-male-declaration/

[6] Muhammad, F. Environmental agreement under the non-interference principle: the case of ASEAN agreement on transboundary haze pollution. Int Environ Agreements 22, 139–155 (2022). https://doi.org/10.1007/s10784-021-09545-4

change policy should include air pollution and emission reduction strategies, given that climate change is driven by higher levels of gaseous emissions. However, Pakistan has developed both the Climate Change Policy and the National Clean Air Policy to address climate change risks and air pollution. Below is a review of national and provincial climate change and clean air policies to contextualize the air pollution issue in Pakistan and evaluate the effectiveness of policy response in addressing concerns and risks to the population.

National Climate Change Policy

In response to the adverse impacts of climate change in Pakistan, particularly the devastating floods of 2010, the country developed its first National Climate Change Policy (NCCP) in 2012. The policy objectives of the first NCCP focused on climate-resilient development and adaptation measures in high-emission sectors. In 2021, Pakistan revised the NCCP to incorporate the transformational aspects of the Paris Agreement on Climate Change (2015) related to emission reduction. Under the Paris Agreement, each member state has agreed to submit a national climate action plan (Intended Nationally Determined Contributions) as the core mechanism for accelerated climate action. In addition, countries are free to set their climate targets and instruments as expressed in their Nationally Determined Contributions (NDCs). The Paris Agreement legally requires each country to report their NDCs every five years, including updated emission control plans and strategies, as well as a review of the previous NDC report. In the context of the Paris Agreement and major initiatives of Green Pakistan aimed at increasing forest cover to strengthen the resilience of the ecosystem, the NCCP 2021 focuses on nature-based solutions, green economic growth, and robust adaptation and mitigation mechanisms. The primary objectives of NCCP are to mainstream climate change in policy planning and build climate resilience across all sectors of the economy. Sustainability, conservation, and restoration of natural resources are cross-cutting objectives of NCCP 2021.

However, no specific policy objectives address air quality and air pollution in the country. Given the broad scope of the NCCP, the lack of targeted air quality and pollution reduction mechanisms raises questions about the emission control efforts outlined in the policy. One critical aspect missing is a sustainable climate framework for systematically integrating processes, mechanisms, and institutions to ensure coherent implementation. Instead, the policy design uses a sectoral emission reduction approach with minimal interlinkages. Policy coherence has not been explicitly emphasized, which is essential to avoid contradictions and conflicts.

National Clean Air Policy 2023

In 2023, Pakistan formulated its first National Clean Air Policy (NCAP) to provide a framework for improving air quality. As a national document, its efficacy depends on

the commitment and actions of provincial governments and other key stakeholders. The NCAP consists of three interconnected core components to help key national and provincial institutions comprehend the various aspects of air quality, including its implementation and monitoring processes for reducing air pollution.

To combat air pollution, the Federal Ministry of Climate Change launched its first National Inventory for Short-Lived Climate Pollutants (SLCP) in 2022, identifying priority actions. The NCAP's air pollution reduction strategy is anchored on five priority sectors of the economy: agriculture, transport, industry, waste, and households. Specific priority interventions were identified for each sector to accelerate air pollution control and elimination. The NCAP is backed by a robust legal framework and policy coherence for air quality improvement. For instance, it is linked with the National Environmental Policy (2005), which addresses air quality and noise pollution. The Pakistan Environmental Protection Act (1997) also provides a legislative and regulatory framework for the NCAP, supporting and strengthening air quality monitoring mechanisms.

The NCAP implementation structures are based on constitutional guarantees that bind ministries and departments to formulate policies, plans, and implementation strategies. The NCAP emphasizes the central role of provincial governments in the overall air pollution reduction framework. Each province independently identifies the major sources of air pollution and formulates mitigation actions that best suit its local context. The NCAP identifies four essential policy objectives, with two being pivotal for effectively monitoring the proposed actions: gathering baseline data and setting air quality targets. The other two objectives focus on identifying major sources of air pollution, formulating subsequent mitigation actions, and ensuring effective implementation of the framework.

The NCAP is a valuable contribution to the country's efforts to combat air pollution despite its complexities and challenges. Given the limited role of national institutions after the 18th Amendment, NCAP should clearly identify the coordination and oversight mechanisms with provincial governments. The severity of the air pollution problem requires continuous collaboration among federal, provincial, and area government institutions.

The policy fails to demonstrate the role of technology within the overall framework for air quality improvement, including specific responsibilities of the provincial governments. The legal framework for air quality should be explicitly highlighted, even if it coincides with corresponding environmental and climate change policies. This clarity will help assign responsibilities to relevant ministries and departments at both

national and provincial levels. Finally, NCAP should legally require provincial governments to formulate clean air policies linked to national and provincial climate change policies.

Punjab Clean Air Policy

The Government of Punjab is the only provincial government to formulate its first clean air policy, the Punjab Clean Air Policy (PuCAP), in 2023. This move recognized the severity of the air pollution problem and the ineffectiveness of the *2017 Policy and Action Plan for Control, Mitigation, Advisory, and Protective Measures in Extreme Weather Conditions of Dense Smog in the Punjab.* PuCAP strongly highlighted the deterioration of air quality in Punjab using scientific data from various sources and described its implications for human life and the economy. The policy acknowledges that limited air quality data in the province is a major obstacle in implementing spatial enforcement of regulatory and administrative measures. It also recognized air quality as a fundamental human rights issue in accordance with Article 9 of the Constitution of Pakistan.

The core objectives of the policy are focused on environmental protection and conservation, enforcing and achieving air quality standards, identifying air pollution hotspots, improving coordination and monitoring, engaging stakeholders, and providing economic incentives to adopt green technologies. What distinguishes PuCAP from NCAP is its quantifiable targets for various air pollutants by 2030, using 2022 as the baseline year. The achievement of these targets depends on policy interventions in major emission-emitting sectors like transport, agriculture, livestock, energy, industrial, household, and municipal sectors.

Despite providing a comprehensive overview of the causes of air pollution and identifying emission-producing sectors with the roles of each stakeholder, the PuCAP lacks support for a decentralized structure to address major sources of air pollution, which would help enforce administrative and regulatory measures. Identifying air pollution hotspots is linked with data collection and dissemination, which can assist in the decision-making processes. However, the PuCAP has not established a coordination mechanism for data collection and data sharing. Additionally, viewing smog solely as an administrative and regulatory issue rather than a human behaviour issue reduces the chances of successful implementation and achieving the policy's objectives. The scale of the air pollution problem requires an inclusive approach, holding each individual responsible for the environment. Decentralized structures at the district and local levels would help accelerate the implementation of policy objectives. Moreover, the PuCAP should be aligned with the National and Provincial Climate Change policies and other environmental protection and conservation policies.

Provincial Climate Change Policies

In 2024, the Government of Punjab developed a comprehensive Climate Change Policy and Action Plan (PCCP&AP) with the overarching vision of building a climate-resilient province. It is the only province in Pakistan that explicitly includes smog and air quality in its specific policy objectives: "*achieve low-emission development that yields social, environmental, and economic benefits and mitigate smog by improving the air quality index, making the province greener and more competitive."* The PCCP&AP has effectively identified three policy areas for development planning and target setting. Proposed adaptations cover key sectors such as water, bio-diversity, disaster management, health, and climate justice. The policy also emphasizes the emission reduction path through mitigation in the energy, industry, transport, and waste management sectors. The policy recognizes the benefits of synergies between adaptation and mitigation strategies to achieve the policy objectives in cross-cutting sectors such as agriculture and livestock, forestry, climate-integrated planning, and climate financing.

One of the key features of the PCCP&AP is its detailed action plan with policy targets. Adaptive measures needed to achieve the policy targets are documented. Similarly, the low carbon and emission reduction pathways are outlined in the mitigation strategy. A combination of adaptive and mitigation measures is highlighted for cross-cutting sector policy targets. Despite the merits of the PCCP&AP, an explicit air quality improvement strategy was anticipated in the action plan. Like the CCPs of other provinces, the PCCP&AP adopts a sectoral approach to tackle the air pollution problem in the province.

Sindh formulated its first Climate Change Policy in 2022, which aligns with the provincial government's vision to build a resilient and environmentally friendly ecosystem. The Sindh Climate Change Policy (SCCP) is also consistent with the National Climate Change Policy, updated in 2021. The SCCP primarily focuses on restoring natural ecosystems, building capacity and developing robust climate response mechanisms while streamlining development planning to address changing climate patterns. However, the SCCP does not specifically address air quality issues in the province. This omission may be due to the lack of city-wise data on air quality, which has hindered the presentation of a robust analysis of the major sources of air pollution. In Khyber Pakhtunkhwa (KP), the first Climate Change Policy (CCP) was developed in 2017 and updated in 2022. The new KP Climate Change Policy 2022 was aligned with the updated National Climate Change Policy 2021. The CCP of KP is developed on two broad pillars: adaptation and mitigation. The policy aims to safeguard and protect the most vulnerable people from the adverse impacts of climate change through sectoral interventions. The policy specifically focuses on mitigation strategies in various sectors such as energy, transportation, waste, industry, and urban planning. However, no

strategy for improving air quality in the province is mentioned, and no targeted policy intervention addresses air quality issues.

The Balochistan Climate Change Policy (BCCP) 2024 was developed to build climate resilience by embracing a dynamic approach to adaptation and mitigation. The policy objectives are based on a holistic approach responsive to national and international climate obligations, people-centric, and gender sensitive. The BCCP uses the sectoral approach, focusing on agriculture and livestock, water management, biodiversity conservation, natural resource management, and promoting economic viability and diversification. Mitigating Greenhouse Gas Emissions (GHG) is one of the core objectives of the BCCP, emphasizing setting emission targets and adopting renewable energy technologies. However, the BCCP has overlooked critical aspects of air pollution at the provincial level. The policy does not address the current air quality situation in the province or outline provincial air quality standards and regulations in compliance with national and international obligations. The sectoral approach to reducing GHG has some primary flaws, as it completely neglects cross-sectoral linkages.

Air Pollution Holistic Policy Framework

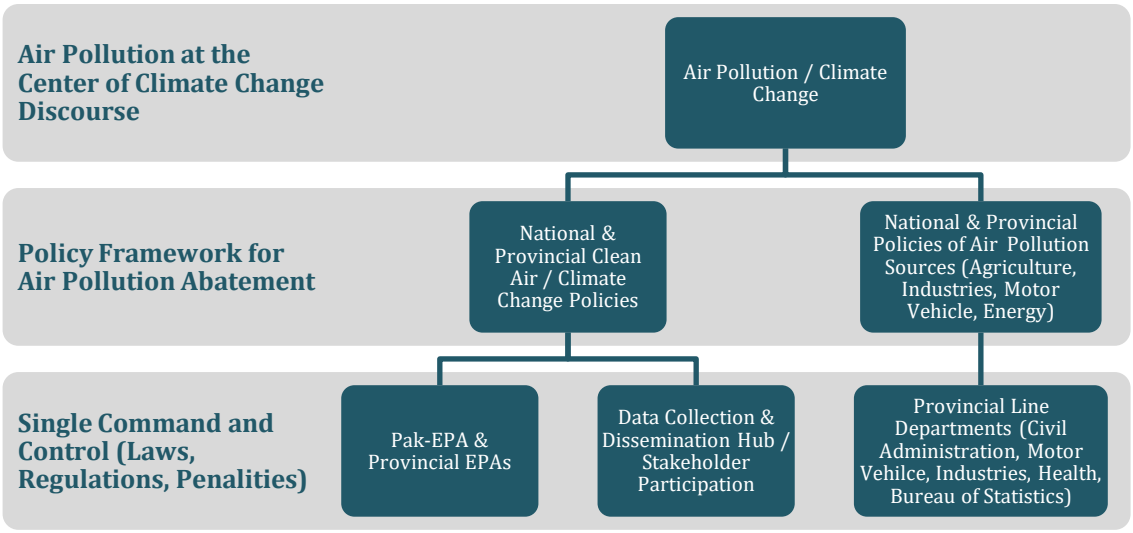
In Pakistan, climate change is often perceived and understood in the context of Disaster Risk Reduction (DRR), rather than as atmospheric pollution contributing to global climate change. The government and its functionaries frequently highlight Pakistan's negligible contribution to the global carbon footprint but fail to address domestic issues, even as three to four cities consistently rank among the world's most polluted cities. Environmental concerns have not been a policy priority for the government, undermining the efficacy of public discourse and discussions. The understanding of interlinkages of environmental issues is also lacking in the federal ministries and provincial line departments, resulting in fragmented policies. Air pollution requires a holistic policy framework that incorporates climate change objectives and ensures strict compliance with environmental laws and regulations through robust administrative enforcement.

Policy coherence is crucial for accelerating achievements in air quality improvement. Instead of adopting a sectoral approach to combat air pollution, all national and provincial policies should develop a mechanism to quarterly exchange total emissions from their respective sectors with the Provincial Environmental Protection Agencies. Also, sectoral policies should either eliminate provisions that potentially harm other sectoral policy objectives or minimize their negative impacts. For instance, while the energy sector encourages clean, renewable technologies, the industrial policy offers

incentives to coal plants and brick kilns to promote small and medium-sized industries. This inconsistency hinders the development of a cohesive policy framework, where provisions across different sectors complement and reinforce one another.

A holistic policy framework for air pollution abatement requires a single command and control authority. The Pakistan Environmental Protection Agency (Pak-EPA) is mandated to possess legislative and punitive powers to enforce compliance with environmental laws and regulations. Provincial EPAs will act as extensions of the Pak-EPA, establishing regular coordination with the provincial line departments, civil administration, and all other stakeholders, including political representatives, CSOs, NGOs, academia, and the media. Provincial EPAs will ensure timely data collection, dissemination, and sharing of air quality data, making it accessible to all stakeholders for compliance and monitoring purposes.

Chart 1: Holistic Policy Framework for Combating Air Pollution



Improving the air pollution governance structure requires enhancing the technical capacity of federal and provincial government functionaries and other implementing institutions. International development partners conduct seminars and workshops on the issue of air quality as part of the SDG's knowledge and capacity-building initiatives. The government can leverage these national and international events to increase technical knowledge and skills and to understand the methods and procedures of air quality measurement and its cross-sectoral nature. Both federal and provincial governments can play an instrumental role in streamlining different data sources by adopting a standard methodology and definition of air quality data and agreeing to avoid duplication.

Data generation and sharing mechanisms should be integral to the air pollution reduction strategy. Data centres produce air quality data hourly, which should be aggregated by a central coordination entity. Disseminating this hourly, daily, weekly, and monthly air quality data is essential to create mass awareness and encourage the adoption of indigenous mitigation strategies.

The government should proactively pursue the agenda of air quality improvement, as it has positive spillover effects on other sectors of society. Enforcing laws and regulations and locally monitoring activities by the civil administration, including the police department, are critical components of this governance structure. In addition, air pollution is equally a rural phenomenon which is not adequately reflected in the government's abatement strategy that focuses primarily on the urban centres in Pakistan.

Policy Recommendations

The following are some policy recommendations for preventing and mitigating smog in major cities of Pakistan:

- The sources of contributing pollutants should be determined based on their time and frequency, location, and specific characteristics before the policy framework is devised. The policy framework should be dynamic and based on real-time data.

- Policy prescriptions should not be based solely on yearly data. Yearly data should be used to assess overall air quality throughout the year and to establish baselines.

- To enhance awareness and knowledge of the harmful impacts of air pollution and excessive gaseous emissions, all the available resources and platforms of communication must be integrated into government policy and non-government stakeholders' communication strategies.

- Both federal and provincial governments should adopt an inclusive data-sharing policy to increase air quality monitoring data coverage. This should include standardizing definitions, ensuring data consistency and accuracy, determining data frequency, and verifying and authenticating data with mutual agreements from all stakeholders.

- Air pollution is an environmental issue and an institutional glitch stemming from administrative failures to effectively enforce existing environmental laws, regulations, and standards. The administrative machinery at the district level

should work closely with provincial EPAs. In the context of a single command and control structure, the execution powers of Pak-EPA should be augmented for compliance, oversight, monitoring, prosecution, and penalties at provincial and district levels.

- The federal government can lead by initiating environmental diplomacy through formal and informal channels. Civil society organizations, media, academia, and social media platforms can play an instrumental role in highlighting the transboundary air pollution issues and their detrimental impact on people.

- All provincial governments must formulate provincial clean air policies with specific emission reduction targets for the next 15 years. The provincial policies should explicitly mention emission targets by source. Additionally, provincial climate change policies must include air pollution reduction strategies, emission control mechanisms, and the provincial share in NDCs.

- The National Climate Change Policy should explicitly include an air pollution reduction strategy and an emission control mechanism with benchmark targets for the next 15 years. This approach would integrate the objectives of the National Clean Air Policy and Nationally Determined Contributions (NDCs).

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