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Lessons from Beijing for Lahore: Toward an Evidence-Based National Clean Air Policy for Pakistan

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Abstract

Background: Pakistan was ranked the most polluted country in IQAir's 2025 report, with a national annual mean PM2.5 of 67.3μg/m^3, roughly 13 times the WHO guideline, and nine of the world's 25 most polluted cities. The country adopted its first National Clean Air Policy in 2023, yet Lahore still sits near 90μg/m^3. Beijing brought its annual mean from close to 90 down to 30.5μg/m^3 between 2013 and 2024. **Objective:** To identify which parts of Beijing's clean air governance can reasonably be carried over to Lahore, and to locate the gaps in Pakistan's current framework. **Methods:** Qualitative, desk-based comparative policy analysis of peer-reviewed studies, official documents, multilateral project records and monitoring reports available to October 2026, organized around eight governance domains. **Findings:** Beijing's improvement rested on a time-bound national plan with binding targets, simultaneous control of coal, industry, vehicles and dust, official accountability, and openly reported monitoring. Pakistan's framework is advisory rather than statutory, proposes an annual PM2.5 target of 35μg/m^3 against an existing standard of 15, had minimal regulatory monitoring outside Punjab in late 2023, lacks an agreed public account of Lahore's pollution sources, has no airshed-level authority, and gives the health sector no defined role. The methods behind Lahore's competing source estimates cannot be ranked with confidence, and eye-disease odds ratios from lower-exposure settings cannot be transferred to Lahore. **Conclusions:** Eight reforms are proposed, starting with a statutory basis for ambient standards and an independent source apportionment for Lahore. The reforms take their design logic from Beijing; they do not copy China's institutional model. Personal accountability of named officials is placed at provincial level, where legal authority sits.

Keywords: Air Pollution, PM2.5, Smog, Clean Air Policy, Pakistan, Lahore, Beijing, Health Policy

Introduction

IQAir's 2025 World Air Quality Report, built on data from 9,446 cities in 143 countries and territories, placed Pakistan first among the world's most polluted countries, with an annual mean PM2.5 of 67.3μg/m^3 [1]. The WHO guideline is 5μg/m^3 [2], so the national average sits at about thirteen times the recommended level. Lahore recorded 88.9

μg/m^3 in 2025 and ranked eighth among cities worldwide, and Faisalabad, at 98.8μg/m^3, ranked fifth [1].

Ambient air pollution is now one of the largest environmental causes of death. An update of the Lancet Commission on pollution and health put pollution-related mortality at about nine million deaths a year, with deaths from ambient air pollution rising even as those from household and water pollution fell [3]. The State of Global Air 2025 report attributed 7.9 million deaths in 2023 to air pollution, 86% of them from non-communicable diseases [4]. For Pakistan, roughly 235,000 premature deaths a year are attributed to poor air quality [5], and a recent national assessment estimated an average loss of 3.9 years of life expectancy [6].

The comparison with Beijing is deliberate. In 2013 China launched its Air Pollution Prevention and Control Action Plan, which the Tsinghua team that later evaluated it called the toughest clean air policy the country had adopted [7]. Beijing's annual PM2.5 fell from close to 90 μg/m^3 to 30.5 μg/m^3 in 2024, and its heavily polluted days dropped from 58 to 2 [8,9]. That is still about six times the WHO guideline, so Beijing is not clean by any absolute standard. Even so, a fall of roughly two-thirds in eleven years, in a coal-dependent megacity, is rare enough to study closely.

Pakistan has started to respond. The National Clean Air Policy (NCAP) was approved in March 2023 and the Punjab Clean Air Action Policy followed a month later [10,11]. One independent review described these first documents as a restatement of existing rules with limited evidence behind the targets [5]. This paper asks which features of Beijing's approach explain its results, and which of them Pakistan, with its federal structure, thinner monitoring and shared airshed, can realistically adopt.

Methods

This is a qualitative, desk-based comparative policy analysis. It is not a systematic review and generates no new exposure data. Sources came from targeted searches run in October 2026 and fell into four groups: the IQAir 2025 report and city ranking; peer-reviewed studies on China's Action Plan and Beijing, on Lahore and South Asian smog, and on air pollution and eye health; official Pakistani policy documents and World Bank project records; and reports from research institutions and monitoring initiatives. Priority went to material from 2019 onward. Where an official policy text could not be read directly, the analysis relied on a published expert review of it. News reports were used only for official statements and for coverage of institutional reports.

The analysis is organized around eight governance domains that recur in the clean-air literature and in critiques of Pakistan's policy: legal basis and targets; ambient standards; monitoring and open data; inventories and source apportionment; sector enforcement; coordination across jurisdictions; financing; and health-system integration. For each, Beijing's practice and Pakistan's position were recorded and the difference described as a gap. The framework and the judgments about transferability are my own and are interpretive. Competing source-apportionment claims were compared on five criteria: the method used (emission inventory, receptor-based measurement or expert weighting), whether the method and data are public, the period covered, whether secondary particulate is accounted for, and whether the work was peer reviewed or independent of the body whose policy it assesses. City values in the IQAir ranking depend on the stations reporting in a given year and should not be read as precise. No human participants were involved.

Findings

Exposure in Pakistan

Pakistan's national mean of 67.3 μg/m^3 in 2025 placed it ahead of Bangladesh (66.1), Tajikistan (57.3), Chad (53.6) and the Democratic Republic of the Congo (50.2) [1]. Nine of the world's 25 most polluted cities were Pakistani: Faisalabad (98.8μg/m^3), Rahim Yar Khan (92.6), Lahore (88.9), Sukkur (88.6), Pattoki (86.7), Lodhran (85.3), Peshawar (81.7), Sialkot (78.6) and Mandi Bahauddin (74.4) [1]. Lahore's annual mean was 133.2 μg/m^3 in 2017, 79.2 in 2020, 102.1 in 2024 and 88.9 in 2025 [1], about three times Beijing's 2024 level. Several cities swung sharply between 2024 and 2025, such as Lodhran (181.3 to 85.3) [1], which more likely reflects changing station coverage than a real halving of exposure and is itself an argument for better monitoring.

Post-monsoon haze over the north-western Indo-Gangetic Plain has been called the "fifth season" since 2016 [12], but the problem is not confined to winter: a 2025 report by the Pakistan Air Quality Initiative (PAQI) found no clean-air day in Lahore in 2024 by WHO standards, and 218 days that failed Punjab's own standards [13].

Sources and a dispute about them

There is no settled public answer to what drives Lahore's pollution. PAQI attributed Lahore's primary PM2.5 emissions mainly to transport (35%), industry (28%) and brick kilns (17%), amplified by winter inversions [6]. The Punjab Environment Protection Agency rejected the report, said more than 80% of Lahore's industry had fitted emission controls, and pointed to cross-border sources [14]. Pakistani environmental authorities have also been reported to put the share of Lahore's smog originating across the border in India at about 30% [15]. Majeed and colleagues ranked

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contributors by expert weighting and gave the highest weight to trans boundary open burning, then vehicles, thermal power and brick kilns. Back-trajectories linked the highest aerosol days in early November to air passing over agricultural fires, but showed no significant trans boundary contribution in 2020 and lower fire activity in 2022 [12]. These findings describe episodes, not annual averages, and are not an emissions accounting.

A Lahore emission inventory was published by the Punjab Urban Unit in 2023 [16], yet a review of the Punjab plan found it did not clearly cite the inventory behind its targets [5]. Reviews of particulate pollution in Pakistan and across China, India and Pakistan, and a call for regional cooperation and better monitoring, support the view that the problem is both local and regional [17–19]. The federal government, the provincial regulator and independent researchers work from different numbers. Beijing did not begin that way, as Section 3.4 shows.

The four accounts differ in method, and the differences decide how far each can support policy. The PAQI report apportions primary PM2.5 emissions to sectors [6]. An emission share is not an ambient share, because part of ambient PM2.5 forms in the atmosphere from gaseous precursors, and the summary reviewed here reports no receptor-side check [6]. The Punjab EPA's rejection, as reported, rests on the share of industry with emission controls and on cross-border transport [14], but no alternative apportionment or method was found in the sources reviewed. Fitted controls do not show that emissions are low, since compliance depends on the controls operating and being monitored, and industrial monitoring is self-reported [5]. The 30% cross-border figure is reported second-hand, and the sources reviewed give no method or period for it [15]. Majeed and colleagues used expert weighting and back-trajectories, which are documented and peer reviewed [12], but expert weighting ranks contributors by opinion and does not measure them, and the back-trajectories cover episodes. On these criteria the Punjab EPA position is currently untestable, PAQI and Majeed and colleagues are open to scrutiny but answer different questions, and neither measures what reaches a monitor. Vehicles and brick kilns appear among the main contributors in both PAQI and Majeed and colleagues [6,12] despite their different methods, which is the strongest point of agreement available.

The Lahore inventory [16] raises a separate question of accuracy. An emission inventory multiplies activity data by emission factors, and in Lahore the largest uncertainties are likely to sit in sectors with informal or unregistered activity: brick kilns, small industry, open waste burning and crop-residue burning. Emission factors borrowed from other countries, activity data that cannot be audited, and the absence of validation against monitor data would each undermine confidence in sector shares, and the review of the Punjab plan already found that the inventory was not clearly tied to the plan's targets [5]. Whether the inventory reports uncertainty ranges, locally measured emission factors or a comparison with monitored PM2.5 could not be established from the sources reviewed and should be checked in the original document before it serves as a policy baseline. The most reliable basis for apportioning ambient PM2.5 would be receptor-based measurement, meaning chemical speciation of PM2.5 at several sites over a full year, reconciled with the inventory and reported with uncertainty ranges. Until that exists, source shares for Lahore are better treated as ranges than as point values, and action can rest on the contributors that independent accounts share (Recommendation 3).

Health burden, including the eye

The national mortality estimates quoted earlier [5,6] are modelled. Direct evidence from Pakistani hospitals is thinner: the few available health surveys show more acute respiratory infections and cardiovascular disease during severe episodes [12], and an empirical study of megacity hospitalisation links air pollution to admissions [20]. For eye health the evidence comes almost entirely from elsewhere. A 2024 meta-analysis of twelve studies from China, South Korea, the United Kingdom and Canada estimated that each 10 $\mu g/m^3$ rise in PM2.5 was associated with higher odds of vision disorder (OR 1.10, 95% CI 1.01 to 1.19), with glaucoma (OR 1.12) and age-related macular degeneration (OR 2.24) in subgroup results and greater susceptibility in children [21]. An earlier meta-analysis reported possible associations with cataract, macular degeneration and glaucoma, with limited evidence [22]. These studies used exposure levels well below Lahore's, and none is from Pakistan, so extrapolating the odds ratios would be unsafe.so the odds ratios should not be applied to Lahore. The reasons go beyond a formal caveat. There is no basis for assuming that a ratio per 10$\mu g/m^3$ estimated at low concentrations holds far above the range studied.

The particle mix differs by setting. Exposure in these studies was mostly assigned from fixed monitors or modelled grids, which misclassifies personal exposure, and the error is likely to be larger where monitoring is sparse, as in Pakistan. The pooled estimates also combine different outcomes and study designs [21], and the review of age-related eye disease found few studies with differing methods [22]. The defensible reading is narrower: eye disease is a plausible, under-measured part of the smog burden and is absent from the Pakistani policy documents reviewed here. No attributable-case or burden estimate for eye disease is made in this paper, and the ocular recommendation concerns data collection, not projection.

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What Beijing did, and what the evidence says it achieved

Beijing's Clean Air Action Plan ran from 2013 to 2017 on four fronts: coal combustion, vehicle emissions, industrial pollution and dust [9]. Annual PM2.5 fell from nearly 90 μg/m^3 to 58 by 2017, 33 in 2021 and 30.5 in 2024 [8,9], and the Beijing-Tianjin-Hebei region as a whole fell by more than 60% from 2013 [8]. Zhang and colleagues found that tougher industrial emission standards, boiler upgrades, retirement of outdated capacity and clean household fuels drove the national decline from 2013 to 2017, far more than year-to-year weather, and averted about 370,000 deaths in 2017 [7]. A model-based decomposition for Beijing agreed on the dominant role of emission cuts [23]. An analysis of 74 cities reported a 33.3% fall in PM2.5 and about 47,000 fewer deaths in 2017 than in 2013, while warning that ozone and nitrogen dioxide needed attention [24]. Estimates differ: Yue and colleagues found the plan lowered PM2.5-attributable deaths by about 64,000 (6.8%) against 2013 and argued that more ambitious policy was needed [25]. The difference reflects baselines and methods, not disagreement on direction. Figure 1 sets Beijing's trajectory beside Lahore's reported annual means.

An analysis by the Centre for Research on Energy and Clean Air identifies the governance features it considers transferable: targets and timelines with clear accountability, plans covering all key sectors and pollutants, plans based on a scientific assessment of sources, and absolute coal caps in key regions [26]. Beijing also worked jointly with Tianjin and Hebei [8].

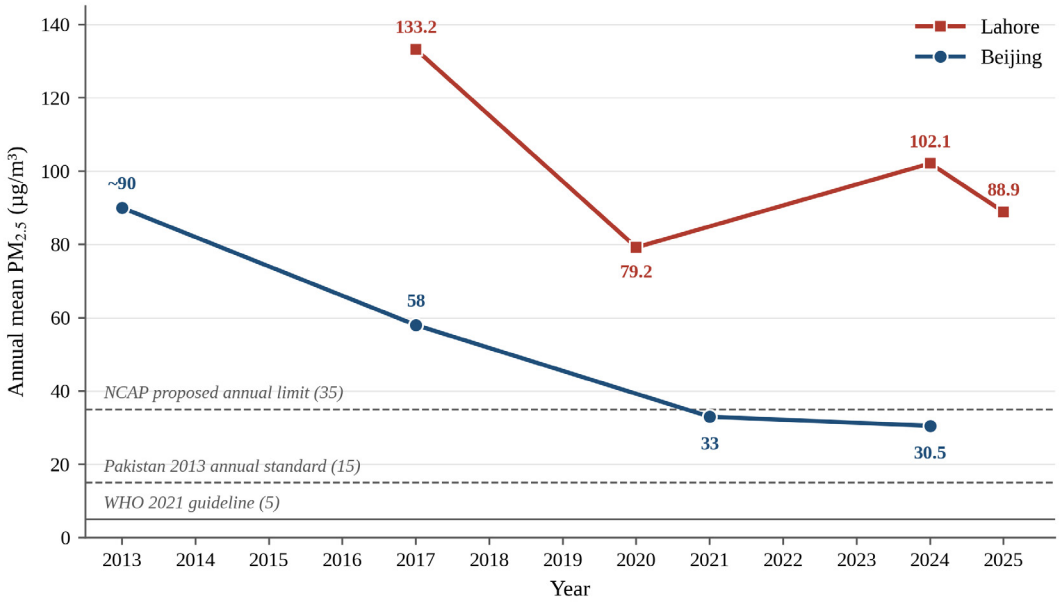


Figure 1: Annual mean PM2.5 in Beijing and Lahore against reference levels (μg/m^3). Sources: Beijing [8,9]; Lahore [1]; WHO guideline [2]; Pakistan standards and NCAP proposal [5]. Beijing's 2013 value is reported as close to 90μg/m^3. Lines join reported years only and do not show intermediate values.

Pakistan's current framework

Pakistan's air quality rules have accumulated in layers. The 1983 Ordinance created the agencies, the 1997 Act replaced it, and national ambient standards followed in 2010 and were lowered in 2013 [5]. The 18th Amendment of 2010 devolved environmental legislation to the provinces, and Sindh relaxed its limits in 2016 [5]. The courts have driven much of the action: the Supreme Court read clean air into the right to life in 1994 and the Lahore High Court set up a smog commission in 2017 [5]. Punjab issued its Policy on Controlling Smog that year [27]. The NCAP names one priority intervention in each of five sectors (Euro-5/6 fuel standards, industrial emission enforcement, residue burning, open waste burning, clean cooking) and targets a 38% cut in PM2.5 emissions by 2030 against a business-as-usual baseline, equal to 21% below 2020 levels, and 81% by 2040 [5,10].

The CREA review of December 2023 is the most useful critique [5]. It found the NCAP advisory and without statutory backing, so provinces can set weaker targets; its proposed ambient limits (35 μg/m^3 annual, 75 daily) step back from the 2013 standard (15 and 35) while citing the

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2021 WHO guideline; no sector or city emission caps; no treatment of trans boundary pollution or airsheds; and a federal monitoring network of a single site in Islamabad, with none in Balochistan, Khyber Pakhtunkhwa or Sindh [5]. Industrial compliance rests on self-monitoring rules from 2001 [5]. Recent steps are more encouraging. In March 2025 the World Bank approved a US$300 million credit for the Punjab Clean Air Program, aiming to cut PM2.5 by 35% over a decade for about 13 million residents of Lahore Division and funding more regulatory-grade monitoring [28,29]. In 2026 the climate minister announced work on a time-bound implementation plan, with a National Clean Air Secretariat under consideration, while the Asian Development Bank reviews the policy for a more measurable and legally enforceable framework [30].

Domain	Beijing / China	Pakistan (sources reviewed)	Gap
Legal basis and targets	National plan from 2013, time-bound targets, absolute coal caps, official accountability [7,26]	NCAP advisory; provinces can set weaker targets [5]	No statutory floor
Ambient standards	Grade II standard met four years running [8]	2013 limits in force, but NCAP proposes 35 $\mu g/m^3$ annual against 15 [5]	Proposed retreat
Monitoring and open data	Public series by year, district and air-quality day [8,9]	One federal site in late 2023; none in three provinces; Punjab expanding [5,28]	Thin, uneven, not open
Inventories and source apportionment	Plan built on assessment of all sectors [26]	Lahore inventory exists [16], not clearly linked to targets [5]; shares disputed [6,14,15]	No agreed public account
Sector enforcement	Coal, vehicles, industry, dust [9]; standards, boilers, closures, household fuels [7]	One priority measure per sector [10]; industry self-monitors [5]	Weak enforcement
Cross-jurisdiction coordination	Joint control with Tianjin and Hebei [8]	Devolved system; no airshed mechanism; Malé Declaration not cited [5]	No airshed body
Financing	Not examined here	US$300 million for Lahore Division [28,29]; national plan under development [30]	Partial, Punjab-only
Health-system integration	Health benefits quantified in evaluation [7,24]	Awareness on health impacts in Punjab programme [28]; no role for hospitals or eye care found	Not integrated

Table 1: Gap analysis: Beijing's practice against Pakistan's position.

Discussion

Three features of Beijing's experience travel because they concern design, not the political system. The first is a plan built from a source assessment and covering every large sector at once [9,26]; Pakistan's one-measure-per-sector structure [10] and public argument over who contributes what [6,14,15] show the opposite. The second is targets with consequences: they were timed, and officials answered for them [26], whereas the NCAP is advisory [5]. How far personal answerability can travel is taken up below. The third is measurement outsiders can check. Beijing's trend lines are public [8,9]; in Lahore, the dispute over industrial controls and cross-border smoke cannot be settled without equivalent data [6,14], and Majeed and colleagues note that the effect of Punjab's measures is hard to prove for that reason [12].

Other features do not travel. China's results came from a system in which the centre could set targets for provinces and hold officials to them. Pakistan's post-2010 settlement gives provinces authority over environmental protection, and the NCAP's reach is limited to the federal sphere [5]. The workable adaptation is a federal statutory floor of ambient standards and reporting duties that no province can fall below, with provincial and airshed plans above it. Beijing worked with Tianjin and Hebei [8]; the Punjab equivalent is Lahore with Faisalabad, Gujranwala, Multan and the other cities that suffer the same episodes [12], and, for post-monsoon smoke, India across the border. Majeed and colleagues conclude that Pakistan cannot resolve the problem alone [12], and the same call runs through the wider literature [17,31]. Neither the national nor the Punjab plan refers to the Malé Declaration on trans boundary coordination [5].

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Named-official accountability needs separate treatment, because it worked in a system where the center set targets and could hold officials to them [26]. After the 18th Amendment the federal government has limited power to direct provincial officials on environmental matters [5], so a federally named official would carry responsibility without authority. Accountability has to follow legal authority, and three arrangements look feasible. Each province would name a responsible official in provincial law or notification for its own clean air plan; in Punjab this would be the head of the airshed body proposed in Recommendation 5. The federal level would hold a reporting duty, with provinces reporting against the federal floor to the national implementation committee, not a command role. External review would come from forums that already exist, such as the Judicial Water and Environment Commission, which examines implementation of environmental rules [5]. Naming one person has limits. Where responsibility is split across transport, industry, agriculture and local government, an official without coordinating powers may be blamed for outcomes that other departments control. Named accountability should therefore come with coordinating authority and public reporting. Its feasibility in the other three provinces, and for pollution that crosses borders, has not been tested.

Expectations should stay realistic. Beijing needed eleven years to go from close to 90 to 30.5 μg/m^3 and remains about six times above the guideline [2,8,9]. The Punjab program aims for a 35% cut over a decade [28], and the NCAP's 2030 target is 21% below 2020 emissions [5,10]. Even if met in full, neither brings Lahore near the guideline, so both are first stages. China's later experience adds two cautions: ozone and nitrogen dioxide became the next problem as particulates fell [24], and further reductions in deaths needed policy more ambitious than the 2013 plan [25]. Effect estimates differ by method [7,24,25], Lahore's source shares are contested [6,12,14], and the health evidence most relevant to Pakistan has not been generated in Pakistan [21,22]. These are reasons to build the measurement base first, not to delay action on sources that are not in dispute, such as vehicle fuel quality and open burning.

Policy recommendations

The eight recommendations are my proposals, drawn from the gaps in Table 1 and ordered so that legal, standards and evidence reforms come first, because sector measures depend on them.

SI. No	Recommendation	Lead actors	Horizon
1	Give ambient standards a statutory basis: a federal clean air law, or an amendment of the 1997 Act, setting a floor provincial plans cannot undercut	Ministry of Climate Change; provincial assemblies	0–2 years
2	Keep the 2013 PM2.5 limits (15 μg/m^3 annual, 35 daily) as the floor, publish a dated pathway to WHO interim targets and guideline, and align AQI categories with the US index	Ministry of Climate Change; Pak-EPA	0–1 year
3	Commission an independent, peer-reviewed source apportionment that combines receptor-based measurement with the inventory, and a public emission inventory that documents its emission factors and uncertainty for Lahore and the other Punjab cities in the global top 25, updated yearly	Punjab EPD with universities and independent groups	1 year
4	Build a regulatory-grade monitoring network in every province, publish real-time data, and use low-cost sensors only when co-located with reference monitors	Provincial EPAs; Pak-EPA; Punjab programme funds	1–3 years
5	Create airshed governance: a statutory body for the central Punjab airshed and a formal inter-provincial and cross-border channel using the Malé Declaration	Punjab; Ministry of Climate Change; Ministry of Foreign Affairs	2–4 years
6	Attach targets and public reporting to each sector: fuel quality and public transport; sector-specific industrial standards with public reporting instead of self-monitoring; residue management; open waste burning	Provincial departments	1–5 years
7	Bring in the health system: smog-season plans for hospitals and eye-care services, surveillance linking daily PM2.5 to respiratory, cardiovascular and ocular visits, school-closure triggers, funded Pakistani ocular studies	Provincial health departments; research institutions	0–2 years

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SI. No	Recommendation	Lead actors	Horizon
8	Make delivery accountable: annual published progress report, a named responsible official in each provincial government, designated under provincial law and holding coordinating powers over the sectors concerned; provinces reporting against the federal floor; and reporting to the Judicial Water and Environment Commission	National implementation committee; provincial governments	1–3 years

Table 2: Recommendations, lead actors and time horizon.

Recommendations

1 and 2 answer the most consequential finding of the CREA review: a first national policy proposed looser ambient limits than the standard already on the books, and nothing in law stops provinces from following [5]. Recommendation 3 matters because every sector measure needs a defensible estimate of what it will remove, and the disagreement among PAQI, the Punjab EPA and official estimates [6,14,15] gives regulators and industry room to deflect. The design matters as much as the commissioning: receptor-based measurement over a full year at several sites, checked against the inventory, would show which of the competing shares holds for ambient PM2.5. Recommendation 8 borrows the most transferable part of Beijing's record, targets tied to named officials [26], and Pakistan already has a body that examines implementation of environmental rules, the Judicial Water and Environment Commission [5]. Recommendation 8 adapts the part of Beijing's record that ties targets to named officials [26]. The named official sits in the provincial government, where legal authority lies, and the Judicial Water and Environment Commission, which already examines implementation of environmental rules [5], provides external review. Recommendation 7 is the one the policy documents reviewed here do not touch. Because the ocular evidence comes from other countries [21,22], the first deliverable should be local data, such as routine recording of presenting complaints and daily PM2.5 at eye departments in smog-affected cities, not a new treatment guideline. No attributable-case or burden estimate should be published until local exposure-response data exist.

Limitations

This is a desk-based analysis with targeted, not systematic, searches, so relevant studies may have been missed. Several sources are institutional reports, news items and project pages, and some NCAP details come from an expert review rather than the policy text; these should be checked against originals. Pakistan's monitoring is sparse, and the claim about the federal network describes late 2023 and may have changed. The analysis does not weigh the economic cost of Beijing's measures or Pakistan's fiscal room. Judgments on transferability are interpretive, the ocular evidence comes from other exposure ranges, and developments after October 2026 are not covered. The Lahore inventory and the PAQI report were not re-examined in their original methods, so the statements on their uncertainty are general and should be checked against the documents. The comparison of source estimates in Section 3.2 is qualitative, and the exposure ranges of the individual studies in the ocular meta-analyses were not re-extracted.

Conclusion

Beijing's record is not an argument for copying China. It shows that a polluted megacity can cut particulate pollution by about two-thirds in a decade when the plan covers every major source, rests on an honest account of those sources, carries targets with consequences, and publishes its data. Pakistan's framework has some of these ingredients, and recent financing and the move toward an implementation plan are real steps. As reviewed here, however, it is advisory in law, loose in its proposed standards, thin on monitoring, silent on airsheds and largely absent on health. The most useful early moves are also the least expensive: a statutory floor, a refusal to relax existing standards, an agreed public source apportionment for Lahore, and a role for hospitals and eye-care services in smog response. Named-official accountability, which worked in China's centralized system, would have to sit in provincial governments to fit Pakistan's federal arrangement.

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