



Assessment of Environmental Policies and Institutions for Effective Air Quality Management in Nepal

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Abstract

Air pollution is a serious environmental threat in major cities of Nepal. The major emission source of air pollutants is vehicular emission, resuspension of street dust litter during dry climatic conditions, black smoke plumes from brick kilns, and refuse burning. Effective plans and policies are required for the effective management and monitoring of air pollution. This study aims to review environmental policies and plans prevalent in Nepal and assess their effectiveness in controlling air pollution. The study is based on the literature review and a questionnaire survey using Najam's 5C framework for policy analysis. Although several national policies, plans, laws and standards have been formulated and international agreements have been ratified for the management of air pollution, separate policy dedicated to air pollution management has not been formulated in Nepal. According to Najam's framework, the content, context, and commitment of the overall policies, plans, and agreements for managing air quality in Nepal were assessed as effective. However, the capacity of the implementor, client support, and management coordination was found ineffective. This study recommends that a separate policy on air quality management is required, while the capacities of stakeholders and coordination mechanisms should be strengthened to improve the country's air quality.

Keywords: Air pollution, Clean air, Najam's 5C Framework, Policy Analysis

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1. Introduction

Air pollution has seriously threatened human health and the environment in Nepal (Gurung & Bell, 2013; World Bank, 2019). According to a report published by Yale University, Nepal was ranked the third-highest polluted country in the world in air quality (EPI, 2020). Vehicular emissions in the cities of Nepal are comparatively higher than in other developing cities (Byanju et al., 2012; Mool et al., 2019) suggesting the potential sizable health risk (Gurung & Bell, 2012; Pratali et al., 2019). With the rapid, uncontrolled and unmanaged developmental projects and urbanization, air pollution has increased in Nepal; victimizing people with serious airborne diseases (K. Bhattarai & Conway, 2021; Kurmi et al., 2016; Manisalidis et al., 2020). Airborne diseases such as asthma, Chronic Obstructive Pulmonary Disease (CEN & ENPHO, 2003; Kurmi et al., 2016), non-reversible bronchial obstruction (Pratali et al., 2019), pneumonia in children (Budhathoki et al., 2020) have already been reported in Nepal. The major effect of air pollution can be mainly observed in the cities such as Kathmandu, Biratnagar, Birgunj, Nepalgunj, and Lumbini. The PM₁₀ concentration in major cities such as Kathmandu is much higher than prescribed by World Health Organization (Mahapatra et al., 2019; Saud & Paudel, 2018). Studies show that the transportation sector than the industrial sector, is more responsible for degrading the air quality in the urban cities of developing countries like Kathmandu (Byanju et al., 2012; Das et al., 2019).

With the addition of about 300,000 new vehicles on the road every year in Nepal, it is likely that the problem is going to worsen soon (CBS, 2020). US-EPA (2022) refers to air quality management as all the activities a regulatory authority undertakes to help protect human health and the environment from the harmful effects of air pollution. According to Chow et al. (2007), effective planning and technical, institutional and economic measures can be applied for air quality management. In a country where the persuasion and voluntary commitments for environmental protection are not working properly, continuous emissions monitoring can be complemented by legal enforcement (command and control approach) to control pollution (Chauhan et al., 2021; Downing & Watson, 1974). With its realization and the seriousness of air pollution, Nepal has been making efforts to control and manage air pollution since 1992 (Oli, 1996). Research, monitoring, institutional development, the promulgation of policies and regulations, and the development of emission standards and their enforcement are the major efforts made by Nepal for air pollution management (Jha & Lekhak, 2003). However, the progress on compliance and enforcement of these efforts is yet to be analyzed. Thus, this work conducts a comprehensive study on policies, regulations and institutions and their compliance

and enforcement for air pollution management in Nepal. The specific aims of this paper are to i) document and analyze the policy content that guides the management of air pollution, ii) assess the roles and responsibilities of air quality management agencies, iii) assess the effectiveness of air pollution policies and make recommendations for improving air quality management in Nepal.

2. Research Methods

The study adopts two data collection methods, viz. literature survey and a structured questionnaire survey. The literature was searched using key phrases and words, including ‘environmental policy,’ ‘air pollution in Nepal’, and ‘air pollution management in Nepal’ in Google scholar, Scopus, and PubMed research databases which aided in documenting and studying the status of existing policies on air pollution in Nepal. Relevant search results in journal articles, books, chapters, statutes, and published reports were downloaded and reviewed for evaluation.

Similarly, the relevancy and implementation of the policies and legal instruments were assessed through a structured questionnaire survey that was developed with reference to Najam’s 5C protocol for assessing policy implementation (Najam, 1995). The five critical variables (the 5C Protocol) can assist in unravelling the

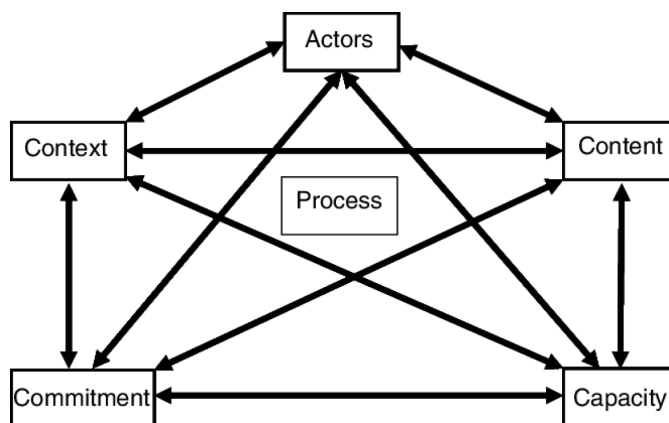


Fig. 1: Analytical framework for policy analysis (Najam, 1995)

management of complex implementation processes. Najam’s framework has been widely used in evaluating the implementation of the policies related to pollution control (Bayrakal, 2006), biodiversity conservation (Dongol & Heinen, 2012), education (Caves & Oswald-Egg, 2020), health (Altenstetter, 2017) and other sectors. Figure 1 shows the analytical framework for policy analysis based on the policy construct from Najam (1995).

The five elements of the Najam protocol are i) Content- The Content of the policy itself, what is set out to do (i.e., goals); how it problematizes the issues (i.e., casual theory); how it aims to solve the perceived problem (i.e., methods), ii) Context- The

nature of the institutional Context, The corridor (often structured as operating procedures) through which policy must travel, and by whose boundaries it is limited, in the process of implementation., iii) Commitments -The Commitment of those entrusted with carrying out the implementation at various levels of the goals, causal theory, and methods of the policy, iv) Capacity- The administrative capacity of implementers to carry out the changes desired of them and v) Clients and Coalition/ Actors- The support of clients and coalitions whose interests are enhanced or threatened by the policy, and the strategies they employ in strengthening or deflecting its implementation.

The questionnaire form thus developed was pre-tested, revised and deployed through online sharing platforms for data collection. The questionnaire form is available at <https://bit.ly/3SoP3HD>. The form was deployed to 40 respondents from various backgrounds, including stakeholders from government authorities, academia, health sectors, non-governmental organizations, INGOs, and practitioners of air pollution management (Fig. 2).

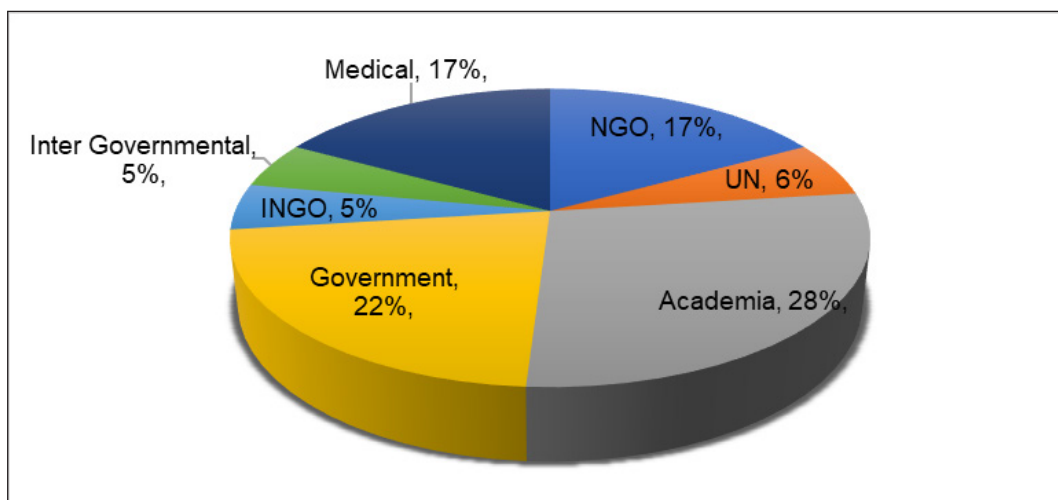


Fig. 2: Proportion of respondents representing different backgrounds

The survey form included questions about the background information of the respondent, perception of air quality, major pollutants and their sources, stakeholders and their responsibilities for air quality management, air quality data dissemination and awareness, and challenges of AQM in Nepal. Besides, the respondents were also asked to rank the effectiveness of given policy/ regulations or initiatives from 1- 5 (1 being not at all effective and 5 being highly effective) for each variable (content, context, commitment, capacity, and clients and coalitions) relating to the policy. For

convenience, brief descriptions of the policies and plans were provided to the respondents. The data collected were analyzed using descriptive analysis and frequency distribution. The resulting outputs are expressed in the form of charts and tables.

3. Results and Discussion

3.1 Policy and legal framework for the management of air pollution in Nepal

Nepal has incorporated the air pollution policies into legal systems and some other sectoral policies emphasized by the National Conservation Strategy 1988, the need to establish policies in response to air pollution (M. Bhattarai et al., 2009),

The Constitution of Nepal secures a clean environment as a fundamental right. Its 30th article states that every person shall have the right to live in a clean and healthy environment. The Constitution of Nepal secures compensatory rights for environmental pollution or degradation. Article 51 (g) of the Constitution provisioned that Nepal can adopt policies relating to protecting, promoting, and using natural resources.

The National Penal Code, 2074 (2017) has criminalized the offence of fouling water and polluting environment under Chapter 5 section 111 and 112 respectively. The code has clearly defined polluting water sources and emitting sound, heat, radiation, and hazardous waste that causes an adverse impact on human health and environment as offensive. According to the section 112 (3) and (4) of the act, the offender could be punished with a fine up to NRs 50,000 or imprisonment of up to 5 years or both. However, 'air pollution' has not been pointed out directly as an offence in the code.

Yet, the objectives of ensuring a clean and healthy environment haven't been realized effectively. Air pollution problems often peak in the winter (Saud & Paudel, 2018), and at this time of the year, the political parties and government seem to have forgotten the Constitutional provision. The overlapping environmental jurisdiction of the three tiers of government has put stakeholders in a dilemma for adding efforts in environmental protection and conservation in Nepal (Acharya et al., 2020).

The policy and gap analysis of different environmental policies, plans and legislations concerning air quality management is presented in Table 1.

Table 1: Policies and legal framework for Air Quality Management (AQM) in Nepal: Major provisions and gap

Policy and legal instruments	Major provision regarding air pollution	Gaps and challenges
3.1.1 Policy and plans		
<i>National Environment Policy 2019</i>	<p>This policy aims to ensure the fundamental right to live in a clean, healthy environment through pollution control, solid waste management and greenery enhancement. In policy 8.1, it envisions to i) development and adoption of concentration-based and load-based standards to curb pollution, ii) establishing emission monitoring stations in major cities, industries and environmentally risk areas, iii) conducting field emission monitoring, source apportionment and dispersion modelling for mapping and controlling air pollution, iv) use environment-friendly clean technologies in industries, vehicles and hospitals, v) promote the use of solar, electric and biogas based improved cooking stoves to reduce the effect of indoor air pollution, vi) promote the use of electric, hydrogen-based and hybrid vehicles that makes the use of clean energy, and vii) encourage the imports of eco-labelled products.</p>	<p>Some of the policy provisions are very ambitious. For instance, the promotion of hydrogen fuel-based vehicle use is irrelevant at the current stage, where the promotion of electric vehicles is still lagging. The provision regarding how cleaner technology import and use can be encouraged, e.g. potential subsidy etc., is lacking. Coordination between three tiers of government and other stakeholders is crucial for implementing this policy. The mechanism for coordination is lacking.</p>
<i>National Climate Change Policy 2019</i>	<p>The National Climate Change Policy 2019 aims to contribute to mitigating climate change and adapting to the observed impacts. The policy highlights the need for developing a low carbon emission pathway and energy-efficient technologies</p>	<p>Air pollution mitigation is incorporated only in the transport, industry and energy sectors and underestimates the co-benefits of</p>

	<p>to mitigate climate change that also aids in controlling air pollution. Technologies shall be developed to reduce black carbon and greenhouse gas emissions from water, land and air pollution. Transport vehicles that have exceeded certain years of running and are highly polluting shall be gradually phased out.</p>	<p>climate change mitigation and pollution prevention in other sectors.</p>
<p><i>Transport policy 2002</i></p>	<p>The transport policy 2002 states the need to expand the utilization of means of transport through solar power and electricity. It also stated restrictions on importing vehicles older than 5 years, and the means of transportation should be reliable, comfortable, free of pollution, safe, affordable, and fit to nature and standards.</p>	<p>The policy has provisions regarding transport management rather than the role of transport in air pollution management, although the transportation sector is one of the major sources of pollutants. The implementation of the policy is weak due to the lack of coordination.</p>
<p><i>The fifteenth five-year plan of Nepal</i></p>	<p>The plan aims to revisit and revise the standards and criteria to regulate and control air pollution. It has stated the alternate energy goal to ensure access to clean energy for all and to contribute to energy security by increasing energy efficiency in production and using alternative/ renewable energy. It also encourages using environment-friendly technology and alternative fuels to develop and manage transport infrastructure. The quantity of air pollution (PM 2.5) in all cities shall be less than 40 micrograms per cubic meter within the next 5 years and 30 micrograms per cubic meter within the next 25 years. Emission-generating activities shall be controlled by establishing and operating air quality measurement centres in major cities, industrial</p>	<p>The plan incorporates a long-term plan for preventing air pollution in major cities. Yet, the financial and institution responsibilities to implement these initiatives are lacking. Control of air pollution caused by domestic and cross-border carbon emissions is missing.</p>

<p><i>Nationally Determined Contribution (NDC)</i></p>	<p>establishments, and risky areas, and integrated mapping of air quality and forecasting of air pollution levels shall be carried out.</p>	
<p>Nepal submitted its first NDC to the UNFCCC in October 2016. This policy aims to reduce climate change, limit temperature rise to safe levels, and make the earth a livable planet. It adopts both adaptational targets and mitigation targets. It had planned to pilot the REDD+ project to reduce about 14 million tons of CO₂-eq by 2020. It also stated to decrease dependence on fossil fuels in the transport sector by 50 percent by 2050 (GGGI, 2018).</p> <p>In 2020, Nepal submitted its second NDC to UNFCCC. The NDC aims the development of strategies for addressing Nepal’s long-term greenhouse gas emissions. It covers the emission reduction target in the sectors such as energy, Agriculture, Forestry, and Land use (AFOLU), Industrial process and product use (IPPU), waste and gases, including carbon dioxide, methane, and nitrous oxides (MoFE, 2020). The commitments that also help to address the air pollution problem are i) By 2020, 15% of the total energy demand shall be supplied from clean energy sources, ii) Targets for the sale of electric vehicles in 2025 shall be 25% of all private passenger vehicles sales, including two-wheelers and 20% of all four-wheeler public passenger vehicle sales. This would decrease fossil fuel dependency by 9% and reduce CO₂ emissions by 8%. And by 2030, this policy targets to increase sales of e-vehicles to cover 90% of all private passenger</p>	<p>The targets of the second NDC are ambitious. Most of the targets set by the first NDC were not met. The learnings of the success and failure were not documented and reflected in the second NDC. Therefore, it is doubted that the implementation of the targets of the second NDC shall be realized.</p>	

	<p>vehicle sales, including two-wheelers and 60% of all four-wheeler public passenger vehicle sales reducing fossil fuel dependency by 28% and ultimately reducing CO₂ emission by 28%, and iii) this policy also targets to reduce the emission of CO₂ from residential cooking and biogas to 23% by 2030.</p>	
<p><i>Road map for Sustainable Development Goal 2016-2030</i></p>	<p>This document nationalizes the global goals and targets for sustainable development. It aims to balance social, economic, and environmental sustainability by 2030. Goal 9, Industry, Innovation and Infrastructures, aims to promote energy efficiency in these sectors. Similarly, goal 13, Climate Action, aims to reduce CO₂ emissions by 2050. Target 7.2 of the SDG goal of Nepal has stated that by 2030, the share of renewable energy will be substantially increased in the global energy mix. Target 7.a.1 focuses on the international financial flows to developing countries supporting clean energy research and development and renewable energy production, including hybrid systems. Target 9.4 indicated that by 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action per their respective capabilities (NPC, 2016).</p>	<p>The goals and targets are well defined. Yet, these goals and targets should be localized at the subnational and local levels, which hasn't been done so far. The centralized monitoring of the targets is challenging.</p>
<p><i>Air Quality Management Plan for Kathmandu</i></p>	<p>This plan has incorporated various components for air quality. It included the development of in-used vehicle emission standards within a year and providing green sticker distribution to the vehicle following this standard, within</p>	<p>The objectives of the action plan are not measurable. The actions set by the plan are generic and lack a clear target. Moreover, the policy</p>

<p>Valley 2017</p>	<p>the 1-year establishment of 5 vehicle fitness centres and vehicle emission test centres and the implementation of EURO IV standards vehicle within 1 year. This plan has made an agenda for encouraging a shift to electric vehicles for a clean environment. Development of the law for transforming old vehicles into electric vehicles within 2 years has been envisioned. The plan also includes greenery enhancement by the plantation at the roadside to help reduce air pollution. It also aims to develop the task force team to monitor and evaluate the imported engine's standard and develop Evaluation and Monitoring Strategies for vehicle emission. It aims for the adoption of the integrated Environment Management Plan as a plan to curb air pollution (MoFE, 2019).</p>	<p>implementation needs vertical coordination (between concerned ministries, departments and local governments) and horizontal coordination (between local governments within Kathmandu valley). These agencies' roles, responsibilities, and coordination mechanisms are poorly defined.</p>
<p>3.1.2 Legal instruments</p>		
<p>EPA, 2019 and EPR 2020</p>	<p>The only legal system solely focused on environmental protection in Nepal is Environment Protection Act (EPA). This act first came into force in 1997 AD intending to maintain a clean and healthy environment by minimizing adverse impacts caused by environmental degradation. The EPA was revised in 2019 (2076). Chapter 3 of the act is related to the control of different kinds of pollution. Article 15 (1) gives power to the government to formulate standards, while 15(2) prohibits any person from creating pollution in such a manner as to cause significant adverse impacts on the public health and environment contrary to the standards determined by the Government of Nepal. Similarly, the act</p>	<p>The provisions are common for all kinds of pollution, including air pollution. Pollution-specific provision is lacking. The establishment of the lab and regular emission monitoring is limited by the technical know-how of the implementing agencies.</p>

	<p>has provided power to i) establish a laboratory and collect samples from industry, factories, mechanical equipment or motor vehicle, and ii) provide pollution control certificate to any industry that significantly contributes to pollution control. The act also has a provision for the appointment of an environmental inspector to monitor if the prescribed pollution standard has been met.</p>	
<p><i>Motor Vehicle and Transport Management Act 1993 and Regulation 1997</i></p>	<p>This act has given the power to the government to formulate criteria and standards for vehicular emission and empowers the transport department to stop vehicle registration owing to environmental problems.</p>	<p>Criteria have been formulated and enforced as mandated by this law. However, compliance has been taken as just a formality. For instance, the issuance of the green sticker after vehicle emission testing has not been effective, and there are many loopholes in it.</p>
<p><i>Industrial Enterprises Act, 2020</i></p>	<p>This act encourages the precautionary principle to be taken for activities that potentially adversely affect the environment and human health. Investment in an industry on process or equipment which has the objective of controlling pollution or which may have minimum effect on the environment is given special privilege with a reduction of up to 50% in the taxable income. The concerned industry shall be responsible for mitigating adverse environmental effects caused or likely to be caused on the environment in the course of its operation.</p>	<p>It has provisioned the requirement of Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) after the registration and operation of the industrial production. Yet, the roles and responsibilities for monitoring are not defined clearly.</p>
<p><i>Local Government</i></p>	<p>This act gives the local governments, i.e. rural and urban municipalities, the roles and responsibilities of managing</p>	<p>Local governments lack the technical capacity for pollution prevention</p>

<p>Act 2017</p>	<p>locally generated water, air, and noise pollution. The act has provided authority to the local government for local policy, law, standards, and plan formulation to address the air pollution problems and their implementation, monitoring and regulations.</p>	<p>planning and monitoring. Local governments need technical human resources for environmental protection planning and monitoring, including air pollution.</p>
<p><i>Solid Waste Management Act, 2011</i></p>	<p>Air emissions can be from solid waste, especially during transportation and landfilling. This act deals with provisions to manage solid waste to mobilize resources and minimize the adverse effect of solid waste on public health and the environment. While prescribing a transfer centre under subsection 1, specifications shall be made that the environment and public health shall not be adversely affected, and necessary provisions shall be made to manage the site against foul odours.</p>	<p>This act lacks provision regarding the control of haphazard waste burning, although there is some provision on emission control during waste transport and landfilling.</p>
<p><i>Disaster Risk Reduction and Management (DRRM) Act and Regulation 2017</i></p>	<p>This act and regulation consider pollution as a non-natural disaster. The act primarily focuses on risk mapping and assessment, monitoring, forecast-based preparedness, planning and responding to natural and human-induced disasters through an integrated approach to disaster management and mobilizing the three tiers of DRRM institutions. National Disaster Risk Reduction and Management (DRRM) Authority, the apex body for managing all kinds of disasters, including air pollution, has been institutionalized and functioning as the act envisioned.</p>	<p>The non-natural hazards are mentioned only in the act's preamble, and much emphasis has been given to natural hazards. DRRM institutions lack planning and management of non-natural hazards such as air pollution. Air pollution as a disaster should be under the ministry of home affairs and NDRRMA.</p>

3.1.1 Standard and guidelines on air pollution

As per the provision outlined in Rule 15 of EPA, 1997, the government has been developing, revising and updating standards for controlling and emission of air pollution from different sources. National standards on air pollution are summarized in Table 2.

Table 2: Summary of air pollution standards prevailing in Nepal

SN.	Standard	Date of Introduction	Description
i.	National Ambient Air Quality Standard, 2012	Introduced in 2003 Revised in 2012	<ul style="list-style-type: none"> It provides a standard for nine parameters, viz. Total Suspended Particle (TSP), Particulate Matter (PM_{2.5} & PM₁₀), Sulphur dioxide (SO₂), Nitrogen dioxide (NO₂), Carbon monoxide (CO), Lead, Benzene and Ozone
ii.	National Indoor Air Quality Standards and its Implementation Guidelines, 2009	2009	<ul style="list-style-type: none"> Prescribes standard for the maximum concentration of four indoor pollutants, viz. PM₁₀, PM_{2.5}, CO and Carbon dioxide (CO₂) Implementation guidelines focus on the monitoring procedure for indoor air pollution
iii.	Nepal Vehicle Mass Emission Standard, 2012 (not applied for heavy equipment vehicles imported to Nepal)	Introduced in 1997 Reviewed in 2001 Revised and updated in 2012	<ul style="list-style-type: none"> The Sets standard for the exhaust emission (CO, HC, NO_x), carbon monoxide emission, crankcase gases, vaporized emission and lower temperature test For different categories of vehicles separately under the positive ignition engine type (petrol engine) and compression ignition engine type (diesel engine) Strictly based on EURO III driving cycles

iv.	Standards for Emission from In-Use and Imported Diesel Generators, 2012	2012	<ul style="list-style-type: none"> • All the newly imported diesel generators require compliance with EURO III emission standard • In-use diesel generators require compliance with EURO II emission standard
v.	Standards on Chimney Height and Emission for Brick Kiln Industry, 2008	2008. Revised in 2018	<ul style="list-style-type: none"> • It provides a standard for the minimum height of the emission stack and maximum emission from the stack for bull trench kiln (Natural draught & forced draught) and vertical shaft brick kiln. The revised standard is stricter than the previous one.
vii.	Standards on chimney height and emission for industrial boiler, 2012	2012	<ul style="list-style-type: none"> • It sets the standard for the PM emission from the industrial boiler according to the steam generation capacity of the boiler. • Standard chimney height is based on the emission rate of SO₂ from the boiler and should not be less than 11m
vii.	PM Emission Standards for Cement and Crusher Plants, 2012	2012	<ul style="list-style-type: none"> • Sets standard for the PM emission for cement and crusher plants

3.1.2 International agreements and commitments on air pollution

Nepal has adopted several international environmental instruments. The international environmental instruments are equally important for air pollution management in Nepal. Nepal acceded *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* in 1996. The convention’s objective is to protect human health and the environment against the adverse effects of hazardous waste (Bergesen et al., 2018). To protect human health and the environment from persistent organic pollutants, Nepal ratified the *Stockholm Convention on Persistent Organic*

Pollutants in 2007, which aims to eliminate the intentional production, use, import and export of the chemicals listed in Annex A and restrict the production and use of the chemicals listed in Annex B of the convention. Nepal also supported the global mandate to control the substances that deplete the ozone layer by signing the *Vienna Convention for the Protection of the Ozone Layer* in 1985 and the *Montreal protocol* in 1987. Nepal ratified *UNFCCC* and adopted the *Kyoto Protocol* and *Paris Agreement* in 1994, 2005, and 2015 respectively, to contribute to stabilizing the anthropogenic greenhouse gas emissions for climate change mitigation. Being a stakeholder of the South Asian Cooperation Environmental Program (SACEP), Nepal has been implementing the *Male Declaration on Control and Prevention of Air Pollution, 1998* to achieve intergovernmental cooperation to address the threat of transboundary air pollution in South Asia (SACEP/NFP, 1998).

3.2 Institutions for air quality management

Many governmental, non-governmental, private and academic institutions have played a significant role in air pollution management in Nepal. The institutions are briefly mentioned below, while the institutional diagram is shown in Figure 3.

Government Institutions. National Planning Commission (NPC) is Nepal's apex body for environmental and development planning. The focal stakeholder for pollution prevention and control actions is the Ministry of Forest and Environment (MoEF), whose Environmental Pollution Standard and Monitoring Section under the Environment and Biodiversity Division undertakes air pollution monitoring, management, and other activities. The Ministry's Planning, Monitoring and Coordination Division is also responsible for preparing policies, regulations and guidelines and effectively implementing commitments expressed at regional and international levels.

Similarly, the Department of Environment (DoE) under MoFE is the focal department working on the environmental management of the brown sector. The Environmental Monitoring and Assessment Unit, Pollution Control and Regulatory Unit, and the Environmental Study and Statistics Unit of the DoE are working to prevent and control air pollution and enforce environmental standards in Nepal. In addition to the apex and focal institutions, there are other line ministries such as the Ministry of Federal Affairs & General Administration, Ministry of Industry, Commerce and Supplies, Ministry of Physical Infrastructure and Transportation, Ministry of Urban Development, Ministry of Energy and their line departments and authorities such as department of transport management, Alternate Energy Promotion Centre (AEPC), and National Academy of Science and Technology (NAST) that are responsible for air quality management in Nepal.

After the federalism, the Environment and Climate Change Units within the ministries of Industry, Tourism, Forest and Environment at the province level manage environmental issues within the provinces. As mandated by the Local Government Operation Act, 2017, rural municipalities, urban municipalities and their respective wards units are responsible for controlling air pollution.

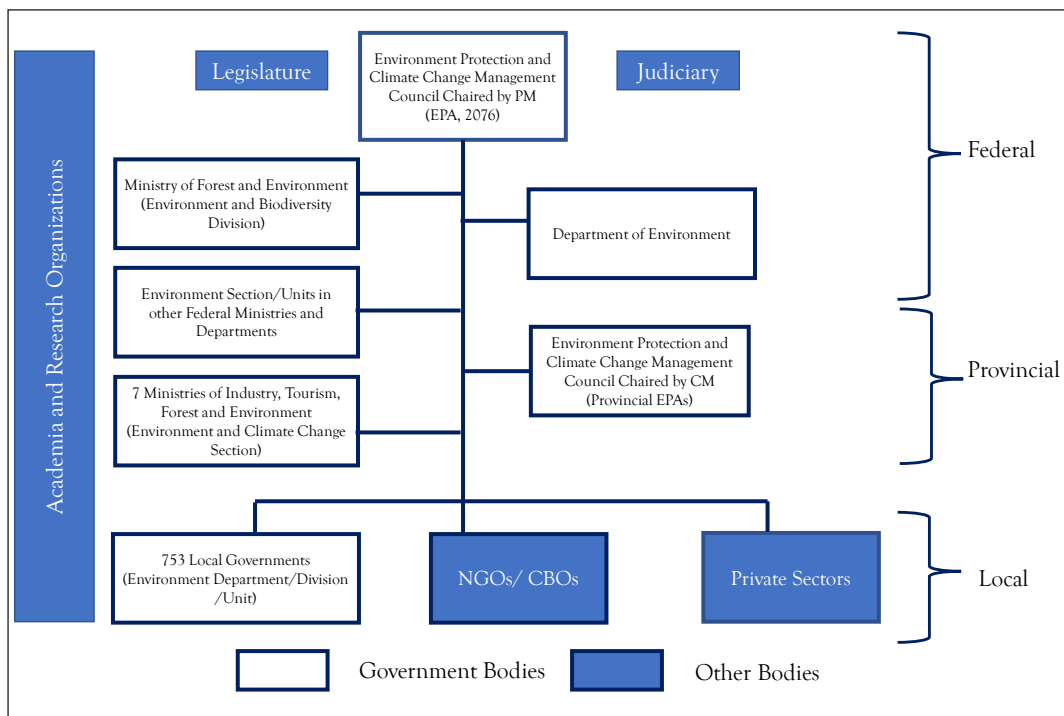


Fig. 3: Existing institutions for air quality management in Nepal

Legislature and Judiciary. The legislature has enacted environmental laws related to pollution control. It also approves budgets and taxes enacted by the executive. Judiciary has played an important role in implementing environmental policies and has issued several important court decisions directing the Government of Nepal and its agency to adopt appropriate environmental standards and measures for air, water and noise pollution (World Bank, 2007). The Godavari Marble Case is a good example portraying the court’s role in favour of air pollution management. In 1992, a petition was filed by Surya Parsad Dhungel against Godawari Marble Industries, considering the impact on biodiversity and human health by air pollution emitted from the quarry site (Mainaly, 2019). The court upheld that a clean and healthy environment is part of the right to life, Article 12 (1) of the Constitution of the Kingdom of Nepal 1990. Consequently, the court ordered to pass the legislation for

the preservation of the environment and to take steps to safeguard the environment in the Godawari region (ELAW, 1995). The court addressed three issues; the right to a clean environment as part of the fundamental right in the Constitution, the legal standing of NGOs or individuals working to protect the environment from bringing a case before the court, and the power of the court to issue an order against Parliament to enact a law (Cha, 2007).

Academic Institutions. Academic institutions play an important role in air pollution management by providing awareness through education; on the other hand, they are building a knowledge base on air quality through research endeavours. For instance, Kathmandu University, Tribhuvan University, Pokhara University and Far-western University have incorporated the theory and practical course content of air pollution in their undergraduate (BSc) and graduate (MSc) degrees in environmental sciences, management and engineering. Similarly, the Institute of Engineering (IOE), Research Centre for Applied Science and Technology (RECAST) and others have been working on developing pollution-free technologies.

Intergovernmental organizations, I/NGOs and the private sector. Private sectors have contributed to air pollution management by operating and promoting electric vehicles such as Safa Tempo and electric cars. Sajha Yatayat restarted its service in 2013 under a cooperative model with 53 seat capacity and 16 standard buses of Euro III emission standards. From 2022 it also started providing services through electric buses promoting mass transit in the capital city. Similarly, the International Centre for Integrated Mountain Development (ICIMOD) and several NGOs, including Clean Energy Nepal, Clean Air Network Nepal, Nepal Forum of Environmental Journalists (NEFEJ), Environment and Public Health Organization (ENPHO), Electric vehicle association of Nepal (EVAN), private sectors such as Nepal Environmental and Scientific Services (NESS) and LEADERS Nepal are working effectively in policy advocacy, research and campaigns for clean air and sustainable urban mobility in Nepal.

3.3 Compliance, enforcement and effectiveness of policies and regulations

Based on Najam's 5C framework, the policies and initiatives were ranked by the respondent from 1- 5 (1 being not at all effective and 5 being highly effective). We considered the threshold of 50% to define the effectiveness of the policies. The result shows that the constitutional provision of a clean and healthy environment was effective and relevant from the content and context perspectives. But the commitment, capacity of the implementing agencies, and client support and coordination for implementing the provision were found to be less effective (Fig. 4a). Similarly, other policies, acts, standards and agreements formulated for air quality management in

Nepal are effective in terms of their content, context, and commitment but the capacity of the implementing institutions and the client support was found to be less effective (Fig. 4b).

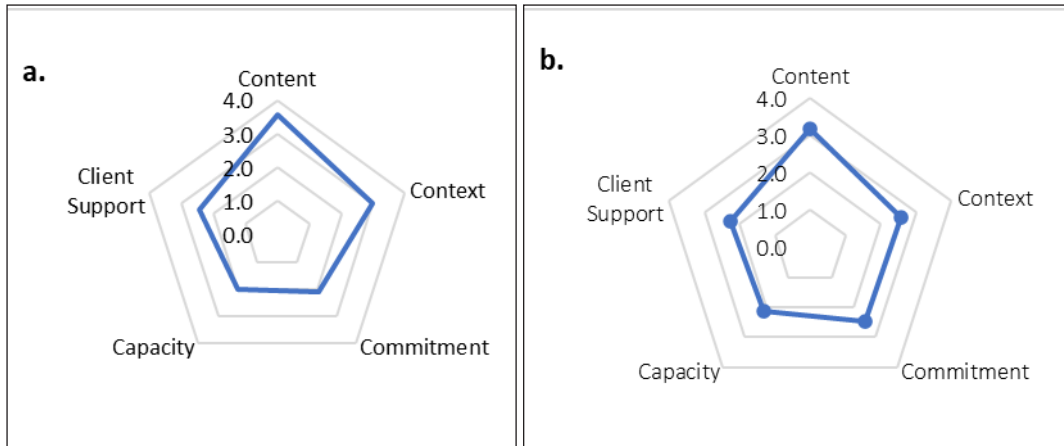


Fig. 4: Respondent's ranking based on Najam's framework a) implementation of article 30 of the Constitution, b) other environmental policies for air quality management

The survey result about the policy provision shows that the existing policies are very superficial in addressing air quality problems. Around 56% of the respondents responded that a separate policy is required for air pollution management (Fig. 5). According to 33%, separate policies are unnecessary. However, the strict implementation of the existing legal instruments and policies shall improve the situation. The policy provision and gap analysis (Table 1) also reveal that the

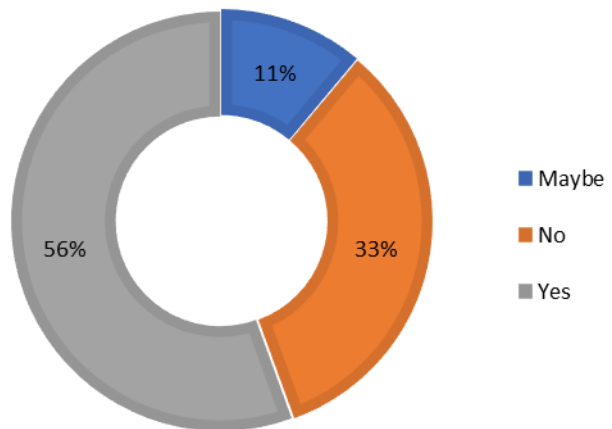


Fig. 5: Response to the need for a dedicated policy for air quality management

clauses related to air quality management are scattered in different acts, regulations, policies, action plans and guidelines. Many of them are amended in the transition to federalism. These rules are poorly enforced for various reasons, including unclear mandates and responsibilities, a lack of monitoring, and a lack of human and financial resources. It demands a separate policy with a consolidated and revised

regulatory provision scattered in multiple regulations. At the same time, a strong and dependable monitoring and enforcement mechanism, including a grievance resolution system, should be developed and implemented to ensure the country's clean air.

Nepal's compliance and enforcement of policies and regulations for air pollution management are satisfactory compared to other environmental sectors, such as solid waste management, water pollution control, and natural resource management. The enforcement of the EPA and EPR in 1997 can be considered a milestone for air pollution management. The provision of EIA and IEE in the law has made environmental considerations mandatory for development works (Bhatt & Khanal, 2010). As per the EPR, the government has developed various air pollution control and emission standards. The government had taken some strong steps to maintain the air quality by banning the operation of heavily polluting diesel three-wheelers and import of new two-stroke and second-hand vehicles in 1999 (Jha & Lekhak, 2003), banning two-stroke three-wheelers in Kathmandu valley in 2004 and banning the heavily polluting movable bull trench brick kilns in Kathmandu Valley in the same year (M. Bhattarai et al., 2009).

By 2005, the use of electric vehicles was scaling up, and all the polluting brick kilns in Kathmandu Valley had been replaced by cleaner vertical shaft brick kilns VSBK. About 10% additional tax per year on vehicles older than 15 years was levied from 2001, and the government implemented the polluters pay principle by collecting pollution tax of NRs. 1.5 from each litre of petrol and diesel in the Kathmandu Valley since 2007 (M. Bhattarai et al., 2009). Though limited within Kathmandu valley and applicable only to three and four-wheelers, monitoring exhaust emissions and issuing Green stickers began in 1993 and 1999, respectively (Jha & Lekhak, 2003). The then Ministry of Science Technology & Environment started ambient air quality monitoring in Kathmandu valley in 2002 from six stations (MoSTE, 2013). Currently, 27 air pollution monitoring stations are operated by the Department of Environment in different parts of the country. These stations' hourly data are live broadcasted through a web portal <https://pollution.gov.np/>. Additional two stations are operated and managed by the US Embassy in Kathmandu.

Similarly, the biogas support programs, installation of improved cooking stoves, solar home systems and micro-hydro are some efforts toward promoting clean energy technologies in Nepal, aiding in reducing indoor air pollution significantly (KC et al., 2011). For implementing Male Declaration, ICIMOD is facilitating the monitoring,

analysis, and impact studies of air pollution in Nepal on behalf of the Ministry of the Environment, the focal point for implementing the Male Declaration. Rapid Urban Assessment of Air Quality for Katmandu was completed in 2012 (Male Declaration, 2013). There are also some cases of public interest litigation, for instance, the Godavari Marble case, where the people have secured their right to a clean environment by bringing the issue of air pollution to the court (Cha, 2007).

However, there are also instances where the compliances have been challenging. For instance, the green stickers issuance system is not effectively implemented as there are several loopholes in the sticker issuance process. The enforcement is difficult due to poor institutional infrastructure, a lack of institutional decentralization, dividing, delegation and shifting responsibilities from one institution to the next. Meanwhile, the harmonious relations between the regulator and the regulated have negotiated compliance (Oli, 1996). The discontinuation of the plan and program, lack of financial resources, lack of collaboration and coordination among the government institutions, under-equipped enforcing agencies, and lack of clear policy vision has always been an obstacle to compliance and enforcement of air pollution regulations in Nepal.

There are air quality management institutions at places. However, their effectiveness is always in question. According to our survey, 22% of respondents felt that local bodies should take major responsibility for air pollution management, while 78% felt that the federal government should be responsible for it. Similarly, 100% of the respondent responded that the existing institutions are not effectively managing air pollution problems in Nepal. Most respondents have suggested a need for a strong institution, which should be independent and have sufficient legal, financial and technical resources to support government plans and programs to manage pollution. The organization could be in the form of the Environment Authority or Environmental Protection Agency, as practised in other countries. For instance, the US Environment Protection Agency of USA, Central Pollution Control Board (CPCB) of India, and Central Environmental Authority (CEA) of Sri Lanka are independent environment authorities with regulatory power that provide advice and technical services to the concerned ministries, coordinate the activities of the federal and state governments and resolve disputes among them (Lauesen, 2013).

Several challenges for air quality management in Nepal such as i) lack of awareness of the impact of air pollution, ii) emission from old vehicles, iii) limited research on the air quality management technologies, and iv) inadequate air quality monitoring stations were reported from the survey. In addition, changing attitude and behaviour

of the people towards preferring the least polluting technologies and products, and the improper and unauthorized use of green stickers by the department of transport were also considered major challenges for effective air quality management. About 15% of the respondents (mainly representing NGOs) also stated that the air quality is taken seriously during the winter season when the pollution level is high, but no action is taken during the rest of the time.

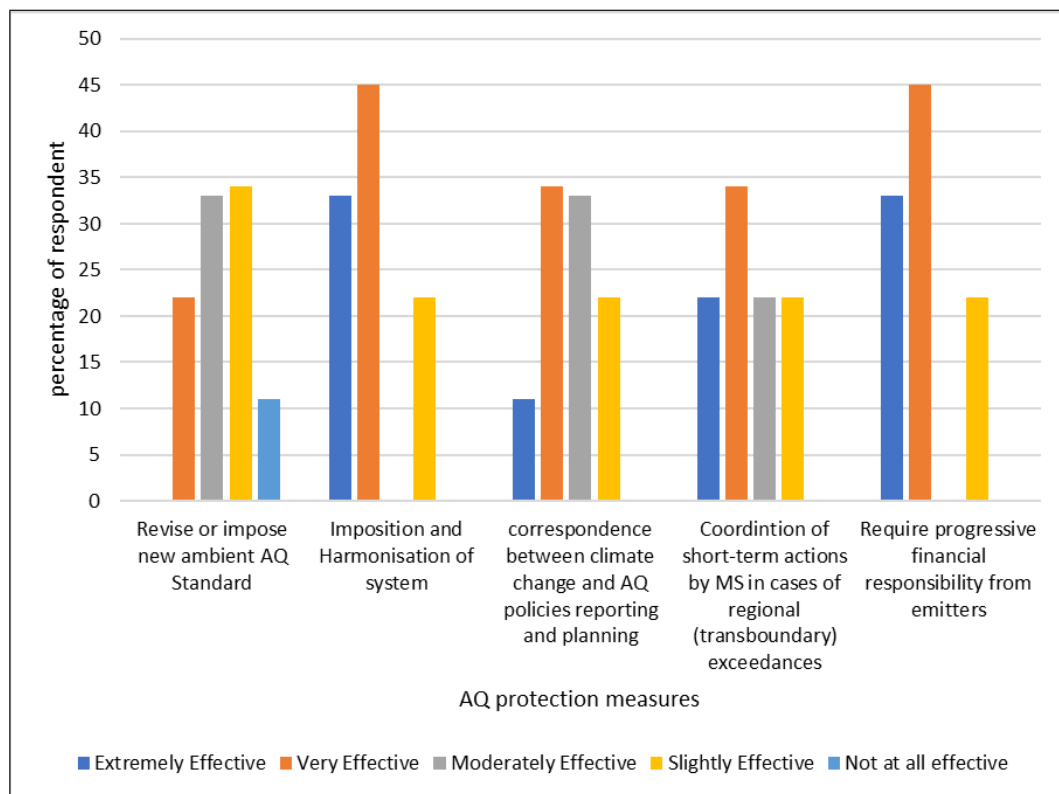


Fig. 6: Effectiveness of the suggested measures for air quality management

Transboundary air pollution is considered another challenge requiring a well-designed cross-boundary effort. Five suggestions for improving air quality common among all the respondents include i) revising or imposing new ambient air quality standards, ii) imposition of harmonization of the system, iii) correspondence between climate change and air quality policies, reporting and planning, iv) coordination for actions in case of transboundary air quality issues, and v) progressive financial responsibility from the emitters.

4. Conclusion and Recommendations

Nepal has formulated several policies, regulations and standards for air quality management and has signed many international and regional treaties, protocols and agreements that directly or indirectly aid in managing air pollution problems. At different times, the government has taken strong steps toward maintaining air quality, including banning heavily polluting old vehicles. Various government bodies, non-government organizations, academia and private sectors are working to manage air pollution in Nepal. Although scattered policies, legal frameworks, regulations, standards, and institutions exist, the air pollution problem prevails. It portrays the ineffective functioning of the institution and non-compliances with the legal instruments.

The result based on the analysis of Najam's 5C protocol also demonstrates the effectiveness of the air quality management provision in policies and legal frameworks in terms of content, context, and commitment. However, the capacity of the implementor and the client to support and coordinate was not effective enough to achieve the desired objectives of these frameworks.

Therefore, the study suggests a need for a dedicated policy with consolidated and revised regulatory provisions scattered around multiple regulations. Besides, i) strengthening and decentralizing institutional infrastructure, ii) continuation of long-term plans and programs, iii) awareness and sensitization, iv) development of well-equipped enforcing and monitoring agencies, v) development of sufficiently distributed network of air quality monitoring stations, and, vi) increment of the technical and financial resources are recommended for effective air quality management in Nepal. In addition, enhancing the capacity of the policy implementor along with effective horizontal and vertical collaboration and coordination among stakeholders should be strengthened to ensure the right of every citizen of Nepal to live in a clean and healthy environment.

Conflict of Interest

The authors declare that there is no conflict of interest.

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