Addressing India's Air Quality Challenge:

Improving Knowledge, Communications and Institutions

Laveesh Bhandari and Shreekant Gupta[1]

Version: October 15, 2019

Abstract

Air Quality in India is widely known to be among the worst in the world; while with economic growth polluting economic activities are expected to increase, with income growth household contribution to pollution is also likely to increase. This monograph addresses the knowledge and institutional gaps that India needs to fill to enable a more environmentally friendly and sustainable economy. We focus on research required to better identify the gaps and the strategy for change. The monograph first delves into how to generate the right information and knowledge, followed by how to enable better communications between all stakeholders, and finally share insights on creation of seamless institutions of coordination and implementation. The objective being to create an ecosystem where incentives of all are aligned to the objectives of sustainable growth.

	ISSUE	URGENT	IMPORTANT	LONG TERM IMPACT	AVOID
1. Measurement Equipment	**Facilitate use of cheaper monitoring equipment**	**Certification of low-cost equipment**	**Maintenance and calibration**	**Developing low or no calibration equipment**	**Over-dependence on high-cost tech and no monitoring of low-cost**
	Conventional air quality (AQ) measure-ment equipment are expensive, consequently few can be put up. Cost-effective alternatives exist but there is no systematic method for their certification No mechanism to monitor calibration and maintenance. [2.1a]	CPCB: Develop and implement protocol and method for certification and categorization of equipment. [2.1a]	CPCB: Identify methods of monitoring related to calibration and maintenance [2.1a]	Niti: Find ways of supporting and developing AQ monitoring equipment that is low cost and requires little calibration or maintenance. [2.1a]	CPCB: Complete dependence on conventional high cost equipment and inability to monitor, test, evaluate and certify cost-effective instruments [2.1a]
2. Synthetic Estimates	**Data from different sources are combined**	**Policymakers accept synthetic estimates**	**Regular monitoring of AQ using synthetic est.**	**A mechanism for culling non-robust methods**	**Accepting non standardised methods**
	Large areas yet to be covered by real time AQ monitoring. Estimates that combine remote sensing data with data from ground based (or *in situ*) instruments can provide estimates that are both granular and cover a large area at low cost and good quality. [2.1b]	CPCB: Accept synthetic methods as legitimate, CPCB: Develop protocol for synthetic estimates acceptable to SPCBs and government. [2.1b]	CPCB+SPCBs: A platform that measures and reports differences over time and space using synthetic estimates. [2.1b]	MoEF+CPCB: Platform for discussion and dialogue of academia + policymakers that (a) evaluates methods and (b) identifies emerging issues. [2.1b]	* Accepting synthetic estimates without adequate evaluation * Keeping silence on applicability of synthetic estimation as is currently the case. [2.1b]
3. AQ Data	**Standardized Emissions Inventory**	**Develop standardized protocol**	**Include all activities+ fuels**	**Fund studies**	**Too many or single studies and inventories**
	Policy requires prioritization of actions based on relative damage each source causes. But studies and data are required for diff. regions of the country. Emissions inventory (EI) required to identify which specific sources pollute. Source Attribution (SA) studies identify how much each source pollutes. Without standardization of EIs, different studies can give varying results. [2.3]	CPCB: Develop standardized protocol. [2.3a] CPCB+SPCB: Undertake or fund such studies for (a) major climatic regions, (b) major cities and (c) separately rural and urban. [2.3a]	CPCB: Have wide coverage of pollutants and polluters in AQ database. Include informal sector activities and include use of fuels such as used cooking oil, PET coke etc. in the ambit. [2.3]	CPCB+Niti: Fund studies by domestic and global researchers to identify gaps in understanding available from standardized studies. [3.5a]	* A single 'official' inventory that is frozen in time and space. * Multiple non standardized EIs being used to recommend policy or used by judiciary. [2.3d]

	Universal accessibility, coverage and segments	A comprehensive data platform	Well-designed data interface & access for all	A living database of AQ research	Non-inclusive approach to research
4. Data Platform	Data and research are currently spread across many organizations and domains. A comprehensive platform is required to bring everything together that incorporates all pollutants, classes of polluters and polluting activity. [2.2]	CPCB: Build platform that contains standardized EI, meteorology + pollutants, and is updated regularly [2.2a]	CPCB: universal data accessibility. MoEFCC: Chief Data Officer brings-in data from different government entities. [2.2a]	Other: A comprehensive global and national database on research, regularly updated along with quality classification. [2.2a]	Avoid Exclusion of global data/studies, indoor air pollution, traffic congestion, traffic hot spots, under-privileged segments etc. [2.2a,b,c,d]
	Complex issues versus simple communication principles	**A well-designed communication plan**	**Engage with students**	**Multimedia communications**	**Absence of communication professionals**
5.Mass Education	Communication needs to be designed for the masses with three different objectives: Awareness of the problem and its ramifications, addressing false beliefs and facilitating behavioural change. There is little understanding on the persistence of false beliefs and communication gaps. Greater research on environment communications to develop a mature mass communications regime. [3.1]	MoEF+CPCB: Evolve a communication plan for the masses that (a) enables conversion of complex issues to simple communication and (b) strengthens research on communications and (c) red flags high pollution events. [3.1a]	MoEF+Other: Engaging with students in schools: * Availability of course curricula for different grades * Teacher education to include environment related topics [3.1a,b]	MoEF+Others: New age mass communications require combination of text, image, audio and video media MoEF+Others: Persistent communications across all media – print, electronic, digital and face to face. [3.1b]	*Aiming research only at other researchers *Not engaging with communication professionals *Not keeping students as priority segments [3.1,3.1a,b]

	Make scientific knowledge accessible and actionable	Ease access to scientific knowledge	Rational and informed prioritization	Research summarization	Classifying environment as another input
6.Engaging Policymakers	Policymakers, regulators and judiciary many times have to decide between various options and opportunity costs of actions. But lack of information, data and studies on pros and cons lead to ad hoc and inconsistent decision-making. Also, scientific community needs to better understand multiple objectives of policymakers. [3.2]	CPCB+Other: A periodic publication on latest studies on links between EI, emissions, health and economic impacts. CPCB+Other: Studies on identification of impacts on health, incomes and employment etc. MoEFCC+Niti+CPCB: Refer to global studies. [3.2a,b]	MoEF+Niti: Prioritizing requires studies that (a) compare environment/ health costs and impact on employment/incomes, (b) impact of AQ related matters on govt revenues and expenditure, (c) link with development and/or welfare programs, and (d) connect with global agreements. [3.2b, 3.4a]	Researchers/Others: *Annual policy report that links environment, economy and sustainability using data and policy analysis. [3.4b] *Summarize each study or reports with learnings that are actionable or intermediate; specifically aimed at policymakers. [3.2a]	*Not considering the environment and sustainability in initial planning of government programs. *Government not sharing the problem of multiple objectives and challenges being faced by it. [3.2, 3.3, 3.4]
	Many organizations with ill-defined and competing responsibilities	**Identify gaps, weaknesses and accountability**	**Public-private interface**	**A coordination mechanism**	**Change without legal reform**
7.Fuzzy Institutions	Many government and regulatory entities with sometimes ill-defined and fuzzy responsibilities. Lack of coordinating institutions within government, problem further exacerbated due to limited transparency. [4.1]	MoEFCC+Niti: Comprehensive study on multiple institutions, strengths, weaknesses, responsibility and accountability. Institution-al and functional mapping of environment related entities. [4.1]	Niti+MoEFCC: Which entity should private parties coordinate their efforts with at state and central level. Multiple government, regulatory and judicial entities make it very difficult for public-private partnerships. [4.2]	Niti+MoEFCC: Environment runs across all human activity. The government will need to find mechanism for coordination across domains and state-entities. Develop formal and informal interaction mechanisms. [4.1]	Niti+MoEFCC: Identify specific changes in the legal and regulatory set-up and also in the rules that are required for easier enforcement of environment laws. [4.1]
	Weak regulatory structure	**Oversight and implementation**	**Regulatory strength and independence**	**Setting of Standards**	**Irresponsible regulation**
8.Regulatory capacity	The CPCB is neither empowered nor does it have adequate capacities. It is ill-resourced and unable to address many of the environment and AQ imperatives. The SPCBs face a similar problem, few resources allocated to most SPCBs and ability to monitor and enforce on the scale required is almost absent. CPCB and SPCBs are underfunded, understaffed, accountability and responsibility not clearly defined. [4.2]	Niti+MoEFCC: Transparency, answerability and accountability go hand in hand with resource allocation, improved training and skills of regulatory staff, and independence from executive. [4.2]	Niti+MoEFCC: Identify if single overarching regulator or multiple ones. Either choice needs to incorporate far greater resources and freedom from executive while allocating responsibility and accountability. [4.2]	CPCB: Ensure standards are set, updated and implemented regularly. Identify all the standards that are 'missing', dated and not implemented yet. [4.4] CPCB+Niti+Other: How to develop a comprehensive and universal mechanism of red flagging possible polluters and detecting polluters. [4.3b]	*A stronger and independent environment regulator that is not answerable to the parliament. [4.2] *Regulation without cross-regulatory coordination mechanisms. [4.1]

	Multiple and non-synchronized Laws	Synchronizing the Laws	Improve legal structure	Role of NGT and Judiciary	Multiple power centres
9. Legal clutter	Many laws directly apply on and AQ (eg. Air Act and Environment Protection Act) and many other laws applicable in other domains have direct impact on AQ (eg Motor Vehicles Act). Laws and regulations may have different criteria, definitions, and enforcement rules as they belong to different vintages to address different contingencies. [4.4]	Niti+MoLJ: A comprehensive study on the various laws that apply on AQ and what changes are required. [4.4]	Niti+MoEFCC: Identify changes in legal, regulatory and rules that are required for easier enforcement of environment laws. [4.1]	Niti+MoLJ: The role of NGT and general judiciary needs to be revisited, so that decisions in one do not need to be reviewed by another. [4.4]	* Multitude of laws with ill-defined boundaries and multiple enforcing institutions with limited accountability. [4.4] * Laws need to be well implementable and not necessarily be more stringent to be effective. Avoid imposing criminality on offenders unless direct, irreversible and clear impact to life. [4.2]
	Limited funding available for research on environment and institutions	**Government funding of environment research**	**Pollution fees/cesses only for better environment**	**Enable private funding of environmental innovation**	**Limited focus on communications**
10. Funding Greater Research	Government is grappling with short term imperatives of growth and employment and liable to miss out on longer term environment needs. Mistaken belief in some quarters that better environment and greater growth are alternatives. Little knowledge and research available that is able to link improved environment with improved economic impact. Limited studies available on institutional, regulatory and legal gaps. Data and research sharing platforms are limited. Finally, government allocations for environment are low. [3.5]	Niti: set up specialized wing to fund domestic research on environment and AQ, with multi-dimensional issues including technology, institutions, economics, science and social aspects. MoF+MoEFCC: Generate funds through pollution cesses and fees. Allocate greater funds so collected only for designated environment purpose. [3.5a]	CAG: identify that central and state governments and regulators use funds only for purpose collected. MoF: Enable greater CSR funding by explicitly mentioning research, workshops and communications on improving environment. MoEF: Funding for communications of scientific knowledge designed for masses, policymakers and judiciary. [3.5b]	Niti+MoF: Enable government contracting for innovative environmental products and services. This will enable greater flow of private investor funds into innovation in the sector. [3.5d] Industry: Allocate some share of CSR for knowledge and education related to environment [3.5]	A funding regime that does not fund (a) interactive platforms including workshops and seminars for government, regulator, industry and academia (b) persistent communications for behavioural change and (c) motivating mass communication professionals to work on environment [3.5]

Participants at Inter-Disciplinary Environment Agenda (IDEA) Roundtable, 18th May 2019, India Habitat Centre, New Delhi, India. In alphabetical order:

Ajay Nagpure, World Resources Institute (WRI)

Anumita Roy Chowdhury, Centre for Science and Environment (CSE)

Ashutosh Dikshit, The Citizens' Alliance (TCA)*

Bhavay Sharma, World Resources Institute (WRI)

Eswaran Somanathan, Indian Statistical Institute (ISI)

Jessica Seddon, World Resources Institute (WRI)

Jyoti Pande Lavakare, Care for Air (CFA)

Kanishka Kacker, Indian Statistical Institute (ISI)

Kirk Smith, University of California, Berkeley (UCB)

Laveesh Bhandari, Indicus Foundation (IF)

Mohan George, Delhi Pollution Control Committee (DPCC)

Mukesh Khare, Indian Institute of Technology, Delhi (IIT Delhi)*

Prarthana Borah, Clean Air Asia (CAA)

Purnamita Dasgupta, Institute of Economic Growth (IEG)

R Suresh, The Energy and Resource Institute (TERI)

Sagnik Dey, Indian Institute of Technology, Delhi (IIT Delhi)

Sanjay Upadhyay, Enviro Legal Defence Firm (ELDF)

Santosh Harish, Centre for Policy Research (CPR)

Shibani Ghosh, Centre for Policy Research (CPR)

Soutrik Basu, Indian Institute of Technology, Delhi (IIT Delhi)

Shreekant Gupta, Delhi School of Economics (DSE)

Sri Harsha Kota, Indian Institute of Technology, Delhi (IIT Delhi)

Valentin Foltescu, United Nations Environment Programme (UNEP)

Via electronic submission

Indicus Foundation   White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

Contents

Indicus Foundation   White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

AQ	Air Quality
CPCB	Central Pollution Control Board
CSO	Central Statistical Organisation
EI	Emissions Inventory
GST	Generalized Sales Tax
IIT	Indian Institute of Technology
MoEFCC	Ministry of Environment Forest and Climate Change
NGT	National Green Tribunal
NMVOC	Non-Methane Volatile Organic Compound
NSSO	National Sample Statistics Organisation
RS	Remote Sensing
SDG	Sustainable Development Goals
SPCB	State Pollution Control Board

1. Introduction

It is evident that India needs to address air quality (AQ) issues at a rapid pace. The conventional methods of long drawn out academic studies, infrequent communication with policymakers, periods of deliberation and final uptake, long time taken for legal and institutional changes, unpredictable speeds of implementation, etc. will need to be disrupted. This disruption can best occur either when a centralized force takes up the mantle for rapid change or when a national consensus emerges on the criticality of the issue.

Pollution needs to be both reduced and cleaned up. While the former requires a range of substitute inputs, technologies, processes and products to replace those being used currently, the latter has different requirements. The current mechanisms of pollution control also need to be made real-time in that monitoring, identification and enforcement are seamlessly linked. Any high polluting event needs to be immediately red-flagged through a constant pollution surveillance mechanism be it through remote sensing (RS) or citizen-reporting based, confirmed through expert monitoring and relevant controls and laws enforced immediately. The technologies and administrative methods exist and indeed are used in many other countries. Such monitoring and identification needs to be supported by precise enforcement of the rules including both punishments and rewards.

It is possible to significantly improve air quality provided informed action is taken.

It is also well known that many cities across the globe had extremely high pollution levels in the past but were able to significantly improve their AQ, examples include London, New York, Los Angeles, more recently Mexico City, and currently Beijing which is making rapid progress. *It is possible to significantly improve air quality provided informed action is taken.* It is sometimes argued that India has a challenge that other countries did not face, namely, the challenge of bad air quality has impacted it despite a low per capita income. Other countries had greater incomes and therefore resources for the transition to an improved AQ economy. More importantly, many larger countries barring China achieved success with an empowered and independent regulatory agency pushing for change. In face of such challenges, it is even more important for greater efforts on research, communications and institutional change, to achieve greater environmental returns at lower cost.

At the same time all the knowledge gaps, whether in the scientific, technological, economic, legal-institutional or administrative domains, do need to be addressed faster and on an ongoing basis. While scientific research cannot be expected to be hastened beyond a point, it is clear that institutional and administrative change and greater knowledge acquisition need to occur together, one feeding into the other.

The solution is therefore multi-pronged. First, start to better understand long term institutional and collateral changes required. Enable greater research not just on the side of science and technology, but also on legal institutional and economic spaces. Second, prepare for a holistic regulatory reform and public investment decision-making that will strengthen the institutions that will carry India into the future. Finally, identify and undertake the quick changes that are possible without thorough regulatory reform to enable speedy decisions with whatever understanding and institutions that exist currently. In all three cases, greater investment will be a precondition.

::

This monograph is divided into the following sections: section 2 discusses the gaps in our understanding related to the creation, measurement and the impact of pollution. It can broadly be considered to include the missing knowledge related to air quality and pollution. Section 3 discusses the various gaps that prevent the knowledge from contributing fully to well informed action. This includes both gaps related to communications as well understanding. Section 4 discusses the gaps in institutions, policies and laws. Section 5 concludes.

2. Understanding Air Quality

2.1 Wider Coverage and Cost-effective Data Generation

… the understanding of air quality, its components, the chemical processes and their interaction with climatic and human activity will need to be better understood.

As India will grapple with endemic pollution across the length and breadth of the country, the understanding of air quality, its components, the chemical processes and their interaction with climatic and human activity will need to be better understood. Improved measurement includes coverage of a larger set of pollutants, availability of data for a full range of pollutants for across the country and for any point in time, universal accessibility and improved analysis of the available data.

2.1a Low Cost Monitoring Equipment

There are 240 cities and towns that have 573 air quality monitoring stations as of July 2019 as per data put out by the Central Pollution Control Board. [2] There are no doubt other monitoring stations as well, for instance those put up by the Ministry of Earth Sciences, ASAR etc. but they are nowhere close to the number of cities and large villages in India; as of 2011 there were a total of 7,935 cities and towns and 5,97,608 villages of which as many as 782 villages have a population above 20,000.[3] Increasing coverage therefore is important so that all locations with significant population are well monitored for a range of pollutants on a real time basis. It is evident that the expensive nature of conventional pollution monitoring is a constraint, the solution is to enable use of other cost-effective alternatives. This will ensure a rapid spread of monitoring devices and availability of estimates for the thousands of cities and also the rural heartlands.

To enable this, India requires (a) building of a robust administrative mechanism where lower cost instruments are recognized/ licensed and kept well-calibrated and (b) developing robust synthetic methods where RS imagery can be combined with a few ground sensors to generate synthetic estimates. The former requires an entity such as the CPCB to first recognize and then to build a proper mechanism for low-cost instruments to be widely accepted. CPCB could for instance develop an innovation window for rapid validation and acceptance of innovation. [4]

> *The role of the research community is important in that it feeds regulatory action…. The development of basic principles and best practices for creating synthetic estimates of pollution is one example*

The role of the research community is important in that it feeds regulatory action, as the latter tends to follow scientific/technology developments. The development of basic principles and best practices for creating synthetic estimates of pollution is one example, where global accepted standards are

---

[2] National Air Quality Monitoring Programme, Central Pollution Control Board, retrieved from http://cpcbenvis.nic.in/airpollution/monetoring.htm on 24/7/19
[3] Office of the Registrar General & Census Commissioner India, Ministry of Home Affairs, Government of India
[4] National Physical Laboratory (NPL), is reported to be developing an indigenous certification facility for air pollution monitoring equipment. https://www.livemint.com/news/india/india-to-develop-own-certification-facility-for-air-pollution-monitoring-equipme-1556561927930.html

Indicus Foundation   White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

emerging following a host of published research. A white paper can be brought out by the CPCB on the same.[5]

Traditionally monitoring equipment meets a certain set of highly precise requirements, and consequently is costly both to acquire and maintain. However, new technologies are making available monitoring equipment which may not be as precise but have low acquisition and maintenance costs. Consider two aspects. First, reduced costs sometimes require much more careful calibration and care of the equipment. A mechanism that ensures careful calibration and maintenance of such equipment needs to be put up. Second, globally as well as in India cost-effective high precision instruments are being developed where such calibration is not required. The CPCB would do well to study, analyse and incorporate such instruments.

2.1b Synthetic Estimates

In the same context, new and disruptive ideas are critical if we need to rapidly generate enough knowledge for a fast-growing problem. The traditional route for the acceptance of new scientific or analytical methods is acceptance by the global research community and then percolation to Indian academia, and finally to the scientific and technical establishments. The use of synthetic estimates where AQ levels are estimated by merging two or more data is a case in point.[6]

Disruptive ideas are critical if we need to rapidly generate enough knowledge for a fast-growing problem

Emerging analytical needs will require the use of synthetic estimates to fill in the large data gaps especially those related to coverage of the large land mass and thousands of small and large cities. For instance, though remote

---

[5] IIT Delhi is working with the CPCB and setting up a PM2.5 database for the entire country at 1 km resolution; we would naturally expect this to be expanded to cover other pollutants such as Ozone, Sox, Nox, VOCs etc. once some standardization of methods occurs.

[6] Based on the measurements carried out at the existing monitoring stations spatial air quality maps can be developed with less resources and can be made publicly available on-line in almost real time basis. These maps not only provide air quality values at all locations in the city but can also be useful in assessing the exposure of pollutants to residing population and also help in identifying hot spots. This can lead to enhanced sensitization of general public and other stakeholders and will also help the policy makers to adjudge the impact of any interventions they make on spatial air quality levels in the whole city. The recently developed Indian Children's Activity Ratings Mark 1 (ICARE1), for instance, can then be used by each school to devise the specific physical activity children in the school can undertake. Thus, protecting health while enabling play.

Indicus Foundation White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

sensing data can cover a large geographical expanse, it may not be covering it frequently or precisely enough.

To put it in another way, in-situ data are spatially discontinuous but temporally continuous and satellite data are opposite. We need to combine them. This is already being done globally well recognized studies (See for instance Shaddick et al., 2018) and needs to be done specifically for India as well.[7]

Moreover, though the protocols for such estimates may not be unique, data platforms need to have the facilities for researchers to create such estimates using their own methods, using a certain minimum set of best practices.

Information channels should not be driven by individual interests but by a well-defined process or investigation and analysis.

While R&D, experiments and pilots are being attempted globally as well as in India, comprehensive and comparative critiques of various emerging technology options are required for policymakers, judiciary as well as potential funders. Information channels should not be driven by individual interests but by a well-defined process or investigation and analysis.

2.2 Data Platform and Wider-Coverage

A comprehensive data platform is one that is able to put together information from all the sources, cover all important AQ related activities, have universal geographical coverage, and be frequently updated and well maintained. Moreover, various aspects of AQ sometimes get left out in research and these include impact on specific demographic segments (such as low-income households), areas (for example rural areas), and pollutants (such as those originating from informal sector manufacturing). A comprehensive data platform would be able to incorporate all such information and data and also enable access to research on AQ and its many dimensions.

2.2a An Environmental Data Platform

India requires a well-developed data management protocol at state/regional as well as national levels. These data centres would require systemically composed and linked databases on pollutants, meteorology and emissions.

---

[7] Shaddick et. al., "Data Integration for the Assessment of Population Exposure to Ambient Air Pollution for Global Burden of Disease Assessment", Environ. Sci. Technol. 2018, 52, 16, 9069-9078

At the same time metadata needs to be carefully collated and made easily accessible to the user. User interface design is another area where current data sources are fairly archaic, easy drag and drop type user interfaces are emerging as the global norm and so should they be in India. It is such a platform that will facilitate monitoring and analysis by a wide cross-section of researchers, students and even laypersons.

Research Database: A database of research, whether originating in India or global, needs to be added to such a data platform. For quantitative analysis requires much research on other experiences, and such a database will be able to facilitate this work. There is much research that would be required in various domains related to the environment and AQ. Some areas are identified in this monograph as well.

Environment Data Protocols: The agencies within the government such as National Statistical Survey Office (NSSO) and Central Statistical Organisation (CSO) are more oriented towards socio-economic or economic data. The CSO has started to bring out a periodical on environmental data, but it is largely a collation of data that is already being collected by different institutions.[8] The environment ministry or the CPCB does not currently have the statistical or organisational capacity to develop such protocols in-house. But this is something that is a core function and needs to be done within the CPCB and State PCBs.

The environment ministry or the CPCB does not currently have the statistical or organisational capacity to develop such protocols in-house. But this is something that is a core function and needs to be done within the CPCB and State PCBs.

Chief Environment Data Officer: There are many types of data (for instance data on working trips collected by Registrar General of India) that can have great use for environment research. A Chief Data Officer or Chief Statisticians Office that is able to motivate varied government entities to collect environment related information as well as put together a comprehensive data platform, both for governments' internal needs and for the public at large, needs to be recommended. For coordination in data is a critical component of the emerging world, and whether it is multiple government organizations, independent regulators, communities, industry

---

[8] EnviStats 2018, Ministry of Statistics and Programme Implementation, Government of India, http://www.mospi.gov.in/publication/envistats-india-2018

Indicus Foundation   White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

or even individuals, *the world of data in the future is all about coordination and platforms that enable such coordination.*

The presence of interactive platforms be they offline such as seminars, online media, and print journals on new technologies are key inputs for rapid innovation in this space.

2.2b Household Sources of Pollution

Few studies exist in India on indoor household pollution, and the ones that do, reveal a rich set of insights on the level as well as impact. A recently published study for instance found that adequate control of indoor health pollution could get national average of pollution levels in India to be below Indian annual standards.[9] Indoor pollution has many dimensions, including cooking fuel being used, interior design, lack of ventilation, thermal conditions, length of exposure, stove design, etc. Moreover, household chemicals are increasingly being used widely in India as well and these include for cleaning, hygiene, odour management, pest control etc; each of these can be potentially large contributors to indoor pollution.

Standards for indoor air quality are yet to be developed for India.

Therefore, while indoor air pollution may have fallen with the fall of biomass-based cooking, there is a considerable distance yet to be covered, and it may increase again with the greater use of synthetic materials and household chemicals. The NMVOCs emissions in India are expected to increase by 25% in 2030, which has implications over outdoor and indoor air quality. At the same time, there are few scientific studies on household plants and their impact on indoor AQ. Furthermore, though outdoor the AQ standards that do exist are for outdoors, and those for indoor air quality are yet to be developed.

2.2c Expanded coverage

Little is understood about AQ levels in a range of areas. For instance, rural areas are assumed to be less polluted than urban areas, even though practices such as crop burning, use of agriculture chemicals, tilled lands with loose soil, increasing use of diesel for transport on agriculture, all would be impacting air quality in significant ways. Similarly, as per one classification India can be divided into a country of 7 climatic zones, and a data platform

---

[9] Indian annual ambient air quality standard is achievable by completely mitigating emissions from household sources, Sourangsu Chowdhary, Sagnik Dey, Sarath Guttikunda, Ajay Pillarisetti, Kirk R. Smith, Proceedings of the National Academy of Sciences, April 2019

that recognizes such underlying factors will help the cause of AQ research. It is expected that most serious pollution abatement strategies would need to be done at a regional level, and issues such as secondary particle formation, interaction with terrain, and nature of air movements need to be well understood at a regional level.

2.2d Hot Spots

There are many types of pollution hotspots that include highly dense markets, eateries with biomass stoves, construction sites, industrial and power plants with weak emission management practices, etc. Hotspot monitoring is possible both remotely and using on-site monitoring equipment. Similarly, traffic congestion is rising across the country and is expected to spread further over the next few years, but greater understanding on the extent of pollution that it causes is required. Residential areas close to major traffic corridors or at crossings with more dense and slower traffic are likely to be more pollution-prone, but the extent is not so well understood. Though a few studies however find that such locations are pollution hotspots with significant potential health impact, more studies would help ascertain the extent better.

2.2e The Underprivileged

An inventory of how and what different income segments contribute to emissions can help policy design in many different ways…. informal sector activities should be incorporated in such a comprehensive data platform.

Though pollution affects all, it is evident that it affects the poor the most. For one access to healthcare is always limited for those less able to afford it. Secondly, the lowest income segments have lesser access to knowledge and means of avoiding exposure, the health impact of which is likely to be worse. Even on the generation side, an inventory of how and what different income segments contribute to emissions can help policy design in many different ways and therefore informal sector activities should be incorporated in such a comprehensive data platform.

2.3 Emission Inventories and Source Attribution

An *emission inventory (EI)* is an accounting of the pollutants discharged. It logs the types and physical quantity of pollutants discharged from each polluting activity over a specific area and time period. The objective is to estimate the discharge as close to the discharge point as possible. As

opposed to *ambient pollution* which attempts to measure the pollutants present in the atmosphere. *Source attribution* is the process of assigning the specific source of the pollution through various means including combinations of chemical/physical analysis of the pollutant and the use of emissions inventory. Currently there is a lack of all three which is reflected in the lack of adequate knowledge inputs being available to policymakers and other decision-makers.

The problem of source apportionment studies cannot be over-emphasized. The IIT Kanpur study is much referred to, and there are other studies that preceded and followed it, but these are Delhi focused, other metro cities as well as regions also need to be well covered, their results analysed and validated, for there remains significant uncertainty related to source apportionment.[10]

Though very frequent source attribution studies may not be required, it is still important to have some done at regular intervals across different climatic zones as technologies and economic activities do change constantly in a fast-growing economy such as India. And for that a protocol for a standardized emission inventory (EI) needs to be developed specifically for India (though global ones do exist). Based on this, a robust emissions inventory needs to be created at the national level as well as for some of the larger cities including those in the northern plains.

Though usage of a single emissions inventory need not be mandatory, having a standardized one would help in the comparability of studies

Though usage of a single emissions inventory need not be mandatory, having a standardized one would help in the comparability of studies. For instance, IIT (Bombay), TERI (New Delhi), Indian Institute of Tropical Meteorology (Pune), all reportedly have their own inventory which presumably varies significantly across institutions. Also use of internationally developed emission factors for estimation of emissions can sometimes lead to large errors in the results. TERI for example, reportedly has a national air inventory for the year 2011 and is now updating it with samples drawn from cities across India and also developing India specific emission factors for agriculture residue burning, refuse burning, road dust and industries. Contrast with Europe where there is a single EI guidance

---

[10] Comprehensive Study on Air Pollution and Green House Gases (GHG) in Delhi, Mukesh Sharma, Onkar Dikshit, Indian Institute of Technology, Kanpur, 2016, http://cerca.iitd.ac.in/files/reports/IITK%20study%202016.pdf

that is followed by all countries, who are therefore using similar methods for estimating emissions.

In other words, a single inventory may not be the solution for India, however one standardized inventory is required, while institutions can develop theirs independently. The latter would enable crosschecking and validating the former. The standardization and having a single inventory are critical as that will enable interaction around a common data language. However, as important is innovation and experimentation with data, and that is possible when there are institutions and researchers who are working independently and in parallel. Whether it is conducted through a single organization or through public academic discussion through journals and other methods of interaction, interactive portals are important for experimentation and innovation. The NGT action plan given to non-attainment cities also calls for developing an emissions inventory.

Further, there are many fuels or technologies which in a sense are unique to India and whose emissions factors may not be available from studies originating in western countries – PET coke, power oil, burning of reused edible oil, furnace oil, are some examples. Also, the informal sector uses many technologies where fuels are sub-optimally burnt, but little is understood of their emissions factors.

Knowledge of the components of particulate matter therefore will better help identify the specific sources and help design superior solutions.

In addition, while it is well understood that particulate matter is a major issue in terms of both extent of pollution and its impact on health, the components pf particulate matter varies over space and time. Latest studies are finding that about half of the particulate matter comprises of secondary particles. That is, particles that have origins in sulphur, nitrogen or other volatile organic compound gases. Knowledge of the components of particulate matter therefore will better help identify the specific sources and help design superior solutions.[11]

Moreover, given the different climatic zones in the country, whether it is source apportionment or EI, a set of climatic zones need to be identified and such data and parameters need to be put together for each of these zones.

---

[11] Even though it is said that the PM level in Delhi is alarmingly high but if we look at the composition of the PM in Delhi and PM in USA, the PM in Delhi contains majorly the dust particles whereas in USA it is majorly sulphur pollutant, and PM containing dust is not deadly while PM with secondary particulates can be. So it is important to look at AQ in terms of health also and not just absolute concentration

Some understanding of seasonality and how the time of the year affects the data also need to be better understood at a regional/zonal level.

It is well understood that India need not over-invest in EIs, but a basic understanding of contributory sources will facilitate more nuanced policymaking. Moreover, inter-temporal changes would also affect emissions and therefore the EI exercise would need to be done periodically though not necessarily frequently. Another alternative of source apportionment at regional/national scale is 'subtraction approach'. A chemical transport model with all sources is run and then one is subtracted, the difference reveals the contribution of that particular source. This type of approaches also depends on the representativeness of the inventories as well as the model configuration (how efficiently the model is able to handle complex chemistry. This is a big gap in India.

The state will have to take up the responsibility of developing and maintain standardized inventory either inhouse, or supporting an external entity.

The CPCB is the most likely organization for evolving and maintaining and updating such protocols every few years. Whatever be the organization, the state will have to take up the responsibility of developing and maintain standardized inventory either inhouse, or supporting an external entity.

3. From Knowledge to Action

3.1 Educating the Masses

Given the importance of democratic institutions in the country, it is well understood that the common citizen needs to be aware of the issues related to air quality and how it impacts their lives. However, it is also true that for a large segment of Indians, immediate employment and income priorities may overwhelm other objectives. While the democratic process will create its own priorities and urgencies, better information on AQ needs to be shared with the masses. *Accessibility of such information requires unpacking complex information into digestible pieces. Creating a mass demand for an improved environment and AQ needs to become a priority, for without it little can be expected in a democratic country.* The SPCBs and CPCB among others need to strengthen this aspect of AQ education.

3.1a False beliefs, illusions of sanguine air pollution and 'pollution panics'

An unidentified and misunderstood problem is, despite being exposed to studies and news and even personal experiences, on how bad AQ impacts health, a large section of people instinctively believe that poor air quality

won't affect them. Those engaging with the masses observe that while bad quality water is immediately associated with poor health by the layperson, poor air is not. There is little literature or understanding of this illusion of 'sanguine air pollution'.

Consumption of jaggery or *amla* (Indian gooseberry), wearing a cloth mask, etc. are sometimes thought to reduce or remove the impact of poor air quality on health. These false beliefs may originate in many different ways, but need to be corrected nevertheless. Health warnings and information on AQ needs to be corrected through comprehensive education and awareness programs from schools to mass media. Moreover, short term forecasting of AQ (eg. over next few days) in a region reasonably and can also help better preparedness of the government and public in case of high pollution episodes.

Creating a panic or widespread fear would serve no one's interest.

At the same time, creating a panic or widespread fear would serve no one's interest. Educating the masses, them on what causes pollution and how to deal with it requires the overcoming that set of false beliefs on both ends. A rational approach therefore rests on education and right knowledge as only that can help build a coherent national consensus and political support for effective action.

3.1b Making information 'accessible'

Researchers are many times not predisposed to engage with communication professionals or mass media. Even the research papers written are rarely amenable to reading by them. Not only does the researcher need to put in more effort in better communicating with media persons, but even funds allocated to studies need to have some component allocated for media and communication professionals to work with researchers in sharing the results widely.

Moreover, many actions be it biomass burning or BS VI implementation have complex underlying technologies. Educating or improving awareness levels among the masses becomes more difficult due to this. The lack of resources available with the scientific community further reduces their incentives for making such complexity more palatable for the layperson.

Communication on the environment will need to encompass text, illustration, sound, and video; be multimodal including face-to-face, print, electronic and digital media; be social media friendly; two-way

communications are increasingly becoming more effective in behavioural change efforts. Moreover, communication strategies differ across age, gender and demographic segments, not to mention cultural-linguistic differences. Education material is also currently missing for school and college teachers that they can use for teaching environment related matters. School going students should be considered priority segments, as they will experience the effects of climate and pollution related changes the most.

School going students should be considered priority segments, as they will experience the effects of climate and pollution related changes the most.

Moreover, sporadic communication cannot be expected to change decades or centuries old behavioural practices, persistent and long-term engagement is required. No single organization can be expected to address all such needs, a multitude of efforts would be. The use of multimedia communications in schools, hospitals, transport hubs, public spaces etc. in a consistent manner will create better awareness and also better response by the masses.

Further, unlike product advertisements or corporate communications, good quality and simple communication on the environment has not yet become an established component of mass media studies. Educational establishments dealing with mass media need to focus more on the environment through specialized courses and research.

3.2 Communicating with Policymakers

Science needs to feed policy and judicial action and this is only possible when a systematic mechanism is developed for it, as there is a wide pool of scientific knowledge which many times decision-makers are unable to access. Many policymakers are also unaware of the various impacts of poor AQ. Though the scientific evidence may be reported in news and mass media frequently, but lack of depth in mass media communications is not amenable to informed policy action. The judiciary as well needs to be adequately informed of the various dimensions of each environmental problem.

At the same time, good communications need to occur in both directions. One issue for improved action is therefore also to better understand what evidence might help policymakers pursue their objectives in ways that improve air quality as well? That is, it is not only about communicating better with policymakers, but also hearing from and listening to the

policymaker - what information do they need, what trade-offs they face, what questions do they have? It is as much the policymakers' responsibility put these questions in the public domain as it is the responsibility of the research community to address those questions.

It is not only about communicating better with policymakers, but also hearing from and listening to the policymaker - what information do they need, what trade-offs they face, what questions do they have.

3.2a Making Scientific Writing Accessible

The policymaker needs to take specific decisions and many times scientific and academic studies are unable to provide definite answers. In some cases, the study design does not enable clear answers required by the policymakers, in others the results are not clear, and in yet others the studies are unable to communicate specific answers and get bogged down with qualifiers. As a general rule scientific writing must include a set of specific and clear summarization for the policymakers. But more importantly, research needs to be designed with specific policy questions underlying them. Further, literature surveys and reviews that attempt at reconciling previous literature, esp. if there are seemingly discrepancies is required; this is best done within the scientific community that is able to put together superior synthesis-oriented studies.

Moreover, the policymaker is often unable to interpret the figures thrown up by researchers, as the former many times are unaware of the significance of those figures. The figures, whether large or small, need to be translated to something that the policymaker and judiciary can appreciate the significance of. A simple categorization of the relative importance of the results, significance and confidence in the estimates, are important from that perspective. An example of the lack of understanding is that of a recent NGT judgement asking for a carrying capacity study by each polluter. In a country such as India where AQ is already extremely poor across the bulk of north India and in most of the large cities across the country, a carrying capacity study becomes mostly redundant. Such appreciation of the nuances of some of the technological and scientific methods needs to exist both among the judiciary and the policymaker.

A periodic publication which logs the latest information on the link between AQ and health and its various dimensions needs to be made available to policy-makers and the judiciary alike.

3.2b Global and National Learnings

India is not the first country that has grappled with high levels of pollution, others, both developed and developing, have faced and addressed the problem with varying degrees of success. These international learnings can help India accelerate its own learnings and undertake knowledge-based action.

India is not the first country that has grappled with high levels of pollution, others, both developed and developing, have faced and addressed the problem with varying degrees of success.

Take the case of Mexico City which faces similar problems to those faced in Delhi and which has had significant success within a few years. How did the Megapolis Commission and the Mexico City form evolve since the 90s when its AQ was considered to be among the worst in the world? How did inter-jurisdictional coordination happen in a city and in an increasing number of municipalities? Similarly, the South Coast Air Quality Management District which encompasses Los Angeles and other cities in its vicinity can be better understood on how to coordinate between different cities. For inter-state coordination as well, policymakers can look at 'The Convention on Long-Range Transboundary Air Pollution' (CLRTAP) which aims at protecting the human environment against air pollution and to gradually reduce and prevent air pollution, including long-range transboundary air pollution. The CLRTAP is implemented by the European Monitoring and Evaluation Programme (EMEP), and directed by the United Nations Economic Commission for Europe (UNECE).

Moreover, many experiments and learnings are available from within India as well, and many times experiments and pilots undertaken in a city or a state can be applied in many others. Case studies also exist on how individuals and communities with little help from the government are successfully beginning their own initiatives, be it RWAs and waste segregation or individuals and afforestation, etc. Such cases need to be documented and shared across the administrative and decision-making landscape.

Further, apart from dissemination, another issue is that of acceptance among policymakers of learnings from other geographies (an example being impact of pollution on health). Every such case may be different from India and therefore not directly applicable. But others have succeeded in reducing pollution levels where India has not, there are many learnings from global success and failures which can help India achieve improved AQ at low cost rapidly.

3.3 Helping Policymakers Address Multiple Priorities

Arguably, for many if not most policymakers, the environment is not among the top priorities. Why might this be so? How can the environment and AQ achieve prominence? Is presenting the health or economic impact the best solution? Is it simply a matter of better communication? Or is it that other priorities touch far more deeper desires than AQ is able to? This is not as yet well understood, and therefore not only is there limited informed communication in the space, its quality is also fairly weak.

3.3a Establishing the Direct Link

Those within the household may not be aware of how much does the sigdi *(coal or biomass-based stove) contribute to AQ and how much do chances of respiratory ailments increase?*

Arguably the direct link between AQ and specific economic, community or household activities is not known to many. For instance, those within the household may not be aware of how much does the *sigdi* (coal or biomass-based stove) contribute to AQ and how much do chances of respiratory ailments increase? Further, large infrastructure sectors contribute significantly such as coal power or transportation, however the informal sector, smaller construction projects, households are also significant contributors whose activities and emissions need to be mapped well. Such information enables better quality policy and judicial decision-making, but it also is a powerful input into behavioural change when individuals can be shown the direct link between their actions and the extent of the direct impact.

3.3b Prioritization

In many cases the underlying economic activity has multiple impacts – on environment, incomes, employment and even government revenues. The policymaker may have a problem of being unable to decide between various

options, and that too with limited information and data. Moreover, the judiciary also needs to be better informed of different options.

What is the rational forward looking decision-making under such circumstances? The current method is fairly ad hoc in that limited information is available to the decisionmaker. And priorities are themselves many times not clearly defined. Multiple institutions (discussed later) further add to the complexity of the process.

While in democracies such as India it is natural to expect political economic considerations to be among the key factors behind any decision, the lack of information prevents choices that are in sync with the priorities of the decision-maker. The first step therefore, whatever be the objective, is the availability of better-quality information on all available options to the decisionmaker.

How should the policy-maker take decisions where there are many options and trade-offs?

The second aspect of this has to do with prioritization. How should the policy-maker take decisions where there are many options and trade-offs? Here as well, the timely availability of independent academic and policy studies can better inform policymakers.

The third aspect of this is the issue of cost-benefits, some countries continue to conduct detailed cost-benefit studies as an input into decision-making. The United States' Clean Air Act has a built-in mechanism of conducting a cost benefit analysis (CBA), which it has been doing. By building in cost-benefit analysis into the act the relevant departments are mandated to provide relevant information for the policymaker.

The results of such studies show that while costs of pollution abatement may be direct and observable, and benefits indirect and not directly observable, the benefits can sometimes massively outweigh the costs once they are systematically measured. "The analysis finds that the Clean Air Act regulations will reduce air pollution and create sizeable health benefits. The annual costs of the regulations analyzed in the study increase from $20 billion in the year 2000 to $65 billion by 2020. These costs are swamped by the projected benefits of the reduction in air pollution, starting at $770 billion in 2000 and rising to $12 trillion by 2020. The study projected the

benefits of the Act would exceed the *costs by a factor of 30 over the study period*."[12],[13]

Note that we do not subscribe to relying solely on such studies for making choices, political and economic imperatives will contribute significantly to the final policy action, but the availability of such studies is an invaluable tool in the hands of the decisionmaker.

3.3c Multi-sectoral Impacts

Another issue has to do with the connection between environment and other sectors. Good urban planning, transport-oriented development (TOD), footpaths, quality of trees are some examples of cross-sectoral issues that currently the CPCB is unable to embrace in its mandate. But it will be difficult to address AQ without addressing urban planning and other related issues. The cross-sectoral linkages in the environment require the key players to have a far wider vision than they are conventionally used to.

Policymakers and regulators in all domains, be they urban planning or security, rural development or telecom, women and child development or finance, need to study the interplay between their actions and the environment and AQ in the conceptualization and planning stages.

Policymakers and regulators in all domains, be they urban planning or security, rural development or telecom, women and child development or finance, need to study the interplay between their actions and the environment and AQ in the conceptualization and planning stages. Just as an example, while NCAP focuses urban areas, the Prime Minister Ujjwala Yojana by reducing the use of biomass and coal burning at the household level is likely to have had a significant positive impact on indoor air quality in both rural and also urban areas.

3.4 What Works Better with Policymakers

Indian policymakers have historically taken many decisions that may not have incorporated environment concerns adequately. At the same time, policymaking has not been entirely blind to environment concerns. Such

---

[12] See Valuing the Clean Air Act: How Do We Know How Much Clean Air is Worth? J. Scott Holladay, Institute for Policy Integrity, New York School of Law, Discussion Paper No. 2011/1
https://policyintegrity.org/files/publications/Valuing_the_Clean_Air_Act.pdf
[13] Also see: The Benefits and Costs of the Clean Air Act from 1990 to 2020, U.S. Environmental Protection Agency, Office of Air and Radiation, April 2011

duality is observed in many ways, however there are ways by which research can better target the policymakers' immediate objectives.

The first is to link national recommendations with global objectives that India is a signatory to. The second is to put AQ in a better perspective for the policymaker, through a structured policy report on the environment.

3.4a Global Commitments

The Sustainable Development Goals (SDGs) that India is a signatory to have as yet not been addressed enough in the AQ policy domain, specifically Goal 3 (Ensure healthy lives and promote wellbeing for all at all ages), Goal 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and Goal 5 (Achieve gender equality and empower all women and girls). Similarly, the AQ and climate change go together and in India at least, pollution and climate change need to be communicated as being deeply connected. Further, the Smart City Framework of the Ministry of Urban Development (MoUD) also has incorporated three air quality indicators (reduce concentration of SO_2, NO_2 and PM_{10}).[14] AQ communications could refer to these commitments of the government in communications with the government to better synchronize with government policy.

3.4b An Environment Policy Report

An annual AQ or environment policy report is currently missing in India that ties together the latest available credible data along with an analysis of various global developments, technological opportunities, analysis of past actions and way forward.

An annual AQ or environment policy report is currently missing in India that ties together the latest available credible data along with an analysis of various global developments, technological opportunities, analysis of past actions and way forward. It could tie-in data on the environment side with data from other sectors such as usage of different fuels in households be it LPG or biomass, automobile growth, trends in power consumption, etc. A periodic follow-up of emissions and relevant policy and implementation developments would be a critical component of such an exercise. Such a study would therefore be able to tie in both developments and opportunities with policy imperatives. A regular report of such type, as is

---

[14] Liveability Standards in Cities, Ministry of Urban Development, Government of India, http://smartcities.gov.in/upload/uploadfiles/files/LiveabilityStandards.pdf

Indicus Foundation White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

available in other domains (eg. Economic Survey, World Development Report etc.) would help anchor policy efforts with credible measures of outcomes, something which is currently missing in India. Such a report would be of benefit to not just the policymaker, but also the judiciary, industry etc.

3.5 Funding of Research and Planning Efforts

Funding for intellectual input for an improved environment takes many forms and needs to be enhanced across all domains – technology, legal, economic or institutional. Funds are required for (a) improved scientific research (b) technology development (c) study of organizational changes required (d) analysis of the interplay between economy, employment, public health and environment etc. The funding can be from the government's budget, additional fees and cesses imposed on polluting activities, individual charity, CSR, global sources oriented at better AQ and sustainable development, etc.

Funding for intellectual input for an improved environment takes many forms and needs to be enhanced across all domains – technology, legal, economic or institutional.

Global bi-lateral and multilateral organizations fund varied efforts; CSR funding in the intellectual input for environment has as yet been limited; and individual efforts many times happen in tiny silos with limited scale. Public funding of private non-profit environment initiatives also seems to be ad-hoc and without systematic well thought objectives.

AQ requires greater research, outreach, pilots as well as engagement with the government, industry and communities. *A documentation of various funding possibilities for those involved in research,* education and awareness or even piloting needs to be put together, for reducing search costs for innovators and social entrepreneurs in this space.

3.5a Government Funding for Environment Research

Research pays off in the long run and research that is aimed at public good is mostly funded by the government globally. In India however this funding source is fairly limited and there is an over-dependence on global or private sources. Whether global or private sources, research funded by non-government entities will tend to reflect the priorities of the funder, even if the researcher is unbiased. Pollution and health, policy action, or for that matter environment and employment imperatives, need to be in sync with

India's objectives of sustainable development, and therefore need to be funded by the government.[15]

The Niti Aayog could play such a role, where independent domestic researchers are funded based on clearly defined proposals on the topic and the capability of the research team. The model of National Bureau of Economic Research in the USA should be studied and transformed for Indian conditions.

This is not to say that the government does not fund research, only that its scale and scope need to increase ... if such expanded research is integrated with policymaking, the quality of government decisions is likely to improve significantly.

This is not to say that the government does not fund research, only that its scale and scope need to increase. Perhaps as important, if such expanded research is integrated with policymaking, the quality of government decisions is likely to improve significantly.

3.5b Publicly Funded Research and Development via Fees and Cesses

India has experimented and succeeded in generating significant funds from charging for polluting activities. However, it has been fairly weak in being able to direct such funds towards the activities they were collected for, case in point being the use of the coal cess funds to make-up for the GST shortfall. Whether it is coal or petroleum or water charges, such fees or cesses can generate significant funds for studies or research and development aimed at improving the environment. A larger understanding of why such cesses rarely get transferred to environmentally beneficent actions needs to be conducted and the bottlenecks corrected.

3.5c Enhancing CSR funding for Research and Education

The CSR route is currently limited and oriented largely at specific projects and pilots. Research and communication get very limited funding, partly because CSR rules in India currently are framed less towards research studies and journals. These can be changed fairly easily and the lead for this

---

[15] India Global Burden of Desease for instance was initiated by ICMR. We need more cohort studies to further strengthen Indian evidence of acute and chronic impacts of air pollution – as discussed in previous sections, a system needs to be developed so that any policy action to reduce air pollution can be judged in view of the quantifiable health benefits.

Indicus Foundation   White Paper: Addressing India's AQ Challenge, *version: October 15, 2019*

needs to be taken by established think tanks and corporates that have a longer-term perspective of the environment.

3.5d Contracting with Innovators

A key issue has to do with innovation and funding received by innovators. While India has a large start-up community, and the ecosystem for enabling start-ups is relatively well-developed, innovation and new ventures require other enabling factors that are currently weak. The government's ability to tie-up with start-ups with innovative efforts and pilots is one such example where the typical L1 (lowest bidder wins) contracting mechanisms don't work well. Government rules are only just starting to change and enabling departments to support innovative organizations requires the bureaucracy-technocracy to be incentivised and not punished for such acts.

A specialized mechanism can be evolved within entities such as the Niti Aayog, MoEFCC and CPCB for vendor contracts for innovators both in knowledge and technology creation.

Take for instance a supplier contract, even if for a short-term project or pilot, makes it feasible for innovators to obtain funding. While it would be difficult to change such entrenched mechanisms as lowest-bid route across all government departments, a specialized mechanism can be evolved within entities such as the Niti Aayog, MoEFCC and CPCB for vendor contracts for innovators both in knowledge and technology creation. At the state level as well, similar mechanisms can be developed where innovators obtain contracts with government and associated buyers.

On the knowledge creation end, what is most needed is a funding regime that funds (a) interactive platforms including workshops and seminars for government, regulator, industry and academia (b) engages in persistent communications for behavioural change and (c) is able to motivate mass communication professionals to work on environment, and at the same time monitors the quality so generated.

4. Getting the Institutions Right

This section aims at identifying the process by which institutions that can better address the environment challenge be created. While the objective is to address the AQ challenge, the institutions so required would tend to apply to all environment matters.

While there are multiple organizations with defined roles, there are many spaces where the delineation of the boundaries between different organizations is fuzzy. Further, the current regulatory set-up is rather weak with the CPCB (Central Pollution Control Board) and its State level SPCBs (State Pollution Control Boards) not being empowered enough. The increasing role being played by the judiciary on the environment is only highlighting the many gaps in the institutional space. While the borders between the executive and the judiciary has been breached for some time, that between the rest of the judiciary and the National Green Tribunal is also fuzzy in that all layers of the judicial mechanism look at environment matters but from different angles.

..the capacities within the regulatory agencies [and] departments also are limited relative to the task at hand … roles and responsibilities of various elements within the institutional set-up and also the rules governing monitoring and enforcement, have many grey areas and gaps.

Moreover, the capacities within the regulatory agencies or the relevant departments also are limited relative to the task at hand. At the same time, the roles and responsibilities of various elements within the institutional set-up and also the rules governing monitoring and enforcement, have many grey areas and gaps. Consequently, enforcement of the laws is limited both due to poor institutional design and individual default by those manning such institutions. There are no doubt gaps in the laws which need to be identified and explicitly addressed; but there are also multiple laws, sometimes contradictory, that apply on the same issue. Some of these issues are further addressed below

4.1 Multiple Tiers of Governance

Within the central government there are multiple departments that have a direct bearing on the environment. The Ministry of Environment, Forests and Climate Change (MoEFCC) is the entity expected to plan, promote and oversee the implementation of policies on environment and forestry and climate change. While the prevention and control of pollution is technically under its ambit as well, the bulk of the implementation is by other arms of the government, many of those at the state and local level. The Central Pollution Control Board (CPCB) has multiple functions ranging from monitoring, environment assessment and research, providing technical assistance and advisory to the government including the MoEFCC, coordinating between the State Pollution Control Boards (SPCBs),

maintaining national standards, help implement environment legislations such as Air (Prevention and Control of Pollution) Act, 1981, and Water (Prevention and Control of pollution) Act, 1974. The National Green Tribunal (NGT) was set up to focus on cases pertaining solely to environment issues in 2010. However, the Supreme Court of India, the High Courts and the lower courts continue to play some role on environment matters.[16] At the state level the main regulatory entity is the State Pollution Control Boards (SPCB), but other organizations also exist in different parts of the country, for instance in Delhi the Environment Pollution Control Authority (EPCA) was constituted by the Supreme Court of India and mandated to improve the environment in the National Capital Region of Delhi region by regulating or controlling pollution. But this is not all, whether it is electric or water utilities, or regulators in the energy sector such as the Petroleum and Natural Gas Regulatory Board, or public sector behemoths such as National Thermal Power Corporation or Coal India, all have a well-defined role which sometimes intersects with others.[17] In addition multiple departments and ministries also have a direct role to play in environment matters – Ministry of Petroleum and Natural Gas, Ministry of New and Renewable Energy, Ministry of Power, Ministry of Coal, Ministry of Road Transport and Highways, etc.

Who is to be held responsible for each important source in a given city/ state? Who is to be ultimately held accountable for worsening pollution?

Accountability: With so many organizations across centre and states the first issue has to do with the demarcation pf accountability over specific aspects related to the environment. Who is to be held responsible for each important source in a given city/ state? Who is to be ultimately held accountable for worsening pollution? These are important issues that are currently hazy.

Intra-government coordination: The critical issue here is that related to boundaries, delineation of roles and responsibilities, and coordination between various agencies within the government. While the federal nature of the country mandates multiple tiers, there is a stated problem on

---

[16] The lower courts may be playing a limited role due to the existence of the appellate structure above them; however their presence does add to the delays and costs.

[17] This paragraph borrows from description published in from Business Knowledge Resource Online, National e-Governance Plan, Government of India, https://archive.india.gov.in/business/starting_business/environment_laws.php

coordination compounded by different levels of prioritization and capacities within various government agencies.

Informal interaction and coordination: Formal structures notwithstanding, informal social connection need to be created within the government. For instance, workshops and seminars of various organs of the state, government and regulatory organizations will vastly improve efficiency within the government.

Inter-state coordination: There are in addition many issues that go beyond state boundaries. The pollution in the Indo-Gangetic Plain has many inter-state issues for instance. Many times, even the state actors are unaware of how coordination can best be ensured. Moreover, even within the government individual and even organization level knowledge has many gaps of what is happening in other entities. The role of the centre in coordinating across states is also not well defined, and many times agencies have to wait for a judicial decision in such matters. This needs to be corrected as whether it deals with water or air or other environment issues, addressing cross-state issues needs a better mechanism.

Private sector answerability: To that is the added issue of increasing role of the private sector in many domains. How does the private sector operate, to which state entity is it answerable, especially since actions of one state entity can adversely and critically impact its operations?

A detailed mapping of institutions, functions and domains would be a first step, followed by a decision on whether India needs to go for a single all-encompassing environment overseeing organization or multiple entities focussing on specific issues but coordinating with each other.

Study on environment-institutions: This complexity is natural, but it is by no means unsolvable. A detailed mapping of institutions, functions and domains would be a first step, followed by a decision on whether India needs to go for a single all-encompassing environment overseeing organization or multiple entities focussing on specific issues but coordinating with each other. The way forward therefore requires a clear division of the various functions to be better understood both within the government and outside, and fuzzy areas clearly identified for further action via a comprehensive report on environment related institutions. The report will also need to elaborate a mechanism such that various components can

work in tandem. India needs to move away from the practice of waiting for the judiciary to provide guidance or issue directions.

Action plans: One solution at can be the publication of city level action plans that emphasize the most important things needed to be done in each city, how progress will be measured and by whom, and who is responsible for its overall implementation as well as specific components. The same can be done at the state and regional level that also incorporates rural and inter-state elements. The key point here *transparency and placing in the public domain both the targets as well as the fixing of responsibility.*

4.2 Regulatory capacity: Start Afresh or Strengthen the Old?

The CPCB is currently the key national-level regulatory entity however there are a multitude of weaknesses in its design, funding, capacities and general functioning. The pollution control board may be mandated to monitor and regulate, but has neither the financial or human resources nor does it appear to have any inclination to take up the mantle thrown before it. The lack of autonomy and missing political support have made it even more feeble. What holds for the CPCB at the central level also holds for the SPCBs at the state level. Note that the State PCBs have a significant workload, as central rules allocate many regulatory functions related to solid waste, plastics, e-waste, hazardous waste, air, water etc to them. A greater focus on their effectiveness is therefore critical.

Note that the State PCBs have a significant workload, as central rules allocate many regulatory functions related to solid waste, plastics, e-waste, hazardous waste, air, water etc to them. A greater focus on their effectiveness is therefore critical.

The CPCB is effectively operating largely under the control of the MoEFCC and not as an independent regulator like it needs to be. For many years, historically, the CPCB has operated without a full-time chairman. The appointment of fulltime Chairman from the IAS with little domain knowledge has been quite prevalent. The same is true of most SPCBs. Moreover, the many if not most Indian Forest Service officers are not trained or experienced on many pollution and AQ issues who head such organizations.[18]

---

[18] See DG Forests had served as Member Secretary, SPCB!), https://www.dailypioneer.com/2017/state-editions/siddhanta-das-new-dg-of-forests.html

With such step motherly treatment CPCB (and SPCBs) can hardly be expected to fulfil their mandate leave alone address the multiple environment issues that will emerge in the near future. Moreover, the CPCB (and SPCBs) are statutory bodies created through an Act of Parliament. They must be given the respect, resources and independence they deserve and require.[19]

The key components of such a study that is aimed specifically at improving regulation (which supplements the study on institutions) include how would scientific information be accessed by the regulator, how and who will translate that into a health and economic perspective, the routes by which executive is advised, how and who will play the direct monitoring and enforcement role, what mechanism will determine what research and/or pilots will be undertaken, and whether these will be in-house or outsourced, etc.

Study on Strengthening Regulation: A focused study on the CPCB and SPCBs that maps what is required for the environment regulatory set-up with what is would be the first step before a comprehensive institutional structure (see section 4.1) for the environment can be created. The key components of such a study that is aimed specifically at improving regulation (which supplements the study on institutions) include how would scientific information be accessed by the regulator, how and who will translate that into a health and economic perspective, the routes by which executive is advised, how and who will play the direct monitoring and enforcement role, what mechanism will determine what research and/or pilots will be undertaken, and whether these will be in-house or outsourced, etc. A systematic method of engagement with academia and civil society including consumer groups will be an important element for such an organization. Such a focused study on the regulatory set up will help set the base for future policy action on strengthening regulation. As a corollary to that the required legal and (perhaps even) constitutional changes needs to be well-delineated.

Whether a new organization or building on the old structure of multiple entities with CPCB at the forefront, the new environment regulatory regime

---

[19] This 2001 report by the PEO on SPCBs
http://planningcommission.nic.in/reports/peoreport/cmpdmpeo/volume1/180.pdf. Also see
http://www.indiaenvironmentportal.org.in/files/spcb-final.pdf and
http://www.indiaenvironmentportal.org.in/content/11089/board-trouble/

will need to be independent, empowered with the power to punish and reward both those in the public and private sectors, accountable to the masses and not simply to the executive, and have the necessary financial resources.

[T]he new environment regulatory regime will need to be independent, empowered with the power to punish and reward both those in the public and private sectors, accountable to the masses and not simply to the executive, and have the necessary financial resources.

The executive, however well-meaning and empowered, cannot be expected to take on such a regulatory role either at the centre or the state level. For the regulator typically has a longer-term focused agenda and is more specialized in its domain, whereas the executive tends to be more sensitive to many different objectives and more immediate priorities.

4.3 Incentives, Taxes and Subsidies

4.3a Taxes and Subsides

A wider and deeper informed discussion is required on legal reform to enable a carbon tax regime, or something on similar lines, that imposes some additional burden on environmentally harmful activities.

The GST regime and the principle of uniform taxation underlying it does not by itself provide much scope for 'sin' tax type of a mechanism where high taxation can be imposed on polluting activities. A new carbon tax regime would be ideal, but since current legal provisions do not allow it, a wider and deeper informed discussion is required on legal reform to enable a carbon tax regime or something on similar lines that imposes some additional burden on environmentally harmful activities. In any event there is a possibility to impose a pollution cess both at the central and state level, even in the current regime. The environment cess on trucks plying in National Capital Region is one such example.

In this respect the route taken by China can be studied in more detail. The Chinese government's The Environment Tax Law came into force in 2018 and allowed for cities to impose a tax rate on emissions of various pollutants. While the law specifies a minimum rate for different pollutants, it gives flexibilities to the provincial governments to increase them by a factor of 10 after permissions by the people's congress.[20]

Increasingly the government is attempting to subsidize investments or have lower tax burdens on activities that are deemed to be environmentally less harmful than the conventional technology. Renewable power is one such example and electric vehicles another, domestic electricity consumption is yet another example. As environment issues achieve greater prominence, it is but natural for more industry segments to ask for reduced tax burden or subsidies. Whether they should be granted or not needs to be taken in a well-informed manner, and not merely based on results from ad hoc studies or empty claims.

4.3b Punishing non-compliance

Non compliance is an endemic problem and exists for many reasons. Gaps in definitions, laws and regulations, inability to monitor economic activities on a large scale and on a real time basis, lack of state capacity in enforcing laws, the leakages in imposing fines due to corruption, are some problems with the current environment protection regime. There is another aspect which has to do with the ever-growing list of activities that cause environmental damage that come to light with greater research and information. The mechanism for the identification by the government is not well structured and is time taking, the incorporation of those in policy is another long drawn out process and many times requires great effort by the scientific and activist community. Finally, government capacity in enforcement is weak in many domains, local governments may have limited capacity, the punishment may be too insignificant relative to the gains from non-compliance, and sometimes it may be too stringent leading to greater oversight by the judicial mechanism which has its own flaws in terms of timely decisions.

The form of penalty impacts how the judiciary deals with cases. Long time is taken as the case proceeds through the legal system, followed by dismissal for a minor error by the prosecuting agency. Then there are other issues such as informing (potentially) polluting units with a notice before a site-visit which works against enforceability. Enforceability needs to be an important criteria in addressing issues of non-compliance.

---

[20] https://www.reuters.com/article/us-china-environment/china-to-levy-new-taxes-in-bid-to-strengthen-pollution-fight-idUSKBN14E05T

While the regulatory and institutional studies will necessarily need to study these issues and find solutions, there are certain obvious actions that need not wait. First, the regulator will need to have a specialized monitoring division that identifies and red flags activities that damage the environment including AQ. Second, a legal backend that makes it easy to monitor and red-flag non-compliance. Solutions such as remote monitoring, real-time public availability of monitoring data, transparency of both data as well as state action, imposition of significant economic punishments rather than criminalization where lives are not threatened directly damage are well known in India and globally. However, they have been used more as ad-hoc rather than systemically. These need to be incorporated even before a comprehensive action to overhaul institutions and regulations are devised.

…the regulator will need to have a specialized monitoring division that identifies and red flags activities that damage the environment including AQ.

4.3c Dealing with the Informal Sector

India's large informal sector is exploited at many levels, but it is also a significant polluter. Not only is it extremely difficult to monitor the informal sector, it is almost impossible to regulate or enforce any environmentally beneficent practices. However, since a large amount of air pollution resides in combustion, *pollution fees on fuels at source could better direct use of polluting fuels at the informal sector level without directly regulating their activities.*

Regulating informal sector activities can have limited success as state capacity at the local level is limited and the informal sector is not only large but also spread across all parts of the country. The banning of single use plastics in some states, districts and cities is a case in point, its success has been limited to those areas where local governments have been better able to impose regulations and punish non-compliance in a transparent manner.

4.4 Missing Laws, Many Laws and Judicial Priorities

There are many laws that govern AQ, and they are not merely limited to the Air Act 1981, Environment Protection Act 1986, Motor Vehicles Act 1988, etc. Many of these laws are dated, or based on principles that need to be better deliberated. Take criminal penalty for instance, while some actions should require criminal liability, many environment issues can also be addressed with other forms of fines and punishments as well. The laws need to be assessed and amended according to current needs and priorities.

Setting the Standards: There is an additional issue on the standards for emissions from industry, machinery, power plants, etc. There are domains where standards are missing, or were set many years and decades back yet not implemented or updated. Where are the standards missing, how can they be put together and implemented fairly rapidly and how can they be enforced seamlessly are factors that continue to be fuzzy. A separate study on missing or dated standards needs to be conducted if a comprehensive AQ improvement strategy is to be developed.

Relooking at NGT: The NGT itself appears to have evolved into a forum that gives permissions rather than a mechanism for environment justice, and this is taking up a substantial amount of time of the state actors as well as those desiring to put up economic value creating activities. An analysis of the kind of cases and decisions by the NGT could help further enhance, focus and finetune its role.

Specialized Forums: Moreover, many of these issues related to AQ and environment require specialized understanding, which members of the judiciary are not aware of. Since judicial time is constrained a lack of scientific understanding adversely affects decision-making. Specialized forums within the judiciary, or accessible to it, could contribute in better informed decisions.

Judicial Forbearance: At the same time, the role of the judiciary is also limited as it is difficult to legislate behaviour. Actions such as segregation can't easily be mandated as state enforcement capacity is limited when mass behaviour change is involved. The judiciary itself needs to be educated on the limits of executive action and what it can achieve in the real world.

While judicial forbearance may be advisable in some matters, lack of state capacity cannot be used as an excuse for allowing the state to be free of judicial oversight.

Making the State Responsible: While judicial forbearance may be advisable in some matters, lack of state capacity cannot be used as an excuse for allowing the state to be free of judicial oversight. The power to punish the executive for non-performance on the environment front can rest with the judiciary, the judiciary however has generally been lax in using this. Lack of well-delineated accountability further reduces the scope of the judiciary in punishing the state and those occupying positions of responsibility.

5. Conclusion

It should at the very outset be recognized by researchers and policymakers alike that scientific and technological knowledge mostly does not provide unambiguous answers for policy-makers. Studies typically have results that need to be qualified, there are limitations and assumptions behind any study. And ecosystem issues further cloud the direct applicability of scientific knowledge. However, the underlying understanding that research provides, can go a long way in good policymaking.

Environment policy is a classic case of facts being uncertain, values being contested, stakes being very high, but the decisions need to be taken rather quickly. The path from generating knowledge via research and experiments, to policy has many intermediate processes, especially in a democracy. Improved scientific or technical knowledge needs to be placed in an economic and institutional setting, and these in turn need to go through a political-economic churn before policy can be expected. While this is the natural order of any science-fed policy, robust analysis and a transparency in the process enables a certain maturity in the mechanism delivering environment policy change.

Change across multiple dimensions requires the executive, legislature, public and private sector, government communities and individuals to act together; a mammoth problem that will only grow in coming years and decades and affect everyone, and consequently require large and continuing efforts. However, as the problem grows in scale and impact, so will the power of humanity to deal with it. There are new and emerging technologies, knowledge, implementation models, organizational forms, that can have a significant impact on environment monitoring, air quality improvement and consequently AQ policy.

***