Climate Change, Air Pollution, and Sustainable Development Goal 3: An Indian Perspective

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Abstract

Climate change and air pollution are caused by a range of natural phenomena. The situation is further compounded by human beings who are leading increasingly resource-intensive lifestyles. Climate change is a major threat to public health. Our health systems are already under pressure, and they are being further crippled by a rise in the incidence of heat waves, floods, droughts, and other vagaries of nature. It is the poor and developing countries that are bearing the highest brunt of climate change. According to some estimates, 22 of the 30 most polluted cities in the world are in India. The health consequences of this are already proving to be lethal, with the State of Global Air Report, 2019 highlighting that over 1.2 million deaths took place in India in 2017 due to air pollution on account of conditions such as stroke, heart disease, and lung cancer. In fact, the Global Burden of Disease Study, 2017, shows that “India accounts for a higher proportion of global health loss owing to air pollution as compared to the country’s proportion of the worldwide population.”

In the recent past, the severity of the situation and therefore the need for urgent measures have gained traction within the political and policy spheres in the country. In this chapter, we review the global best practices along with their applicability to the Indian context, as well as initiatives that have been taken in India with respect to mitigating climate change and air pollution. Based on this, we also make recommendations for tackling this growing public health emergency and protecting the well-being of the current and future generations.

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course, government alone cannot achieve this; hence, we also suggest steps that need to be taken by the private sector and citizens.

Keywords
Climate change · Air pollution · Clean energy · Sustainable environment · Global warming · Public health

14.1 Introduction

Climate change and air pollution are caused by a range of natural phenomena, including, but not limited to, volcanic eruptions and dust storms. The situation is further compounded by human beings who are leading increasingly resource-intensive lifestyles. This means that we are producing and consuming more, thereby generating more greenhouses gases, particulate matter, and chemicals that pollute the air. A report published by 90 scientists from across 40 countries warns that lack of urgent and concerted action could result in climate change with catastrophic consequences over the next 20 years (Schlanger 2019).

Climate change is a major threat to public health. Our health systems are already under pressure, and they are being further crippled by a rise in the incidence of heat waves, floods, droughts, and other vagaries of nature. It is the poor and developing countries that are bearing the highest brunt of climate change. Within these countries, the poor, whose number far exceeds the prosperous class, are the worst affected. Thus, the externalities arising from the actions of rich and industrialized countries are being borne by their poorer counterparts. For instance, while the carbon footprint of the poorest billion people in the world is only 3%, the consequences of climate change are borne disproportionately by them. In the year 2000, 75% of the 5.5 million disability-adjusted life years lost were in Africa and Southeast Asia.

Climate change has the potential to raise the temperature of oceans as well as the air. A rising sea level can result in coastal flooding, ultimately causing severe loss of life and money, besides triggering large-scale migration to other areas. Rising temperatures and changing rainfall patterns could lead to a decline in crop yields (Venkatramanan et al. 2020a, b). This may cause severe shortage of resources vital for survival, further denting population health.

Climate change–induced health impact can be classified as extreme weather-related health effects, air pollution–related health effects, water- and food-borne diseases, vector-borne diseases, effect of food and water shortages, psychosocial impact on displaced populations, as well as the health impact of conflicts that take place over access to vital resources.

One of the areas which can be adversely impacted by climate change is mental health. Obradovich et al. (2018) reported that climate change can cause a serious and large-scale deterioration of mental health. Further, it was stated that for every 1 °C increase in temperature over a 5-year period, mental health issues increased by 2%. In places where the average temperature already ranges between 25 °C and 30 °C, a
shift in the temperature to just over 30 °C can add 0.5% to the population’s mental health burden.

Further, climate change is bound to have a serious impact on labor productivity with the inequality between low- and high-income countries deepening and those who are most vulnerable experiencing worsening working conditions. Informal workers, who constitute 90% of all workers in India, Bangladesh, Cambodia, and Nepal, are likely to be especially badly impacted. Moreover, those in older age groups, who represent an increasing share of workers in India, will also be hit hard, owing to lower physiological resistance to high levels of heat. In fact, studies have estimated that substantial national-level gross domestic product (GDP) losses can occur in 2030 due to heat stress, with Thailand, Cambodia, India, and Pakistan experiencing reductions in GDP of more than 5% each.

According to the World Health Organisation (WHO), nine out of ten people worldwide today breathe air, which is unsafe. While there are many pollutants which degrade air quality, the most common indicator for air pollution is PM2.5 (tiny particulates smaller than 2.5 microns which penetrate the lungs), which is generally used as an overall measure of air quality (Makkar and Singh 2019).

Household air pollution results largely from the ignition of domestic solid fuels for cooking and to a lesser extent due to heating of wood, dung, agricultural remains, coal, and charcoal. When volatile organic compounds emitted from vehicles, power plants, and factories react with nitrogen oxides in the presence of sunlight, ground-level ambient ozone is produced (Balakrishnan et al. 2019). Solid wastes are another significant contributor to air pollution through incineration because plastics tend to produce toxic substances, such as dioxins, when they are burned. It is estimated that 11.2 billion tons of solid waste is collected worldwide every year. The decay of the organic portion of solid waste contributes roughly about 5% of global greenhouse gas (GHG) emissions.

An estimated one-third of deaths globally from stroke, lung cancer, and heart disease are caused by air pollution. Toxic air has now also been linked to dementia, Alzheimer’s disease, and declining mental health. Every year, globally, more people die from air pollution–related diseases as compared to road traffic injuries or malaria. This adds up to seven million deaths annually with welfare losses to the tune of INR 5.11 trillion. Household air pollution is responsible for 3.8 million deaths annually, accounting for nearly 8% of deaths worldwide. Nearly all of these deaths occur in low- and middle-income countries (LMICs), with non-communicable diseases being the leading cause of death. It is believed that phasing out the use of fossil fuels could prevent more than three million premature deaths annually worldwide.

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1Household air pollution—the world’s leading environmental health risk. (2020). In: World Health Organization. Retrieved from https://www.who.int/airpollution/household/about/en/. Accessed 1 Jan 2020.

2Air pollution. (2020) In: Who.int. Retrieved from https://www.who.int/airpollution/en/. Accessed 1 Jan 2020.
To mitigate the impact of climate change on human health, it is important to create a strong health system, as well as robust service delivery mechanism through timely disease surveillance and control. The health insurance system also needs to be strengthened, in addition to increasing investment in research and development, health risk assessment, and vulnerability mapping studies.

14.2 Indian Scenario

Over the last century, India has contributed only 2% to the total fossil fuel carbon emissions; however, the country is grappling disproportionately with the consequences of extreme weather conditions arising due to such emissions. Rapidly developing countries, like India, are faced with the dual challenge of being exposed to both ambient and household air pollution. India, unfortunately, has one of the highest exposure levels to air pollution, which comprises primarily of polluted ambient particulate matter and indoor air. Most places in the country exceed the WHO-defined safe air quality standards multiple times over. Nearly half of the 50 worst polluted cities in the world, and 22 of the top 30, are in India (Griffiths 2019). In fact, the Global Burden of Disease Study, 2017, shows that that India accounts for a higher proportion of global health loss, owing to air pollution as compared to the country’s proportion of the worldwide population (Balakrishnan et al. 2019). The major originators of ambient particulate matter pollution in India are emissions from coal-fired thermal power plants, industry, brick kilns, vehicles, diesel generators, as well as burning of biomass, waste, and agricultural stubble, along with construction activity and road dust.

As per the India State-level Disease Burden Initiative Report, air pollution was at the second position among all risk factors that contributed to the country’s disease burden in 2016. The Study also indicated that exposure to ambient particulate matter pollution is on the rise, while household pollution is declining. Of course, there is considerable interstate variability in India, with respect to exposure to ambient particulate matter and household air pollution. This emphasizes the need to take heterogeneity into consideration while designing policies and interventions for controlling air pollution in the country.

It has been reported that exposure to outdoor and indoor air pollution contributed to over 1.2 million deaths in India in 2017. In fact, India accounts for 25% of global mortality on account of air pollution, with more than two million premature deaths.

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3Ministry of Finance (2019) Economic Survey 2018–19 (Volume 2). Government of India, New Delhi.

4The India State-Level Disease Burden Initiative. (2017). Public Health Foundation of India. In: Phfi.org. Retrieved from https://phfi.org/the-work/research/the-india-state-level-disease-burden-initiative/. Accessed 1 Jan 2020.

5Air pollution kills 1.2 million Indians in a year, third biggest cause of death. (2019. April 3). In: Business-standard.com. Retrieved from https://www.business-standard.com/article/current-affairs/
Cardiovascular ailments and diabetes constitute around 40% of diseases caused by air pollution, in addition to lung cancer and chronic obstructive pulmonary disease. In fact, health gains made as a result of lower tobacco usage among the population can be significantly dented if air pollution and other negative environmental conditions are not checked.

An analysis by Brookings Institute also highlighted the deleterious impact of air pollution on children’s health (Singh et al. 2019). It showed that exposure to air pollution during the first trimester of pregnancy contributes adversely to both underweight and stunting for children under 5 years of age, especially those belonging to poorer households and living in north India.

Global warming is another key challenge. An International Labour Organization Study, 6 projects that India is set to lose 5.8% of working hours in 2030, owing to global warming. Heat stress generally occurs in places with high humidity, coupled with temperatures over 35 °C. Those working outside are its worst victims and are highly prone to fatal heat strokes.

It is also estimated that heat stress could amount to a productivity loss 7 equivalent to 34 million full-time jobs in the country. Agricultural and construction sectors are likely to be especially impacted, affecting both male and female workers.

Every year, there is news of heat waves engulfing one or the other part of the country. As a consequence, deaths take place by the hundreds, hospitals get stretched beyond their capacity, educational institutions remain closed, construction activities halt, and people start migrating.

Estimates suggest that more than 6000 people have died since 2010 due to heat waves (Williams and Viswanath 2019). The situation is only going to worsen in the times to come, owing to a rise in global temperatures on account of human-induced changes in climatic conditions. Experts have predicted that by the end of this century, parts of South Asia could be so hot and humid that people may not be able to remain outdoor for more than 6 h.

In India, researchers have found that the number of suicides increases when crops are damaged during the growing season due to heat. In fact, beyond 20 °C, every degree rise in temperature per day correlates with around 70 more people killing themselves. 8 Such a trend could lead to an estimated 59,300 suicides in India over a period of 30 years.

6International Labour Organization (2019) Working on a warmer planet: The impact of heat stress on labour productivity and decent work. International Labour Organization, Geneva.

7India could lose the equivalent of 34 million jobs in 2030 due to global warming, says ILO. (2019, July 02). Retrieved from https://www.thehindubusinessline.com/news/india-could-lose-the-equivalent-of-34-million-jobs-in-2030-due-to-global-warming-says-ilo/article28259436.ece. Accessed 1 Jan 2020.

8Suicide data. (2020). In: World Health Organization. Retrieved from https://www.who.int/mental_health/prevention/suicide/suicideprevent/en/. Accessed 1 Jan 2020.
Further, coastal flooding due to rising sea levels is expected to impact tens of millions of Indians. Farmer incomes may be hit to the tune of 15–18%, owing to the changing agricultural productivity patterns. Acute water scarcity is also knocking at India’s doors, with the demand for water expected to exceed supply by 2020. India’s poor, who already face disproportionate barriers in accessing these critical resources, will be worst affected by such shortages.

Climate change is a crisis for public health, as it impacts just about everything, right from the nutritional content of our food to the strength of our immune system. Unfortunately, the world’s richest nations are the biggest contributors to this problem, while their poorer counterparts are the most vulnerable.

India has witnessed several positive developments on the public health front over the previous decade, including a steady decline in mortality rate as well as improvements in the sex ratio, food security, nutritional status of the population, and average life expectancy. While climate change poses a formidable challenge and has the potential to halt this upward trajectory, it also presents an opportunity to mitigate and prevent the negative consequences by taking action in a timely manner. In fact, the WHO has highlighted that India could gain health benefits to the tune of INR 3.28–8.4 trillion if it can contain global warming and limit increase in temperature to 1.5 °C by the end of the century.

### 14.3 Global Cooperation Is a Must

The Sustainable Development Goals (SDGs) encompass a broad range of interconnected issues, including economic growth, social challenges, and global public goods. In order to realize such an ambitious vision, an equally robust financing plan is required. Globally, United Nations Conference on Trade and Development (UNCTAD) estimates suggest that investment to the tune of USD 5–7 trillion per annum will be required for achieving the SDGs (Kituyi 2015). The total investment requirements for developing countries are estimated to be approximately USD 3.9 trillion every year, primarily in the areas of health, education, food security, basic services, and mitigation of climate change impact.

For India, some estimates suggest there is a shortfall of USD 8.5 trillion over the 15-year period for accomplishing the SDGs. On an annual basis, this works out to approximately USD 565 billion, which is equivalent to nearly 25% of India’s GDP in 2014–2015.

While domestic budget resources will assume greater importance as compared to international public finance, Official Development Assistance (ODA) will also

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9International Solar Energy Alliance Launched at COP21. (2015, Nov. 30) UNFCCC. Retrieved from https://unfccc.int/news/international-solar-energy-alliance-launched-at-cop21. Accessed 2 Jan 2020.

10United Nations Environment Programme (2016) Delivering a Sustainable Financial System in India. United Nations Environment Programme.
play an important role. High-income nations that are a part of the Development Assistance Committee (DAC) need to honor their commitments of providing 0.7% of Gross National Income as ODA.\textsuperscript{11} ODA assumes special significance for financing of global public goods like mitigation of climate change. At the 21st Conference of the Parties of the United Nations (UN) Framework Convention on Climate Change, developed nations made a commitment to mobilizing additional resources in the range of USD 100 billion annually by 2020 through the Green Climate Fund for addressing the needs of developing countries (Brittlebank 2016).

However, countries often fall short of the 0.7% ODA target. Thus, it is imperative to ensure greater transparency and explicitly define what constitutes aid. In the absence of this, a substantive part of ODA is often double counted as climate finance, thereby contradicting the spirit of the Cancun agreement. Robust mechanisms for monitoring the aid commitments of donor countries are critical.

Signed by 32 nations in the pan-European region, the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution\textsuperscript{12} was the first international treaty to address the issue of air pollution at a broad regional level. The Convention which came into effect in 1983 established the general principles for international cooperation to reduce air pollution and put in place an institutional framework, which has subsequently laid emphasis on policy and research. Over time, the scope of the Convention and its protocols has been expanded to also include organic pollutants, heavy metals, ozone at the ground level, and particulate matter. The Convention’s activities are supported by a number of intergovernmental bodies, scientific centers, and research groups. One of the major achievements has been its contribution to the establishment of a general framework for international environmental law. Emission of harmful substances has been reduced by 40–80% since 1990 in Europe. Similarly, sulfur emissions in the region are close to 20% of their 1990 levels. Nitrogen emissions too have been reduced, albeit to a lesser extent as compared to sulfur emissions.

More recently, over 190 countries came together in 2015 to approve the Paris Agreement at the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) for addressing the challenge of climate change (Rastogi 2019). As part of this Agreement, all countries committed to working toward limiting global temperature rise to below 2 °C. In fact, it states that best efforts should be made by all to ensure that global temperature does not increase beyond 1.5 °C to enable the accomplishment of the Sustainable Development Goals. If the goals of the Paris Agreement are met, at least a million lives

\textsuperscript{11}ODA is defined as government aid designed to promote the economic development and welfare of developing countries. Aid may be provided bilaterally, from donor to recipient, or channeled through a multilateral development agency. Aid includes grants, “soft” loans (where the grant element is at least 25% of the total) and provision of technical assistance.

\textsuperscript{12}The Convention and its achievements. A common framework for transboundary cooperation on air pollution. (2020). Retrieved from https://www.unece.org/environmental-policy/conventions/envlrtpwelcome/the-air-convention-and-its-protocols/the-convention-and-its-achievements.html. Accessed 2 Jan 2020.
could be saved across the world on account of the consequent reduction in air pollution.

The WHO also launched an initiative in 2017 on Climate Change and Health in Small Island Developing States. Though these countries make a minimal contribution to the problem, they are among the most vulnerable to the consequences of climate change.

India too has pledged for global cooperation on climate change through the Paris Agreement. It is worrying that carbon emissions, which are a key contributor to global warming, are increasing at a faster pace in India compared to other countries. Recognizing the seriousness of the situation, the government has put in place ambitious targets such as installing 175 GW of renewable energy by 2022. By 2030, the country is committed to cutting its emission intensity of GDP by 33–35% of the 2005 levels. The country is also committed to securing 40% of its total electricity capacity from nonfossil fuel-based energy sources. Further, India intends to create an additional sink of 2.5–3 billion tonnes of carbon dioxide through additional forests by 2030.

14.4 Promoting Clean Energy and a Sustainable Environment in India: Current Initiatives and Way Forward

At the highest political level, India’s prime minister has stated that failing to act in a concerted manner on curbing climate change would amount to no less than an “immoral and criminal act.” The Indian government recognizes that multi-sectoral efforts pertaining to power production, industry, transport, city planning, construction, and agriculture need to be made for mitigating the impact of climate change. In the “Strategy for New India @ 75” released by National Institution for Transforming India (NITI) Aayog in 2018, several suggestions have been included for tackling the issue of pollution comprehensively. Some of the key recommendations include expeditious implementation of the recommendations of the Task Force on Biomass Management, constituted by NITI Aayog under the “Cleaner Air, Better Life” initiative; creation of a “Clean Air Impact Fund” to provide viability gap funding for projects with long gestation periods and low returns on investment such as bio-power or bioethanol projects; effective implementation of the Solid Waste Management Rules, 2016, which have significantly expanded the scope of efficient solid waste management in the country; continued efforts to switch households from the use of solid biomass to cleaner modes of cooking through the provision of liquified petroleum gas (LPG) connections under the Pradhan Mantri Ujjwala Yojana; expedited use of biodigester toilets, a technology licensed by the Defence Research and Development Organization for nationwide implementation;
as well as prioritization of large-scale and sustained behavior change campaigns for citizens.

To tackle the challenge of air pollution across the country in a comprehensive manner, the government has launched a number of initiatives. The National Air Quality Monitoring Programme (NAMP), for instance, covers 312 cities/towns in 29 states and 6 union territories across the country. Four major types of air pollutants, that is, sulfur dioxide (SO2), oxides of nitrogen as NO2, suspended particulate matter (PM10), and fine particulate matter (PM2.5) are being monitored regularly under the NAMP. Smaller PM2.5 is particularly deadly, as it can penetrate deeper into the lungs.

National Ambient Air Quality Standards (NAAQS) have been developed for ambient air quality with reference to various identified pollutants, notified by the Central Pollution Control Board (CPCB) under the Air (Prevention and Control of Pollution) Act, 1981. A key objective of NAAQS is (a) “to indicate the necessary air quality level as well as the appropriate margins required for ensuring the protection of vegetation, health and property” and (b) to provide a uniform yardstick for assessment of air quality at the national level. The Air Quality Index (AQI) is a mechanism for effectively communicating information about air quality to citizens in an easily understandable manner. This is possible because the index converts complicated air quality metrics pertaining to numerous pollutants into a single number (the index value).

The National Clean Air Programme14 (NCAP) is a 5-year plan with 2019 as its first year. It will be institutionalized by ministries with oversight provided by inter-sectoral groups, comprising Ministry of Petroleum and Natural Gas, Ministry of New and Renewable Energy, Ministry of Road Transport and Highways, Ministry of Health, Ministry of Housing and Urban Affairs, Ministry of Agriculture, Ministry of Heavy Industry, NITI Aayog, CPCB, as well as experts from industry, academia, and civil society. NCAP aims to prevent and control air pollution alongside enhancing the monitoring network for air quality across India. The overall objective of NCAP is prevention, control, and abatement of air pollution, besides augmenting the air quality monitoring network across the country. The tentative national level target of a 20–30% reduction in PM2.5 and PM10 concentration by 2024 is proposed under the NCAP with 2017 as the base year for comparison of concentration. City-specific plans will be formulated for 102 non-attainment cities—where the prescribed National Ambient Air Quality Standards (NAAQS) are violated.

In addition, the Program will focus on channelizing technological support, setting up certification agencies for monitoring equipment, and catalyzing greater awareness among citizens. The number of ambient air quality monitoring stations has been increased across India over the last few years. The National Clean Air Programme proposes to establish monitoring stations in rural areas and increase their presence

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14 Government launches National Clean Air Programme (NCAP). (2019, Jan 10). In: Pib.nic.in. Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=187400. Accessed 2 Jan 2020.
nationwide for measuring PM2.5 levels. It is also important to create a data system for assessing India’s exposure to ozone.

The CPCB has issued a detailed set of directions under section 18 (1) (b) of the Air (Prevention and Control of Pollution) Act, 1986, for implementing 42 measures that can reduce air pollution in key cities, including Delhi and the National Capital Region (NCR). Some of the critical action points include controlling and mitigating vehicular emissions, industrial pollution, biomass/municipal solid waste burning, and construction activities, among other steps.

A Graded Response Action Plan for Delhi and NCR has also been notified by the government for tackling every source of pollution as per the categories of the AQI. The Action Plan also notes the health advisory in broad terms for every level of the AQI adopted by the Indian government.

Ambient particulate matter pollution could be controlled greatly if relevant action is taken across sectors, and the necessary linkages are established. For instance, the Ministry of Power is making efforts to reduce particulate matter emissions by coal power plants and lower energy consumption for industrial purposes. The Ministry of Environment, Forests, and Climate Change has set emission standards for the brick-making industry and is facilitating agricultural residue management to prevent stubble burning. The Ministries of Road Transport and Highways, as well as Petroleum and Natural Gas, have put in place stringent regulations pertaining to vehicle emissions and the requirement for vehicle upgradation to more fuel-efficient standards. The Ministry of Housing and Urban Affairs is taking steps to enhance the availability of public transport.

The government has also accelerated the adoption of Bharat VI emission standards. The deadline for automakers for adoption is April, 2020. With the norms becoming considerably tighter, PM levels in diesel cars can be brought down by up to 80%. By 2030, India plans to shift to selling only electric vehicles.15

Further, states and union territories are taking steps to improve the quality of the environment in general, and air in particular. At least 32 states/UTs have also prepared State Action Plans on Climate Change consistent with the objectives of the National Action Plan on Climate Change. The Plan will, however, need to specify targets for different sectors and put in place the necessary mechanisms for enforcing implementation (Abi-Habib and Kumar 2019).

Delhi, for instance, has mandated the use of compressed natural gas in vehicles; Punjab provides subsidies for using alternative technologies that prevent stubble burning and Maharashtra necessitates compulsory usage of fly ash in constructions within a 100-km radius of coal and lignite thermal plants. Other states and union territories can also incorporate such provisions in their policies to effectively control

15A total of 2500 government buildings to be fitted with super-efficient ACs for the first time in the country. (2018, Jan 24). In: Business Standard. Retrieved from https://www.business-standard.com/article/government-press-release/2500-government-buildings-to-be-fitted-with-super-efficient-acs-for-118012301313_1.html
particulate matter emissions. Other efforts include electrification of public transportation and upgradation of vehicles to Bharat Stage-VI emission standards.

The Gujarat government has introduced an emissions-trading scheme aimed at reducing particulate air pollution. Emissions have been capped by the government, and industries are allowed to buy and sell permits for staying below the cap. This is a pioneering market-based approach to regulation of emissions in India. It is expected that such an approach can lower air pollution at reduced costs for the government as well as industry. It can also serve as a best practice for replication of trading schemes to other emissions (Sharma 2019).

In Delhi, construction activities were halted for a fixed period of time in November 2018, for checking smog. For reducing vehicular traffic and associated pollution, the Delhi government has implemented the odd-even road-rationing scheme. Under the scheme, cars with license plates ending with an odd or even digit are allowed to ply on the roads on alternate days, with certain exemptions. The aim is to reduce vehicular traffic by half and check emissions. Further, the Delhi government tested an “anti-smog” gun in one part of the city in 2017, which sprays water into the air, in order to bring down pollution levels (Thakur 2017). Such measures, of course, can, at best, be short term, implemented for defined periods of time to bring down prevailing high levels of pollution. Certain longer-term and more sustainable efforts are also underway. For instance, the Badarpur Thermal Power Plant, which was considered a major source of air pollution in Delhi, has been permanently shut down. By the end of 2002, the city had replaced all its diesel buses with those using compressed natural gas (CNG), making it among the cleanest public-transport systems in the world (Jain 2016). Delhi is now in the process of adding electric buses to its fleet. Moreover, following an order of the National Green Tribunal, all petrol vehicles older than 15 years and diesel vehicles older than 10 years have been banned from operating in the NCR area. Similarly, in Pune, vehicles older than 12 years have been banned from plying on the roads (Dharwadkar 2018). Additionally, a subsidy of around INR 12,000 is provided to autorickshaws for switching to CNG. Over 18 projects of bio-methanization have been launched in Pune, and efforts are being made to substitute diesel generators with solar generators.

Alappuzha in Kerala was recognized by the United Nations Environment Programme (UNEP) as one of the five cities in the world, making strides toward reducing pollution through sustainable solid waste management practices. Since November 2012, the city has implemented the Nirmala Bhavanam Nirmala Nagaram (Clean Homes Clean City) initiative. It has also adopted the practice of decentralized waste management and is now on the path toward ensuring 100%...
segregation across all 23 wards in the city. Biodegradable waste is separated at the ward level and treated in small composting plants, providing over 174,000 residents with biogas for cooking purposes. As many as 80% of households in the city now have biogas plants and a decentralized composting system (Agarwal 2017).

Though severe ambient particulate matter pollution in north India during the winter season in particular and its immediate impact on health have attracted considerable attention from the public and media, what is needed now is to raise awareness about the adverse long-term and chronic health impact of high pollution levels throughout the year. There is a shortage of long-term studies that evaluate the ill effects of air pollution on health in the country. Thus, another focus area should be building the evidence base around health loss caused by air pollution. Findings from such a data system will help policymakers, in particular, to ascertain the states where the situation is more alarming, thereby paving the way for state-specific solutions to be devised.

To tackle indoor air pollution, Government of India has launched the Pradhan Mantri Ujjwala Yojana in May 2016 with the objective of providing liquefied petroleum gas to low-income households. More than 80 million LPG cylinders have been distributed to poor households under the scheme (Dutta 2019). LPG is a cleaner source of energy compared to solid fuels like wood and dung. The scheme provides financial support of INR 1600 each to eligible below poverty line (BPL) households for LPG connections. The connections are registered in the name of the female head of the household (Mhamia 2016). Use of LPG as household fuel goes a long way in curbing air pollution, besides helping to achieve the WHO-recommended air quality norms for within the home. The focus of the scheme should now shift to ensuring sustained usage of LPG. Targeted and innovative subsidies could help in achieving this objective. Another important scheme is UJALA under which more than 300 million LED bulbs have been distributed, and more than 7 million LED streetlights have been installed.18

Another important policy initiative is the launch of the Green Highways Policy by the Ministry of Road Transport and Highways in 2015. The objective of the Policy is “to promote the greening of highway corridors with participation from all stakeholders including farmers, private sector, NGOs, and government institutions.” A strong monitoring mechanism is in place through the Indian Space Research Organisation (ISRO’s) Bhuvan and GPS-aided Geo-augmented navigation (GAGAN) satellite systems. It has also ensured that regular auditing of every planted tree is carried out. If successful, the initiative is expected to bridge the gap between the current status and the goal of having at least 33% forest and tree cover as per the National Forest Policy.

18PIB (2018, Dec 12). Year End Review 2018- Ministry of Power. In: Pib.nic.in. Retrieved from http://pib.nic.in/PressReleseDetail.aspx?PRID=1555605. Accessed 8 Jan 2020.
19Shri Nitin Gadkari launches Green Highways Policy. (2015, Sept 29). In: Pib.nic.in. Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=128298. Accessed 8 Jan 2020.
The Bureau of Energy Efficiency (BEE)\textsuperscript{20} was set up under the Energy Conservation Act, 2001. It coordinates among the government, industries, manufacturers, and consumers to facilitate energy conservation. The Bureau also sets performance standards for appliances and designs labeling schemes for the same. The star rating of various appliances, including air-conditioners, refrigerators, fans, pumps, and water heaters falls within its mandate. Additionally, BEE organizes training sessions for people who implement energy efficiency projects. It also develops certification procedures along with promoting testing facilities, as well as innovative financing of energy efficiency projects.

To deal with the challenge of heat stress, Ahmedabad, in its 2017 Heat Action Plan, incorporated a cool roofs initiative as part of which the city’s poor and slum residents were provided cool roofs at affordable rates. The initiative aimed to ensure that at least 500 slum dwellings have cool roofs along with improving the reflectivity of roofs on government buildings and schools. Heightened awareness about the cause and impact of heat waves could go a long way in spurring collective action to tackle the problem. For instance, though heat waves are rising year after year, related deaths have been on a downward spiral in India. While 2015 saw more than 2000 deaths due to heat-related fatalities, in 2016, the death toll was 375, and 2017 saw only 20 deaths. This impressive trend is perhaps a result of the government’s well-coordinated efforts to make people aware about the ill effects of extreme heat, as well as the mechanisms for tackling it.

The Indian government is also taking several steps to provide an enabling policy and regulatory framework to offer compelling reasons for businesses to engage. For instance, in the context of increased use of nonfossil fuel sources, a combination of Feed in Tariff and Renewable Energy Certificates has been provided. Enhanced use of renewable sources will also create demand for supporting technologies and supply chains.

In this context, initiatives like the International Solar Alliance, launched by India and France for boosting solar energy in developing countries, are important. A Report\textsuperscript{21} launched by the Federation of Indian Chambers of Commerce and Industry and the United Nations Environment Programme also highlights several initiatives that have been taken in India for attracting private funding for green assets. For example, social infrastructure and decentralized renewable energy have been included in the priority sector lending requirements for banks, and the \textit{Pradhan Mantri Fasal Bima Yojana} has been launched for extending crop insurance.

\textsuperscript{20}Bureau of Energy Efficiency (2020). Bureau of Energy Efficiency. A statutory body under Ministry of Power, Government of India. Retrieved from https://www.beeindia.gov.in/. Accessed 8 Jan 2020

\textsuperscript{21}New Report Shows How India Can Scale up Sustainable Finance. (2016, April 29). In: UNEP - UN Environment Programme. Retrieved from https://unepinquiry.org/news/new-.report-shows-how-india-can-scale-up-sustainable-finance/. Accessed 9 Jan 2020.
An example of a public-private collaboration in this area is the India Innovation Lab for Green Finance, which brings together diverse stakeholders for developing innovative investment vehicles for promoting green and sustainable growth in India. A recent initiative launched by the Lab is the Rooftop Solar Private Sector Financing Facility, which structures small projects together in a manner such that the collective deal is of a substantive enough size and credit quality for attracting additional investments.

It is critical that businesses design products and services that can better meet the world’s ever-growing environmental needs. Multinationals can aid the abatement of air pollution by reporting on emissions and the steps taken to reduce energy use. Businesses can also calculate the life-cycle pollution footprint of their products and identify the process changes, technology improvements, and material substitutions necessary for making their products more environmentally friendly and sustainable.

Capacity-building and employee-awareness programs are other strategies that businesses can adopt. Many employees are not aware of how pollution affects their health and the consequent need for behavioral change. Efforts need to be made to encourage people to switch to alternative, cleaner modes of transport, as well as using cooking fuels in their homes that can protect the environment. Providing training on a regular basis or recruiting already-trained employees such as those with advanced degrees or a specialization in environmental engineering and science could be a helpful step toward creating a more livable environment. Further, companies with superior technology can help address gaps in air quality data. Currently, India has one air-pollution-monitoring station for every two million people, with a larger number of manual stations as compared to those that can generate real-time data (Nandi 2018).

UNEP lists an important role for the financial sector as well in combating pollution (UNEP 2017). Some of the suggestions include internalizing the costs of pollution in financial decisions and seeking to create a positive impact; reorienting finance away from polluting companies and activities toward greener technologies; preventing, reducing, and managing risk through insurance pricing and risk research and analytics, catastrophe risk models, and loss prevention; as well as working with multilateral development banks to ensure compliance with their own pollution management and control standards.

The energy sector too has a key role to play, as it is the biggest emitter among all industries. Royal Dutch Shell has announced that it plans to halve its carbon footprint by 2050, by increasing its output of lower-carbon products, including natural gas, biofuels, electricity, and hydrogen (Bousso 2019). Rival BP has announced that it has established a USD100 million fund for projects that will deliver new GHG emission reductions in its upstream oil and gas operations. BP

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22The Global Innovation Lab for Climate Finance. (2020). Retrieved from https://www.climatefinancelab.org/the-labs/india/. Accessed 9 Jan 2020.

23The India Innovation Lab for Green Finance (2016) Rooftop Solar Private Sector Financing Facility: Lab Instrument Analysis.
has defined short-term specific targets aimed at reducing its emissions and advancing the energy transition, including achieving 3.5 million tonnes of sustainable GHG emission reductions across the BP Group between 2016 and 2025, as well as targeting a methane intensity of 0.2%. Similarly, ExxonMobil has reported that it has spent around USD 8 billion since 2000 to deploy low-emission energy equipment across its operations, and that it is conducting and supporting research on technologies to make further reductions. Estimates suggested that the five largest oil companies have collectively curbed their emissions by an annual 13% between 2010 and 2015.

In the wake of increasing pollution and climate concerns, large corporations need to make such voluntary cuts in emissions, even as renewable and cleaner sources of fuel provide new business opportunities. In India, some companies have started making notable efforts. For instance, KPIT Technologies, an Indian technological firm, won the Promising Innovation in Transport Award in 2016 for developing a modular system for converting new and existing diesel buses to electric buses through retrofitting. Graviky Labs in Bengaluru has developed a device that can be fitted onto the exhaust pipe of a car or portable generator to collect the soot that forms from burning diesel fuel. By mixing the fine black powder with solvents, they produce ink that can go into bottles and markers. Not only is this device recycling the soot from vehicles, it is also replacing the carbon black that otherwise would have been used to make black ink (Nunez 2017).

In addition to the government and private sector, citizens can also make a difference by switching to climate-friendly means of transportation, harvesting rain water, saving electricity, reducing all kinds of waste, and promoting promote green spaces.

Greenhouse gas emissions, for instance, can be reduced considerably through some simple changes in our daily lifestyles (Rastogi 2019). Old gadgets should be replaced with energy-efficient ones. Similarly, turning off lights and appliances that use electricity when not in use not only saves energy but is also good for the climate. If the option exists, solar panels should be installed in homes.

Landfills can be checked if we recycle waste of different kinds, including plastic, paper, and glass. Of course, using refillable water bottles and not using plastic bags when shopping can also cut down on the amount of waste we generate. Composting food scraps is another doable and effective strategy.

24BP commits USD 100 million to fund new emission reduction projects. (2019, March 26). In: BP global. Retrieved from https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-commits-100-million-to-fund-new-emissions-reductions-projects.html. Accessed 9 Jan 2020.
25Big Oil Becomes Greener with Progress in Cutting Pollution. (2017, Sept 18). In: Bloomberg NEF. Retrieved from https://about.bnef.com/blog/big-oil-becomes-greener-with-cuts-to-greenhouse-gas-pollution/. Accessed 9 Jan 2020.
26Indian Tech Company wins innovation award for turning diesel buses into electric vehicles. (2016, May 17). In: ERTICO Newsroom. Retrieved from https://erticonetwork.com/indian-tech-company-wins-innovation-award-turning-diesel-buses-evs/. Accessed 9 Jan 2020.
Further, using bikes or public transport whenever possible is also a lifestyle modification that can go a long way in mitigating the impact of climate change. Such measures can not only reduce emissions, control rising global temperatures, and improve air quality but also yield several direct health benefits by preventing diseases like diabetes and cancer. For instance, if people walk or cycle to work instead of using a car, it will allow them to be physically active, thereby addressing one of the key risk factors for chronic diseases, that is, a sedentary lifestyle.

14.5 Notable Global Initiatives That India Can Adopt

An example of an effective legislation is the Clean Air Act in the United States, which was passed with the mandate of controlling air pollution. Under the Clean Air Act, the Environmental Protection Agency (EPA) specifies standards with respect to the maximum permissible levels of air pollutants across the country. The Clean Air Act vests the EPA the authority to limit emissions of air pollutants emanating from sources such as chemical plants, utilities, and steel mills. The Act also addresses issues like acid rain and ozone depletion. While individual states or tribes can put in place stronger air pollution laws, the standards cannot be weaker than those prescribed by the EPA. To reduce pollution, the Act requires manufacturers to build more environmentally friendly engines, refiners to produce cleaner fuels, and areas with high levels of air pollution to adopt and run passenger vehicle inspection and maintenance programs. In fact, the EPA has issued a series of regulations, affecting passenger cars, diesel trucks, and buses.27

In Freiburg, Germany, people are forbidden from parking cars near their homes. They are required to pay a fee of approximately €20,000, in order to secure a spot near the boundary of the town (Aravind 2016). In return, they are provided cheap housing and an efficient public transport system with trams and bicycle routes spanning 500 km. As a result, nearly 70% of residents in the town do not own cars. Zurich too has capped the number of parking spaces in the city and allows only a certain number of cars into the city at a given time. Additional more car-free zones, plazas, tram lines, and pedestrianized streets are also being developed in the city. The results have been encouraging in terms of reduced traffic congestion and air pollution.

Mexico City and Beijing have dealt with air pollution in urban centers by switching over to cleaner energy options, increasing the application of technology for controlling emission, promoting public transport, controlling total energy consumption, encouraging environmental education and research, as well as ensuring coordinated air quality management.

The Finnish capital of Helsinki has been at the forefront of introducing innovations in its public-transport system, with the goal of eliminating car

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27Overview of the Clean Air Act and Air Pollution. (2020). In: US EPA. Retrieved from https://www.epa.gov/clean-air-act-overview. Accessed 9 Jan 2020.
ownership. The city rolled out a minibus service called Kutsuplus, which allows riders to specify their own desired pickup points and destinations through smartphones. The requests are then aggregated, and the application calculates an optimal route to meet the requirements of most riders to the extent possible. While it costs more than a regular bus fare, it is less expensive as compared to a cab ride.

China is actively encouraging households to switch to low-emission heating systems. Nearly 9 million households made the transition from coal to natural gas and electricity during 2017 and 2018. The share of coal in the nation’s overall energy mix is now 59%, down from more than 68% in 2012.

Another global good practice is the use of district heating wherein “heating is supplied by a central plant which can use advanced methods to run on many different fuels or recover heat from other sectors, instead of every building having its own boiler. This is beneficial for households, industry and the environment.” Besides, district heating can make use of many kinds of renewable energy (biomass, geothermal, solar thermal). A key aspect of district heating is that it comes from combined heat and power CHP (plants), where electricity and heat are produced at the same place.

To tackle the challenge of solid waste, the Swedish government has implemented a legislation stating that recycling centers must be located within 1000 feet of residential areas (Folk 2019). Conveniently located facilities encourage citizens to dispose their waste properly. It is estimated that more than 50% of the waste produced in Sweden is processed in waste-to-energy plants. The energy generated by these facilities, in turn, serves as a source of heat for households across the country during the winter months. Ash and other by-products of the burning process can be used for road construction materials. The Swedish government has shifted the responsibility for managing waste from cities to industries, which produce materials that eventually become waste. Tax incentives are offered to companies for burning waste to generate energy.

Another noteworthy example is from Kamikatsu in Japan, which is on track toward becoming a zero-waste town by 2020. Residents of this region sort their garbage into 34 separate categories such as aluminum cans, steel cans, paper cartons, and paper flyers. The waste-management center has deliberately been morphed into a hub of the local community. For instance, a shop accepts clothing, tableware, and other items that are in a useable condition but no longer wanted by their owners, and it offers them to those who might need them. More than 8000 items of tableware can be borrowed by people every year, thereby eliminating the requirement for single-use cups and plates for special or one-off occasions. They also have an upcycling craft center where old kimonos brought by residents are converted into usable products by women from the community. Today, less than a fifth of the town’s

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28 Swedish district heating: Reducing the nation’s CO₂ emissions. (2017, May 02). In: Euroheat & Power. Retrieved form https://www.euroheat.org/news/swedish-district-heating-reducing-nations-co2-emissions/. Accessed 9 Jan 2020.
waste needs to be sent to incinerators or landfills as a result of these efforts (Gray 2019).

A deposit-refund scheme for cans and drinking bottles is in place in the United Kingdom and European Union for incentivizing consumers to return the bottle or can for which they are compensated, thereby reducing the pressure on landfills, increasing the life cycle of the product, and ultimately abating waste generation. Consumers pay an up-front deposit between 8–22 pennies when purchasing cans or bottles, which can be redeemed upon the return of the empty drink container. It is hoped that implementation of a deposit-return system will help boost beverage-container recycling from 57% in the United Kingdom to more than 95%. A similar program in Iceland has enabled them to retrieve more than 300,000 bottles in less than a year (Mace 2019). ECOBOT vending machines in Colombia provide shopping discount coupons, movie tickets, or monetary rewards every time a citizen deposits a plastic bottle or bottle caps.29

Other techniques include the use of vermiculture in Cajicá, Colombia, for instance, involving the use of worms for making compost from decomposing food waste. The outcome is rich compost with lower levels of contaminants that local residents can use as organic fertilizer for their vegetable beds. Instead of the trash can, leftovers at food stalls in Penang, Malaysia, end up in a machine that turns them into fertilizer for use on farmers’ fields. To minimize the amount of trash going into landfills, Bio-Regen food-processing machines are used for composting as much of the Malaysian city’s waste as possible. The machines are compact, odorless, and do not attract any vermin. They grind organic waste with microbial solution and water for producing a bio-liquid soil enhancer. Composting also lowers the cost of transporting and disposing of waste and helps prevent pollution of the city’s waterways.30

China is building Asia’s first vertical forests, which are high-rises packed with greenery in the form of trees, shrubs, and plants. While acting as a carbon sink, they are also expected to produce 60 kg of oxygen every day. If placed horizontally, the forests will cover an area of 6000 m².31 In fact, a tower in Xian in Shaanxi province in China has been dubbed as the world’s largest air purifier. It has large greenhouses around its base, which absorb polluted air, which, in turn, is heated using solar power, and released after going through multiple layers of cleaning filters. This has contributed to a substantial reduction in average PM2.5 levels around the tower (Chen 2018).

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29 Turning Trash into Cash: Colombian company gives coupons for recycled bottles, cans. (2017, Aug 24). In: News.cgtn.com. Retrieved from https://news.cgtn.com/news/3d3d674d79674464776c6d636a4e6e62684a4856/share_p.html. Accessed 9 Jan 2020.
30 Solid approach to waste: how 5 cities are beating pollution. (2017, Nov 22). In: UN Environment. Retrieved from https://www.unenvironment.org/news-and-stories/story/solid-approach-waste-how-5-cities-are-beating-pollution. Accessed 9 Jan 2020.
31 China Is Building Asia’s First Vertical Forest to Fight Air Pollution. (2017, Feb 21). In: Interestingengineering.com. Retrieved from https://interestingengineering.com/china-vertical-forest-fight-air-pollution. Accessed 9 Jan 2020.
Copenhagen in Denmark has invested significantly in cycling infrastructure. In fact, there are five times as many bikes in Copenhagen as cars. The enabling infrastructure for encouraging cycling includes innovative bridges and super-cycling highways. It has been estimated that for every kilometer someone rides on their bike in Copenhagen, the city experiences an economic gain of 75 cents (Fleming 2018). Cities like Madrid, New York, and London too are imposing restricted bans on usage of cars. In Paris, the first Sunday of every month is car-free. Many cities around the world plan to phase out diesel cars over the next few years (Bendix 2019).

### 14.6 Building a Resilient Public and Preventive Health System

The science of public health, which is the primary tool for disease prevention and health protection, does not have concerted institutional mechanisms for its implementation in India. While there are several strategies implemented under the various national health programs that address disease prevention, an area that is largely missed is that of health promotion through targeting behavioral risk factors for disease, as well as determinants of health that often lie outside the purview of health departments, including environmental and social determinants. According to the Global Burden of Disease Study, 2010, the top 15 risk factors contributing to India’s disease burden include, among others, dietary factors, household and ambient air pollution, smoking, high blood pressure, occupational risks, alcohol use, physical inactivity, high body mass index, high total cholesterol, and sanitation.

A robust public health system is a must for better preparedness, as well as mitigating the impact of climate change and pollution on human health. Climate change is putting health systems around the world to test (Agarwal and Bass 2019). In India, changing weather patterns such as rising temperatures, extreme rainfall, and flooding are causing sudden and often unpredictable outbreaks of various diseases. For instance, the first major outbreak of dengue occurred in Chhattisgarh in 2018, which was rare for the region based on historical trends. In the same year, Kerala suffered its worst episode of flooding in 100 years. This, in turn, challenged the health system with outbreaks of a range of water-borne and vector-borne ailments.

Much like other low- and middle-income countries, India too, historically, had a health system, which focuses on vertical disease programs such as malaria, tuberculosis, and human immunodeficiency virus (HIV). However, for tackling the widespread effects of climate change on health, which range from malnutrition to waterborne diseases, lung cancer, and mental health, a resilient and adaptive public health system is the need of the hour. Moreover, in a rapidly urbanizing India, there

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32This section draws on insights from the Health Division Team at NITI Aayog, comprising Mr. Alok Kumar, Adviser; Mr. Sumant Narain, Director; and Dr. Kheya Melo Furtado, Research Assistant.

33Global Burden of Disease (GBD). (2020). In: Institute for Health Metrics and Evaluation. Retrieved from http://www.healthdata.org/gbd. Accessed 10 Jan 2020.
is an urgent need for a strong public health system, as the risk of disease outbreaks and spreading of contagion are much higher in densely populated urban areas. It took a significant human cost and sociopolitical crisis after the severe acute respiratory syndrome (SARS) outbreak for China to boost investments in public health and disease monitoring on a priority basis. A strong public health system would exemplify several elements, including an emphasis on ensuring the continuum of care, effective surveillance systems, disaster preparedness plans, and adequately trained health personnel at every level. Without a robust public health system, morbidity and mortality caused by climate change will continue to worsen.

Experiences from nineteenth-century Europe, Japan in the early twentieth century, China, Sri Lanka and closer home from Tamil Nadu provide a compelling case for investing in public and preventive health. This approach is particularly relevant for India as it works well for both communicable and non-communicable diseases. In addition to the cost-effectiveness of public health interventions, the case for government investment in this area is buttressed by the fact that it is a pure public good and will therefore be under-provided in any market mechanism. Thus, in order to optimize limited resources, it is important for the government to assure public and preventive health in a comprehensive manner, while other services can be implemented by the private sector either exclusively or with monitoring from the government.

Unfortunately, the Government in India has inadvertently deemphasized public health programs through a series of policy decisions. For instance, in 1943, the Bhore Committee recommended the amalgamation of the medical and public health services, resulting in career incentives for the latter being done away with. The Madras presidency dissented to this, and the strong performance of Tamil Nadu on various public health indicators is considered to be largely due to this decision. Additionally, disease-specific programs for targeting high-priority conditions were introduced, but they diverted attention from the provision of public and preventive health services. Further, the concept of a multipurpose worker was developed by merging the roles of sanitary workers with disease-specific workers. This, in turn, resulted in lower priority being accorded to environmental health services. Another crucial action was the separation of nutrition, water, and sanitation from the department of health.

While the National Health Mission’s (NHM) focus on health system strengthening did make some course corrections, it has perhaps not gone far enough. We believe that the government would be failing in its stewardship role if it does not accord top priority to establishing a strong public health system. This also implies that expenditure on public health should be the first charge on government expenditure on health.

Bringing public health to the center stage would require the creation of a designated focal point within the Union Health Ministry to deal with public health functions. The functions would include disease surveillance and response, monitoring of health status, informing the public, providing evidence for public health action, as well as enforcing public health regulation. A number of these functions are especially relevant for promoting consciousness among citizens about the
environment as well as protecting public health from the deleterious effects of climate change.

A counterpart to the focal point in the Union Health Ministry will need to be established in every state. This body should be autonomous and empowered to enforce compliance from other public authorities and citizens. Without this, it will not be effective in its role since action is often required from multiple stakeholders to establish accountability and achieve a measurable impact on population health. For example, control of dengue/chikungunya is highly dependent on proper enforcement of building regulations to prevent clean stagnant water collection. The authority to enforce such regulations does not rest with the Health Department, and mere fogging after breeding sites are established is insufficient to control the spread of the mosquito vector. Similarly, the toxic levels of air pollution experienced in major cities and directly impacting respiratory health require action with respect to regulation of construction site practices, vehicular regulation, etc. Road traffic injuries are a major public health concern in India; however, health departments can do little to put in place the required preventive interventions, since road and traffic legislations do not fall within their ambit.

The specific powers that will need to be vested in this public health focal point include assigning responsibility to different levels of government and agencies with specifications about the source of funding for discharging their duties, as well as taking action for protecting public health, including powers of regulation, oversight, and inspection and use of such powers in situations of “public health nuisances.” For instance, health facilities that dispose potentially harmful waste inappropriately should be held accountable as should residential colonies that allow water to stagnate, providing breeding grounds for mosquitoes that spread dengue and malaria. Other necessary powers include setting standards or overseeing bodies that set standards for food, hygiene, water quality, sanitary practices, and the environment.

The success of the state-level focal points for public health would be critically dependent on financing and the availability of motivated and capable human resources. To this end, it would be essential for the central government to partner with state governments for creating a dedicated structure for public health at the state, district, block, and village levels (Fig. 14.1). This may be largely achieved by ensuring that existing personnel have the requisite skill sets with the need for only minimal additional staff. The required skills include the ability to integrate health with the key social determinants, carry out community surveillance, analyze data, and enable public participation. Currently, expertise in the discipline of public health is limited with a majority of posts in the central health service belonging to the teaching, nonteaching, and general duty medical officers sub-cadres and a smaller percentage to the Public Health sub-cadre. In addition, frontline health workers such as accredited social health activists (ASHAs), auxiliary nurse midwives (ANMs), and multi-purpose workers (MPWs) must be trained to deliver effective health promotion information and effect behavioral change.

Postgraduate training of in-service officers may be carried out to improve capacities in the management and delivery of public health services. Additionally,
Fig. 14.1 Illustrative design of public health cadre. (Source: NITI Aayog and McKinsey)
while the setting up of public health cadres should be prioritized in the short term, the establishment of an All India Public Health Service should be explored in the longer term.

Making population-level data available at required periodicity is critical. Data on the population prevalence of risk factors, as well as complete disease/health outcome data are not made available regularly to guide public health and health system action. Unless risk factors and disease data are available, we will not know what to budget for or what health resources are needed. Timely use of the data for local-level decision-making, identifying emerging health threats, and for shaping larger health strategies for the country is vital. These data must also be regularly published and publicized so as to make them available to the common man, thereby making health and health issues central to public discourse and creating demand for its provision. For this, institutions at the state level would need to be set up with the capacity to generate the required data, at district levels of disaggregation, on a regular basis. In several states, academic institutions are involved in providing public health education to in-service government officers of the health departments. These institutions could also be engaged in data collection, analysis, and interpretation according to uniform protocols to ensure comparability across states.

Another crucial public health function that needs to be strengthened is disease surveillance and response at the urban ward/rural block level. The ability of the current health system in India to detect disease outbreaks early, especially those that are unforeseen or difficult to anticipate, given changes in climate patterns, and initiate a coordinated response is inadequate. Developing countries such as China paid the human cost of large-scale pandemics such as SARS before efficient surveillance systems were instituted. In India, disease estimates are affected by incomplete surveillance data captured as part of national programs. This is largely since cases recorded in these databases are restricted to those accessing services in public health care facilities, and the larger proportion of cases accessing care in private health care facilities remain largely unreported. With the exception of HIV (sentinel surveillance) and polio surveillance, denominator-based data are unavailable for infectious diseases. Measures to integrate private sector health facilities in disease reporting as part of regular surveillance systems is an impending priority. For this purpose, disease surveillance activities must be coordinated at the district level, with block-level managers being responsible for recruiting the appropriate number of private sector providers into a surveillance network. A 6-month pilot study at each block (or ward level in cities) would provide sufficient information on which private sector health providers are appropriate to include in the surveillance network. Lessons from the polio surveillance program must be utilized to develop an appropriate integrated surveillance system for all diseases. This is linked to the need for strengthening the role of the National Centre for Disease Control to coordinate disease surveillance and control and empower the body sufficiently to perform this function in the context of outbreaks and emergencies. This includes providing dedicated staffing for the implementation of all surveillance and response-related activities to translate into what was achieved for polio surveillance and its ultimate elimination, in an integrated manner.
One of the major challenges, however, is the inability of these systems to interact with each other, leading to the formation of multiple and disassociated clusters of information across programs. This has happened as a consequence of lack of standards for health records and consistent design principles, as well as the absence of a strategic vision for developing a nationwide system. Surveillance data are generated through multiple vertical disease surveillance systems and the Integrated Disease Surveillance Project, which is not adequately integrated with these programs. There are also issues related to the use of data at all levels and the extent to which it informs program planning and implementation. Further, there is incomplete disease reporting from the private sector and urban areas.

14.7 Role of *Ayushman Bharat* in Building a Climate-Resilient Health System

*Ayushman Bharat* has two key pillars—Health and Wellness Centers (HWCs) and the *Pradhan Mantri Jan Arogya Yojana* (PM-JAY) for providing comprehensive primary health care and health insurance, respectively (Fig. 14.2). Both these initiatives have a key role to play in building a strong health system that is resilient to the adverse effects of climate change.

The existing Primary Health Center (PHC) model in the country is limited in scope. Even where there is a well-functioning public PHC, only services related to pregnancy care, limited child care, and certain services related to national health programs are provided, which represent only 15% of all morbidities for which people seek care. Global evidence points to the fact that a selective model of primary health care cannot respond adequately to the interrelationship between health and socioeconomic development (Magnussen et al. 2004).

![Fig. 14.2 Comprehensive primary health care and financial protection – Pillars of Universal Health Coverage](image)
In this context, by providing a comprehensive package of primary care services, HWCs (Fig. 14.3) will promote healthy lifestyles as well as ensure that chronic diseases are detected early. Tackling non-communicable diseases is all about prevention in the first place. It requires lifestyle and community-level interventions. However, of the total current expenditure on health classified by health care functions, preventive care accounts for a meager 6.7%. The money spent on curing people, on the other hand, is 51% of the expenditure. This approach also makes tremendous sense because we continue to face a high burden of malnutrition, tuberculosis, respiratory infections, and neonatal conditions, all of which are preventable or treatable at a low cost.

Data from the United States shows that emphasizing primary care reaped rich dividends in the form of a 36% reduction in the days spent in hospital, a 42% decline in emergency admissions, as well as a 25% increase in childhood vaccination (Sujatha Rao 2017). Countries like Brazil and Estonia have also improved their health outcomes significantly by focusing on primary health care, in addition to other measures. In fact, comprehensive primary health care is at the core of any universal coverage system, and it is perhaps why developed nations such as the United Kingdom, Australia, Canada, Netherlands, and Sweden spend 80–90% of the federal health care budgets on primary care.

Thus, we can expect that if implemented well, the comprehensive primary health system built on the foundation of 150,000 HWCs will produce outcomes such as a reduced disease burden, lengthened life expectancies, reduction in emergencies and

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34 Ministry of Health and Family Welfare (2017) National Health Accounts: Estimates for India. National Health Systems Resource Centre, Government of India.
hospitalizations, as well as averting of avoidable morbidity. A team led by a mid-level health provider35 (MLP) along with ANMs, ASHAs, and a male health worker will be responsible for catering to a population size of 5000 each and managing the comprehensive primary health care system. This team can also play an important role in making people aware of the health risks of climate change and identifying the early signs of disease outbreaks that occur in the aftermath of weather changes, leading to extreme heat or flooding, for instance.

Despite all efforts to promote good health and prevent disease, some individuals will inevitably fall sick. PM-JAY will ensure that the most vulnerable and poor families in the country are able to access the requisite secondary and tertiary care services on such occasions by strengthening the public health sector and creating effective demand to trigger private investments in supply deficit areas. India’s out-of-pocket expenditure (OOPE) is 62%, which places the country at 182 out of 191 countries. Nearly 80 million people are pushed into poverty due to catastrophic health expenses. Since PM-JAY covers most secondary and tertiary services without any co-payment from poor families, it can play an important role in reducing OOPE.

A study of Askeskin, Indonesia’s largest health insurance scheme that covered about 76.4 million people (34%) in 2007, showed that it had a protective effect on OOPE (Aji et al. 2013). The scheme had a generous benefits package, covering almost all types of care with no cost-sharing policy. While initially focusing on the poorest families, PM-JAY can eventually be expanded to also include families that are “nonpoor” but equally vulnerable to falling into poverty each year due to medical expenses. A strong insurance system is a key pillar of universal health coverage that will allow people to receive treatment for illnesses, including those that might occur unexpectedly due to sudden changes in weather patterns, for instance, without experiencing financial distress and getting pushed into poverty.

14.8 Conclusion

There is no doubt that climate change and air pollution are leading to serious consequences for human health and well-being. In an interconnected world, global cooperation on this issue is a must, especially since the poor in developing countries often bear the brunt of actions taken largely by the developed world. At a national level, there is a growing recognition of the seriousness of this challenge in India, across stakeholders and sectors. Several initiatives have been launched; however, their implementation needs to be ensured across the country in a consistent manner. There is also a lot that we can learn from global good practices and adapt them to the Indian context. Finally, while decisive and strong action by the government and policymakers is key, businesses, civil society, and citizens too must play their part. Only then will we be able to ensure that the deleterious impact of climate change and

35With a degree in Nursing, AYUSH or Community Health, and with required training in public health and primary care.
air pollution is prevented or minimized at the very least and good health for all is achieved.

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