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Evaluating Environmental Awareness, Attitudes and Perceptions of Urban Residents for Sustainable Environmental Management in Chandrapur District (MS), India

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Abstract

Environmental awareness and public perception are vital components in shaping effective strategies for sustainable environmental management, especially in rapidly urbanizing regions. This study assesses the awareness, attitudes, and perceptions of urban residents in Chandrapur district, Maharashtra, India—an area significantly impacted by industrial emissions, vehicular exhaust, and mining activities. A structured questionnaire survey was conducted among 376 participants to document demographic profiles, understanding of environmental issues, perceived sources of pollution, and preferred control measures. Findings revealed moderate to high levels of awareness, with 76% of respondents recognizing the adverse effects of air pollution on human health, particularly respiratory and cardiovascular systems. Industries (42.55%) and automobiles (14.09%) were perceived as the dominant contributors to urban air pollution. Industrial emission control (43.35%) and the adoption of renewable energy (9.04%) were considered the most effective mitigation strategies, while enhancing public transport, promoting electric mobility, and advancing waste-to-energy initiatives were also strongly supported. Interestingly, while policymakers often prioritize awareness campaigns, participants emphasized the importance of regulatory enforcement and technological improvements for long-term impact. These insights highlight the critical need to integrate public perceptions into policy frameworks to develop locally relevant and socially acceptable interventions. Strengthening industrial regulation, promoting clean energy transitions, and advancing sustainable transport—complemented by awareness initiatives—can help Chandrapur move toward effective and participatory environmental governance.

Keywords: *Environmental awareness, public perception, air pollution, sustainable management, Chandrapur, Maharashtra.*

1. Introduction

Over the past few decades, the global environment has undergone profound transformations, exposing humanity to escalating environmental degradation and associated health risks. Human activities—ranging from industrial operations to vehicular emissions—contaminate soil, water, and air, destabilizing essential ecosystem functions [1]. While the Industrial Revolution catalysed technological and societal advancements, it simultaneously triggered pervasive air pollution with long-lasting consequences for human health [2]. Today, air pollution is recognized as one of the most severe environmental health challenges, responsible for approximately 7 million premature deaths annually worldwide—ranking second only to hypertension as a leading global risk factor [1,3]. Furthermore, a comprehensive analysis determined that ambient air pollution shortened the average global life expectancy by about 1 year and 8 months in 2019, with fine particles ($PM_{2.5}$) contributing the most significant share of this loss [4,5].The health burden of air pollution is disproportionately borne by low- and middle-income countries, especially in South Asia—regions characterized by rapid urbanization, industrial growth, and high population density [1,6].The global onset of the COVID-19 pandemic created an inadvertent environmental experiment. Nationwide lockdowns resulted in sharp declines in anthropogenic emissions. For example, in Delhi, $PM_{2.5}$ levels dropped by approximately 50%, nitrogen dioxide by nearly 52%, and carbon monoxide by roughly 30% in just a few days after lockdown implementation [7,8]. Similar reductions were documented across India and globally, underscoring the dominant role of human activity—particularly traffic and industrial operations—in sustaining poor air quality [9,10]. However, not all reductions were sustained: statewide declines in $PM_{2.5}$ concentrations were not always statistically significant, highlighting the complexity of pollution dynamics [11].

Wildfires, intensified by climate change, are emerging as another formidable source of hazardous air. A recent study reported that climate-fueled wildfires caused about 15,000 additional deaths in the U.S. between 2006 and 2020, along with an estimated $160 billion in economic losses [12]. These findings stress the expanding interplay between environmental degradation, climate change, and human health.Urban centers in South Asia, including Delhi, continue to suffer chronically high pollution. Despite heavy rainfalls in 2025, Delhi failed to record a single "good air" day (AQI 0–50); the last such reading was back in September 2023 [13]. Persistent baseline pollution and suboptimal emission control policies contribute heavily to this trend.Given the magnitude and persistence of air pollution's impact, understanding public awareness, attitudes, and behaviours concerning environmental issues is more critical than ever. This motivated our random survey assessing public perception of air pollution and mitigation strategies. Prior research suggests a strong correlation between environmental awareness and active public participation in sustainability initiatives [1,6]. Furthermore, heightened environmental consciousness and awareness can precipitate shifts in behaviours and resource use—especially among younger generations—paving the way toward sustainable environmental management [5].

Therefore, the present study aimed to evaluate residents' perceptions, attitudes, and awareness regarding environmental pollution, as well as their environmental concerns about both their immediate surroundings and the broader district environment.

2. Methodology

2.1 Study Area:

The study was conducted across Chandrapur District, located in the southeastern region of Maharashtra, India. Geographically, the district lies between approximately 19.30° N to 20.45° N latitude and 78.46° E longitude (Figure 1), within the Godavari basin and bordered by Nagpur, Bhandara, Wardha, Yawatmal, Gadchiroli, and Adilabad districts (Nag-Vidarbha Chamber of Commerce [14]. It covers an area of about 11,443 km², representing roughly 3.7% of Maharashtra's total geographical area [15].

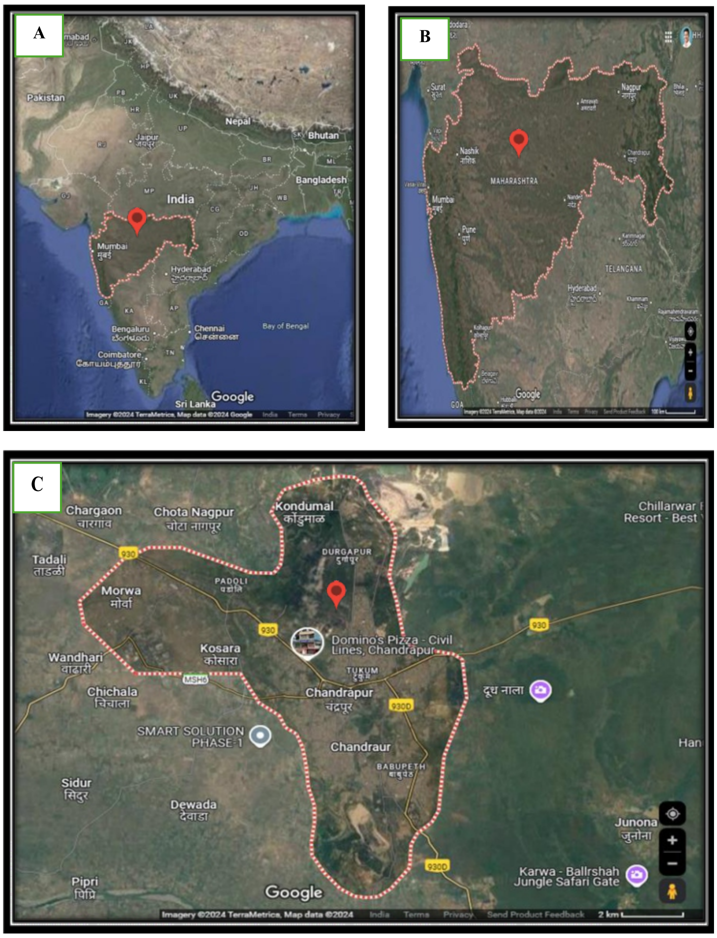

Figure 1: Map showing study area (A-India, B-Maharashtra, C-Chandrapur District)

Chandrapur City, the district headquarters, is known for its rapid urban development, historic temples, bustling traditional marketplaces, and cultural heritage [14]. It attracts migrants from nearby rural areas in search of employment, education, and healthcare facilities, leading to overcrowding and strain on local resources [14].The city faces major environmental challenges, including air and water pollution, unplanned industrialization, climate change effects, and inadequate waste management, largely linked to rapid population growth and insufficient environmental regulation [16]. Chandrapur ranks among India's critically polluted industrial zones, with emissions primarily from the Chandrapur Super Thermal Power Station, coal mining, and cement plants, all contributing to respiratory and cardiovascular health issues [16,17]. Recent assessments indicate that Chandrapur is also climate vulnerable, requiring urgent adaptation strategies [18]. In response, the Chandrapur Municipal Corporation, in collaboration with the Aga Khan Agency for Habitat and Tata Trusts, has launched a three-year urban resilience program involving passive cooling retrofits in low-income housing, flood-risk mapping, and heatwave mitigation measures [19].

2.2 Sampling, surveying, preparing questionnaires, and choosing parameters:

This study examined how select demographic factors—gender, age group, educational attainment, and occupational type—influence public attitudes, perceptions, and environmental awareness. While the research primarily relied on primary data, secondary sources were also included to enrich analysis. To collect primary data, a semi-structured questionnaire was developed through insights from prior studies that emphasize the relevance of socioeconomic variables in shaping environmental consciousness. For instance, a study of Indian consumers found that women demonstrated higher environmental concern and more proactive behavior than men, while education and income were positively associated with environmental awareness [20]. Similarly, research from Bangladesh identified higher education, income, and full-time employment status as significant predictors of environmental concern and behavior; younger and more educated respondents exhibited greater awareness and willingness to act [21]. Leveraging these findings, the questionnaire was crafted in five thematic sections: (1) impact of air pollution, (2) health effects of air pollution, (3) sources of air pollution, (4) pollution control strategies, and (5) application of mitigation measures. A cross-sectional survey was conducted in the Chandrapur District of Maharashtra, India. The sample comprised students, working professionals, and other individuals with awareness of climate change, all of whom completed the online survey hosted via Google Forms.

3. Results and Discussion

3.1 The demographic profile of the participants in the research area

Table 1 presents the demographic characteristics of the 376 individuals surveyed. Among the respondents, 51.86% were male and 48.13% were female (Figure 2). The largest proportion belonged to the 18–35 age group (52.65%), followed by individuals aged 36–59 years (38.82%), while only 8.51% were aged above 60 years. This age distribution aligns with previous surveys reporting higher participation of younger adults in ethnobotanical and socio-cultural studies due to their accessibility and willingness to engage in research [22,23]. Regarding educational attainment, 36.17% had completed undergraduate or postgraduate studies, 29.25% held board-level qualifications, 20.74% had secondary education, and 13.82% had only primary education. Such educational stratification is consistent with patterns observed in rural and semi-urban population-based surveys in South Asia, where literacy rates are steadily improving, particularly at higher education levels [24]. Occupationally, 70.21% of participants were students (school or college), while 15.42% were employed in professional services such as accounting, banking, medicine, engineering, teaching, law, and policing. Farmers constituted 12.23%, and 2.12% were engaged in other occupations. Similar occupational profiles have been documented in demographic surveys, where students and professionals dominate participation, reflecting both accessibility and educational awareness [25].Overall, these findings highlight the diverse representation of age, education, and occupational groups in the survey sample (Table 1).

Table 1: Participants' demographic composition

Parameter	Specification	Frequency (n=376)	Percentage (%)
Gender	Male	195	51.86
	Female	181	48.13
Status	Youth (18–35)	198	52.65
	Adults (36–59)	146	38.82
	Elder (>60)	32	08.51
Education	Primary	52	13.82
	Secondary	78	20.74
	Board	110	29.25
	UG/PG	136	36.17
Occupation	School/Collage Students	264	70.21
	Servants	58	15.42
	Farmers	46	12.23
	Others	08	02.12

3.2 Environmental perceptions and attitudes of the respondents

Approximately 51.86% of the 376 individuals who responded to the Google survey form in the present study were male, and 48.13% were female (Figure 1). The majority of participants indicated awareness of the diverse consequences of air pollution. Reported impacts included agricultural production (12.76%), climate change (29.63%), visibility reduction (20.21%), and effects on human and animal health (43.35%). These findings are consistent with earlier studies highlighting that air pollution significantly influences agricultural productivity, visibility, and ecological sustainability [26,27]. Human health, particularly respiratory function, was perceived as being most negatively affected (47.34%), as shown in Figure 3. This aligns with well-established evidence that exposure to particulate matter (PM2.5 and PM10) and gaseous pollutants increases the prevalence of asthma, bronchitis, and other respiratory diseases [28,29]. Additionally, respondents reported mild impacts on skin (15.69%) and eyes (16.75%) and considerable effects on the cardiovascular system (21.01%)(Figure 3). Prior studies corroborate these findings, linking air pollutants not only to respiratory disorders but also to dermatological issues, ocular irritation, and heightened risks of cardiovascular morbidity and mortality [30,31].Overall, the survey responses emphasize that the population perceives air pollution as a multidimensional threat, with the most severe consequences for human health, particularly respiratory and cardiovascular systems, while also recognizing its broader environmental and agricultural effects.

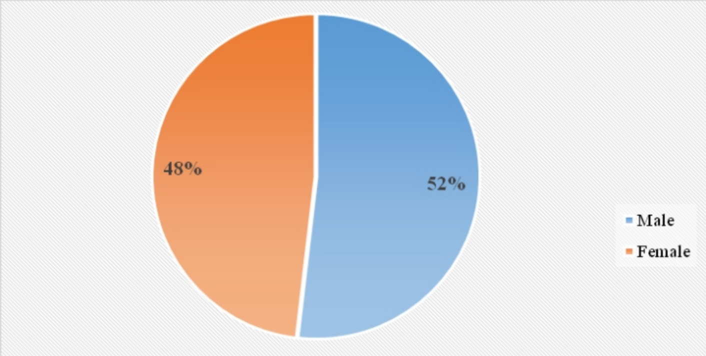

Fig.2: Respondents Involved in Study

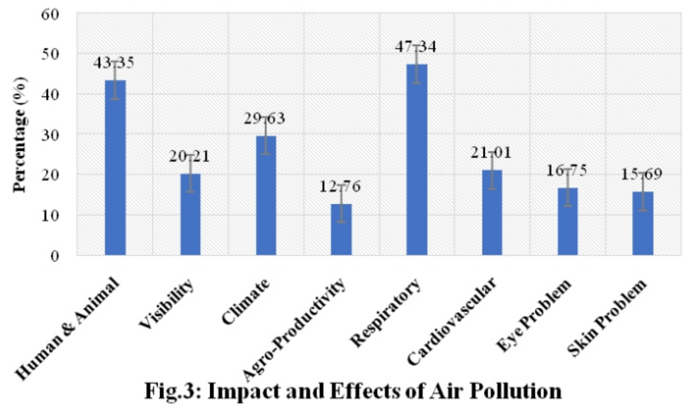

Fig.3: Impact and Effects of Air Pollution

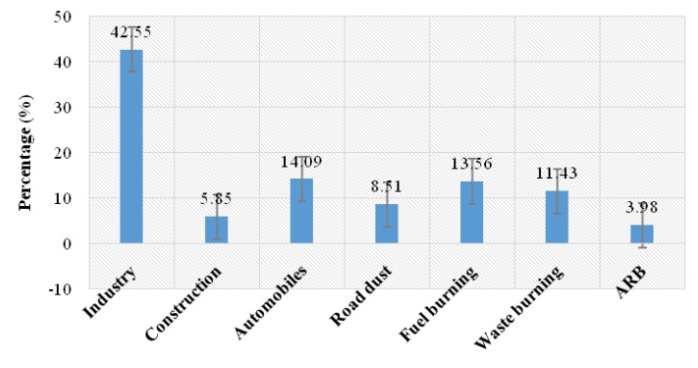

Fig.4: Different Sources of Air Pollution

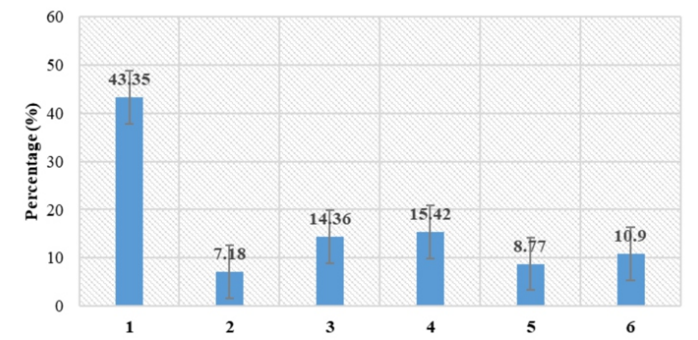

Fig.5: Strategies to Control Air Pollution

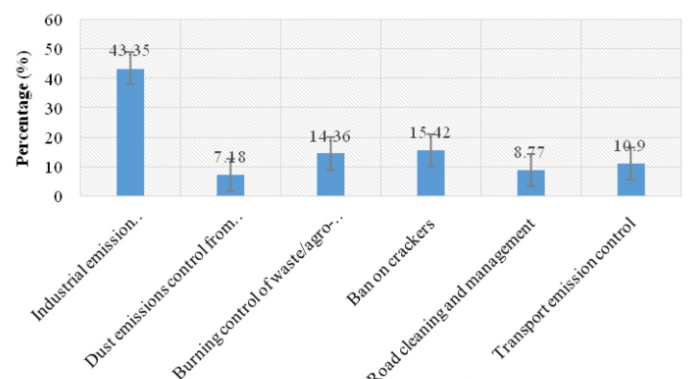

Fig.5: Strategies to Control Air Pollution

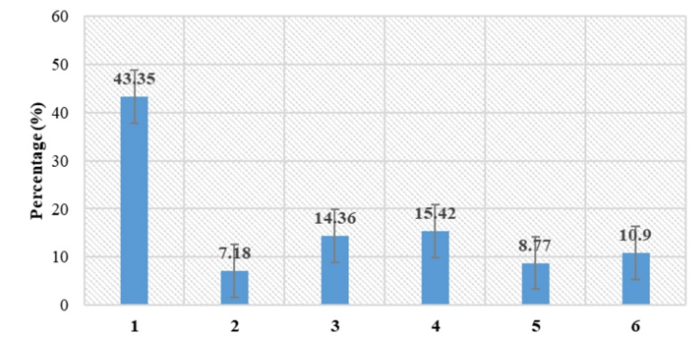

Fig.5: Strategies to Control Air Pollution

According to the perceptions of the surveyed population, industries (42.55%) and automobiles (14.09%) were identified as the primary sources of air pollution in the city, followed by residential fuel burning (13.56%), waste burning (11.43%), road dust (8.51%), and agricultural residue burning (ARB) (3.98%) (Figure 4). These results are consistent with previous studies indicating that industrial emissions and vehicular exhaust are dominant contributors to urban air pollution in South Asian cities [32,33]. Residential biomass burning, municipal waste burning, and road dust have also been widely reported as significant contributors to urban particulate matter concentrations [34,35]. Regarding mitigation strategies, respondents considered industrial emission control (43.35%) to be the most critical measure, followed by banning firecrackers (15.42%), controlling open burning of wastes and agro-residues (14.36%), transport emission control (10.90%), and road cleaning and management (8.77%) (Figure 5). Similar priorities have been emphasized in policy frameworks for Indian cities, where stricter industrial monitoring and restrictions on open burning are seen as crucial interventions [36,37]. The survey further revealed that dust emission control at construction sites (7.18%) was perceived to have the least impact on improving air quality, despite evidence suggesting that construction dust contributes substantially to urban PM10 levels [38].

In terms of long-term strategies, the population highlighted the importance of encouraging waste-to-energy conversion (5.85%), enhancing public transport systems (11.17%) and electric mobility (10.10%), promoting renewable energy (9.04%), improving automobile engine technology (7.71%), introducing clean fuels in automobiles (9.57%), and upgrading industrial processes (39.09%) as indicated in Table 2. These preferences mirror global recommendations for sustainable air quality management, where technological innovation and energy transitions are recognized as essential components [39,40]. While policymakers often emphasize public awareness campaigns as key to pollution control, the present study suggests that the surveyed population also perceives awareness creation as an importantpriority, indicating the need for integrated strategies that combine regulatory, technological, and behavioural interventions.

Table 2: Showing questions asked in the questionnaire to respondents and their responses

Sr. NO.	Questions were asked in the questionnaire to respondents regarding the impact of environmental pollution and awareness.		Response and perceptions of people	
			Frequency (n=376)	Percentage (%)
1.	Impact of air pollution	Human and Animal Health	163	43.35
		Visibility	76	20.21
		Climate	89	29.63
		Agricultural Productivity	48	12.76
2.	Effects of air pollution on human health	Respiratory	178	47.34
		Cardiovascular	79	21.01
		Eye Problem	63	16.75
		Skin Problem	59	15.69
3.	Different sources of air pollution	Industry	160	42.55
		Construction activity	22	05.85
		Automobiles	53	14.09
		Road dust	32	08.51
		Residential fuel burning	51	13.56
		Waste burning	43	11.43
		Agricultural Residue Burning (ARB)	15	03.98
4.	Different strategies to control air pollution	Industrial emission control	163	43.35
		Controlling dust emissions from construction activities	27	07.18
		Controlling open burning of waste/agro-residues	54	14.36

4. Conclusion

The present study highlights the significance of environmental awareness, attitudes, and perceptions of urban residents in shaping sustainable environmental management strategies in Chandrapur district, Maharashtra. Findings revealed that industries and automobiles were perceived as the dominant sources of air pollution, while industrial emission control, renewable energy adoption, and sustainable transport initiatives were identified as key mitigation priorities. These results align with earlier studies suggesting that urban populations are increasingly aware of the health and environmental risks of air pollution and support stricter regulatory measures combined with technological interventions [30,36]. Interestingly, while policymakers frequently emphasize awareness campaigns as primary tools, respondents in this study favoured enforcement of industrial regulations, adoption of cleaner technologies, and improved waste-to-energy systems. This indicates that public perception is shifting from passive awareness toward active demand for structural and policy-based solutions—a trend also observed in other South Asian contexts [24,35]. Overall, integrating public perceptions into environmental policy frameworks can enhance the effectiveness, acceptance, and sustainability of interventions. Strengthening industrial emission standards, expanding renewable energy use, and promoting sustainable mobility—supplemented by continuous awareness programs—can collectively advance environmental quality and public health in Chandrapur. This participatory approach ensures that management strategies are both scientifically sound and socially relevant, fostering long-term sustainability in rapidly urbanizing districts [28,40].

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Authors Contribution: All authors contributed equally.

Conflict of Interest: Nil.

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