IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, April 2025
Impact Factor: 7.67

A Study on the Effectiveness of Environmental Laws and Regulations in Addressing Industrial Pollution in India

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Abstract: *This study evaluates the effectiveness of environmental laws and regulations in mitigating industrial pollution in India. Industrial activities have been a significant contributor to environmental degradation, affecting air, water, and soil quality across the country. India has implemented various laws, such as the Environment Protection Act (1986), the Water (Prevention and Control of Pollution) Act (1974), and the Air (Prevention and Control of Pollution) Act (1981), to address these issues. However, enforcement challenges, regulatory gaps, and compliance issues often undermine the efficacy of these laws. This research uses a mixed-method approach, combining quantitative data on pollution levels with qualitative insights from policy analysis. The data was collected from the public in and around Chennai with a sample size of 205. The tool used for the study was a structured questionnaire. The independent variables included in the study are age, gender, locality, marital status and occupation. The dependent variables are the major factors contributing to industrial pollution, whether existing environmental laws are effective, the major challenges in implementing environmental laws and the best measure for implementation and the rating scale on how high the industrial pollution has contributed to environmental degradation. The findings highlight the need for stronger enforcement mechanisms, increased public participation, and the integration of modern technologies to enhance regulatory effectiveness. This study aims to provide recommendations to ensure sustainable industrial growth while safeguarding the environment in India.*

Keywords: Environmental law, Pollution, Industrialization, Urbanization, Degradation

I. INTRODUCTION

Industrial pollution has emerged as one of the most pressing environmental challenges in India, where rapid industrialization and urbanization have led to significant ecological degradation. The adverse impacts of industrial pollution on air, water, and soil quality pose serious threats to public health, biodiversity, and the overall sustainability of the environment. In response to these growing concerns, the Indian government has enacted several laws and regulations aimed at controlling and mitigating pollution, such as the Environment Protection Act of 1986, the Water (Prevention and Control of Pollution) Act of 1974, and the Air (Prevention and Control of Pollution) Act of 1981. Despite the existence of a robust legal framework, the effectiveness of these environmental regulations in addressing industrial pollution has been questioned. Issues such as weak enforcement, lack of stringent penalties, corruption, and limited public awareness continue to undermine efforts to control industrial emissions and waste. Many industries exploit loopholes in the law or evade regulations due to inadequate monitoring by regulatory agencies. Additionally, India's growing industrial sector, driven by economic development goals, often conflicts with environmental sustainability objectives. This study aims to critically examine the effectiveness of environmental laws and regulations in addressing industrial pollution in India. It will assess the extent to which these laws have succeeded in reducing pollution levels, analyze the role of government agencies in implementing and enforcing regulations, and identify the

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challenges that hinder their effectiveness. By understanding the strengths and limitations of the current regulatory framework, the study seeks to provide insights into potential reforms and strategies that can enhance environmental protection while supporting industrial growth. The research is particularly relevant as India continues to balance its developmental ambitions with the need to protect its natural resources and ensure long-term ecological sustainability.

OBJECTIVES:

- To evaluate the extent to which existing environmental laws and regulations in India effectively mitigate industrial pollution.
- To identify gaps and challenges in the implementation of environmental laws and regulations pertaining to industrial pollution in India.
- To examine the effectiveness of pollution control technologies adopted by industries in compliance with environmental laws in India.

II. REVIEW OF LITERATURE

Thakur (1997), This study examines India's environmental laws and regulations' impact on industrial pollution mitigation. Evaluating enforcement mechanisms and compliance levels, it analyzes policy effectiveness and identifies gaps in implementation. It examines enforcement mechanisms, compliance levels, and stakeholder engagement to identify avenues for policy enhancement.

Divan and Rosencranz (2001), This study explores regulatory frameworks, enforcement practices, and stakeholder engagement to determine areas for improvement. It also evaluates the implementation gaps and enforcement challenges hindering the effectiveness of environmental laws in mitigating industrial pollution and advancing sustainable development goals in India. **Shyam Divan And Armin Rosencranz(2001)**, This book also focused on environmental policy in India and the constitutional and legal provision regarding environmental protection. In his book discussed cases, articles and statutes and interpretation of current cases dealing with a whole range of environmental issues. He has paid special attention to equity issues and to environmental problems of the urban and rural poor and International environmental law and global issues such as global warming, climate change, and GreenHouse Gases effect is also discussed.

Aggarwal (2003) This study examines the effectiveness of environmental laws and regulations in addressing industrial pollution in India and assesses regulatory enforcement, compliance mechanisms, and stakeholder involvement to identify gaps and propose policy reforms. It also assesses the environmental and economic impacts of regulatory interventions aimed at reducing industrial pollution in India.

Kumar Sarkar et al. (2004), This research study examines regulatory enforcement, compliance mechanisms, and stakeholder engagement to evaluate policy effectiveness and recommend improvements. It evaluates the degree of regulatory effectiveness and institutional capacity in addressing industrial pollution challenges in India.

Mark Maslin (2004), has explained global warming and its most critical and controversial issues facing the world 21st century. He has explained some topics and its correlation with the environment, global warming and its impact on climate change and explaining proposed solutions. He has also included a chapter on local solutions and gives important steps that state as well as individuals should go together hand in hand then and then they can achieve their goal.

Clark et al. (2005), This study investigates India's environmental legal framework effectiveness in mitigating industrial pollution. Assessing regulatory enforcement, compliance mechanisms, and stakeholder involvement, it offers insights into policy effectiveness and areas for improvement. It also examines the role of the judiciary in interpreting and enforcing environmental laws to mitigate industrial pollution in India.

Gupta (2006), This research investigates the perceptions and attitudes of industry stakeholders towards environmental regulations and their role in shaping compliance behavior and pollution management practices in India. It assesses regulatory frameworks, enforcement mechanisms, and stakeholder participation to identify opportunities for policy enhancement.

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Mark Stallworthy (2009), in his article principle of inter-general equity and joint environmental justice discourse with necessary responses to the climate change .she argue that environmental justice toward incorporate values into law policy process based on significant perspective of integrity and functioning of societies and participation in the search for numerous issues such as climate related threats global warming. So there is a need to protect the environment.

S.M.K Naqvi and V.Sejian (2010), in their article stated that climate change is a threat to the survival of many species, ecosystem and sustainability of livestock production systems of the world. GreenHouse Gases (CHG), CH4 (Methane) considered to be the largest potential contributor to global warming.

Prabha Kumar Rai Kumar Rai(2013), in their article they have highlighted that impact of climate change is a major problem on productive capacity of soils and in pattern on human settlement. It is linked to human health directly or indirectly. They have explained how climate related environmental change may influence human societies. So there is a need to control it through green India.

Mabobane C.Sebopela, Kola.O.Odeku (2014), in this article researchers have analyzed the modest Comparison of regulatory interventions on climate change in India. South Africa and India, both developing countries, have responsibility, located in countries with or without obligations to reduce emissions to tackle global warming and climate change.

Deepa and Lingappa (2014), This study identifies lessons learned and policy recommendations for enhancing the effectiveness of environmental laws in India and analyzes their impact on industrial pollution reduction. It evaluates enforcement mechanisms, compliance levels, and stakeholder engagement to suggest policy improvements.

Jalpa Rohit Pate (2014), In his paper researcher is going to discuss the goal of effectiveness of the world and its solution. This environmental education within the school system including primary to higher-secondary. There is a need to take efforts to educate the public and other audiences for example-Websites, print materials, media campaigns as well as outdoor education and experiential education.

Dr. Mariamma.A.K (2014), in his research paper he said that the environment is omnipresent so there is a need to protect the environment because of global warming and climate change. Environmental law is an instrument to protect and improve the environment and prevent environmental pollution, so the Indian judiciary is playing a very important role for the protection of the environment. Global warming and climate change is a major problem of today's world.

Poonan Kataria (2015) in her article has stated that nowadays development of the industries are increasing throughout the world is the issue of the ecological imbalances. It is between the natural factor and human activities that are socio ecological crises. i.e. balance between environment and society is broken. There is a need to protect the environment. One of the important issues i.e. global warming and climate change and its harmful impact on the crops and human beings and living creatures. So there is a need to create awareness of the protection of the environment.

Rajesh Kumari (2016) in his article has explained global warming, rising temperature of earth's atmosphere due to climate change. GreenHouse Gases (CHG) are in the atmosphere increasing the temperature of earth. It will affect living creatures and also non living creatures. **Bhattacharyya (2022)**, This study assesses how successful India's environmental laws and regulations are. It makes use of a multidisciplinary methodology to evaluate how well India's environmental laws work to reduce industrial pollution and promote sustainable industrial growth. The study highlights significant obstacles and prospects for enhancing environmental governance and compliance frameworks in India.

Kohli and Menon (2022) This study evaluates the historical trends and regulatory reforms aimed at addressing industrial pollution in India and explores their effectiveness in curbing industrial pollution. It examines regulatory enforcement, compliance mechanisms, and stakeholder collaboration to identify avenues for policy enhancement.

Naseem (2023), This research study scrutinizes the effectiveness of environmental laws and regulations. It evaluates enforcement strategies, institutional capacity, and regulatory compliance to propose policy enhancements. It explores the interconnectedness of environmental laws, industrial practices, and socio-economic dynamics in shaping pollution outcomes and regulatory outcomes in India

III. METHODOLOGY

The research method used here is empirical in nature. The data was collected from the public in and around Chennai by adopting the convenience sampling method, and the sample size was 205. The tool used for the study was a structured

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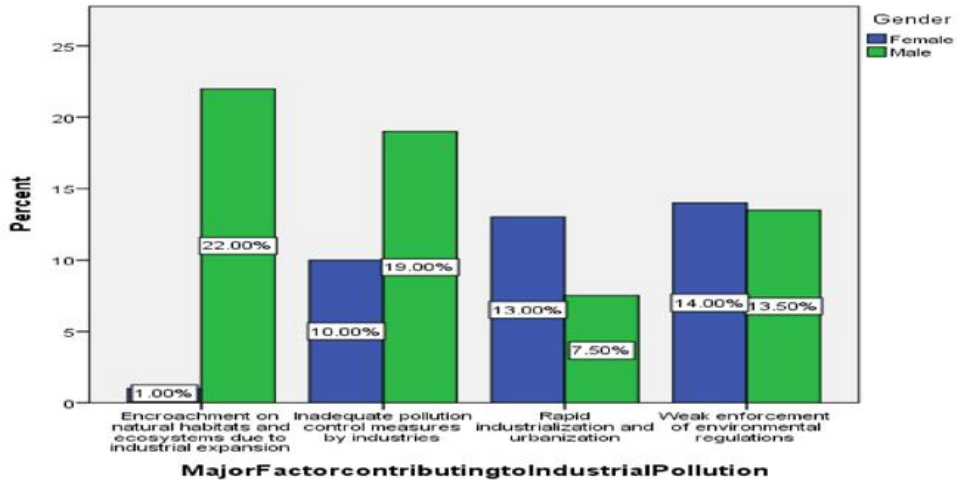
questionnaire. The independent variables included in the study are age, gender, locality, marital status and occupation. The dependent variables are the major factors contributing to industrial pollution, whether existing environmental laws are effective, the major challenges in implementing environmental laws and the best measure for implementation and the rating scale on how high the industrial pollution has contributed to environmental degradation. The data collected were coded and analyzed using the SPSS software.

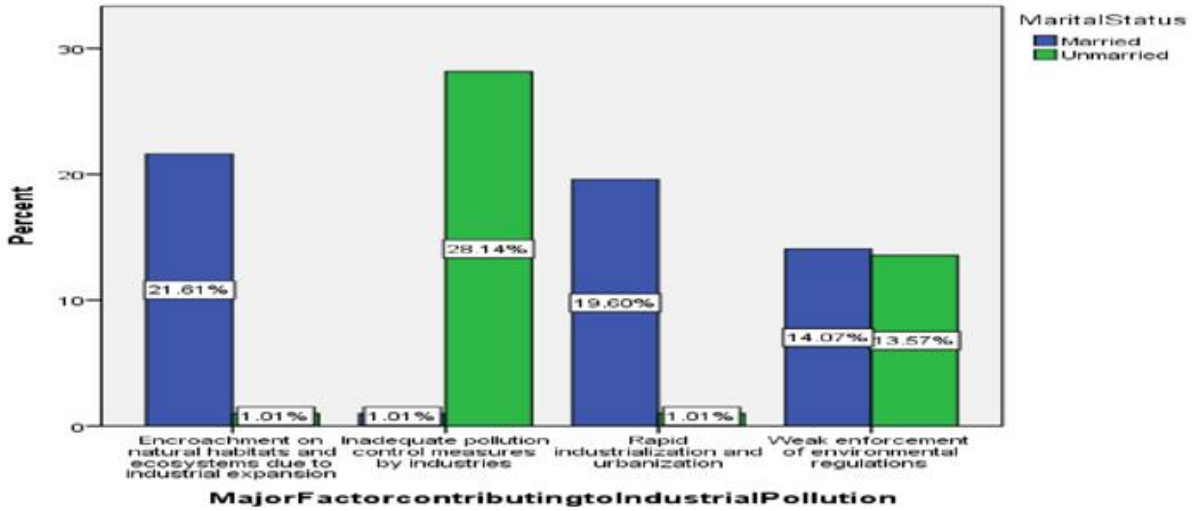
IV. ANALYSIS

FIGURE 1:



LEGEND: Figure 1 shows the major factor contributing to the industrial pollution in India with respect to the gender distribution of the sample population.

FIGURE 2:



LEGEND: Figure 2 shows the major factor contributing to the industrial pollution in India with respect to the marital status of the sample population

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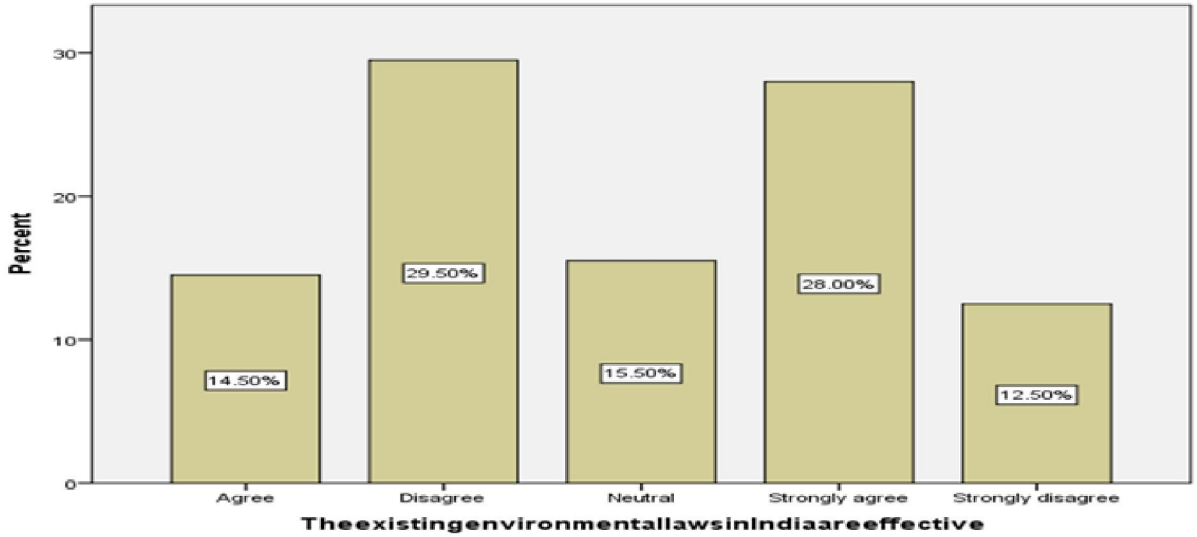
FIGURE 3:

LEGEND: Figure 3 shows the major factor contributing to the industrial pollution in India with respect to the total sample population.

FIGURE 4:



LEGEND: Figure 4 shows whether the existing environmental laws and regulations in India effectively mitigate industrial pollution or not with respect to the total sample population.

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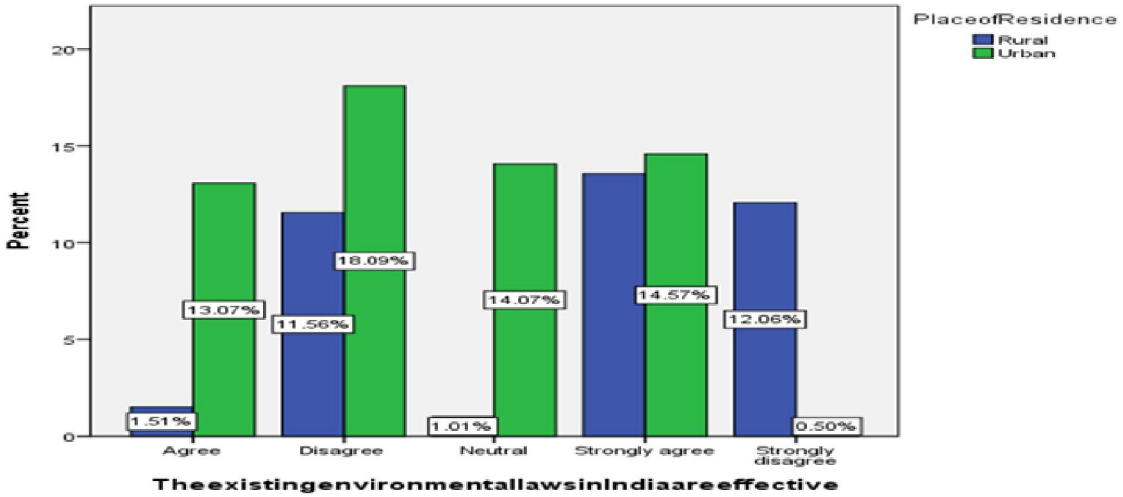
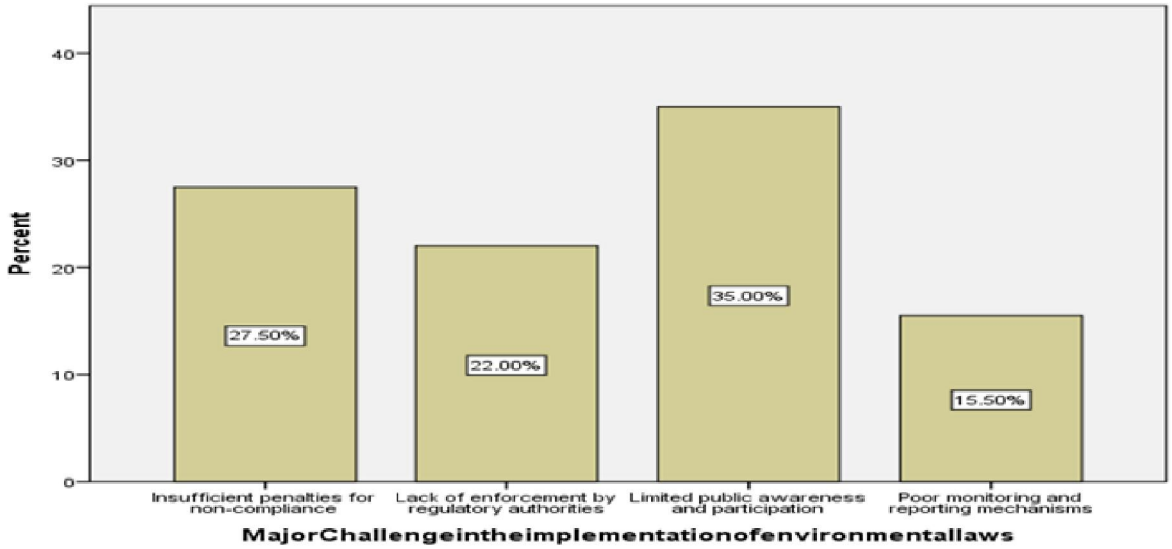
FIGURE 5:



LEGEND: Figure 5 shows the locality of the respondents and their opinion on whether the existing environmental laws in India effectively mitigate industrial pollution or not.

FIGURE 6:



LEGEND: Figure 6 shows the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India with respect to the total sample population. **7:**

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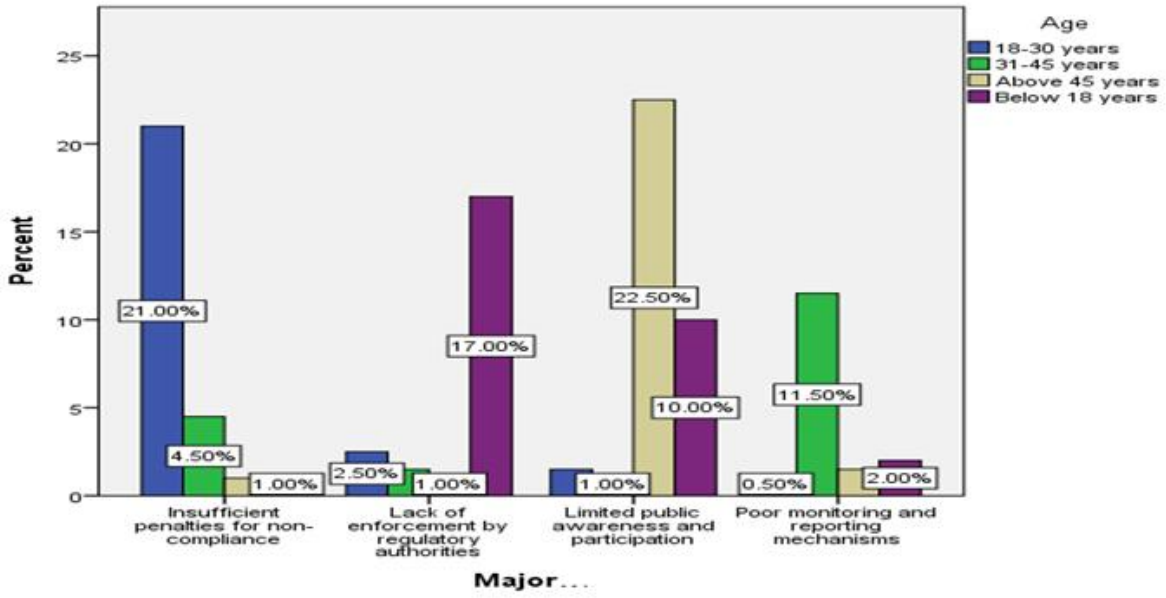
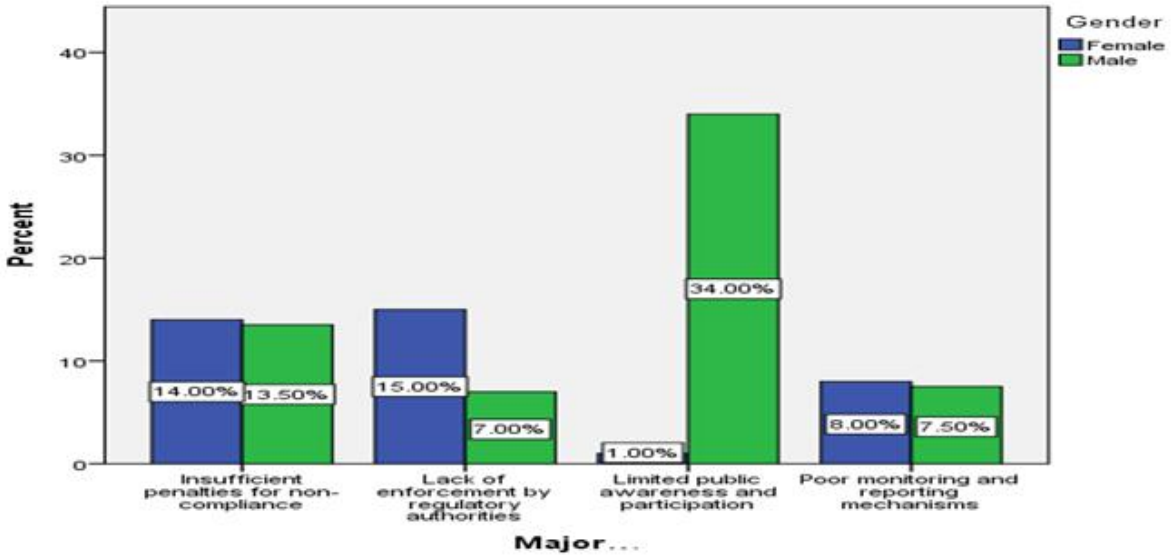
FIGURE 7:



LEGEND: Figure 7 shows the age of the respondents and their view on the major challenge in the implementation of environmental law pertaining to industrial pollution in India.

FIGURE 8:



LEGEND: Figure 8 shows the gender of the respondents and their view on the major challenge in the implementation of environmental law pertaining to industrial pollution in India

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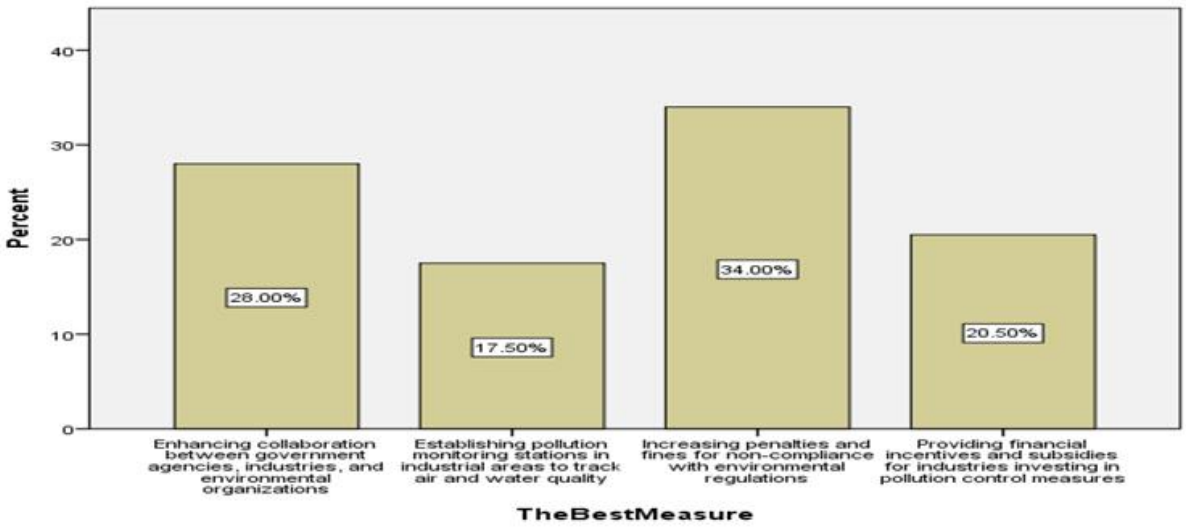
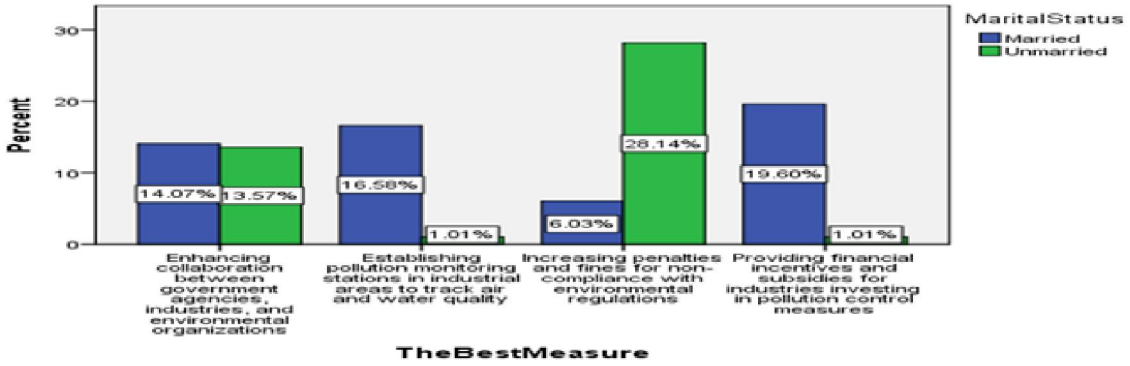
FIGURE 9:



LEGEND: Figure 9 shows the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India with respect to the total sample population.

FIGURE 10:



LEGEND: Figure 10 shows the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India with respect to the marital status of the sample population.

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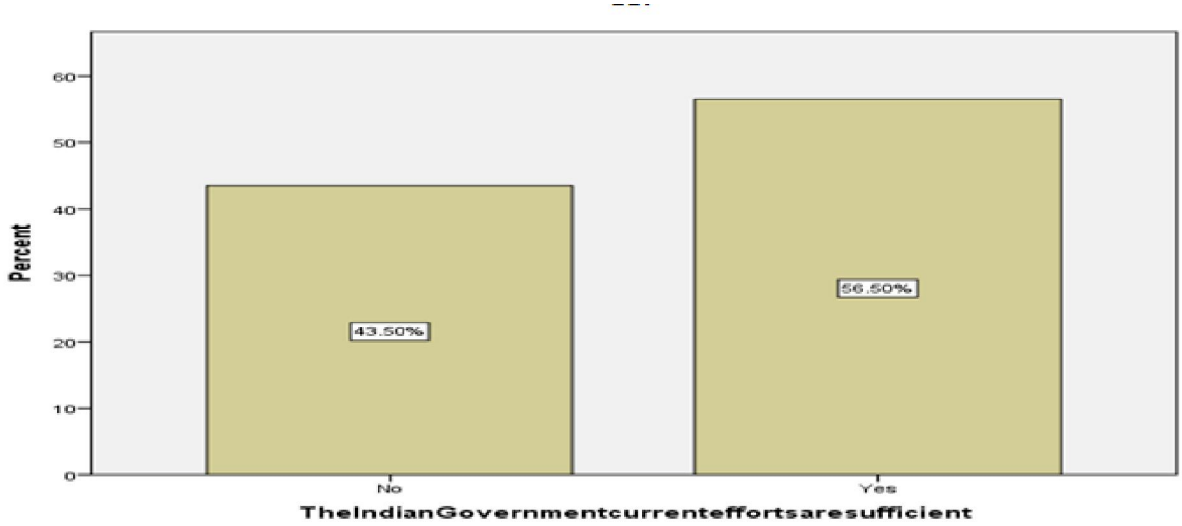
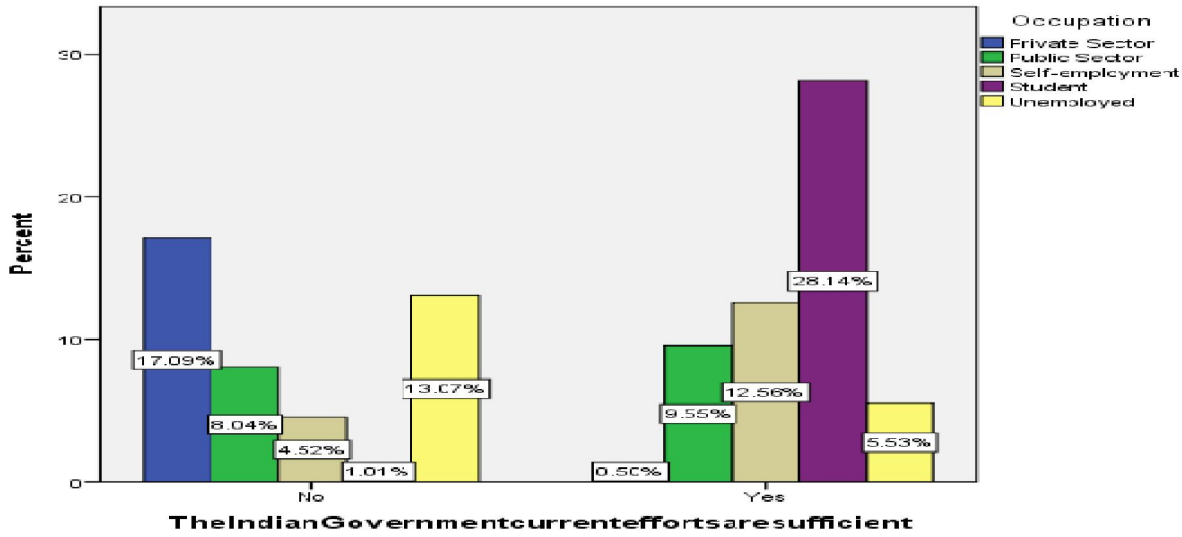
FIGURE 11:



LEGEND: Figure 11 shows whether the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient or not with respect to the total sample population.

FIGURE 12:



LEGEND: Figure 12 shows the occupation of the sample population and their opinion on whether the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient or no

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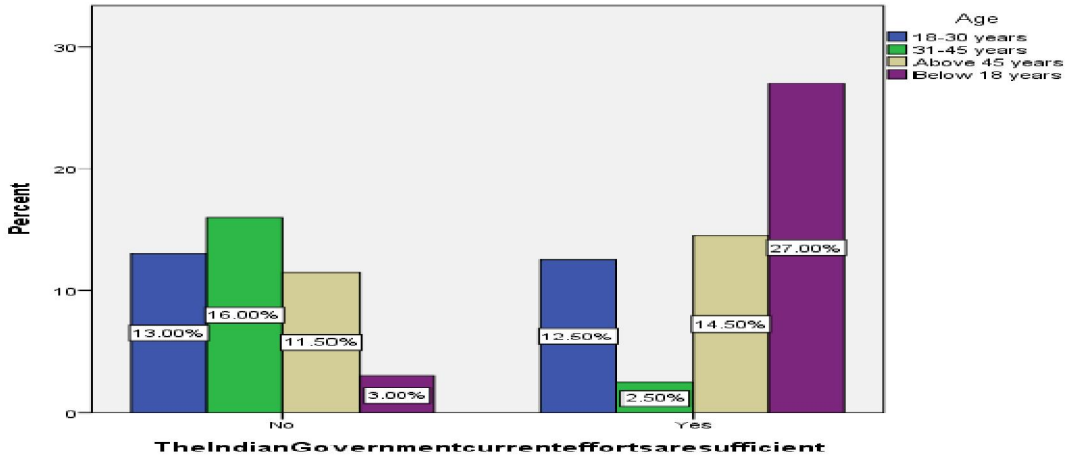
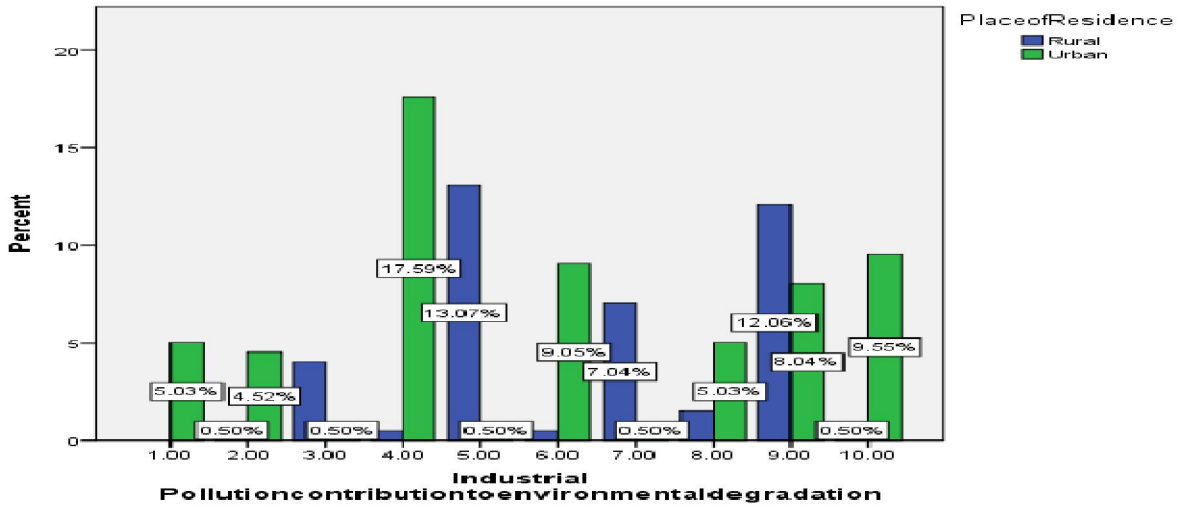
FIGURE 13:



LEGEND: Figure 13 shows whether the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient or not with respect to the age distribution of the sample population.

FIGURE 14:



LEGEND: Figure 14 shows how much industrial pollution has contributed to environmental degradation in India with respect to the place of residence of the sample population with the help of a rating scale

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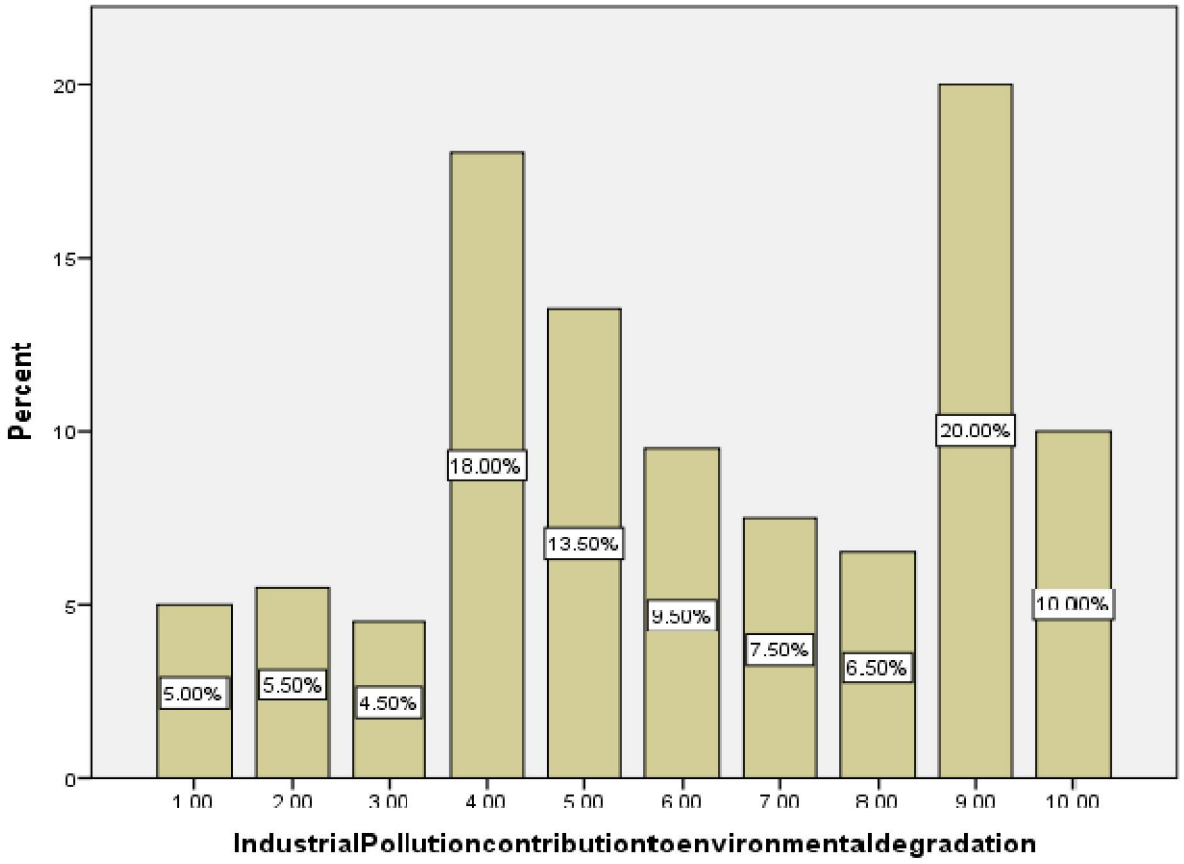

LEGEND: Figure 15 shows how much industrial pollution has contributed to environmental degradation in India with respect to the total sample population with the help of a rating scale.

V. RESULT:

It is revealed that 19.00% of males and 10.00% of females (majority in proportion) chose inadequate pollution control measures by the industries as the major factor contributing to the industrial pollution in India. **(Figure 1)**

It is revealed that 28.14% of married respondents and 1.01% of unmarried respondents (majority in proportion) chose inadequate pollution control measures by the industries as the major factor contributing to the industrial pollution in India. **(Figure 2)**

It is revealed that 29.00% of the total respondents (majority in proportion) chose inadequate pollution control measures by the industries as the major factor contributing to the industrial pollution in India. **(Figure 3)**

It is revealed that 29.50% of the total respondents (majority in proportion) disagreed that the existing environmental laws and regulations in India effectively mitigate industrial pollution.

(Figure 4)

It is revealed that 18.09% of the urban respondents and 11.56% of the rural respondents (majority in proportion) disagreed that the existing environmental laws and regulations in India effectively mitigate industrial pollution. **(Figure 5)**

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It is revealed that 35.00% of the total respondents (majority in proportion) chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India. **(Figure 6)**

It is revealed that 22.50% of the respondents aged above 45 years (majority in proportion) chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India. **(Figure 7)** It is revealed that 34.00% of males and 1.00% of females (majority in proportion) chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India. **(Figure 8)**

It is revealed that 34.00% of the total respondents (majority in proportion) chose increasing penalties and fines for non-compliance with environmental regulations as the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India. **(Figure 9)**

It is revealed that 28.14% of the married respondents and 6.03% of the unmarried respondents
(majority in proportion) chose increasing penalties and fines for non-compliance with environmental regulations as the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India. **(Figure 10)** It is revealed that 56.50% of the total respondents (majority in proportion) responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient. **(Figure 11)**

It is revealed that 28.14% of the students (majority in proportion) responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient. **(Figure 12)**

It is revealed that 27.00% of the respondents aged below 18 years (majority in proportion) responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient. **(Figure 13)**

It is revealed that 12.06% of the rural respondents and 8.04% of the urban respondents (majority in proportion) rated 9 on 10 and responded that industrial pollution has contributed to environmental degradation in India to a greater extent. **(Figure 14)**

It is revealed that 20.00% of the total respondents (majority in proportion) rated 9 on 10 and responded that industrial pollution has contributed to environmental degradation in India to a greater extent. **(Figure 15)**

VI. DISCUSSION:

In **figure 1,** the majority of the respondents chose encroachment on natural habitats and ecosystems due to industrial expansion as the major factor contributing to the industrial pollution in India because lax enforcement of regulations allows industries to prioritize profit over environmental responsibility, leading to unchecked emissions and waste disposal.

In **figure 2,** the majority of the respondents chose inadequate pollution control measures by the industries as the major factor contributing to the industrial pollution in India because insufficient investment in sustainable technologies and reluctance to adopt cleaner practices exacerbate the problem, perpetuating environmental degradation.

In **figure 3,** the majority of the respondents chose inadequate pollution control measures by the industries as the major factor contributing to the industrial pollution in India because the absence of stringent penalties and accountability mechanisms fails to deter industries from disregarding pollution control measures, perpetuating a cycle of environmental harm and public health risks.

In **figure 4,** the majority of the respondents disagreed that the existing environmental laws and regulations in India effectively mitigate industrial pollution because the regulatory framework often fails to address the complexities of industrial pollution, leading to loopholes and inadequate measures that allow pollution to persist and worsen over time, exacerbating environmental degradation and public health risks.

In **figure 5,** the majority of the respondents disagreed that the existing environmental laws and regulations in India effectively mitigate industrial pollution because the enforcement mechanisms of existing environmental laws in India often lack proper monitoring, allowing industries to flout regulations with impunity.

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In **figure 6,** the majority of the respondents chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India because limited public awareness leads to a lack of understanding among citizens about their rights and the implications of environmental laws.

In **figure 7,** the majority of the respondents chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India because without active public participation, enforcing regulations becomes difficult, and industries might not face enough pressure to comply with environmental standards.

In **figure 8,** the majority of the respondents chose limited public awareness and participation as the major challenge in the implementation of environmental laws and regulations pertaining to industrial pollution in India because raising awareness and encouraging involvement empower communities to hold industries accountable, fostering a culture of environmental responsibility and ensuring effective implementation of regulations.

In **figure 9,** the majority of the respondents chose increasing penalties and fines for non-compliance with environmental regulations as the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India because stricter financial repercussions create a stronger deterrent against industrial pollution.

In **figure 10,** the majority of the respondents chose increasing penalties and fines for non-compliance with environmental regulations as the best measure that should be taken to improve the effectiveness of environmental laws and regulations in addressing industrial pollution in India because the prospect of substantial financial losses often prompts industries to invest in cleaner technologies and adopt sustainable practices, aligning their operations with environmental laws.

In **figure 11,** the majority of the respondents responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient because currently the Indian government has implemented a series of stringent environmental laws and regulations aimed at curbing industrial pollution, many perceive these efforts as adequate.

In **figure 12,** the majority of the respondents responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient because the government's recent initiatives to enforce compliance and hold polluting industries accountable have garnered support from various sectors.

In **figure 13,** the majority of the respondents responded yes and agreed that the Indian government's current efforts in addressing industrial pollution through environmental laws and regulations are sufficient because the belief in the sufficiency of the recent measures taken by the government reflects a trust in the government's ability to address environmental concerns effectively.

In **figure 14,** the majority of the respondents rated 9 on 10 and responded that industrial pollution has contributed to environmental degradation in India to a greater extent because industrial pollution in India has reached alarming levels, evident through rising air and water pollution indexes, affecting both human health and ecosystem integrity.

In **figure 15,** the majority of the respondents rated 9 on 10 and responded that industrial pollution has contributed to environmental degradation in India to a greater extent because industrial activities often bypass regulatory standards, exacerbating pollution concerns and causing long-term damage to the environment.

VII. RECOMMENDATIONS:

Enhance capacity of regulatory agencies: Provide additional funding, resources, and technical training to the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) in hiring more staff and providing specialized training on pollution control technologies and compliance monitoring.

Increase the frequency of inspections: Regular and surprise inspections of industrial units should be conducted to ensure compliance with environmental standards.

Independent monitoring mechanisms: Establish independent bodies to monitor industrial pollution and ensure regulatory agencies act impartially, free from political or industrial influence.

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Simplify compliance processes: Streamline regulatory processes and reduce bureaucratic delays, making it easier for industries to comply with environmental regulations while eliminating opportunities for corruption.

Incentivize clean technologies: Introduce government incentives, such as tax breaks or subsidies, for industries that adopt cleaner and more efficient technologies. Encouraging the use of pollution control equipment like scrubbers, filters, and effluent treatment plants can help reduce emissions and waste.

Increase fines for non-compliance: The fines and penalties for violating environmental laws should be increased significantly to deter industries from polluting. The current penalties are often too low to act as effective deterrents.

Fast-track environmental cases: Establish special environmental courts or fast-track mechanisms for addressing industrial pollution cases to expedite legal proceedings and ensure timely justice.

Increase environmental awareness campaigns: Launch nationwide public awareness campaigns to educate citizens about the harmful effects of industrial pollution and their rights to a clean environment. This can foster stronger civil society engagement in holding industries and regulators accountable.

Green certification programs: Promote green certification and eco-labeling for industries that meet higher environmental standards. Such programs can motivate industries to adopt sustainable practices and gain a competitive edge in the market.

VIII. LIMITATIONS:

One of the major limitations faced was the time. The questionnaire has been answered by male respondents, who constitute the main users. The survey had been conducted in a particular area and could not be extended further due to the time limit. The study has a limited sample size of 205, which limits the generalizability of the findings to the larger population. Certain limits could not be avoided yet tried to reduce it without causing any damage to the reliability of the research work. Lastly, it is difficult to judge whether the respondents who participated in the survey gave a true reply or not.

IX. CONCLUSION:

This study highlights the critical need to strengthen the effectiveness of environmental laws and regulations in addressing industrial pollution in India. While India has a comprehensive legal framework aimed at controlling pollution from industries, the actual implementation and enforcement of these laws remain inconsistent and often inadequate. The study reveals that while certain sectors and regions have shown progress in reducing pollution, widespread non-compliance and the exploitation of regulatory loopholes continue to pose major barriers. Additionally, insufficient monitoring and weak enforcement mechanisms have allowed many industries to evade accountability. The role of the judiciary, through public interest litigations and judicial activism, has been crucial in holding industries accountable, yet the systemic issues within regulatory institutions need urgent attention. To enhance the effectiveness of environmental laws, the study recommends several key reforms. These include stricter enforcement protocols, increased transparency, and greater public participation in monitoring industrial pollution. Leveraging modern technologies like real-time monitoring and adopting global best practices in pollution control can significantly improve compliance. Moreover, policy reforms must strike a balance between industrial growth and environmental sustainability, ensuring that economic development does not come at the cost of environmental health. While India's legal framework for environmental protection is robust in theory, its effectiveness in practice requires substantial improvement. Strengthening regulatory agencies, fostering greater accountability, and adopting a multi-stakeholder approach that includes government, industry, and civil society are essential steps toward achieving a cleaner and more sustainable industrial sector in India.

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IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 2, April 2025
Impact Factor: 7.67

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DOI: 10.48175/568