



ASSESSING THE ENVIRONMENTAL SUSTAINABILITY OF HARYANA'S INDUSTRIALIZATION: A CASE STUDY

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ABSTRACT

Increased industrialisation and digitalization have contributed to economic growth around the world. New technology and more efficient production procedures have emerged as a result. The high pace of industrialisation has also resulted in significant shifts in the global distribution of consumer demand. These shifts in focus have greatly increased the prevalence of items and practises that have devastating effects on the natural world. The financial and environmental stability of today's markets are profoundly affected by the revolutionary changes brought about by these environmental consequences. The effects of industrialization on Haryana's environment are the focus of this research. Finding out how industrialization affects environmental sustainability is a primary motivation for this study. The author has done interviews to gather data for qualitative analysis, and raw data has been gathered to aid in quantitative analysis, therefore the study methodology is a mix of qualitative and quantitative methodologies. To better achieve a sustainable and balanced approach to industrial development in Haryana and possibly as a model for similar regions globally, the findings of this study contribute valuable insights to policymakers, industry stakeholders, and environmental advocates.

Keywords: *Environment, Environmental sustainability, Industrialization, Technology, Infrastructure, Capital investment, Haryana.*

1. INTRODUCTION

Pollution of India's air, water, and land is mostly attributable to the country's industrial sector. While recent political reforms in India bode well for industrial expansion, we must also take greater precautions to avoid the risks inherent in the sector. Industrial sector has not improved much despite Bhopal disaster, one of the worst in history, occurring in 1984. About 8,000 people lost their lives throughout the course of the three days. After three decades, thousands



of individuals are still dealing with the aftermath. Industrial pollution clearly has negative effects, one of which is the eradication of rare species and other forms of biodiversity. There is a squeezing need to track down a center ground between modern turn of events and security of the regular habitat to decrease the effect of contamination on creating economies like India's during this season of progress.

1.1. Background of the study

India's rise to prominence as one of the world's largest, fastest-growing economies has far surpassed everyone's wildest dreams. India has made a name for itself as an international hotspot for lucrative business opportunities. As a result, many groups from different parts of the world have been drawn to the sovereign land in the name of bringing about economic change and modernising countries in the developing world. Haryana, a state in northern India, has become an important industrial and commercial powerhouse thanks to its rapid industrialization over the past few decades. The economy has benefited greatly from the fast industrialization that has occurred, particularly through the creation of new jobs and the influx of new tax dollars. These issues undermine the region's ecological balance and the well-being of its inhabitants. In light of these factors, evaluating the environmental impacts of industrialization in Haryana is crucial, as is investigating ways to lessen the blowback and promote a more long-term, mutually beneficial relationship between the state's growing manufacturing sector and the natural environment. The effects of industrialization are mixed, including both positive and negative outcomes. Negative ecological deterioration has accompanied the beneficial economic and social results of industrialised expansion. As India's agrarian, fabricating, iron mineral, coal, wood, packaging plant, auto, gas and compound areas all went through modernization, the parasitic corruption of the environment and its occupants slipped by everyone's notice, regardless of representing an inescapable long haul danger to the life expectancy, environmental condition, and vegetation local to the industrialized belt. The rapid growth of so-called "Noble Industrialization" is accompanied by a number of problems, counting the obliteration of the bio-framework, the expanded loss of intriguing types of creatures, the fast decrease of regular assets, and deforestation. Increased industrialisation and digitalization have contributed to economic growth around the world. New technology and more efficient production procedures have emerged as a result. The high pace of industrialization has also altered the global demand structure dramatically. As

illustrated in Fig. 1, these shifting priorities have greatly increased demand for items and approaches that have a major negative influence on environmental sustainability.

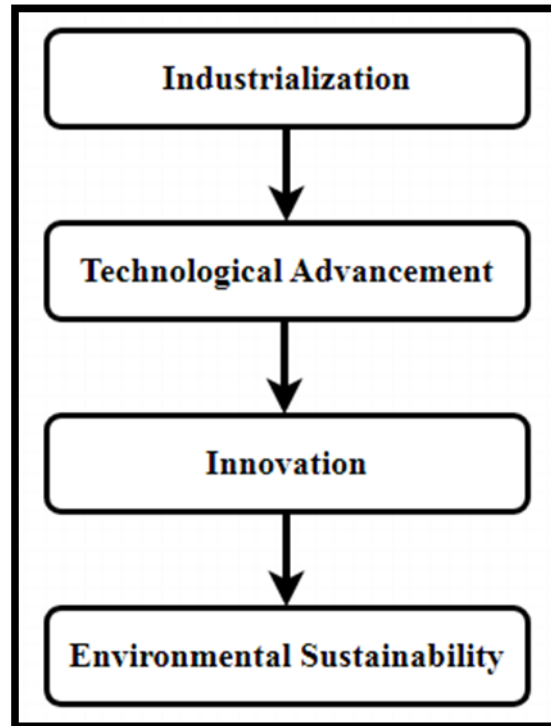


Figure 1:Transition from Industrialization to Environmental Stability

1.2. Objectives of the study

- To determine how Haryana's industrialization has affected the sustainability of the environment.
- To pinpoint key environmental issues caused by Indian industrial industries

2. LITERATURE REVIEW

Chandran M. Vijaya et al., (2013), stated that environmental appraisal methods like environmental impact assessments and environmental management plans are frequently employed in project analysis and have a significant impact on supporting sustainable development. The main obstacle to strengthening and upgrading EIA reports was poor data or information quality. Regulation, the type of expert gatherings and their experience, checking, the extent of land use change inclusion in EIA reports, public reaction, and the idea of tasks are the components that influence the nature of EIA reports.**Azumiand Bichi, (2010)**, demonstrated how environmental pollution brought on by fast industrialization seriously



degrades the pedosphere, hydrosphere, and atmosphere. Due to the entry of numerous contaminants like heavy metals into soil and water resources, water utilised in businesses produces waste that could be hazardous to the environment. **Tiwari Jeetendra Kumar and Rawani A. M., (2012)**, they investigated the effects of the cement production process on the environment at the ACC cement plant in Chhattisgarh, India. The review exhibits how to produce viewpoints from activities and how to figure out which angles are significant or not. As indicated by the contextual investigation, factors like outlaw residue outflow and commotion should be focused on, given more thought, and handled. **Veena Bamba et al., (2012)**, due to people's lack of awareness of nature in the current technological era, where the environment is being exhausted day to day, timberlands are vanishing at a disturbing rate, landmasses are disintegrating, the environment is changing all through the world, and clean air and water are becoming increasingly scarce, they concentrated on environmental awareness. They therefore emphasised environmental protection and raised awareness of it. **Hoque, Mohiuddin, and Su (2018)**, in research on organisations and their interaction with the natural environment, it is essential to stress the critical importance of taking into account the socio-ecological consequences resulting from business firms' inadequate compliance with environmental standards in developing countries with weak institutional frameworks. They support making these companies liable for the socio-ecological damage brought on by their unethical commercial practises. Their research, which uses an exploratory qualitative research methodology, sheds light on how unsustainable practises in industries that produce fertiliser, textiles, cement, pulp and paper, tanneries, and other forms of pollution have far-reaching effects. The study uncovers considerable negative impacts on both human health and the environment, leading to enormous socioeconomic costs that are especially noticeable in nations like Bangladesh. The study highlights the urgent need for greater environmentally responsible practises in these sectors, particularly given how little corporate environmental responsiveness exists within Bangladesh's polluting industries..

3. RESEARCH METHODOLOGY

3.1. Research Approach

A combination of qualitative and quantitative methodologies was used for this investigation. In Haryana, an exploratory study has been conducted in the fields of industrialization and environmental sustainability. Targeted industries in the Faridabad district as well as

government organisations have been used for the research. It was carried out using in-depth face-to-face interviews, field trips and a self-administered questionnaire.

3.2. Population and Study Sample

Locals who live close to the industrial zones in the Faridabad District have been selected as a representative group. Purposive sampling was used in this study to choose cases with a very specific goal and need in mind. 200 locals made up the sample limit.

3.3. Data collection

Both primary and secondary wellsprings of data were utilized to assemble the information. While main data were gained through in-depth face-to-face interviews with the businesses in the Faridabad district and with government officials, secondary data were gathered through books, journals, and the internet.

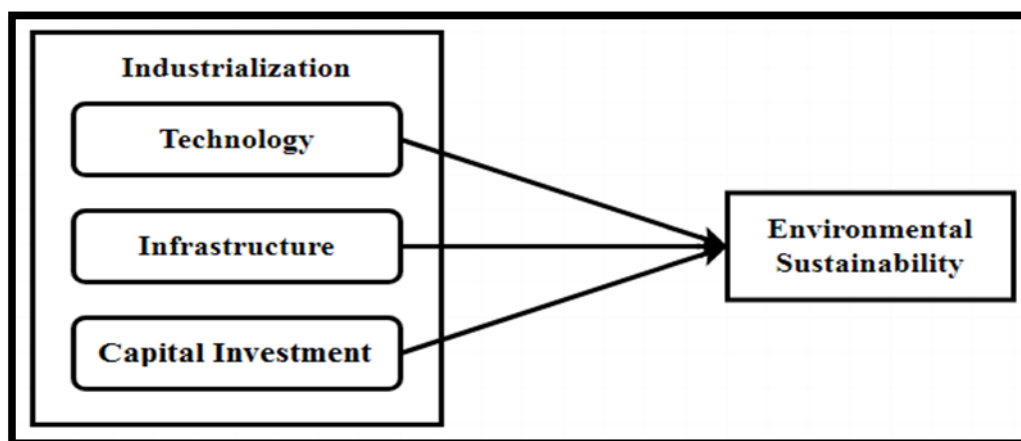


Figure 2: The Conceptual Framework

3.4. Research Hypothesis

H1: Technology and environmental sustainability have a major connection.

H2: Infrastructure and environmental sustainability have a strong connection.

H3: Capital investment and environmental sustainability have a major relationship.

4. DATA ANALYSIS AND RESULTS

Research has been conducted using a mixed method since the researcher used both qualitative and quantitative approaches. The general population who have been impacted by industrial



activities were the emphasis of the quantitative approach, while the government and environmental authority (GEA) were the focus of the qualitative approach. Based on the research variables, questionnaire and interview questions were created. Here is a list of these elements:

Technology: Within the context of industrialization, technology plays a crucial role in determining the course and effects of this revolutionary process. The establishment of an industrial zone makes the area more efficient and urbanised. A more comfortable way of life benefits those who live close to rural areas as well. Industrial zones are growing alongside specific telecommunication and electrical infrastructure. Therefore, one of the key factors in industrialisation might be considered to be technology.

Infrastructure: In the framework of industrialization, infrastructure acts as a fundamental variable and is crucial in determining the effectiveness and success of industrial development. Because it supports R&D centres, industrial clusters, and efficient logistics, adequate infrastructure also promotes innovation and competitiveness. On the other hand, a lack of suitable infrastructure can provide a serious obstacle to industrialisation by obstructing the movement of resources, restricting market growth, and lowering the potential for industrial progress. Infrastructure is thus a crucial factor in determining the course and results of industrialization in any given region or nation.

Capital investment: In the context of industrialization, capital investment is a key factor that drives both economic growth and technological development. Investment in capital provides the funds required for the expansion of production facilities, the acquisition of new technologies, and the training of a trained workforce—all of which are essential for increasing industrial output and competitiveness. A positive investment environment can draw both public and private capital investment, quickening the industrialization process. It is characterised by stable economic policies, availability to funding, and predictable regulatory environments. Therefore, a key factor influencing the rate and effectiveness of industrialisation initiatives is capital investment.

Environmental Sustainability: Everything, from food to rain, depends on the environment and how to use it in a sustainable way, thus environmental sustainability is the main priority. The Brundtland Report, which warned of the adverse effects of human activity on the environment in the form of man-made disaster, introduced the idea of environmental sustainability for the first time in 1987. This report, which focused on the threats to human life, the beauty of the environment, and the extinction of endangered species, was supported



by substantial data and is therefore very significant. Sustainability in the environment encourages the use of recycled and new materials. The "recycled and renewable" method uses trash and energy sources to cut down on the use of harmful materials, safeguard species' natural habitats, create better and healthier living conditions for people and the environment, and enhance the beauty of nature. Therefore, stakeholders must pay serious attention to developing a strong framework to preserve all of these aspects.

4.1. Descriptive statistics: Table 1 displays the descriptive results of the study sample.

Table 1: Profile of respondents' demographics

Characteristics	Frequency	Percentage
Gender		
Male	67	33.5%
Female	133	66.5%
Age		
Below 22	9	4.5%
22 to 30	18	9%
31 to 37	45	22.5%
38 to 45	71	35.5%
46 and above	57	28.5%
Educational qualification		
Under graduates	17	8.5%
Graduate	81	40.5%
Post Graduate	53	26.5%
Other	49	24.5%

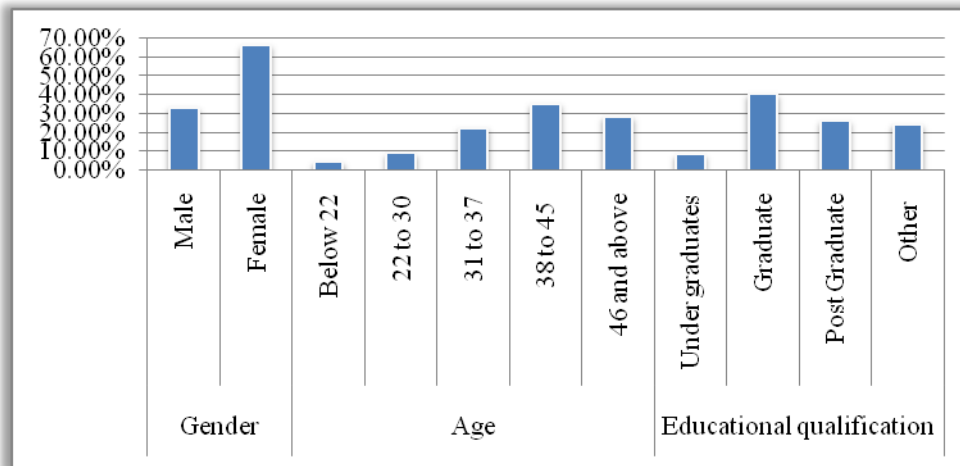


Figure 3:Graph showing respondents' demographic profile percentages

4.2. Cronbach’s Alpha Reliability Testing

$$\alpha = \frac{N.C}{V + (N - 1).C}$$

Table 2:Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	No. of Items
0.756	10

Cronbach's alpha, which is more than 0.7 and is displayed in Table 2, is 0.756, demonstrating strong consistency across the data used to quantify the variable.

4.3. Correlation Analysis

Table 3:Industrialization and Environmental Sustainability Correlation Matrix

Correlations				
		Technology	Infrastructure	Capital investment
Technology	Pearson Correlation	1	.619**	.568**

	Sig. (2-tailed)		0	0
	N	200	200	200
Infrastructure	Pearson Correlation	.619**	1	.632**
	Sig. (2-tailed)	0		0
	N	200	200	200
Capital investment	Pearson Correlation	.568**	.632**	1
	Sig. (2-tailed)	0	0	
	N	200	200	200
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 3 shows association coefficients for three important variables: capital investment, infrastructure, and technology. Significantly positive correlations between these variables are shown by the Pearson Correlation coefficients. In particular, there is a substantial correlation between technology and both capital investment and infrastructure ($r = 0.568$, $p 0.01$). Similar to technology, capital investment and infrastructure have high correlations ($r = 0.619$, $p 0.01$, and $r = 0.632$, $p 0.01$, respectively). Additionally, there is a significant positive link between capital investment and both technology ($r = 0.568$, $p 0.01$) and infrastructure ($r = 0.632$, $p 0.01$). These results underscore the interdependence of these factors in the context of industrialization by showing that as one of these variables improves, there is a propensity for the others to also show improvement.

4.4. Multiple Regression Analysis

Table 4: Model summary of variables

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.773 ^a	.597	.589	.90049
a. Predictors: (Constant), Technology, Infrastructure, Capital investment				

Table 5: Anova summary

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	234.071	4	58.518	72.165	.000 ^b
	Residual	158.124	195	.811		
	Total	392.195	199			
a. Dependent Variable: Environmental Sustainability						
b. Predictors: (Constant), Technology, Infrastructure, Capital investment						

Table 6: Coefficient of Determination of the Variable

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.757	.303		-2.498	.000
	Technology	.065	.088	.045	1.742	.000
	Infrastructure	.378	.108	.255	3.486	.000
	Capital investment	.161	.099	.102	1.629	.000
a. Dependent Variable: Environmental Sustainability						

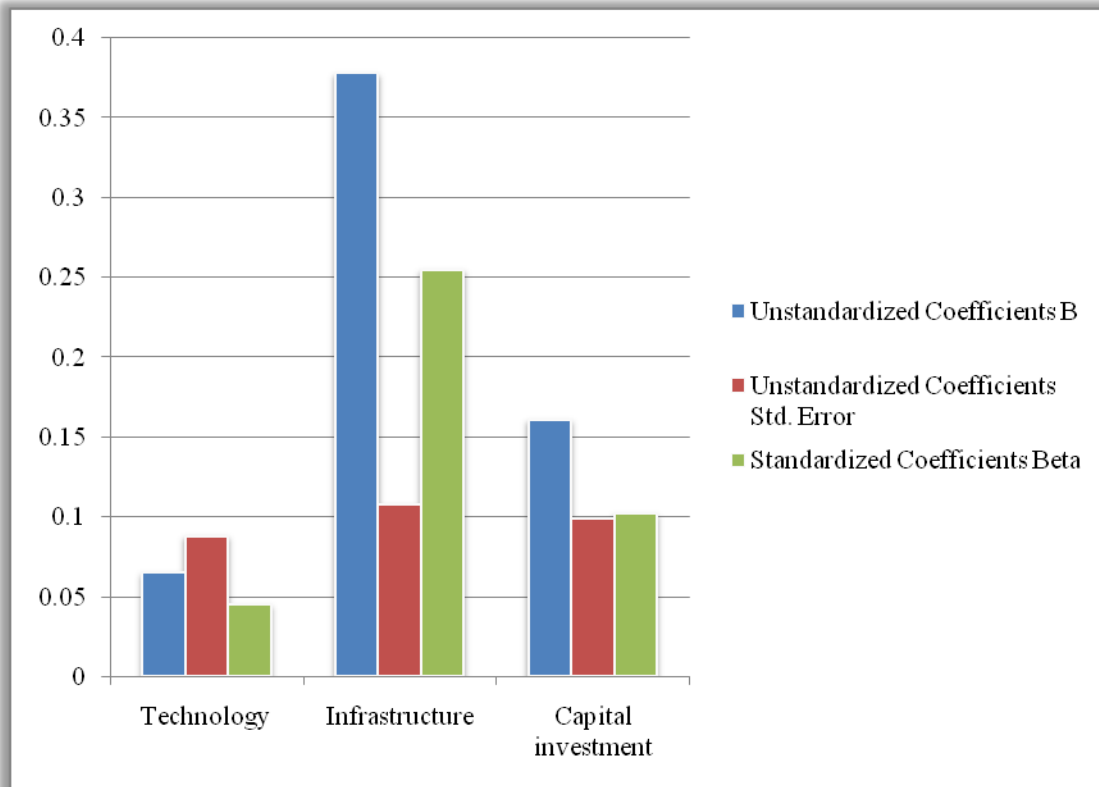


Figure 4: Visualisation of the variable's coefficient of determination

Regression analysis was used to look at how independent factors affected a dependent variable. Three independent variables and one dependent variable were employed in the study. Regression analysis also shows the model's appropriateness using the R square value. Regression analysis, which ascertains the degree to which an independent variable influences a dependent variable, is a method for testing hypotheses. According to the coefficient of determination (r-square), industrialisation accounted for 77.3% of the entire variation in environmental sustainability.

5. DISCUSSION

Table 7 gives the overview of hypotheses in a clear representation of the hypotheses investigated and their associated results in a research review or experiment. It provides as a concise and organised way to communicate the key findings in regard to the research questions or hypotheses set before to the review's conduct.

Table 7: Summary of Hypothesis

Hypothesis	Findings
H1: Technology and environmental sustainability have a major connection.	Accepted
H2: Infrastructure and environmental sustainability have a strong connection.	Accepted
H3: Capital investment and environmental sustainability have a major relationship.	Accepted

Three independent variables that have a positive impact are present in the study model, and all hypotheses are accepted when the coefficient Sig0.5 is present. The findings of three hypotheses about the connections between various characteristics and environmental sustainability are shown in table 7. The first hypothesis—that there is a significant link between technology and environmental sustainability—has been confirmed. This argues that there is strong evidence demonstrating the close relationship between technical breakthroughs and environmental sustainability and their considerable contribution to it, maybe through inventions that lessen environmental effect. Second, Hypothesis 2 has also been accepted, which makes a significant connection between infrastructure and environmental sustainability. This suggests that well-developed infrastructure systems, including those for transportation, utilities, and communication, play a crucial role in promoting environmental sustainability. This is probably because they make it possible to manage resources effectively and lessen environmental stressors. The third hypothesis, which claimed a significant connection between capital investment and environmental sustainability, has also been accepted. This emphasises the notion that increased environmental sustainability is intimately related to capital investments, whether they are made in environmentally friendly practises, conservation initiatives, or sustainable technologies. When taken as a whole, these findings highlight the complexity of the variables influencing environmental sustainability and emphasise the importance of technology, infrastructure, and capital investment in fostering environmentally sound behaviour in the context of industrialization or economic development. Utilising natural resources like water for our industrial production processes properly and efficiently is the most comprehensive answer to the environmental risk. Overall, the endless production capacities of different



economies will continue to have an impact on the environment and the sustainability of other resources. The lack of water has already had a significant influence on the climate. To stop the climate change as well, certain severe regulations must be implemented right away. The people who can create a sustainable future for our generations are policymakers, water managers, and qualified technicians. To reduce these risks and mitigate the effects of climate change, highly competitive policies and innovative manufacturing methods must be implemented. Today, effective management of water resources is also crucial. It is clear from evaluations of the numerous industrialization-related driving and restraint forces that technological advancement has significantly harmed environmental sustainability and climate change. Despite the fact that the sustainability of the environment falls under the umbrella of the sustainable development goals, it is evident that people are still unaware of the harms caused by climate change, water scarcity, and advanced technology. Such resources must be conserved, which necessitates awareness, empowerment, and education among people, communities, and governments. Despite the research's inherent shortcomings, it brought attention to a critical issue for the benefit of economies and societies more broadly. The involvement of stakeholders in the creation of laws and policies governing resource conservation is essential for a better environment.

6. CONCLUSION

The reason for the exploration was to decide how industrialization has affected environmental sustainability. The evaluation of environmental sustainability in light of Haryana's industrialisation highlights the pressing requirement for a balanced strategy that balances economic development with ecological preservation. The qualitative analysis of the data indicates that industrialization's contribution to technical improvement has had a favourable effect on the homes near industrial areas. The area's infrastructure has grown as a result of industrialization. Before choosing a suitable location to establish an industry in a specific area, a number of indicators are taken into account when considering capital investment. It is clear that industries care about the natural resources, but there are some difficulties when putting environmental management plans into practise. Additionally, every component (technology, infrastructure, and capital investment) has a favourable impact on pollution formation in the Faridabad District, according to the quantitative statistic. The aforementioned facts lead to the conclusion that industries are a significant contributor to the



nation's economic development, but companies must become more sustainable in order to reduce environmental damage.

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