

Industrial Pollution in Indian Industries: A Post Reform Scenario

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Abstract—Industrial pollution is one of the most evident environmental problems experienced by now in industrialized countries and majority of the newly industrializing economies are facing it today. India's industrial structure has gone through various changes especially since the economic reforms. However, in India no major environmental reforms were initiated to take into consideration the impact of changing industrial pattern on environment. Therefore, there is a need for analyzing the environmental impacts of industrial sector in India. Since different industries have different pollution intensity, this paper has first taken a look at the composition of industrial structure. Using the Industrial Pollution Projection model of World Bank for calculating pollution load in developing countries where continuous industrial pollution data is not available, we have calculated the changes in the pollution load of Indian industries. Finally, we conclude by suggesting policy reforms that are needed to encourage more efficient use of resources and substituting away from scarce resources and adoption of technologies and practices that minimize environment impact.

Key words: Environment, Industrial sector and Industrial pollution.

1. INTRODUCTION

Since the advent of industrial revolution, performances on economic indicators alone have been used as the principal criteria for measuring progress. Consequently, when India got independence, the major concern was on achieving economic prosperity through rapid industrialization. Introduction of liberalization measures in 1991 further eased the entry of private and foreign investment & technology in industrial sector. Due to this India was able to develop a strong and diversified industrial structure, which put our country in the league of emerging economies. However, rapid industrialization carried with it the seeds of environmental damage. Industrial pollution is one of the most evident environmental problems experienced by now industrialized countries and majority of the newly industrializing economies are facing it today. Industrial pollution and waste encompass the full range of materials generated by industrial activities that are unwanted by the producer. At times, they represent an unrealized opportunity to improve production efficiency and reduce disposal costs. Certain components of industrial pollution and waste are hazardous to human health and the

environment. Pollution of natural environment not only affects people but also have adverse impact on economic growth in the long run. Analysis of pollution load shows that there are few industries which contribute to more than 90 percent of the pollution in the country during 1990-2010. So, there is an urgent need on the part of policymakers to give top most priority for controlling pollution in these industries which will help in reducing industrial pollution to a great extent.

Our industrial structure has gone through various changes especially since the economic reforms. However, in India no major environmental reforms were initiated to take into consideration the impact of changing industrial pattern on environment. Therefore, there is a need for analyzing the environmental impacts of industrial sector in India. Since different industries have different pollution intensity, this paper tries to have a look at the composition of industrial structure in India. Then using the Industrial Pollution Projection (IPPS) model of World Bank for calculating pollution load in developing countries where continuous industrial pollution data is not available, we have calculated the changes in the pollution load of Indian industries. Finally, we have concluded by pointing out the policy reforms that are needed to encourage more efficient use of resources, substituting scarce resources by renewable ones and adoption of technologies and practices that minimize environment impact.

2. OBJECTIVES

The paper has been written with the following objectives:

1. To analyze the changes that has occurred in Indian industrial sector since 1991.
2. To estimate industrial pollution load in India using the World Bank Industrial Pollution Projection System (IPPS) database and identify critical industrial sectors for the immediate attention of regulator so that priorities for enforcement of environmental regulations are set.

3. DATABASE AND RESEARCH METHODOLOGY

Data for this paper has been collected from Annual Survey of Industries (various issues) and World Bank publications on IPPS. Apart from this several papers on industrial pollution which are based on the use of IPPS are also studied.

Pollution load has been calculated using IPPS of World Bank since in India year wise estimates on pollution level at industries level is not available even now. The IPPS is a modelling system which merges the US Environment Protection Agency (EPA) data on pollution emissions and the Longitudinal Research Database (LRD) on industrial activity at the plant level to calculate pollution intensity of industrial sectors. Pollution intensity is defined as the level of pollution discharge/emissions per unit of manufacturing activity. In calculating the pollution intensity, the choice of the variable to measure the level or size of manufacturing activity is very important. How applicable are US-based estimates to other economies? It is clear that many country-specific factors will affect the accuracy of prototype IPPS projections outside the US. For particular sectors such as wood pulping, average pollution intensity is likely to be higher in developing countries. However, the pattern of sectoral intensity rankings may be similar. For example, wood pulping will be more water pollution-intensive than apparel manufacture in every country. The present version of IPPS can therefore be useful as a guide to probable pollution problems, even if exact estimates are not possible.

The IPPS database provides estimates for three alternative measures of the level of manufacturing activity, viz. value of output, value added and employment. Hettige et al. (1994) [5] has shown that in the case of US, the ranking of industrial sectors by their pollution load is almost identical, irrespective of whether the value of output or employment is used as the unit of measurement. Total value of output was, however, judged superior to value added because the energy and materials inputs are critical in the determination of industrial pollution. Since pollution load is given in US dollars, it is converted into Indian rupees using purchasing power parity of dollar for rupee in 1987-88 and then applied to deflated data of value of output of manufacturing sector given in ASI.

4. BRIEF REVIEW OF LITERATURE

Results from the IPPS database have been used in various studies where firm level data on environmental parameters does not exist. *Frickmann Young* (2000) [2] employed input-output techniques to estimate industrial emissions from export oriented activities in Brazil during the period 1985-96. This was done to know the impact of shift towards export economy on the pollution level in the country. Water polluting parameters like BOD and heavy metals and air polluting parameters like particulate matter, SO₂, NO_x and HC were measured using Industrial Pollution Projection System

whereas, CO₂ emission data was taken from Brazilian Greenhouse Gases Inventory. Both groups of data indicate that export activities have been more pollution intensive than other economic activities thus, showing the negative impact of export liberalization on environment in developing countries like Brazil.

Sunil K. Sinha [10] in his paper has made an effort to measure the magnitude of industrial pollution in post-reform period. He has used the technique of industrial pollution projection system of World Bank. This technique is designed for measuring industrial pollution load in developing countries where environmental data is not available. Share of highly polluting industries in terms of output and value added has increased in post reform period. Accordingly, air, water and land pollution from manufacturing industries has increased by whooping 200 percent during 1990-91 to 2005-06. This is due to the fact that industrial policies so far has failed to take into consideration the rising problem of industrial pollution.

Rita Pandey (2005) [7] in her study of 17 highly polluting or "red category" industries of India for the year 1994-95, has used Industrial Pollution Projection System of World Bank and related abatement cost coefficients to differentiate industries on pollution level and its abatement costs. She is of the view that for effective pollution control strategy there is need for concentrating on industries which are highly polluting but has low abatement costs. She also favours the use of market based instrument in place of command and control type mechanism for efficient pollution control mechanism.

Oketola and Oladele (2011) [1] has compared industrial pollution loads of 14 industries of Lagos

(Nigeria). Calculation was done by using Industrial Pollution Projection System to employment and total output, with conventionally analyzed effluent pollution loads. The data was validated statistically using t - test at 95% confidence interval (2- tailed) and analysis of variance (ANOVA) to ascertain if there is any significant difference between IPPS pollution loads with respect to employment & total output and pollution loads from conventional effluent analysis. They found that there is no significant difference between the pollution loads estimated with respect to the two variables in all the industries except basic industrial gas manufacturing where the two means are significantly different. IPPS pollution loads also compared favourably with pollution loads from conventional effluent analysis at this limit. Seeing the result, they are of the view that IPPS technique provides a cheap way for estimating pollution load in developing countries. It will enhance industrial pollution control in the developing countries where funding for environmental protection is inadequate. The effectiveness of the intervening measures would significantly reduce the overall industrial pollution.

Most of the studies have used only one or two mediums of pollution to estimate industrial pollution and has concentrated on only few industries. Apart from this they did not provide comparison of industrial pollution at different periods of time and did not include latest data on the variables. This study throws light on the state of industrial pollution at different periods of time including recent data and it covers all the major industries at two digit level.

5. INDUSTRIAL STRUCTURE AND INDUSTRIAL POLLUTION IN INDIA

5.1 Structural composition of Indian industrial sector

Industrial structural composition is one of the main determinants of pollution in any country. Liberalization has changed the structure of Indian industrial sector. On the basis of this we can analyze whether domestic manufacturing production has moved towards more pollution intensive industries as compared to less polluting industries. Industrial structure is being analyzed on the basis of four parameters- types of industries, total employment, total output and net value added.

a) Red category (more polluting industries)

Table 1 clearly reveals that the share of red category industries has gone up on all the three indicators of industrial performance. In total persons engaged and value of final output of this category of industries has increased. However, a slight decline of around 1 percent was seen in percentage of red category industries between 2000-01 and 2010-11, on these two parameters. In terms of total value of output and net value added, red category industries got past to orange category industries with a very slight margin to become the largest fragment among the manufacturing industries. Share of rubber, petroleum, plastic and coal has shown highest increase in terms of value of output and NVA during 1990-91 to 2010-11. While in terms of employment its share has declined. On this parameter, chemical and chemical products have shown highest increase in the period concerned. A steep jump in net value addition in case of red category industries during 2000-01 to 2010-11 is reflective of the fact that these industries have

taken least care for the environmental issues and made modest expenses to control the pollution.

b) Orange category industries (somewhat polluting)

This category is the largest employment provider which is not surprising considering the inclusion of textile industries which is highly labour intensive. Textiles industries showed highest gain on all the three parameters. On the other hand food & beverages group which is the highest provider of employment among all the categories saw a drop in its share from 19.4 percent in 1990-91 to 16 percent in 2010-11. This is true with respect to other parameters also.

In terms of value of output and net value added, share of orange category industry is only slightly lower than that of red category. In fact in terms of value of output in orange category shows an addition of 4.2 percent during the period concerned as compared to 1.8 percent by red category industries.

c) Green category industries (less polluting industries)

Share of green category industries has shown a decline on all the parameters in the post-reform period as compared to pre-reform period. Highest decline is in the net value added by these industries which registered a fall of 38.9 percent between 1990-91 and 2010-11. Its contribution declined from 28.25 to 17.83 in the period concerned.

In 1990-91, 31.72 percent of the total persons engaged in the manufacturing sector covered under ASI, were working in green category industries.

This has fallen by more than 9 percent points to 22.39 percent in 2010-11.

Contribution of this category in terms of value of output has also decreased in the period under study and has come down from 20.4 percent to 14.4 percent. Although situation improved between 2000 and 2010 as we observe more than 50 percent increase in the share of these industries in terms of value of output.

**Table 1: Structural composition of Indian industrial sector
(In percentage)**

Types of industries	Value of output			Net value added			Total persons engaged		
	1990-91	2000-01	2010-11	1990-91	2000-01	2010-11	1990-91	2000-01	2010-11
Red category	41.83	44.24	43.63	37.26	27.63	41.74	26.19	28.88	27.11
Paper and paper products	2.73	2.02	1.27	3.11	2.61	1.23	3.5	2.25	1.96
Rubber, petroleum, plastic and coal	12.25	11.53	17.84	11.82	8.11	15.18	6.68	4.01	4.93
Basic metal	12.53	10.08	13.86	10.89	9.41	11.93	7.6	7.06	7.97
Non-metallic minerals	3.41	3.52	3.13	4.37	5.38	4.87	5.34	5.56	7.29
Chemical and chemical products	10.91	17.09	7.53	7.08	2.12	8.52	3.07	10.01	4.96
Orange category	37.81	46.37	42.01	34.48	42.55	40.43	42.09	37.88	50.49

Food products, beverages & tobacco	15.55	17.18	13.02	10.02	13.71	9.11	19.47	21.48	16.34
Textiles	1.58	9.81	5.82	0.94	8.85	5.39	2.13	1.61	11.43
Leather and leather products	1.07	1.07	0.67	0.85	0.8	0.65	1.27	1.73	2.31
Fabricated metal products	2.16	2.36	3.31	2.09	2.83	4.56	3.06	3.69	5.25
Electrical and non-electrical machinery	11.58	10.33	10.99	13.58	13.14	13.38	10.39	9.88	10.73
Transport equipment	5.87	6.91	8.76	7.01	6.06	8.62	5.79	5.53	7.69
Green category	20.37	9.39	14.36	28.25	29.82	17.83	31.72	33.24	22.39
Wood and wood products	0.33	0.24	0.34	0.37	0.21	0.16	0.83	0.62	0.64
Other industries	20.04	7.86	13.45	27.88	26.77	16.39	30.89	26.57	18.51
Total	100	100	100	100	100	100	100	100	100

Source: [3]

The above facts clearly depicts that in post reform period attraction towards more polluting industries has increased. The government has not been in a position to enforce on these industries to make use of environment friendly technology. The industries on their own are not bringing it into use as it will increase their cost of production and might reduce the net value addition. So, increase in contribution of high pollution intensive industries has become one of the causes of environmental pollution. Pollution of natural environment not only effect people but it also have adverse impact on economic

growth in the long run as it slows down the supply mechanism in the economic system.

5.2 Pollution load of Indian industries

In order to gain some further insight on the level of industrial pollution in India in the aftermath of economic reforms we have calculated the pollution load of different industries using IPPS of World Bank. The IPPS of World Bank data has been used because of the fact that in India reliable information on the nature and level of emissions by industries/ factories is not available.

Table 2: Toxic and Water pollution load by type of industry (in metric tonnes)

Types of Industries	Toxic Pollution Load			Water Pollution Load		
	1990-91	2000-01	2010-11	1990-91	2000-01	2010-11
Red category						
Paper and paper products	2998 (1.50)	6886543 (1.61)	19949 (1.76)	16224 (2.14)	31797965 (2.94)	66337668 (1.60)
Chemical and chemical products	102677 (51.50)	260595 (61.07)	525859 (46.36)	144433 (19.06)	156248 (14.43)	315295 (7.59)
Rubber, petroleum, plastic and coal	12605 (6.32)	26795 (6.28)	137039 (12.08)	6730 (0.89)	14307 (1.32)	73168 (1.76)
Basic metal	36498 (18.31)	46733 (10.95)	212330 (18.72)	487529 (64.33)	624239 (57.64)	2836244 (68.27)
Non-metallic minerals	2023 (1.01)	3808 (0.89)	10997 (0.97)	1362 (0.18)	2563 (0.24)	7402 (0.18)
Orange category						
Food products, beverages & tobacco	6631 (3.33)	13513 (3.17)	33016 (2.91)	70524 (9.31)	143711 (13.27)	351138 (8.45)
Textiles	15670 (7.86)	32078 (7.52)	68113 (6)	424 (0.06)	868 (0.08)	1844 (0.04)
Leather and leather products	2992 (1.50)	5500 (1.29)	11281 (0.99)	279 (0.04)	512 (0.05)	1050 (0.03)
Fabricated metal products	1399 (0.70)	3340 (0.78)	15443 (1.36)	205 (0.03)	489 (0.05)	2261 (0.05)
Electrical and non-electrical machinery	11010 (5.52)	17868 (4.19)	61268 (5.40)	520 (0.07)	844 (0.08)	2893 (0.07)
Transport equipment	4101 (2.06)	8834 (2.07)	36997 (3.26)	38 (0.005)	81 (0.01)	338 (0.01)

Green category	774 (0.39)	2910 (0.68)	11907 (1.05)	29543 (3.90)	107332 (9.91)	496783 (11.96)
Wood and wood products	170 (0.09)	716 (0.17)	1747 (0.15)	29 (0.0038)	121 (0.01)	296 (0.01)
Other industries	604 (0.30)	2194 (0.51)	10160 (0.90)	29514 (3.89)	107211 (9.90)	496487 (11.95)
Total	199379	426744	1134326	757809	1082992	4154754

Note: figure in parentheses shows percentage share of industry in pollution load.

Source: [3, 5]

Pollution load is calculated using the value of output as the parameter for industrial activity. The relative contribution of each industry to pollution load depends on three parameters-air, water and toxic pollution. The details at the all India level is presented in table 2 & 3. Total pollution load from manufacturing sector in India has no doubt increased in the period concerned. However, the point is that it increased more rapidly in the post reform period. During 1990-2000, ten years after the reform, total pollution load nearly doubled but in the subsequent decade it tripled. Overall during 1990-2010 the

total pollution load has increased almost six times. This is quiet similar to the growth in the value of output over the period concerned, as output increased by six times and tripled between 2000 and 2010. Coming to individual industries, we can see that traditional categorization of industries according to their pollution intensity seems to overlap as some industries do not belong to red category but contributes highly to industrial pollution level. It can be seen from the tables above that the basic metal industry is the highest polluting industry on two out of three indicators except toxic pollution where it ranks second to chemicals.

Table 3: Air pollution load by type of industry (in metric tonnes)

Types of industry	Air Pollution Load		
	1990-91	2000-01	2010-11
Red category	753603 (78.26)	1440969 (77.46)	4734403 (80.99)
Paper and paper products	20127 (2.09)	39455 (2.12)	82362 (1.41)
Chemical and chemical products	209042 (21.71)	530550 (28.52)	1070607 (18.31)
Rubber, petroleum, plastic and coal	117485 (12.20)	249743 (13.42)	1277260 (21.85)
Basic metal	240661 (24.99)	308146 (16.56)	1400067 (23.95)
Non-metallic minerals	166288 (17.27)	313073 (16.83)	904106 (15.47)
Orange category	207764 (21.58)	412906 (22.20)	1094061 (18.72)
Food products, beverages & tobacco	144638 (15.02)	294735 (15.84)	720145 (12.32)
Textiles	19710 (2.05)	40347 (2.17)	85673 (1.47)
Leather and leather products	599 (0.06)	1102 (0.06)	2260 (0.04)
Fabricated metal products	1285616.7 (0.13)	3069352.1 (0.16)	14192000.2 (0.24)
Electrical and non-electrical machinery	29761 (3.09)	48300 (2.60)	165616 (2.83)
Transport equipment	11771 (1.22)	25352 (1.36)	106176 (1.82)
Green category	1554 (0.16)	6423 (0.35)	17253 (0.30)
Wood and wood products	1355 (0.14)	5702 (0.31)	13916 (0.24)
Other industries	198 (0.02)	721 (0.04)	3338 (0.06)
total	962921	1860297	5845718

Source: same as table 2

Basic metal is the highest water polluting industry throughout the period taken, followed by chemicals and food products. However, we can see that in 2010 chemical slipped to fourth position and other manufacturing categories has taken the second spot.

In the toxic pollution category chemical industry is the highest polluter. The second most polluting industry in this category is basic metal followed by textile. However, in 2010 rubber, petroleum & coal products pushed textiles to fourth place.

If we carefully look at the data on pollution load we can see that there are only few industries which contribute to most of the industrial pollution. These industries are chemicals, basic metals, non-metallic minerals, rubber, petroleum & coal products, food & beverages and other manufacturing industries. In comparison to 1990, share of chemicals has declined on all the three indicators in 2010, whereas, that of basic metals has increased in water pollution category, slightly declined in air pollution and, remained almost similar in toxic pollution. Overall, we can say that pollution has increased in the post reform period but there are few selected industries which contribute to most of it. Chemicals, basic metals, non-metallic minerals, rubber, petroleum & coal products, food & beverages and other manufacturing industries taken together contributed to 93 percent of total pollution in the country in 1990, 92 percent in 2000 and 93 percent in 2010. In comparison to this their share in total output was 75 percent in 1990, 67 percent in 2000, and 69 percent in 2010. So, these industries contribute more to pollution than to the total output. In fact, their share in total output has come down since 1990 whereas the pollution load has increased.

6. CONCLUSION

Industrial reforms introduced in 1991 has benefitted industrial sector of the country and the total industrial output increased six times between 1990 and 2010. However, when policy was made for industrial reforms we forgot to take into account the problem of rising industrial pollution associated with industrialization. In the post reform period considered here, pollution level has increased by nearly six times. Further, the share of six most polluting industries in total output has declined in 2010 as compared to 1990 whereas, their share in total industrial pollution remained similar in both these years which equals to whopping 93 percent. India is a developing country and there are host of problems facing our economy and society. Industrial pollution, though, is a major problem but people do not care about it as much as they attach importance to problems like poverty, hunger, unemployment, lack of basic necessities to name a few. There is no doubt that these problem are of outmost importance but pollution is also a serious problem and it may not appear so at present but it is going to prove catastrophic for both society especially marginalized section and economy. The problem of poverty and hunger is likely to deteriorate if environmental issues are

not being taken care of. We do not have large resources to spend on introducing clean technology in the whole industrial sector, however, as the analysis shows more than 90 percent of the pollution is caused by selected industries so there is a need for making special pollution control policy for these industries which will help in reducing pollution significantly.

REFERENCES

- [1] Adebola Oketola and Oladele Osibanjo (2011): Assessment of Industrial Pollution Load in Lagos, Nigeria by Industrial Pollution Projection System (IPPS) versus Effluent Analysis, Environmental Management in Practice, Dr. Elzbieta Broniewicz (Ed.), ISBN: 978-953-307-358-3. Downloaded from: <http://www.intechopen.com/books/environmental-management-in-practice/assessment-of-industrial-pollution-load-in-lagos-nigeria-by-industrial-pollution-projection-system-i>
- [2] Frickmann Young, E. C. (2000): International trade and industrial emissions in Brazil: an input-output approach, XIII International Conference on Input-Output Techniques, Macerata, Italy
- [3] Government of India (2010): Annual Survey of Industries, CSO-Dept.of Statistics. MOSP: New Delhi
- [4] (2000-01): Annual Survey of Industries. MOSP: New Delhi
- [5] (2000-01): Annual Survey of Industries. MOSP: New Delhi
- [6] Gupta, Shreekant (2002): 'Environmental Benefits and Cost Savings Through Market- Based Instruments: An Application Using State-Level Data From India'. Working paper no. 02-005, Centre for Energy and Environment Policy Research.
- [7] Hettige, M. et al., (1994): 'The Industrial Pollution Projection System', Policy Research Working Paper No.1431, Washington, DC: World Bank.
- [8] Mehta, S., Mundle, S., and U. Sankar (1994): Controlling Pollution: Incentives and Regulation, New Delhi: Sage Publications.
- [9] Pandey, Rita (2005): "Estimating Sectoral and Geographical Industrial Pollution Inventories in India: Implications for Using Effluent Charge Versus Regulation", Journal of Development Studies, Vol. 41, pp 33-61.
- [10] Rita Pandey (2005) - "Estimating Sectoral and Geographical Industrial Pollution Inventories in India: Implications for Using Effluent Charge Versus Regulation", The Journal of Development Studies, 41:1, 33-61. Accessed from <http://dx.doi.org/10.1080/0022038042000276563>
- [11] Shanti Gamper-Rabindran & Shreyasi Jha (2004) - Environmental Impact of India's Trade Liberalization. Accessed from <https://www.gtap.agecon.purdue.edu/resources/download/1690.pdf>
- [12] Sunil, K. Sinha – Industrial Structure and Industrial Pollution. Where do we stand? Accessed from http://crisil.com/Ratings/Commentary/CommentaryDocs/CRISIL-ratings_ind-structure ecoview_jan10.pdf