

Impact of paper industrial pollution: a case study from Moolimangalam Village in Karur District, Tamil Nadu

Dr. R. Manikandan*

* Assistant Professor, Department of Economics, Bharathiar University, Coimbatore – 641046, Tamil Nadu
maninoble@gmail.com

Abstract

Objectives: This study investigates the economic and environmental impact of paper industrial pollution on rural communities in general and on agricultural production, human health in particular.

Methods/Statistical analysis: Both primary and secondary data were collected for this study. A Case study method is followed. Moolimangalam village of Karur District, Tamil Nadu, and India has been chosen for this study. This village is located nearby Tamilnadu Newsprint and Papers Limited (TNPL). 30 samples from small farmers and medium farmers have been chosen randomly. The secondary data collected from TNPL, production, usage of water, effluent discharged, volume of waste water treated and other relevant data collected and analysed.

Findings: According to this study, 73.7% of small farmers and 90.9 percent of medium farmers claimed that their human health is affected by Industrial pollution. Majority of farmers said that the change their cropping pattern due to industrial pollution.

Application/Improvements: The pollution level of TNPL is under check. However, constrained to state that there are damages caused by the environmental pollution in the surrounding of TNPL.

Keywords: Industrial Pollution, Paper Industry, Tamil Nadu.

1. Introduction

Industrialization is necessary for the economic development of a country. Apart from directly contributing to income and employment generation, industrialization induces output and employment growth indirectly through its linkages with other sectors. However, industrialization can also lead to worsening of environmental conditions. Environmental pollution is the one of the vital problems of today, faced by mankind. Environmental pollution in general and industrial pollution in particular is one of the major environmental problems both in developed and developing countries as well. Even though our country like India faces a number of other environmental problems such as deforestation, loss of drinking water, land degradation, soil erosion, automobile pollution, loss of biodiversity and so on, the problem of industrial pollution causes bigger concern over a long period. Water pollution poses a serious impact on a high number of economic and social activities. It is estimated that 75% of the world population mostly in developing countries does not have access to safe drinking water [1].

The pulp and paper industry has historically been considered a major polluter. It consumes vast resources and release large volumes of wastewater, substantial emissions of gases and generates a huge amount of residual solid waste. With development in technology and improved emission controls, the emissions from global pulp and paper sector have reduced significantly over the years. However, the Indian pulp and paper sector continues to lag behind, because it has not invested much in cleaner technology and pollution control. Indian mills primarily rely on pollution control techniques to reduce pollution. Technology up gradation and pollution prevention is a rarity. The result is that there is a tradeoff between economics and environment that has to take the back seat.

1.1. Paper Industry in India

In India, the first machine-made study was manufactured in 1812. During this time there were 15 mills with a total production of lakh tones. In India the soft wood is the principal raw material used for making paper especially newsprint and high class printing papers.

With the rise in population and broadening of education, the demand for paper has been constantly escalated. Owing to very narrow forest resources, wood pulp is in a shortage. As soft woods grow in temperate climate, India is in short supply of such woods. Thus, in such circumstances, the Bamboo became the major raw material for the manufacture of paper in the country as it grows very quickly even after cutting. India is the 15th largest paper industry in the world. It provides employment to nearly 1.5 million people and contributes ₹25 billion to the government's kitty. The government regards the paper industry as one of the 35 high priority industries of the country.

1.2. Impact of Industries over Environment

India is one of the 10 most industrialized nations of the world. Industrial activities are essential to generate goods for the development of the nation, to meet the needs of the people, and to generate employment. At the same time, it must be accepted that industrial activities release pollutants that contaminants air, water bodies and land, and adversely affect the quality of human and other life. While Industries are vital for development, it is equally important to aware of the impacts industries on environment. Contamination of groundwater due to the release of industrial effluents on land and sludge dumped in and around the industry. Studies on their influence on groundwater quality revealed the presence of chromium ground water of polluted area above permissible limits for drinking water standards [2].

The study industry is characterized by its intensive use of water. The industry consumes considerable quantities of water for the processing purpose. Apart from processing, water is required for cleaning and washing purposes. Among the agro-based industries the study industry is one of the largest water polluters in the world. Similarly, the paper industry is the third largest user of energy. The recycled paper reduces water pollution by 35% reduces air pollution by 74% and eliminates many toxic pollutants. Contaminated drinking water will impact the various diseases such as cholera, typhoid, dysentery, intestinal infections and viral diseases. The chemicals, which are present in the effluent water discharged by the paper industry, are highly dangerous to biotic and aquatic life. In few, cases cancer causing agents are present in the effluent water [3].

The environmental problems of pulp and paper industry are not limited by the high water consumption. Wastewater generation, solid wastes including sludge generating from wastewater treatment plants and air emissions are other problems and effective disposal and treatment approaches are essential. The significant solid wastes such as lime mud, lime slaker grits, green liquor dregs, boiler and furnace ash, scrubber sludge, wood processing residuals and wastewater treatment sludges are generated from different mills. Disposal of these solid wastes cause environmental problems because of high organic content, partitioning of chlorinated organic, pathogens, ash and trace amount of heavy metal content [4].

1.3. Statement of the problem

Industrial pollution has been and continued to be a major factor causing the degradation of the environment around us, affecting the water use, the air we breathe and the soil we live on. But of these, pollution of water is arguably the most serious threat to current human welfare. Water is polluted not only by industries but also by households. Both industries and household wastewater contain chemicals and biological matter that impose high demands on the oxygen present in water. Polluted water thus contains low levels of dissolved oxygen as a result of the heavy biological oxygen demand (BOD) and chemical oxygen demand (COD) placed by industrial and household waste materials discharged into water bodies and water systems, both above and below the earth's surface. In addition to low levels of dissolved oxygen in water, industrial wastes (effluents) also contain chemicals and metals, which are directly harmful to human and ecosystem health [5]. A large number of chemicals are used in the manufacture of a very wide range of commercial products, generating in the process several potentially toxic and hazardous wastes. The type of wastes generated could be either liquid or solid. These are stored near the industrial site or discharged into the surrounding environment [6].

The character and quantity of the wastes from different industries vary, depending on the nature of the products, raw materials, processes used, by-products recovered and the size of the plant. The overall impact of such effluents is conditioned by the nature of the water course and its surroundings. Effluents or waste from no two industries are the same and even vary from factory to factory. India is poised for a significant industrial growth and in future the pollution load will increase manifolds unless proper care is taken.

Industrial wastes contain chemicals and heavy metals such as arsenic, lead, mercury, cadmium and zinc, which are harmful to human health and the ecosystem. When used for irrigation, polluted water has serious impact on land productivity. Heavy concentration of chemicals and metals in both surface and groundwater bodies causes serious damage to the ecology of river systems. The consequences of water pollution due to heavy discharge of industrial effluents. In this backdrop, this paper analyses and investigates the economic and environmental impact of paper industrial pollution on rural communities in general and on agricultural production, human health in particular.

2. Methodology

A case study method is followed in the present study. Moolimangalam village of Karur district has been chosen for this study. This village is located nearby Tamil Nadu Newsprint and Papers Limited (TNPL). In selection the village the direction from the mill is also considered. This village is one of the problem acute villages due to paper industrial pollution. 30 samples respondents have been collected from small farmers and medium farmers randomly. In this study farmers were classified into small farmers (up to 4.94 acres) and medium farmers (4.94 acres to 12.35 acres) according to agricultural census, Government of India.

This study based on both secondary and primary data. The secondary data re collected from TNPL , production, usage of water, effluent discharged, volume of waste water treated and other related data have been collected from concern TNPL. The primary data were collected from field survey with detailed questionnaire, which includes drinking water sources affected by industrial pollution, changing the cropping pattern, affected human health and treatment cost, etc.

3. Analysis and Discussion

This section is set to present the analysis and results of Secondary data and Primary data of the present study. Moolimangalam village of Karur District has been selected for primary survey. This village is located nearby Paper industry (TNPL). In this village there is 155 households with population is 1100. Total number of farmer in this village is 60. Out of the total farmers 30 farmers has been selected for this study. Primary data includes landholding, impact of human health, agriculture, animal health due to effluent discharged by study industry (TNPL). Also investigate the ground water quality and drinking water sources have been collected from primary survey.

Table 1. Year wise production by TNPL

Year	Production (MTS)	Sales and Other Income	Rs. In Lakhs	Export (Rs. In Crores)
2006-07	231161	88040	255.62	52712
2007-08	245471	96965	222.89	42492
2008-09	254903	110030	184.55	33461
2009-10	245008	107362	191.62	50394
2010-11	265044	122504	155.57	64776
2011-12	343306	153899	103.43	80459
2012-13	371637	188118	66.43	71226
2013-14	387714	230195	36.01	65875
2014-15	373259	215237	45.46	72815
2015-16	403430	255384	22.59	72719
2016-17	403261	313092	31.25	83547

Source: TNPL, Pugalur (2018)

The Table 1 represents the year wise production, Sales and other income and yearly exports in TNPL. In the year 2006-2007 the production was 0.04% in the year 2007-08, the production increased to 8.04, the production decreased to 4.01% in the year 2008-09. In the year 2014-15 the production decreased to 64.28% and the production rose to 74.45% in 2015-16. In the year 2006-2007 the Sales and Other Income was 22.59%, in the year 2007-08, the Sales and Other Income increased to 45.46% the Sales and Other Income decreased 36.01% in the year 2008-09.

In the year 2014-15 the Sales and Other Income Increased to 184.85% and the Sales and Other Income raised to 255.62% in 2015-16. In the year 2006-07 the Exports was 52712 Crores, in the year 2007-08 the Exports was decreased to 42492 Crores, the Exports decreased to 65875 in the year 2013-14 and the Exports raised to 83547 Crores in 2016-17 [7].

Table 2. Water Drawn from River

year	Water Drawn from River(KL)	Lagoon Out flow (KL)
1994-95	18886900	13361820
1995-96	24642000	17806000
1996-97	27877000	20420170
1997-98	26019000	19514250
1998-99	22225000	18816310
1999-2000	21930000	17786500
2000-01	20969000	17823650
2001-02	20540764	17359568
2002-03	19347843	14412080
2003-04	18000784	12672240
2004-05	207484494	14112380

Source: TNPL, Pugalur (2018)

The Table 2 shows that the water drawn from river (in KL) for industry and the water lagoon out flow from the industry after ETP from 1994-2004, water flow in to the industry & flow out from the industry, in which, nearly 0.5-0.7% (approx) of water has been evaporated (mainly in summer time), from the reserve tank inside the industry. Which highlight that is single industry extracting these much of water for its production purpose annually and only 20% of water is used in production purpose.

Table 3. Water Consumption Pertonne of Paper

Year	Water consumption of One tonne of paper (M3)	Water Discharge Effluent (M3)
1990-2000	124	96 (80%)
2002-2003	105	
2003-2004	83	
2016-2017	40	

Source: TNPL, Pugalur (2018)

The Table 3 shows the water consumption for paper production per tonne of paper in KL, for the years 1999-00, 2002-03, 2003-04, 1999-00 and 2016-17 water consumption for year is 124 KL, 105 KL, 83 KL & 40 KL respectively, this is because of adoption of new technology for production. Finally nearly 80% of flow water the production per tonne has been discharged as effluent.

Table 4. Pollution Level Achieved by TNPL

Parameter	From Baggase handling & Preparation (mg/L)	From Pulp mill Paper Machine utilities (mg/)	TNPCB Norms	Achived by TNPL (mg/L)
BOD	3500	350	30	-
TSS	3500	700	100	40-50
COD	7000	1300	250	170-220

Source: TNPL, Pugalur (2018)

The Table 4 indicates that they have achieved their pollution (water) level, below, the norms formed by TNPCB. The above table suggests that the industry has been performing well with pollution control measures. But the fact remains there are externalities due to TNPL effluents. However the present study could not go into assenting damage cost.

4. Analysis of primary data

The Table 5 represents the monthly income of the family. According to the survey of average monthly family income of small farmers is ₹13337.71 their expenditure is ₹14112.50. Average monthly family income of medium farmers is ₹18333.33 their expenditure is 18550.60. Their expenditure is higher than their monthly income because there is no much income from Agriculture, and the land of cultivation is affected by the industrial pollution. The income and expenditure of the medium farmers is higher than the income and expenditure of the small farmers because the medium farmers own the lands above 5 acres where the small farmers own land below 5 acre. The total average monthly income of the both the farmers is 15169.4444 and their total expenditure is 15739.80. Income from all farmers through agricultural production. All the farmers are cultivated coconut tree only. Because only source of water is outlet water from TNPL industry. This water is not suitable for agriculture, so productivity and income is very less. But expenditure is very high. In this table concludes that expenditure is higher than the income of the family.

Table 5. Monthly Income and Expenditure of the Respondents

Types of Farmers	Statistics	Total Monthly Income	Total Expenditure
Small Farmers	Sum	253416.67	268137.50
	Mean	13337.71	14112.50
Medium Farmers	Sum	201666.67	204056.67
	Mean	18333.33	18550.60
Total	Sum	455083.33	472194.17
	Mean	15169.44	15739.80

Source: Primary survey, 2018

Table 6 shows that, the farmers where asked that if they are affected by the pollution. At 63.3% of small farmers, 36.7% of medium farmers claimed that their land is affected by pollution. All the agricultural land is affected by industrial pollution. The small farmers claimed that 10.5% of agricultural land, 5.3% of human health, there is no affect to the animal health. 84.2% of all the agricultural land and human health.

Table 6. Impact of agricultural land and human health due industrial pollution

Types of Farmers	Affect Pollution	Total	Type of Affect				Total
	yes		Agricultural land	Human health	Animal health	All the above	
Small Farmers	19	19	2	1	0	16	19
	(100.0)	(100.0)	(10.5)	(5.3)	(0.0)	(84.2)	(100.0)
	[63.3]	[63.3]	[100.0]	[100.0]	[0.0]	[61.5]	[63.3]
Medium Farmers	11	11	0	0	1	10	11
	(100.0)	(100.0)	(0.0)	(0.0)	(9.1)	(90.9)	(100.0)
	[36.7]	[36.7]	[0.0]	[0.0]	[100.0]	[38.5]	[36.7]
Total	30	30	2	1	1	26	30
	(100.0)	(100.0)	(6.7)	(3.3)	(3.3)	(86.7)	(100.0)
	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]

Source: Primary survey, 2018

The medium farmers claimed that, there is no affect to the agricultural land and human health. 9.1% of affected by the animal health. Majority of the respondents (86.7%) says that, due to industrial pollution, Agricultural land, Human health, Animal health are affected both small and medium farmers. This table concludes water from TNPL industry. This is not suitable for agriculture and also affects the ground water suffering a lot for TNPL industrial pollution.

Table 7 shows that, the small farmers were asked if the drinking water is contaminated due to pollution or not affected. 15.8% of farmers said that pollution did not affect the drinking water, and 84.2% of farmers said that the pollution affected the cultivation land. The medium farmers were asked if the drinking water is contaminated due to pollution or not affected. 27.3% of farmers said that pollution did not affect the drinking water, and 54.5% of farmers said that the pollution affected the cultivation land. 18.2% of farmers claimed that pollution affected both the drinking water and cultivation land. The averages of small farmers are affected by 63.3%. The average of medium farmers is affected by 36.7%.

Table 7. Drinking Water Sources affected by Industrial Pollution

Types of Farmers	Water Pollution affected by Drinking water sources			Total
	No affect	Cultivation land	Drinking Water and Cultivation land	
Small Farmers	3 (15.8) [50.0]	16 (84.2) [72.7]	0 (0.0) [0.0]	19 (100.0) [63.3]
Medium Farmers	3 (27.3) [50.0]	6 (54.5) [27.3]	2 (18.2) [100.0]	11 (100.0) [36.7]
Total	6 (20.0) [100.0]	22 (73.3) [100.0]	2 (6.7) [100.0]	30 (100.0) [100.0]

Source: Primary survey, 2018

Table 8 shows that the changing cropping pattern due to industrial pollution. The farmers were asked if they changed their cropping pattern due to industrial pollution. 31% of small farmers and 27.3% of medium farmers said that the change their cropping pattern due to industrial pollution. 68.4% of small farmers and 72.7% of medium farmers of said that they did not change their cropping pattern due to industrial pollution.

Table 8. Changing Cropping Pattern due to Industrial Pollution

Types of Farmers	Change Cropping Pattern due to Industrial Pollution		Total
	Yes	No	
Small Farmers	6 (31.6) [66.7]	13 (68.4) [61.9]	19 (100.0) [63.3]
Medium Farmers	3 (27.3) [33.3]	8 (72.7) [38.1]	11 (100.0) [36.7]
Total	9 (30.0) [100.0]	21 (70.0) [100.0]	30 (100.0) [100.0]

Source: Primary survey, 2018

Table 9 shows that, 73.7% of small farmers and 90.9% of medium farmers claimed that their human health was affected by pollution. 26.3% of small farmers and 9.1% of medium farmers said that pollution did not affect their health and life. Thus, 80% of farmers' health and life was affected by the pollution. Many farmers health was affected by the pollution. Where, 26.3% of small farmers and 9.1% of medium farmers were affected by skin diseases. 15.8% of small farmers and 9.1% of medium farmers were affected by headache. 15.8% of small farmers and 18.2% of medium farmers were affected by foot damage. 5.3% of small farmers and 9.1% of medium farmers were affected by jaundice and 36.8% of small farmers and 54.5% of medium farmers were affected by other diseases. The total farmers affected by skin disease are 20% headache is 13.3% foot damage is 16.7%, jaundice is 6.7%, and other disease is 43.3%. The total expense of small farmers for treatment per year costs around ₹8263. The total expense of medium farmers for treatment per year costs around ₹12454.

Table 9. Health impact and Treatment cost for water borne disease due to Industrial Pollution

Types of Farmers	Affected Industrial Pollution		Total	Types of Diseases					Total	Statistics	Treatment Cost (per year) (in Rs.)
	Yes	No		Skin diseases	headache	Foot damage	Jaundice	others			
Small Farmers	14	5	19	5	3	3	1	7	19	Sum	157000
	(73.7)	(26.3)	(100.0)	(26.3)	(15.8)	(15.8)	(5.3)	(36.8)	(100.0)	Mean	8263
	[58.3]	[83.3]	[63.3]	[83.3]	[75.0]	[60.0]	[50.0]	[53.8]	[63.3]	N	19
Medium Farmers	10	1	11	1	1	2	1	6	11	Sum	137000
	(90.9)	(9.1)	(100.0)	(9.1)	(9.1)	(18.2)	(9.1)	(54.5)	(100.0)	Mean	12454
	[41.7]	[16.7]	[36.7]	[16.7]	[25.0]	[40.0]	(50.0)	[46.2]	[36.7]	N	11
Total	24	6	30	6	4	5	2	13	30	Sum	294000
	(80.0)	(20.0)	(100.0)	(20.0)	(13.3)	(16.7)	(6.7)	(43.3)	(100.0)	Mean	9800
	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	[100.0]	N	30

Source: Primary survey, 2018

5. Conclusion

It is concluded from the present study that paper and pulp (TNPL) industry causes water pollution. The TNPL has been undertaking a lot of measures to abate pollution. But, in primary survey results shows that the study area of Moolimangalam village has been affected in terms of human health, agriculture due to discharge effluents from the paper industry. Similarly, groundwater is affected by pollution. On record, the pollution level is under check. However, constrained to state that there are damages caused by the environmental pollution in the surrounding of TNPL.

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