Impact of Industrial Pollution on Health: A Case Study of Nagaon Paper Mill

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I. INTRODUCTION

Development and environment are inter related in a crucial manner. Economic development of a country requires industrialization to enhance GDP and employment. But pollution from the industries have adverse effects on environment. Thus the industrial units create the problem of negative externalities leading to inefficiency and market failure. Correction of such inefficiencies necessitates various policy measures including environmental regulation. Moreover, uncontrolled exploitation of natural resources by industries can render various economic activities unsustainable in the long run. In light of the potential damages to environment and natural resource base from industrialization, revaluation of economic contribution of industries has become necessary. As an illustrative example for estimation of impact on health of industrialization a study of the Nagaon Paper Mill has been proposed.

Objectives of the Study:

The objective of the study is to investigate the impact of industrial pollution (NPM) on health of the people in the surrounding areas.

II. METHODOLOGY

The study is based on both secondary and primary data. The secondary data are collected from various sources. The main source of secondary data is the Hindustan Paper Corporation Limited, Nagaon Paper Mill unit. The data relating to year wise income and expenditure statements are collected from the Finance Department of the mill. The secondary data regarding the production, bamboo requirement per annum, the sources of bamboo supply are collected from the Forest Department of the industrial unit. The census data of the Government of India, 2001 is also collected to know the demographic profile of the study area.

A field survey is carried out to investigate the effect of pollution on health.

Coverage of the Study Area for Capturing Possible Damage Health

The study area covers a radius of ten kilometers from the Nagaon Paper Mill. The field study is confined to only 11 villages that come under the Mayang development block and Dimoria development block in Morigaon and Kamrup district (metro) of the state of Assam respectively.

Sampling Design

The primary data were collected through a sample survey.

The sample has been selected through a two-stage sampling design. In the first stage, eleven villages have been purposively selected keeping in consideration the representation of villages within a radius of ten kilometers at different distances from the mill. In selecting the villages the direction from the mill is also considered so that data can be gathered from villages located in east, west, north and south. The selected villages are Tegheria, Ghunusa, Sakumaku, Bangthaigaon, Bihita, Bangpkor, Kamarkuchi, Palesung, Paliguri, Topatoli and Dhopguri. Among these villages two villages Topatoli and Mainajan (Dhopguri) are from the Kamrup (metro) district. In the second stage roughly ten percent farm households from each of the selected villages were randomly selected for survey. Total number of households thus surveyed is 110.

To investigate the effect of pollution on agricultural productivity and on the health of the people of the study area, multiple regression analysis is carried out.

IIII. RESULTS AND DISCUSSION

To investigate the impact of the paper mill's pollution on health, emphasis was given to the diseases which may arise from the pollution of a paper mill. Thus, while preparing the questionnaire for the household survey information was gathered by consulting doctors to know the type of diseases associated with the paper industry and accordingly data were collected. The informations were collected regarding respiratory problem, chronic disease and endemic disease.

The highest percentage of population in the study area suffers from endemic diseases followed by chronic diseases which are 38.53 percent and 26.63 percent as presented in the table 4.12. The percentage of population suffering from respiratory diseases is 19.12.

Table 4.12: Percentage Distribution of Sample Population by types of Diseases

Type of Disease	Percentage of Diseases
Respiratory Disease	19.12
Chronic Disease	26.63
Endemic Disease	38.53

Source: Field Study

The chronic diseases have been classified in to eight types namely Asthma, Diabetes, Cancer, Blood Pressure, Tuberculosis, Heart Disease, Eye Disease and other Disease .Among these diseases the highest percentage of sample population are getting asthma which is 28.19 percent as presented in table 4.13. 27.66 percent of people have the problem of high blood pressure. The percentage of people having the problem of eye and Heart Disease are 11.7 and 7.45 respectively. The percentage of people suffering from Tuberculosis, Diabetes and Cancer are 6.38, 2.13 and 1.06 respectively.

Table 4.13: Percentage Distribution of Sample Population by types of Chronic Diseases

Type of Chronic Disease	Percentage of Chronic Disease
Asthma	28.19
Diabetes	2.13
Cancer	1.06
Blood Pressure (BP)	27.66
Tuberculosis (TB)	6.38
Heart Disease	7.45
Eye Disease	11.70
other Disease	15.43
	100

Source: Field Study

The endemic diseases are again classified into six categories. These are Jaundice, Malaria, Diarrihoea, Skin, Gastritis and 0ther diseases.

The percentage of population suffering from gastritis is 53.5. That means more than half of the population having endemic diseases have gastritis. This may be because of the continuous generation of smoke of the mill. This smoke goes in and around the study area depending upon the distance and the direction of the wind. Another cause of high percentage of this disease may be the source of drinking water.

The second highest percentage of people getting endemic disease is the skin disease which is 22.88 percent. Before collecting the primary data when a few local doctors were consulted, they also informed that the percentage of patients suffering from skin disease and gastritis is high in the study area. The percentage of population suffering from Jaundice, Diarrihoea and Malaria are 8.45, 5.28 and 3.17 respectively as presented in table 4.14.

Table 4.14: Percentage Distribution of Sample Population by types of Endemic Diseases

Sl No.	Type of Endemic Disease	Percentage of Endemic Disease
1	Jaundice	8.45
2	Malaria	3.17
3	Diarrihoea	5.28
4	Skin	22.89
5	Gastritis	53.52
6	0thers	6.69
	Total	100

Source: Field Study

The distribution of the sample population on the basis of source of health advisers as presented in the table 4.15 indicates that 42.97 percent of the total population depends on the government doctors. This is followed by the private doctors which is 28.65 percent. The percentage of sample population taking health care advises from Pharmacist /Nurse, Quack and Alternative Practitioner are 17.84, 9.20 and 1.35 respectively.

Table 4.15: Percentage Distribution of Sample Population by Source of Health Advisers

Source of Health Advisers	Percentage of Health Advisers
Government Doctor	42.96
Private Doctor	28.65
Alternative Practitioner	1.35
Pharmacist /Nurse	17.84
Quack	9.20
Total	100

Source: Field Study

In order to investigate the environmental impact of the Nagaon paper mill on the number of sick days of the members of the sample household a multiple linear regression analysis is carried out. First we calculated the average number of sick days by dividing total number of sick days by the total number of family members of the respective household. Then the regression is carried out taking average number of sick days as the dependent variable and three independent variables namely safe drinking water, index of economic status and distance from mill.

Regression model is

$$ASD=f(SDW, DIM, IES) \quad \text{---------- (i)}$$

Where

Variables / Items	Variable Level
Dependent Variable	ASD
Average no of sick days	
Independent variables	SDW IES DIM
(i) Safe drinking water (ii) Index of economic status (iii) Distance from NPM	

The regression model is given by the equation:

$$ASD= \alpha + \beta_1 SDW + \beta_2 IES + \beta_3 DIM + u \quad \text{---------- (ii)}$$

Where

α is the intercept, β_1, β_2 and β_3 are the coefficients and u is the disturbance term.

Table4.12

Regression Analysis of Health Indicators of Sample population

Variables / Items	Estimated co-efficient values	Standard error	t-values (df=106)
SDW (X_1)	(-) 2.355	4.117	(-).572
IES (X_2)	(-) 1.042	11.001	(-).095
DIM (X_3)	(-) 3.192	.722	(-).499***
Constant(α)	53.7312	7.691	6.986***
R^2	.25		
F($\mathfrak{y}_1$=3, $\mathfrak{y}_2$ =106)	11.49***		

Note: *** indicates significance at .01 levels.

The value of R^2 is not very large but F for overall regression is highly significant. Therefore results are credible. Among the three explanatory variables, coefficient of only one variable distance from the mill (X_3) is significant at 0.1 levels. The sign of the coefficient of this variable is negative which indicates that smaller the distance of the household from the mill more is the average number of sick days.

The coefficients of the other two variables namely safe drinking water (X_1) and the index of economic status are not significant and negative. This means the index of economic status and the safe drinking water (X_2) do not have an adverse effect on the average number of sick days of the sample population. Since our main area of interest is the distance from the paper mill, we can say that there is positive impact of the environmental pollution of the Nagaon paper mill on the number of sick days of the people in the study area.

The value of the intercept α is significant at .01level and positive.

The pollution generated by Nagaon paper mill may also affect the people by respiratory diseases. To investigate the effect of this pollution another regression linear regression analysis is carried out taking incidence of respiratory diseases as the dependent variable and the distance of the sample household from the industrial unit as the explanatory variable. The incidence of respiratory diseases (Y) is found out by dividing the total no of persons affected by respiratory disease in the sample household in the village by total population of the sample household in the village.

The model is given as

RD=*f* (DIM)

Where

RD= Incidence of respiratory diseases

DIM= Distance from the paper mill

RD= α +β DIM+ *u* ---------- (iii)

Where

α is the intercept, β is coefficient and u is the disturbance term.

Table: 4.13 Regression Analysis of respiratory diseases of the sample population

Variables / Items	Estimated co-efficient values	Standard error	t-values (df=108)
DIM (X)	(-).05	.032	(-)9.113***
Constant(α)	.448	.005	14.227***
R^2	.436		
F($ע_1$=1, $ע_2$ =108)	83.414***		

Note: *** indicates significance at .01 levels

The value of R^2 is not very high. Moreover, the large F value implies the high overall significance of the fitted regression.

The coefficient of the independent variable distance from the paper mill (X) is significant at .01 levels and it is negative. This means as the distance from the mill increases incidence of respiratory diseases in the sample household decreases and vice versa.

The value of the intercept α is significant at .01level and positive

IV. CONCLUSION

As far as the environmental impact of the industrial pollution of Nagaon paper mill is concerned, in case of health there is effect of the pollution generated by the mill which is obvious from the regression analysis carried out in this study. To estimate the quantum of the health effect a detailed study is required.

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