CHAPTER I  INDUSTRIALISATION AND ENVIRONMENTAL POLLUTION
INDUSTRIALISATION AND ENVIRONMENTAL POLLUTION

Industrial development has been accorded much priority to augment the production of goods and services utilising the resources, factor endowments and the technologies available to meet the evergrowing requirements of the population and for providing a higher standard of living.¹ The spurt in industrialisation has led not only to the

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production of a higher volume of goods but also increased the industrial pollution and the delivery of the industrial pollutants, wastes and effluents into the environment. The delivery of these industrial pollutants and wastes into the environment affects the environment culminating in the environmental pollution.


INDUSTRIALISATION AND ENVIRONMENTAL POLLUTION

The rapid growth and development of the industrial units of organic chemicals, antibiotics, dairy, plastic, paper, fertilizers, paints, pharmaceuticals, leather and tannery, drugs, cellulose, textile, thermal power plants, jute, sugar, oil refineries, iron and steel, distilleries and manufacture of alcohol, etc., and the production/manufacturing processes associated with the usage of the available technologies have aggravated the discharge of the industrial pollutants/wastes, effluents, gases.

liquids and solids. Toxic chemicals like ammonia, arsenic, chromium, phenols, cyanide, thiocyanide, and gases like sulphur dioxide, carbon dioxide, carbon monoxide, etc., and methane, chlorofluoro carbons, dust, sand and obnoxious gases, fumes and smoke\(^5\) are released into the environment through the industrial pollutants and wastes. These industrial pollutants/wastes and effluents are causing the air, water and land pollution and thereby resulting in the environmental pollution.

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Pollution of air occurs mainly due to the phenomenal growth of these industries. The abnoxious gases like sulphur dioxide, carbon dioxide, carbon monoxide, hydrocarbons and nitrogen oxides, mercury, vapour, sulphuric acid, flyash, dust and smoke containing high level of acid forming oxides of sulphur and toxic fluorides are released by various industries like sulphuric acid plants, power stations, boilers, nitric acid plants, cement plants, paper mills, foundaries, chlor-alkali industries, plastic and textile units, distilleries and sugar plants. The release of these emissions and effluents/pollutants both in the process of production of the raw materials and the manufacture of commodities by these industries
is causing the air pollution and thereby affecting the environment. The growth of these polluting industries causes the water pollution also through the discharge of the industrial wastes and effluents. The delivery of wastes from the food processing industry, meat and dairy products, sugar refining, brewing and distilling, etc., containing decomposable organic matter leads to the oxygen depletion. The wastes of the textile units generated in the processing of the cooking and designing of the fabrics produce alkales affecting the water quality.

Paper and pulp mills, chemical plants and the

manufacture of synthetic fibers, acids, pesticides, detergents, organic and inorganic compounds generate lots of industrial effluents/pollutants and their release through the wastes are causing the water pollution. The development of the industrial units results not only in increasing the production levels but also in increasing the industrial wastes. The disposal of industrial wastes and effluents and the polluted water into the lands is causing the land pollution also.


Moreover, the development of industrial units connected with the manufacture of metal products, iron and steel, fabrication, textile, printing, cement and sugar utilising the available technologies is causing noise pollution also. The culmination of the air, water and land pollution owing to the discharge of industrial pollutants, wastes and effluents is leading to the environmental pollution.

The rapid growth of these industrial units apart from increasing the production of commodities further, also increases the greater release of the industrial effluents/pollutants, wastes and emissions and consequently it increases the environmental pollution. The environmental

pollution due to industrialisation affects the human beings and other living organisms imposing health hazards. Environmental pollution has adverse effects on human health and leads to the problems like breathlessness, common cold, skin infection, eye irritation, dysentery, indigestion, body pains, palpitation, restlessness and mental torture in human beings causing the deadly diseases like lung cancer, blood cancer, emphysema, pneumonia, asthma, tuberculosis, bronchitis, jaundice, cholera, typhoid, heart diseases, gastroenteritis, deafness and high blood pressure and the medical disorders like abortions, conceiving

problem, immature/blue baby births, infant mortality, birth of physically handicapped and mentally retarded children and the non-attaining of puberty at the proper age, etc. Environmental pollution generated by the disposal of industrial effluents/pollutants and wastes brings in health hazards (problems, diseases and medical disorders) for the households reducing their ability to work and leads to the loss of working days and employment while adversely affecting their earning capacity and the income generation of the households. The environmental pollution

also affects the value and productive capacity and yields of the material and non-material assets of the households. The material assets like lands are polluted due to the release of industrial pollutants/effluents resulting in the decline of fertility, productivity and the value of the asset/land. The non-material assets like milk yielding animals, etc., are also affected by the pollution and thereby they lose their yields and value. Therefore, industrialisation has led to the discharge of industrial pollutants/effluents and wastes causing the air, water, land and noise pollution culminating in the environmental pollution. Environmental pollution has adverse effects on the households.

The increase in the environmental pollution due to the spread of industrialisation also imposes a greater strain on the state exchequer and budget to provide the additional resources for meeting the increased spending on health, sanitation and housing, the increased expenditures to cover the industrial pollution abatement costs and on the import of the resources needed to combat the problem of resource depletion, the additional investments for the exploitation and utilisation of the resources including the development of alternatives on an economically viable basis and for the development of the pollution free technologies either indigenously or to get them through imports, and the expenditures on the exigencies arising out of the rising industrial pollution over the years. The emergence of these trends associated with an increase of the industrial pollution levels and
consequently the environmental pollution has resulted in the greater distortions in the resource allocation\textsuperscript{13} patterns and aggravated the levels of inequalities of distribution of income and wealth. The acceleration of industrial pollution has affected not only the quality of natural resources and factor endowments including the human resources required for the sustenance of development but also led to deterioration in the quality of life of the households living in the areas affected by the industrial pollution.

\textbf{DESIGN AND METHODOLOGY}

\textbf{STATEMENT OF THE PROBLEM}

The spurt in industrial development to enlarge the production of commodities for meeting the ever...
increasing developmental and other requirements has resulted in the discharge of industrial wastes, effluents and pollutants on a massive scale which has not only accelerated the industrial pollution leading to the environmental pollution beyond the tolerable levels of limits and the absorbent capacity of the nature culminating in the deterioration of environment with adverse effects on the environs and living conditions of the households dwelling in the industrially polluted areas, subjecting them to acute suffering due to diseases, lowering their health conditions with serious consequences on their earnings capacity, but also imposed strain on the state for increased spending on health, sanitation, housing and increased expenditures to meet the industrial pollution abatement costs and the exigencies arising out of the rising industrial pollution over the years. These trends have distorted the resource allocation patterns and aggravated the levels of inequalities of
distribution of income and wealth. The rise of industrial pollution and consequently the environmental pollution has affected the quality of life of the households living in the areas affected by the industrial pollution. In this study an attempt is made to examine the industrialisation and environmental pollution and its effects on the households living in the areas affected by the industrial pollution in Pattancheru of Medak District within the purview of the suburbs of the city of Hyderabad in Andhra Pradesh.

**REVIEW OF LITERATURE**

Barber Conable (1989) has analysed the relationship between development and environment and emphasized the maintenance of a balance of the two at the global/national level for attaining a
diversity of interests.\textsuperscript{14}

Fernando, V. (1985) has explained the environmental aspects related to development and indicated the deliberate need for the conservation of resource to protect the environment.\textsuperscript{15} James Lee and Robert Goodland (1986) have indicated that sound environmental management is a prerequisite for achieving sustainable development.\textsuperscript{16}

Andrew Steer (1992) has analysed that without the pursuit of proper environmental policies, the development will be undermined and the sustenance of development is a prerequisite for environmental


protection.\textsuperscript{17}

Richard Lecomber (1975) has examined the relationship between economic growth and environment and suggested the policies that have to be adopted for minimising/reducing the environmental pollution.\textsuperscript{18}

Qasim, S.Z. and Dilip Biswas (1981) have studied the environmental aspects related to developmental planning and stressed the need for the conservation of resources to protect the environment from pollution.\textsuperscript{19}

World Health Organisation (1985) analysing the relationship between environment and development, stressed the need for controlling the environmental

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pollution through the effective implementation of appropriate policies and pollution control acts.\(^\text{20}\)

Jain, H.K. (1991) has analysed that with the liberalisation of industrial policy and consequently the growth of industrialisation is increasing the levels of air and water pollution, which pose environmental threats and affect the life of humanbeings.\(^\text{21}\)

Kumar B. Das (1992) has stressed the need for improving the environmental quality in the context of environmental degradation and rapid depletion of natural resources and suggested the measures.\(^\text{22}\)

Vandana Siva and Buch, M.N. (1992) have examined the


need for the maintenance of environmental quality particularly in view of the environmental deterioration to promote development.\textsuperscript{23}

Robert Dorfman and Nancy S. Dorfman (1972) have analysed the causes for environmental deterioration and stressed the need for maintaining the environmental quality in a growing economy.\textsuperscript{24} Sapru, R.K. (1987) has analysed that there is need to maintain the environmental quality to improve the environment for the present and future generations through the implementation of environmental protection acts and laws.\textsuperscript{25}

*The Stockholm Declaration (1972) emphasized that the maintenance of environmental quality is a precondition for the welfare of the human beings and*


made several declarations to protect the environment so as to improve the quality of human life. OECD (1985) analysed the environmental pollution arising from the pursuit of industry, energy, transport and agricultural activities and the responses of the public to this, and the policies pursued by the enterprises and governments to minimize the environmental pollution.

World Development Report (1992) analysed the factors that intensify the environmental problems associated with the rapid industrial development. The phenomenal increase of emissions/pollutants from the existing industrial activities beyond the protective capacity of the environment, the spurt

in the growth of industrial activities/firms and the structural shifts within the industry with the concentration of more highly polluting industries are the factors resulting in the increase of environmental pollution.\textsuperscript{28}

Nicholas Holmes (1976) has examined the various polluting industries which affect the environment through the discharge of the wastes and emissions.\textsuperscript{29} Stadinger, J.J.P. (1974) has analysed the reasons for environmental pollution and the waste products produced by the plastic industry at different stages that increase the pollution.\textsuperscript{30}


\textsuperscript{29} Nicholas Holmes (1976), Environment and Industrial Society, Hodder and Stoughton, London.

Srivastava, N.Y. (1989) has stressed that the increase in environmental pollution is due to the growth of industrialisation.  

Mahajan, S.P. (1985) has examined different types of polluting industries which are causing the air, water, land and noise pollution.  

Junvi (1985) has analysed the environmental deterioration caused by the industrial pollution and the consequent effects of this on the levels of living of the people.  

Verma, S.R., Tyagi, A.K., Dalela, R.C. (1977) have emphasized that the problem of the disposal of

industrial wastes is affecting the environment.34 Subodh K. Gupta (1989) has stressed that the organic fuel burnt at thermal power stations contain harmful impurities and the release of the gaseous and solid components in the combustion process by these plants into the environment leads to the increase of environmental pollution.35 Singh, P. (1985) has analysed the causes for the environmental pollution.36 Kumar, V.K. (1982) has emphasized that the haphazard growth of industrialisation and the lack of rigorous pollution control measures have led to the increase

of environmental pollution.\textsuperscript{37} Rais Akhtar (1990) has analysed the growth of environmental pollution due to the industrial wastes/effluents and others and the health problems caused by the increase of pollution.\textsuperscript{38}

Richard N. Barrett (1982) has examined the environmental pollution problems faced by the countries throughout the world and related it to diverse factors like economic constraints, nationalism, international relations, etc.\textsuperscript{39}

Promod Singh (1990) has examined the causes for the environmental pollution and analysed the problems of environmental pollution.\textsuperscript{40} Chandola, R.P.

\begin{thebibliography}{9}
\bibitem{37} Kumar, V.K. (1982), Kanpur City, A Study in Environmental Pollution, Tar Book Agency, Varanasi.
\bibitem{38} Rais Akhtar (1990), Environmental Pollution and Health Problems, Ashish Publishing House, New Delhi.
\bibitem{39} Richard N. Barrett (1982), International Dimensions of the Environmental Crisis, West View Press, USA.
\bibitem{40} Promod Singh (1990), Urban Environmental Conservation, Ashish Publishing House, New Delhi.
\end{thebibliography}
(1990) has examined the problems arising out of the deterioration in the environment due to pollution.\textsuperscript{41} Hari, M. and Rajeswari, N.V. (1985) have analysed the environmental pollution caused by the depletion of natural resources and stressed the need for conserving the natural resources for future generations.\textsuperscript{42}

Wheeler David (1992) has analysed that the growth of industrial pollution is affecting the environment in several countries and suggested the measures to control the industrial pollution.\textsuperscript{43}

The World Commission on Environment and

\begin{itemize}
\item \textsuperscript{41} Chandola, R.P. (1990), Environment in the Maze of Life, Ashish Publishing House, New Delhi.
\item \textsuperscript{42} Hari, M. and Rajeswari, N.V. (1985), This Growing Pollution Menace, Yojana, Vol.29, No.10, December, pp.16-30.
\item \textsuperscript{43} Wheeler David (1992), The Economics of Industrial Pollution Control, An International Perspective, Industry Series Paper 55, World Bank, Industry and Energy Department, Washington, D.C.
\end{itemize}
Development (1987) analysed the problems of environmental pollution in different countries and suggested the measures that have to be followed for maintaining the environmental quality.\textsuperscript{44} Government of India (1992) analysed environmental problems emerging out of the growth of pollution and stressed the need for international cooperation for maintaining the environmental quality while sustaining the development, adopting the appropriate developmental policies and conserving the natural resources for the developmental requirements of the future.\textsuperscript{45}

Pasupathi Nath and Siddanath (1990) have examined the causes of environmental pollution particularly the pollution generated by the growth

\textsuperscript{44} The World Commission on Environment and Development (1987), Our Common Future, Oxford University Press, New Delhi.

of various industries and stressed the need for promoting environmental education and public involvement and the use of scientific methods to control pollution. Walker, C. (1975) has analysed that the effluents and wastes produced by the chemical industries are resulting in the increase of environmental pollution.

Misser (1985) has analysed the pollution caused by the cement plants and the damages done to the environment by these plants.

Mishra, P.C. and Sunando Sahoo (1989) have analysed that the discharge of liquid and solid

wastes by paper mills is leading to the environmental pollution.\textsuperscript{49} OECD (1973) analysed the pollution generated by the pulp and paper industries and their discharge of wastes, effluents and emissions and its adverse effects on the environment.\textsuperscript{50}

Vinod Vyasulu (1988) has examined the pollution generated by the various industries and its effects on the environmental degradation.\textsuperscript{51}

National Centre for Human Settlements and Environment (1990) analysed the growth of industrial pollution and the effects of this including the disasters and emphasized the need to maintain the


\textsuperscript{50} OECD (1973), Pollution by the Pulp and Paper Industry, OECD, Paris.

industrial development and ecological balance and the effective implementation of legal measures, raising of the public awareness, the constitution of an Independent Environmental Auditing Agency for making environmental impact assessment and the active public participation in the environmental decisionmaking.  

Khare, G.R. (1991) has analysed that the polluting industries located along the coastal side of the rivers discharge their pollutants and wastes into these waters and thereby generate the environmental pollution. Mohan, I. (1989) has examined the sources of air and water pollution and discussed the legal framework and the laws necessary for checking the pollution levels.


Nilay Chaudhuri (1984) has emphasized the impact of air pollution generated by the emissions and pollutants of cement industries and its effects on human health.\textsuperscript{55} Parker, A. (1978) has analysed different sources of air pollution and its effects on the environment and stressed the implementation of adequate measures of pollution/emissions control to reduce the environmental pollution.\textsuperscript{56}

Lave, L.B. and Seskin, E.P. (1977) have examined the sources of air pollution and its effects on the environment and human health.\textsuperscript{57} Lambert, P.M. and Reid, D.D. (1970) have analysed the industries releasing the emissions and smoke and

\textsuperscript{55} Nilay Chaudhuri (1984), Constraints and Conflicts in Pollution Control, Industrial Times, April 30 - May 13, pp.16-17.
\textsuperscript{57} Lave, L.B. and Seskin, E.P. (1977), Air Pollution and Human Health, Johns Hopkins University Press, Baltimore.
thereby generating the air pollution. Madhu Bala (1980) has examined different sources of air pollution and its effects on human beings.

Ostro Bart, D. (1983, 1984 and 1987) has analysed various effects of air pollution particularly the health problems and diseases faced by the human beings and the consequent effects of these in terms of loss of work and employment, increase of mortality and decrease of immunity and the rise in morbidity.

Acheson, M.A. (1983) has examined the causes for the water pollution and its effects on human

59. Madhu Bala (1980), Air Pollution and Its Hazards, Industrial India, Vol.31, No.4, April, pp.41-42.
beings, animals and vegetation and suggested the measures for reducing the effects of the water pollution. McCaul, J. Crossland, J. (1974) have analysed the sources of water pollution and its effects on human beings particularly the health problems arising out of water pollution. Khoshoo, T.N. (1984) has analysed the sources of environmental pollution and stressed the need for maintaining the water quality.

OECD (1964) analysed the water pollution caused by the firms producing detergents and the effects of water pollution on human beings and animals and suggested the measures to control the water pollution. Eckenfelder, W. Jr. (1966) has analysed

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64. OECD (1964), The Pollution of Water by Detergents, OECD, Paris.
the water pollution caused by the delivery of industrial wastes and stressed the adoption of waste water treatment methods. 65

Chhatwal, G.R., Katyal, Mohan Katyal, Mehra, M.C., Satake, M., and Nagahiro, T (1989) have analysed that the land pollution is increasing by the disposal of industrial wastes/effluents, chemicals, fly ash and pesticides and examined the health effects emerging thereof and suggested the measures for the prevention and control of land pollution. 66 Shukla, S.K. and Srivastava, P.R. (1992) have examined the problems of noise pollution in the industrial/urban areas. 67

Albert Wall (1979) has examined the association between the environmental degradation and the health problems arising thereof. 68 Kumar, R. (1987) has analysed the relationship between the environmental pollution and health. The pollution of the environment results from the pursuit of wide range of industrial activities and it has adverse effects on the human health. 69

Indera P. Singh and Tiwari, S.C. (1978) have analysed that the deterioration in the external environment affects the human life and it has adverse effects on human health. 70 Anil Kumar and Umesh Prasad Singh (1990) have studied the environmental hazards posed by the location of the

industrial units in Bihar. Kshetri Munal Singh (1989) has analysed the problems of environmental pollution and its effects on the human health in Manipur.

Murthy, M.N. (1988) has analysed the changes in the distribution of welfare pertaining to the environmental pollution. The polluters and the consumers of commodities produced by the polluting industries secure the welfare gains while the users of resources or the commodities affected by pollution suffer welfare losses.

Biman Basu (1988) has stressed the need to maintain the balance of various components of atmosphere and indicated that the fast depletion of the ozone and the continuous rise in the level

of the carbon dioxide threatens the existence of human race and examined the impact of acid rain on the environmental pollution and its effects on the human health.\textsuperscript{74}

Ali, S.A. (1979) has examined the problems of environmental deterioration and suggested the measures for controlling it.\textsuperscript{75} National Centre for Human Settlements and Environment (1991) expressed concern about the deteriorating environmental conditions and viewed that the Environmental and Pollution Acts are not so effective. Urging the government to take effective measures to protect the


environment in order to safeguard the rights of the people, it has recommended the rigorous implementation of the environment protection Act of 1974 and the pollution Act of 1986.  

World Bank (1978) recommended the adoption of planning jointly by the developers and the environmentalists for minimising and prevent the deleterious effects of the industrial pollution.  

Nagachoudhuri, B.D. and Bhatt, S. (1987) have stressed the need to maintain the international cooperation for achieving the environmental standards.  

Agarwal, S.K. (1991) has analysed the need for adopting the various measures including the

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promotion of the environmental education for achieving the prevention and control of pollution.  

World Bank (1992) analysed the various policies and practices adopted by it for dealing with the environmental problems faced by several nations.  

Attarchand (1989) has stressed that the increase of environmental pollution has necessitated the adoption of the environmental protection measures.  Robert W. Crandal (1983) has indicated the need for proper implementation of the pollution Acts to control the industrial pollution.  

(1975) has stressed the need for the maintenance of the environmental balance in the context of increasing international economic interdependence.  

Malviya, A. (1986) has stressed the need for enforcing the environment laws at the international levels to protect the environmental quality.  

Vandana Siva, J. and Bandyopadhyaya (1986) have indicated the need for awakening the public interest for protecting the environment.  

Though these studies have covered the various aspects of environmental pollution, no specific study has been carried out to examine the industrialisation and environmental pollution and

particularly the effects of the environmental/industrial pollution on the households. In this study, an attempt is made to examine the industrialisation and environmental pollution and its effects on the households living in the areas affected by the industrial pollution in Pattancheru of Medak District within the purview of the suburbs of the city of Hyderabad in Andhra Pradesh.

OBJECTIVES AND HYPOTHESES

The specific objectives of the study are

(1) To analyse the relationship between industrialisation and the environmental pollution.

(2) To know the background of the households affected by the environmental pollution.

(3) To examine the effects of environmental pollution on the households due to industrialisation, and
(4) To analyse the measures for controlling the environmental pollution.

In conformity with the objectives, the hypotheses of the study are

1. There are no effects (problems, diseases and disorders) of environmental pollution on the households living in the environment/industrially polluted area (the study area).

2. There is no significant association between the locations and the affected and non-affected members (family members including the households) owing to the environment/industrial pollution in the study area.

3. There is no significant difference between the various mean losses of the households (loss of the material and non-material assets, loss of income due to the loss of productivity/yield of the material and non-material assets and the loss of income due to the loss of mandays and employment) owing to the environment/industrial pollution in different locations of the study area.
4. There is no significant difference between the various mean losses of the households (loss of the material and non-material assets, loss of income due to the loss of productivity/yield of the material and non-material assets and the loss of income due to the loss of mandays and employment) owing to the environment/industrial pollution with respect to the households below the mean income and the households above the mean income groups in different locations of the study area.

5. There is no consistency of the loss of material and non-material assets, the loss of income due to the loss of productivity/yield of the material and non-material assets and the loss of income due to the loss of mandays and employment of the households owing to the environment/industrial pollution in the study area.

6. There is no significant difference between the various types of mean expenditure (the medical and social expenditure) of the households owing to the environment/industrial pollution in different locations of the study area.
7. There is no significant difference between the various locations of the households who have suggested the measures to be adopted by the industry, the government and the voluntary organisations for controlling the environment/industrial pollution in the study area.

**DATA COLLECTION**

Data has been collected from the various sources for carrying out the analysis in conformity with the objectives of the study to draw the inferences. The secondary data and the information needed for the present study has been collected from the various publications of the Government of India and the State Governments, and from the Ministries and the departments of Environment, Energy, Finance and Law both at the State and Central level, and from the Andhra Pradesh Pollution Control Board and the other pollution control boards, and from the research studies in the area at the national/international level.
Information and data has also been drawn from the various publications of the World Bank, United Nations Environment Programme and other institutions connected with the environment, and from the national level institutions such as the National Engineering and Environmental Research Institute, the National Centre for Human Settlements and Environment and other institutions and from the Libraries of the Osmania University and the University of Hyderabad, Hyderabad, and Sri Venkateswara University, Tirupati, and from the voluntary organisations actively engaged in preventing the environmental pollution. The primary data has been collected for making an in depth study from the selected sample of the households living in the environment/industrially polluted area in Pattancheru, i.e., the study area, of Medak district within the purview of the suburbs of the city of Hyderabad in Andhra Pradesh through a well designed
questionnaire.

**SAMPLE DESIGN**

The sample design of this study is as follows: Jeedimetla, Nacharam, L.B. Nagar, Pattancheru, and Sarur Nagar are identified as the major industrially polluted zones facing the environmental pollution by the Andhra Pradesh Pollution Control Board of the Government of Andhra Pradesh, Hyderabad. Of these, the Pattancheru industrially polluted area is chosen as the sample zone on a simple random sampling basis and it constitutes the study area. Of the fifteen (15) locations in Pattancheru industrially polluted area, five (5) locations, viz., Sultanpur, Krishnareddipet, Bachi guda and Pochavaram, Lakdaram, and Ganapathiguda, Peddakanjarla and Inole have been selected as the sample for examining the effects of the industrial pollution vis-a-vis the environmental pollution on the households living in these areas.
In these five locations of industrially polluted area, considering the total 1800 households living in the industrially polluted area, 500 households have been selected as the sample for the study by a multi-stage sampling procedure consisting of three stage random sampling technique at each stage using the simple random sampling method. The units of the three stage random sampling technique are the zones (first stage), locations (second stage) and the households (third stage) respectively.

In the first stage, the five zones, identified by the Andhra Pradesh Pollution Control Board, of the Government of Andhra Pradesh, Hyderabad as polluted zones have been taken and from them using the simple random sampling method one polluted zone has been taken as the selected first stage unit. From this selected first stage unit comprising of fifteen (15) locations, five (5) locations have been selected as
the second stage units using the simple random sampling method. From these selected second stage units of the five locations, the households are taken as the third stage units and out of the total 1800 households of the third stage units, 500 households have been selected as the selected third stage units as the sample for the study (which constitutes 27.78 per cent of the total) using the simple random sampling method and information has been collected from these selected third stage units of 500 households by using the simple random sampling procedure with replacement. These selected sample of households living in the industrially polluted area have been interviewed through a well designed questionnaire to elicit the information required for this study. Data collection has been done by the researcher by personal observation and conducting the face-to-face interview with the households living in the environment/industrially
polluted area (the study area). Adequate care has
been taken by the researcher in canvassing the
questionnaire. Methods of substitution have been
adopted in case of non-response problem. Much care
has been taken to see that the investigators bias
and the respondent bias might not enter in
canvassing the data. After collecting the data
tables were prepared to suit the inferences.

TOOLS OF ANALYSIS

Chi Square test has been used in this study to
know the association between the locations and the
affected and non-affected members (family members
including the households) living in the environment/
industrially polluted area (the study area) following
the procedure given below.
- TEST FOR THE INDEPENDENCE OF TWO ATTRIBUTES

Suppose A and B be any two attributes (qualitative characteristics) with 'r' and 's' levels respectively. Consider the following \((r \times s)\) contingency table.

\[(r \times s)\) CONTINGENCY TABLE

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Total \((B_1)\) \((B_2)\) \(...\) \((B_j)\) \(...\) \((B_s)\) \(N\)
Where

- $O_{ij}$ = the frequency in the $(ij)$th cell
- $(A_i)$ = sum of frequencies under $i$th row
- $(B_j)$ = sum of frequencies under $j$th column
- $N$ = total frequency in the data
- $i = 1, 2, \ldots \ldots \ldots r$
- $j = 1, 2, \ldots \ldots \ldots s$

To test for the independence of these two attributes, one can state the null hypothesis as

$H_0$ : There is no significant association between the two attributes $A$ and $B$.

To test the null hypothesis, the $\chi^2$-test statistic is given by

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{s} \left( \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \right)$$

Where $E_{ij}$ = The expected frequency corresponds to $O_{ij}$
Eij's can be computed by using the following formula.

$$E_{ij} = \frac{(A_i)(B_j)}{N}$$

i = 1, 2, .................................. r
j = 1, 2, .................................. s

Compare the calculated value of $\chi^2$ with the critical value of $\chi^2$ for (r-1)(s-1) degrees of freedom to know the level of significance and draw the inference accordingly.

The mean and the combined mean are used in this study to examine the various losses such as the loss of the material and non-material assets, the loss of income due to the loss of productivity/yield of the material and non-material assets and the loss of income due to the loss of mandays and employment of the households living in the environment/industrially polluted area (the study area) and to analyse these
losses for the below mean income and above mean income groups of these households and (ii) to examine the medical and social expenditure of the households living in the environment/industrially polluted area (the study area) and to analyse these expenditures for the below mean income and above mean income groups of these households using the following formulae.

**MEAN**

Let $x_1, x_2, \ldots, x_n$ be a sample of 'n' observations, then the mean is defined as the sum of the given observations divided by the number of observations. It is denoted by $\bar{x}$.

Mean = $\bar{x} = \frac{x_1 + x_2 + \ldots + x_n}{n}$

$\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$
COMBINED MEAN

Let $\bar{x}_1, \bar{x}_2, \ldots, \bar{x}_k$ be the means of $k$ groups of sizes, $n_1, n_2, \ldots, n_k$ respectively. The combined mean is given by

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2 + \ldots + n_k\bar{x}_k}{n_1 + n_2 + \ldots + n_k}$$

The co-efficient of variation is used to know the consistency of the loss of the material and non-material assets, loss of the income due to the loss of productivity/yield of the material and non-material assets and the loss of income due to the loss of mandays and employment of the households owing to the environment/industrial pollution in the study area following the procedure cited below.

CO-EFFICIENT OF VARIATION

For comparing the variability of two series, the co-efficient of variation for each series has been
calculated. The series with greater co-efficient of variation is said to be more variable than the other series. The series with lesser co-efficient of variation is said to be more consistent than the other. It is given by

\[ \text{Co-efficient of variation} = \text{C.V.} = \frac{\sigma}{\bar{x}} \times 100 \]

\[ \bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} = \text{Arithmetic Mean} \]

\[ \sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n}} \]

**ANALYSIS OF VARIANCE (ANOVA)**

**ANALYSIS OF VARIANCE OF TWO-WAY CLASSIFICATION MODEL**

Analysis of variance of two-way classification model has been used (i) to study whether there is significant difference between the various mean losses.
of the households (loss of the material and non-material assets, loss of income due to the loss of productivity/yield of the material and non-material assets and loss of income due to the loss of mandays and employment) owing to the environment/industrial pollution in different locations of the study area, and to examine whether there is significant difference between the locations with respect to these various mean losses of the households in the study area and (ii) to examine whether there is significant difference between the various mean losses of the households owing to the environment/industrial pollution with respect to the households below the mean income and the households above the mean income groups in different locations of the study area and to study whether there is significant difference between the locations with respect to these various mean losses of the households belonging to the households below
the mean income and households above the mean income groups in the study area.

The Anova two-way classification model has also been used to study whether there is significant difference between the various types of mean expenditure (the medical and social expenditure) of the households owing to the environment/industrial pollution in different locations of the study area and to examine whether there is significant difference between the locations with respect to these various types of mean expenditure of the households in the study area.

ANALYSIS OF VARIANCE (ANOVA) TECHNIQUE FOR TWO-WAY CLASSIFIED DATA WITH SINGLE OBSERVATION PER CELL

Consider the following two-way classified data with single observation per cell.
### II CLASSIFICATION (LOSSES)

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>1</th>
<th>2</th>
<th>...</th>
<th>j</th>
<th>...</th>
<th>s</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>$y_{i1}$</td>
<td>$y_{i2}$</td>
<td>...</td>
<td>$y_{ij}$</td>
<td>...</td>
<td>$y_{is}$</td>
<td>$B_i$</td>
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<td>2</td>
<td></td>
<td>$y_{21}$</td>
<td>$y_{22}$</td>
<td>...</td>
<td>$y_{2j}$</td>
<td>...</td>
<td>$y_{2s}$</td>
<td>$B_2$</td>
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<td>...</td>
<td>$y_{ij}$</td>
<td>...</td>
<td>$y_{is}$</td>
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<td>r</td>
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<td>$y_{r1}$</td>
<td>$y_{r2}$</td>
<td>...</td>
<td>$y_{rj}$</td>
<td>...</td>
<td>$y_{rs}$</td>
<td>$B_r$</td>
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<tr>
<td>T</td>
<td></td>
<td>$T_1$</td>
<td>$T_2$</td>
<td>...</td>
<td>$T_j$</td>
<td>...</td>
<td>$T_s$</td>
<td>$G$</td>
</tr>
</tbody>
</table>
Where

\[ Y_{ij} = \text{observation in the } (ij)\text{th cell} \]

\[ i = 1, 2, \ldots, r \]

\[ j = 1, 2, \ldots, s \]

\[ B_i = \text{sum of observations in the } i\text{th sub-class of I classification} \]

\[ T_j = \text{sum of observations in the } j\text{th sub-class of II classification} \]

\[ G = \text{grand total} \]

\[ r = \text{number of sub-classes of I classification} \]

\[ s = \text{number of sub-classes of II classification} \]

To analyse the data, one can state the null hypothesis as

\[ H_0 = (I) \text{ there is no significant difference among the means of sub-classes of I classification} \]

\[ (II) \text{ there is no significant difference among the means of sub-classes of II classification} \]

To test the null hypothesis, one can compute the
following sums of squares:

Correction Factor (C.F) \( = \frac{G^2}{r_s} \)

Sums of squares due to I classification (SSI)

\[ \zeta \zeta \frac{B^2_i}{s} - c.f \]

Sums of squares due to II classification (SSII)

\[ \zeta \zeta \frac{T^2_i}{r} - c.f \]

Total sums of squares (TSS) \( = \zeta \zeta \zeta y_{ij}^2 - c.f. \)

Where \( \zeta \zeta \zeta y_{ij}^2 \) = sum of squares of all \((rs)\) individual observations

Error sums of squares (ESS) \( = TSS - SSI - SSII \)

The Anova table for two-way classified data is given by the Anova table.
### ANOVA Table

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degree of freedom</th>
<th>Sums of squares</th>
<th>Mean sum of squares</th>
<th>F-test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>I Classification</td>
<td>r-1</td>
<td>SSI</td>
<td>$SSI = M_i$</td>
<td>$F_I = \frac{M_i}{E}$</td>
</tr>
<tr>
<td>II Classification</td>
<td>s-1</td>
<td>SSII</td>
<td>$SSII = M_{II}$</td>
<td>$F_{II} = \frac{M_{II}}{E}$</td>
</tr>
<tr>
<td>Error</td>
<td>(r-1)(s-1)</td>
<td>ESS</td>
<td>$ESS = E$</td>
<td></td>
</tr>
</tbody>
</table>

| Total               | rs-1              | TSS             |                     |                  |                  |
Compare the calculated value of F-statistics with their corresponding critical values at 5 percent or 1 percent level of significance and draw the inferences accordingly.

**ANALYSIS OF VARIANCE OF ONE-WAY CLASSIFICATION MODEL**

Analysis of variance of one-way classification model has been used to study whether there is significant difference between the various locations of the households who have suggested the measures to be adopted by the industry, the Government and the voluntary organisations for controlling the environment/industrial pollution in the study area. The scaling method has been used for analysing these measures suggested by these households in different locations of the study area and the scores have been obtained assuming that these scores follow the normal distribution.
ANALYSIS OF VARIANCE (ANOVA) TECHNIQUE FOR ONE-WAY CLASSIFIED DATA WITH EQUAL NUMBER OF OBSERVATIONS IN EACH SUB-CLASS

Consider the following one-way classified data with equal number of observations where different locations as sub-classes of the classification.

**DATA**

<table>
<thead>
<tr>
<th>SUB-CLASSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>[ y_{11} ]</td>
</tr>
<tr>
<td>[ y_{12} ]</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>[ y_{1r} ]</td>
</tr>
</tbody>
</table>

| Total | \[ T_1 \] | \[ T_2 \] | ... | \[ T_k \] | \[ G \] |
Where

$y_{ij}$'s are observations (normal scores)

$k$ is the number of sub-classes

$r$ is the number of observations in each sub-class

$T_1, T_2$ are the sub-class totals

$G$ is the grand total of all observations in the data

State the null hypothesis as

$H_0$ there is no significant difference among the means of sub-classes

To test the $H_0$, compute the following sums of squares

(i) correction factor (c.f) = $\frac{G^2}{rk}$

(ii) between sub-classes sums of squares

(B.S.S.) = $\left[ \frac{\sum T_i^2}{r} - c.f \right]$
(iii) total sums of squares \( T.S.S = \sum_{i<j} y_{ij}^2 - c.f \)

where 

\[ y_{ij}^2 = \text{sums of squares of all (rk) individual observations} \]

(iv) within sub-classes sums of squares or error sums of squares \( E.S.S = (T.S.S - B.S.S) \)

The ANOVA table for the one-way classified data is given by

**ANOVA TABLE**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sums of squares</th>
<th>Mean sum of squares ( F_{cal} )</th>
<th>F-test statistic ( F(k-1)k(n) )</th>
<th>Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between sub-classes (locations)</td>
<td>( k-1 )</td>
<td>B.S.S.</td>
<td>( \frac{B.S.S}{k-1} = M F_{cal} = \frac{M}{E} F(k-1)k(n) )</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Within sub-classes (Error)</td>
<td>( k(r-1) )</td>
<td>E.S.S.</td>
<td>( \frac{E.S.S}{k(r-1)} )</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>( rk-1 )</td>
<td>T.S.S.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Compare the calculated values of 'f' statistic with their corresponding critical values at 5 or 1 per cent levels of significance and draw the inferences accordingly.

LIMITATIONS OF THE STUDY

As the data for the present study has been collected from the selected sample of households living in the environment/industrially polluted area in Pattancheru (the study area) of Medak District within the purview of the suburbs of city of Hyderabad in Andhra Pradesh. The study is a micro level study. These households are facing the multiplicity of problems, i.e., more than one problem/disease/disorder due to the environment/industrial pollution in the study area. As the levels of the environmental pollution, industrialisation and the living conditions of the households differ and the socio-economic conditions
of the households vary widely, the conclusions drawn in the study may not be exactly applicable to the households affected by the environmental pollution due to the industrial pollution in other areas. However, the conclusions drawn in the study useful for policy formulation to solve the problems arising out of the environmental pollution due to the industrialisation and to reduce the effects of the environmental pollution arising out of the industrial pollution in order to improve the environmental quality.

CHAPTER SCHEME

Chapter one deals with industrialisation and environmental pollution. In this, the industrialisation and environmental pollution and the design and methodology of the study are presented.

Chapter two deals with the background of the households affected by the environmental pollution.
In this, the background of the households living in the environment/industrially polluted area of Pattancheru - the study area considering the age, sex, educational qualifications, occupation, income and the nature of pollution faced is presented.

Chapter three deals with the effects of environmental pollution on the households due to industrialisation. In this, the effects of air, water and land pollution (problems and diseases) on the households, disorders faced by the women and effects on the children of the households, loss of mandays and employment, loss of material and non-material assets and the loss of income of the households and medical and social expenditure of the households living in the environment/industrially polluted area (the study area) are presented.

Chapter four deals with the measures to control the environmental pollution. In this, measures for
controlling the environmental pollution in the study area and the institutional, financial, technical and legal measures for controlling the environmental pollution are presented.

In chapter five the summary and conclusions of the study are presented.

**CONCLUSION**

The rapid growth of industrialisation and the consequent increase of the delivery of the pollutants, wastes and effluents are causing the air, water and land pollution and thereby resulting in the increase of environmental pollution. Environmental pollution emanating from the rise of industrial pollution brings in the health hazards (problems, diseases and medical disorders) on the households reducing their ability to work and resulting in the loss of mandays and employment and adversely affects their earning and income generation. The environmental pollution
also affects the value and productive capacity and yields of the material and non-material assets of the households. It has also imposed a greater strain on the state exchequer and budget to provide the additional resources for meeting the increased spending on health and other amenities and the industrial pollution abatement costs resulting in greater distortions of the resource allocation patterns aggravating the inequalities. The increase of environmental pollution has not only affected the quality of natural resources and factor endowments required for the sustainable development but also led to deterioration in the quality of life of the households living in the areas affected by the environment/industrial pollution.