

State of Community Health at
MEDAK DISTRICT



Save Our Lakes, Save Our Lives

GREENPEACE

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MEDAK DISTRICT

Supported by
LTM Medical College, Mumbai
Community Health Cell, Bangalore
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We would like to dedicate this report to Rachel Carson, journalist and environmental researcher, author of the landmark book, "Silent Spring" (1962), which alerted the world to the looming environment disaster caused by synthetic chemicals. In our minds, this report only confirms how true Carson's predictions have been. Dirty technologies, releasing lethal chemicals into the environment, have reached all parts of the world, in the name of development. We have failed to learn from our own mistakes.

Finally, we would like to remember the many species of birds, animals, insects and fish, which inhabited the study area before the influx of the industries. Elders in the villages remember a time, as recent as 2 decades ago, when many of the local lakes including the ones at Khazipally and Gandigudem, could boast of a rich variety of fish.

The Research Team - Greenpeace India.

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MAIN RESEARCH FINDINGS

This health study was undertaken to estimate the impact of pollution on the health of the community at Medak. Its findings show that there is an overwhelming increase in most types of systemic diseases across the study group, as compared to the control group at Medak District. The study group villages were Bonthapally, Chitkul, Digwal, Gaddapotharam, Khazipally, Kistareddypet, Pashamailaram, Pocharam and Sultanpur from Patancheru, Jinnaram and Kohir mandals. The villages of the control group were Musapet, Ramojipally, Uthloor and Veerojipally of the Sakarampet A Mandal.

Broadly it can be surmised that a cocktail of poisons in air, water and land has adversely affected the health of the community of Medak District and is continuing to do so.

Field investigations were undertaken based on an exploratory questionnaire. This built a database of health information of the community at Medak. Increased prevalence and incidence of diseases and symptoms at the study villages were clearly observed.

The data generated by stratified random sampling of the study population, when compared with the data generated by the same sampling method in the control population, showed a significantly higher proportion of disease incidence.

The key systems found to be affected are:

- Nervous system – 3 times higher than the control group.
- Circulatory System – 2 times higher than the control group.
- Respiratory System – 3.81 times higher than the control group. 1 in 20 are affected.
- Digestive System – 1.98 times higher than the control group.
- Blood and Blood forming organs – 2.914 times higher than the control group. 1 in 29 people are affected.
- Endocrine, nutritional and metabolic systems – 1.84 times higher than the control group. 1 in 35 persons are affected.
- Neoplasms – 11 times higher than the control group
- Skin and Subcutaneous tissues – 2.67 times higher than the control group
- Congenital malformations, deformations and chromosomal abnormalities – 3.93 times higher than the control group.

A team of doctors from Occupational Health and Safety Centre (OHSC) and Lokmanya Tilak Medical College (LTM), undertook follow up house visits on a random sampling, for medical verification of certain diseases. Environmentally induced respiratory disorders are known to be present in polluted areas. Using spirometry¹ to determine respiratory illnesses, doctors confirmed that the incidence of respiratory disorders is greater in the study group at a statistically significant rate. 28 of the 38 individuals tested in the study group were found to be affected whereas only 12 out of the 34 tested in the control population were affected. The occurrence of asthma and bronchitis is 4 times higher in the study group. The relative occurrence of respiratory disorders in the study population, was double the incidence in the control population.

Doctors also verified medical records to ascertain the incidence² of cancer. Analysis of the records established the occurrence of cancer in the study group to be 11 times higher than in the control group, which is statistically highly significant. Incidence of heart disease in the study group was found to be at least 16 times more than that of the control group.

DISEASE CONDITION	RELATIVE RATE OF OCCURRENCE
Epilepsy	247.49%
Paralysis	349.40%
Heart Disease	355.56%
Bronchitis	473.15%
Asthma	401.81%
Allergic Dermatitis	283.89%
Arthritis	311.36%
Skin Diseases	253.31%
Recurring Headaches	653.14%
High Blood Pressure	193.80%

Figure 1: Illustrates the disease occurrence potentially due to pollution. The relative occurrence of 247.49% for epilepsy means that the rate of occurrence in the study villages is 2.47 times higher as compared to the control villages.

Clinically confirmed cancer is 11 times higher in the study group. 1 in 20 people are affected by diseases of the respiratory system. The prevalence of heart diseases is 16 times higher in the study group.

Footnotes

¹ See Appendix II – Study of effect on lung function in villages exposed to industrial pollution.

² See Appendix III-Follow-up Medical investigations of Carcinoma Questionnaire.

EXECUTIVE SUMMARY

An Introduction to Medak

Medak district with an area of 9702 km², is located in the North-eastern part of Andhra Pradesh. Located on the banks of the Manjira River, a major tributary of the Godavari, this area was predominantly an agricultural landmass. However, in the last few decades Medak has been transformed into an industrial belt as part of the government's drive to industrialise backward areas. The Patancheru Industrial Estate was set up in 1975 as part of government initiative to bring in more industries to the state of Andhra Pradesh. Subsequently industrial areas grew in Khazipally, Bolaram, Pashamailaram, Bonthapally, Gaddapotharam and other places in Medak District. Over a period of 29 years, about 320 industries that manufacture pesticides, chemicals, pharmaceutical and steel rolls have mushroomed in this area. While arguments in favour of this expansion were and are being presented from an economic standpoint, the possible environmental and public health impacts have not been adequately considered. The Central Pollution Control board has identified 24 critically polluted areas in India. Patancheru of Medak District, is one of them.

Background

During the development of these industrial estates, no effort was made by the industrial units to integrate environment management measures to prevent the adverse impacts of industrial discharges. There are few or no mechanisms for the safe treatment and release of effluents. In fact, the industries have been deliberately disposing their wastes into the nearby land and water bodies. The Nakkavagu stream that flows through the industrial estate in Patancheru bears the brunt of waste disposal of over 100 industries, including paint, plastic, chemical and bulk drug industries. A few decades ago this stream was clean enough for surrounding villages to use for irrigation and drinking purposes. Pollution to this stream has destroyed approximately 2000 acres of farmland besides contaminating well water to the level of 140 feet¹. Hazardous wastes found in the water include persistent organic pollutants, heavy metals, and other organic and inorganic chemicals. The common effluent treatment plant (CETP) located at Patancheru has proved inadequate in dealing with the problems posed by the toxic effluents. In fact, reports indicate that the CETP has been a major cause for further pollution².

Amongst communities located in the midst or on the periphery of these vast industrial zones, there is a strong perception that the industrial processes employed in the region are highly polluting and have a direct negative impact on the health of residents³. Despite representatives of the communities repeatedly voicing their concerns, no concrete and sustained action has been taken by concerned authorities like the Pollution Control Board, to investigate further, and to curtail the ongoing environmental catastrophe, perpetrated by the polluting industries located here.

From their inception to date, most of the industries in the region, have not shared information regarding pollutants and their chronic and acute effects, with the local residents or the local authorities, as envisaged by the Factories Act and Rules under the Environment Protection Act 1986. Disaster management and emergency preparedness procedures are not in place and the medical fraternity of the region is not equipped with the necessary information to treat pollution related health problems.

The destruction of the environment has directly impacted human survival. There has been a sharp rise in morbidity rates, from 10.18% in 1991, to the current rate of 25.49%. Increasing trends of ailments associated with orthopaedic and skin problems have been reported⁴. Elevated levels of heavy metals have been detected in blood, urine, hair and nail samples of people here, a result of the consumption of industrially contaminated water and vegetables grown in the polluted soils⁵

The people of Medak have been protesting the destruction of their habitat, livelihoods and health for over two decades now. The pollution at Medak district has been established by sampling missions and studies by various organisations over the past decade or so⁶. However the legal process, now in its fifteenth year, continues to proceed at a slow pace.

The Health Study

The health study in Medak District was conducted in nine study villages and four control villages, and comprehensive information was gathered, relating to the health of 10,874 individuals from 9 villages in the study group and 4 villages in the control group. Of these 8,925 were from the study group and 1,949 from the control group.

This is a comparative study, where diseases as reported by the respondents of the study group, were compared with those reported by the control group. The control group was chosen on the basis of its similarity to the study group on a variety of relevant and important parameters like socio-cultural composition of the communities, diet, income levels, and ethnicity. Other important factors matched were derived from the "Determinants" and "Processes" of the "Indicators that Count" framework⁸ developed by Hancock and others. The only real defining difference between the 2 groups is the exposure to pollution in the study group. There is no industrial activity of consequence at the control locations as compared to the study locations.

An alliance was formed with Occupational Health and Safety Centre (OHSC) and Lokmanya Tilak Medical College (LTM), wherein their doctors visited the field to medically verify the diagnoses of certain diseases. This was a vital part of the study.

Among the various existing typologies of research in community health, this particular study falls under the category of 'Intervention Outcome Research', which is meant to lead to action from the concerned parties, in the direction of affirming the rights of affected communities.

The methodology is based on an earlier scientific study at Eloor, Kerala, undertaken by Greenpeace India, on the effects on human health caused by exposure to a combination of chemicals in the land, air and water⁹. The adaptation of the research to suit the conditions at Patancheru, was done in consultation with the advisory board.

Features of the health study include

1. Care was taken to obtain community consent to conduct the study and to ensure participation and co-operation from the local authorities and leaders.
2. Setting up of an advisory board of medical experts who helped in the design of the study and monitored its progress. The meetings with the advisory board helped in resolving vital issues like scientific biases, sampling sizes /ratios, training modules for interviewers, study ethics, selection of study and control groups and statistical analysis.
3. A comprehensive literature survey of all available material on the environmental and human health status of Medak.
4. An open ended exploratory questionnaire administered using the random stratified sampling method
5. The training of the interviewers, a community sampling exercise and a pilot survey to identify practical difficulties involved in the field investigation.
6. Adherence to all ethical norms. Voluntary prior informed written consent obtained from each participant.

Analysis and Findings

The analysis was restricted to simple percentage analysis, followed by calculation of the odds-ratio. Manual calculations along with a customised software management system, designed and developed in Access were used to reach the figures on prevalence percentages, incidence, statistical significance and overall patterns.

The results of this study demonstrate that all body systems without exception are adversely affected in the study areas as opposed to the control locations. It is clear that the cocktail of poisons in the air, water and land of the study villages have considerably affected the health and well being of the local population. The morbidity figures due to pollution related illnesses like cancer, asthma and bronchitis and heart diseases are very high. There is a statistically significant increase in confirmed cases of respiratory illnesses.

Recommendations and Remedial Action

The implications of these findings are serious. The study demonstrates that the health of the residents of Medak is being significantly affected by the current levels of industrial activity. It is incumbent upon the state regulatory authorities responsible for public health to investigate this matter, to further define the scope and severity of the problem, and to initiate processes which will return the community to the state of health enjoyed by them prior to this era of reckless industrialisation.

It is evident that the people living around these industrial estates have not received justice even after all these years. Their fundamental right to clean air and water continue to be robbed by greedy criminal corporations, with pliant bureaucracies turning a blind eye to the situation.

Keeping the above facts in mind, Greenpeace demands:

- * **The state and industries must provide immediate health assistance to the communities at Medak , and also undertake long term medical rehabilitation of affected persons**
 - * **The government must declare a state of chemical crisis in the area with immediate effect**
 - * **Zero discharge of toxic effluents into water bodies with immediate effect**
 - * **Full disclosure of chemicals in the industrial products, processes and wastes generated at Medak. Comprehensive information about the health effects of these chemicals to be made available to the communities.**
-

Significance of this Health Study

- 1. While many studies have been undertaken in the Medak district, this independent study has surveyed a significantly large sample size of 10,874 people.**
- 2. Communities have a “Right To Know” about findings regarding their locality, which impact their health and livelihoods. Greenpeace intends to make this report available to the community in both English and Telugu.**
- 3. The most vulnerable section of the population, children are being severely affected in terms of their health and development and in effect being robbed of their futures.**

It is hoped that this health study, will be an effective tool in fore-fronting the widespread abuses to the environment and hence to human health.

Footnotes

¹ *Deccan Herald (1996) Dirty Nakkavagu destroying farms, causing ill health; 19 August 96*

² *Supreme Court of India. Writ Petition C No. 1056/1990 Indian Council for EnviroLegal Action Vs union of India and others; 16 July 1996; Record of proceedings*

³ *See Appendix 11*

⁴ *Health Officer , Patancheru (2002) Subject- Pollution Effects on the Health of People – 11 Jan 2002*

⁵ *K Shekar Chandra et al. Assessment of environmental health risk due to inorganic arsenic in the industrially contaminated areas of Hyderabad. Analytical Chemistry and Environmental Sciences Division, Indian Institute of Chemical Technology Hyderabad & Yashodara Hospital, Patancheru*

⁶ *See Appendices 12, 14 and 15 for details on toxic contamination at Medak.*

⁷ *The “1000 Bhopals Jatha” which was a bus tour across these toxic hotspots. Visit www.greenpeaceindia.org for further information.*

⁸ *See figures 3 and 4, which list in detail the “Indicators that Count” framework developed by Hancock et al (1998 and 1999) on page*

⁹ *The report can be downloaded from www.greenpeaceindia.org*

INTRODUCTION

Medak – A Brief Description

Medak district is located at 17° 31' N latitude and 78° 15' E longitude on the North-eastern part of Andhra Pradesh, which is on the South-eastern coast of the Indian peninsula. It is one of the nine districts of Telangana. It consists of 45 mandals of which Patancheru, Jinnaram and Shankarampet are mandals, which have been affected most by pollution, amongst a few others¹.

Medak is known for its many natural rivulets and cheruvus (lakes) in the catchment areas of the Manjira River. Manjira is the only perennial river here, and is a major tributary of the Godavari. Many villages in the area are situated on alluvium and weathered bedrock. Amidst the granite terrain, the Nakkavagu stream, one of the tributaries of the Manjira, has been identified as a paleo-channel that is composed of clay-silt-sand.

The region experiences a semi-arid tropical climate with persistent drought, unpredictable weather, limited and erratic rainfall. The area gets two monsoons in varying degrees, the Southwest monsoon from end of June till August, and Northeast monsoon from September till November. May is the hottest month with the mean daily temperature of about 40°C. December is the coldest month with a mean daily temperature of about 29°C.

The Patancheru Industrial Estate was set up in 1975 as part of the government initiative to bring in more industries to the state of Andhra Pradesh. In 1977, subsidies and incentives were offered to attract industrialists to Medak District. Over a period of 29 years, about 320 industries that manufacture pesticides, chemicals, pharmaceutical and steel rolls came up in this area. Patancheru was transformed overnight into one India's major industrial zones.

The Problem

Pollution of Ground and Surface Water

However in envisaging industrial development, environmental concerns clearly took a backseat. Environmentally friendly production processes were not incorporated. The industries in Medak are water polluting in nature, without adequate facilities or commitment to deal with the hazards posed by the high quanta of toxic effluents generated. This has resulted in the creation of a multitude of stagnant pools in the vicinity of the industrial areas. These stagnated effluents percolate into drains and the cheravus and pollute the ground water. The effluents let out into the surroundings finally flow into the nearby surface waters and cheruvus and ultimately join the Nakkavagu stream.

In the year 1989, 110 of the industries joined hands and set up a common effluent treatment plant (CETP) in a nearby location. These industries transport their effluent in tankers to the CETP for treatment. However the CETP rather than solving the problem has actually become major cause for further pollution². After treatment to whatever extent, the wastewater is discharged into Peddavagu water stream, which meets the main stream Nakkavagu.

The Nakkavagu stream, receiving sewage, industrial effluents and the CETP discharges, in turn joins the Manjira. The Manjira is one of the main potable water sources in the area. It is also major source of drinking water for the twin cities of Hyderabad and Secunderabad. With the Manjira joining the Godavari, one of the longest rivers of South India, the Godavari too is under threat in the long run. This clearly illustrates that the ongoing environmental catastrophe at Medak district is indeed affecting a much larger population, in addition to the local community.

By the late 1980s, surface and groundwater, as well as the soil had become polluted in the two sub-basins, Nakkavagu and Pamulavagu, (as per the Andhra Pradesh Pollution Control Board). This was mainly due to the presence of hazardous wastes like persistent organic pollutants, heavy metals, and other organic and inorganic chemicals in industrial discharges along with sewage entering the Nakkavagu and other lakes in the vicinity. Besides direct contamination, surface water, ground water were also affected through overflows from the lakes³, contaminating the entire irrigation system.

As per conservative estimates, the industries of the Patancheru and Bolaram area generate a cumulative 8 x 10⁶ litres per day of effluents which are being directly discharged into the surrounding land, irrigation fields, and surface water bodies that finally enter into the Nakkavagu stream, a tributary of the Manjira. A study⁴ on the abundance and distribution pattern of toxic trace elements in the area, indicated the quantitative aspect of pollution in the Nakkavagu Basin. Migration patterns indicate that the pollutants discharged by the industries are entering the surface and groundwater system (aquifers) and are also migrating towards the Manjira further deteriorating the entire hydrological structure of the area. A point to be noted is that the Nakkavagu is a paleo-channel and the alluvial aquifer has a much higher transmissivity than the adjoining granite and hence transports the contaminated water of the river to very large distances invisibly underground⁵.

A National Geophysical Research Institute (NGRI) Study sponsored by the Central Pollution Control Board covered an area of about 160 sq km where more than 400 big and small pharmaceutical and chemical industries operate. This study found high levels of heavy metals such as arsenic, strontium, barium, selenium, boron, manganese and nickel in the ground water and surface water bodies. Residual pesticides, aldrin and endosulphan were also found⁶.

Health Problems

People here have continuously been exposed to high levels of arsenic besides other heavy metals like copper, selenium, chromium and iron. Elevated levels of these contaminants have been detected in the blood, urine, hair and nail samples of people here. This has been a result of the consumption of industrially contaminated water and vegetables grown in the polluted soils⁷.

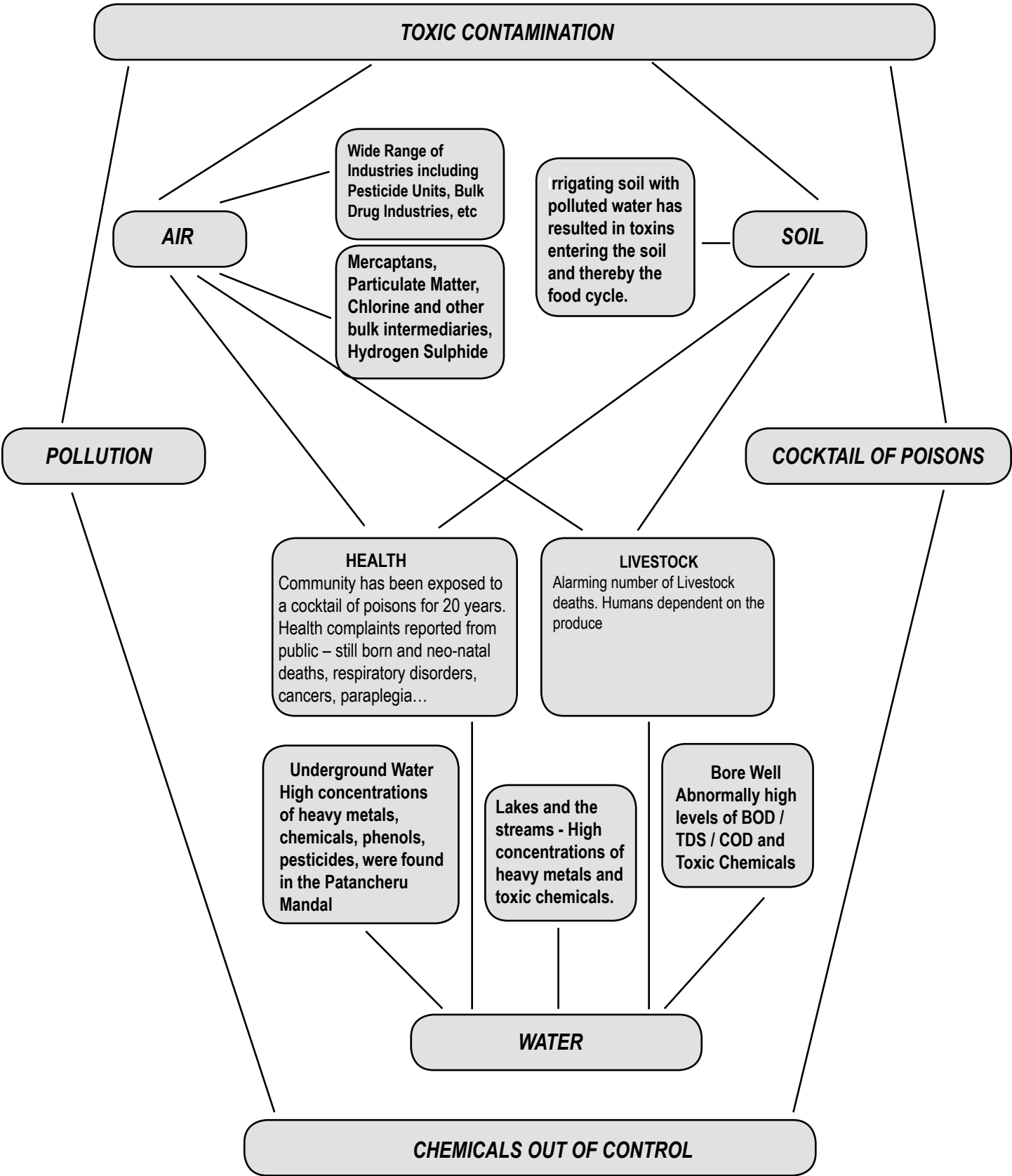
Health complaints have become commonplace at Medak, including respiratory disorders, cancers, congenital problems like mental retardation and physical abnormalities, chronic depression and reproductive problems.

From their inception to date, most of the industries in the region, have not shared information regarding pollutants, their chronic and acute effects, with the local residents, or the local authorities –the village Panchayat, workers and doctors- as envisaged by the Factories Act and Rules under the Environment Protection Act 1986. The plan for 'disaster management and emergency preparedness' inclusive of information on products, storage of hazardous substances, effects and antidotes, again has not been made public (with a few exceptions), as it should be. The medical fraternity of the local area therefore, is not equipped for diagnosing and treating health problems caused by environmental pollution.

A population of 22 lakh lives under the threat of an unfolding Bhopal in slow motion. Primarily red-category industries inclusive of pesticide manufacturing units, pharmaceuticals, chemical industries contaminate surface and groundwater with high levels of heavy metals like arsenic, strontium, barium... and residual pesticides like aldrin and endosulphan

NAKKAVAGU

-Identified as a paleo-channel (composed of clay-silt-sand facies); the transmissivity of the alluvial aquifer varies from 750 to 1315 m² /day. The adjoining granite has a transmissivity that varies from 30 -430 m² /day. More vulnerable to pollution.



Destruction of Livelihood

The population of Medak district is about 22 lakhs, as per the 2001 census with a density of 234 persons per square km. The predominant section of the population was traditional farmers and agricultural labourers cultivating jowar, paddy, groundnut, chillies, tomato, cotton and wheat. With the aggressive industrialisation that began in 1977, most of them moved into jobs in industries or into indirect jobs created by the industrialisation. There was subsequently also an influx of migratory population from other parts of the country to take up jobs in the new industries. Though these industrial estates were set up to develop the surrounding regions and create jobs, ironically they have done quite the opposite. While the 250 odd industries set up in Patancheru created about 25,000 jobs, more than 30,000 people were displaced due to ground water pollution, and robbed of their traditional livelihood in agriculture. Hundreds of farmers became impoverished and are forced to work as casual labourers in the industries⁸. Hence not only do the people of the area suffer from the health impacts of the industrialisation, but they have also been robbed of their livelihoods in most cases.

The Legal Process

The people of Medak have been protesting the destruction of their habitat, livelihoods and health by the polluting industries for over two decades now. There is a long history of legal battle in Patancheru. Concerned with the growing indiscriminate discharge of effluents into the open areas and the consequent large-scale pollution, the Hyderabad based organisation, Indian Council for EnviroLegal Action filed a Writ Petition in 1990 in the Supreme Court.

The Supreme Court over a 3-year period (May 1998 – Feb 2001) passed out many orders. It ordered the state to recover compensation from industries, and this was to be distributed amongst the affected people⁹. In 2001, the Supreme Court moved the petition to the High Court of Andhra Pradesh, and directed it to monitor the implementation of the order passed earlier on stricter measures with regard to Common Effluent Treatment Plants (CETP).

A High Court appointed expert committee submitted in March 2004 that 18 of the 22 lakes in the area are polluted to various degrees and suggested a detailed health study on the people in that area to assess the impact of the pollution. The High Court also appointed a fact-finding committee, to look into the status of implementation of the SC orders, which has recently reported back to the High Court. However the legal process, now in its fifteenth year, continues to proceed at a slow pace.

Footnotes

¹ Dr A. Kishan Rao (Aug 2001) *Hell on Earth*

² Supreme Court of India. Writ Petition C No. 1056/1990. *Indian Council for EnviroLegal Action Vs union of India and others*; 16 July 1996; Record of proceedings.

³ Draft Report by Mission Support Unit, Water Conservation Mission (Govt of A.P.)

⁴ See no.2, appendix 14

⁵ See no.1 of Appendix14

⁶ See Appendix 16 for impact of these substances on human health

⁷ K Shekar Chandra et al. *Assessment of environmental health risk due to inorganic arsenic in the industrially contaminated areas of Hyderabad. Analytical Chemistry and Environmental Sciences Division, Indian Institute of Chemical Technology Hyderabad & Yashodara Hospital, Patancheru.*

⁸ Vasu G.S. (1985) *Fear of MIC-based plant at Patancheru. Indian Express. 20 March 1985.*

⁹ *Indian Council For EnviroLegal Action and others Vs Union of India and others, writ petition no.1056 of 1990*

METHODOLOGY OF THE STUDY

Background and Rationale

Medak district has been established as an environmental disaster zone for over a decade now. The Central Pollution Control Board, in its report has demarcated Patancheru as one of the 24 most critically polluted areas in India. An existing repository of scientific research has substantiated this fact further. Of the 45 mandals of Medak, more than 15 are highly polluted by a wide spectrum of chemical contaminants¹. Scientific investigations over the last 2 decades have revealed that the land, air and water are contaminated with a cesspool of toxins². The fact that environmentally induced community health problems were quite apparent in the region, prompted Greenpeace to undertake an epidemiological health study that would uncover the extent and severity of the crisis³.

While work has been done on the effects of various chemicals on human health, it is very difficult to exactly measure the effects of a cocktail of chemicals on human physiology. The chemicals react with each other in several ways, also creating metabolites that further impact human tissue and bodily processes⁴. Added to this is the problem that the world today, is a place of many synthetic chemicals, and people in their daily lives are in contact with many poisons, which spread rapidly and widely. In fact manmade chemicals have been discovered in the bodies of polar bears in the remote Arctic regions⁵. So how is it possible to discover what the health effects of pollution are, on a particular community?

This question was answered in the following manner. While the exact effects of combination of chemicals and their metabolites, etc. can't be measured, control groups affected only by the general background noise of poisons, can be used to measure the severity of health effects in the study group exposed to much higher levels of pollution.

Salient Features of the Methodology

This is a comparative study, where diseases as reported by the respondents of the study group, were compared with those reported by the control group. It was ensured that the control group was similar to the study group with regard to many relevant and important parameters. The only defining difference between the 2 groups is the exposure to pollution in the study group. There is no industrial activity of consequence at the control locations as compared to the study locations.

The health study in Medak district was conducted in nine study villages and four control villages, wherein comprehensive information relating to the health of 10,874 individuals was gathered. Medical verification of certain significant diseases was an important part of the study. The methodology is based on an earlier scientific study at Eloor, Kerala, undertaken by Greenpeace India, on the effects on human health caused by exposure to a combination of chemicals in the land, air and water⁶. The adaptation of the research to suit the conditions at Medak, was done in consultation with the advisory board.

Ethics in the Study

One of the first steps in the study was to obtain community consent to do the study and ensure participation and co-operation from the local panchayat and community leaders. Several one-on-one meetings with the local Panchayat and community leaders ensured that these objectives were met. In all strategies involving respondents, all basic ethical norms were strictly adhered to with voluntary prior informed written consent being obtained from each participant. Many of the individuals who were part of medical verification exercises, were given medical advice by the doctors. The researchers / interviewers had regular working hours and were paid on a monthly basis for their services.

Guidelines developed by NCESSRH were strictly adhered to throughout the study. Methodology was based on a tested and scientifically approved study design conducted at Eloor, Kerala. Existing secondary data and global frameworks like "Indicators that count", were used to select appropriate study and control groups.

The Chronology of the Study

1. Formation of the Advisory Board

The first step in the study to constitute an advisory board to guide and support the process of designing the study and subsequently also to monitor its progress. The board consisted of medical experts who provided specialised support in gynaecology, toxicology, epidemiology etc. The mandate of the board was to ensure that the study maintained the requirements of scientific rigor in terms of the data collected, selection of study and control groups, sample size/ratio considerations, accounting for confounding variables and good quality of the conclusions drawn. The meetings with the advisory board also helped us resolve issues like scientific biases, training modules for interviewers, study ethics, and statistical analysis.

2. Review of Existing Research Literature

The next step was a comprehensive literature survey of all available material on the environmental and human health status of Medak. All the data from secondary sources **were mapped together**.

When reviewing global research one looked at the existing typologies of research in community health. This particular study falls under the category of 'Intervention Outcome Research', which is in the area of community health situations that warrant further attention, future research and immediate corrective measures. This particular type of study leads to action from the concerned parties, in the direction of affirming the rights of affected communities.

3. Formulation of the Research Question:

The proposed research question for the study was arrived at in consultation with the advisory board. This was:

“What are the health problems faced by the resident community of the nine villages in Medak district, which comprised the study group, that were caused by increased industrial pollution of the air, water and soil?”

4. Designing of the Questionnaire

In setting the criteria to develop the study questionnaire, the attempt was to increase the study power to assess the health status of the maximum possible number of people, given limited resources. This was done by eliminating as many questions as possible from the study questionnaire, without compromising on the quality of data to be collected. The format and the content of the questionnaire were finalised after several rounds of discussions with the advisory board. A crisp questionnaire was arrived at, which would be effective in reaching out to a much larger sample size.

The questionnaire was exploratory in nature and collected information on the prevalence and incidence of various types of diseases that are normally caused due to toxic pollution⁷. A key informant was to be chosen in each family by the interviewer. The criterion was that the key informant must be either the lady of the household or an elder of the family. The key informant was to report the health status of all the living members of the family and the health history of members deceased within the last 10 years.

After recording basic information like the age, education etc, the different health problems would be documented which the key informant of the household reported. The interviewer would take down the family health information in the questionnaire using a set of codes that would later be classified during analysis. Confounding variables like the habit of chewing tobacco/ smoking/ drinking/ taking snuff were factored in, and information of this nature were to be documented as well. Other possible confounders were also to be collected. These included pesticides used at home, their frequency of use, the practice of burning of house hold wastes at home, the presence or absence of a protected water supply, the appearance and details of water available, and the drinking water sources.

The questionnaire had appropriate codes for the various diseases and for the rating of overall health. This would be used by the interviewers to enable easy documentation analysis easier at the later stage.

5. Field Visit by OHSC

A field-visit of the partners in research, the Occupational Health & Safety Centre-Mumbai was arranged to examine the conditions at Medak and to help develop the medical **aspects of the study**

6. Selection of Control and Study Areas

Patancheru, Jinnaram and Kohir were the mandals selected as the study group. The rationale for selection of these areas, was the growing extent

of the pollution in these regions, and the fact that existing research categorises these mandals as the critically polluted ones of Medak District⁸. This choice was further concretised by the fact that the local population in these areas reported a wide range of potentially environmentally induced illnesses⁹. Their selection was also supported by the recommendation of various organisations, local NGOs and individuals that have working on the issue over a considerable period of time. Once these mandals were finalised, a similar process was adopted to select villages within the mandals. Data from the past 2 decades or so on the levels of pollution, were taken into consideration, as were the recommendations of community leaders, panchayats, local NGOs and individuals.

Comparable control locations were selected from the same district, Medak, without compromising on the basic parameters of socio-cultural composition of the communities, diet, income levels, ethnicity and other variables. The control areas varied significantly from the study locations only when it came to elevated levels of pollution and industrial activity. For the selection of control locations, recces were undertaken, and information on pollution collected (from existing literature and/or discussions with community leaders, panchayats and residential doctors). After ensuring that levels of pollution and industrial operation were comparatively low, appropriate locations were chosen.

A variety of possible control locations were explored, and visits were undertaken to many mandals and villages to ensure that an unbiased choice, made on the basis of scientific rigor. The control areas were similar to the study location with respect to a complex mix of influencing indicators. These were based on the “Indicators that Count” framework developed by Hancock et al¹⁰, a framework of health characteristics of the health of communities.

HEALTH STATUS	Positive Health and Quality of Life	well being / self-reported health; life satisfaction; happiness
	Mastery / Self-Esteem / Coherence	
	Health Promoting Behaviours	
	Negative Health	stress / anxiety; other morbidity/disability measures; health utility index
	Mortality	overall mortality rate; infant mortality rate; suicide rate; life expectancy

Figure 3: Health Status in the “Indicators that Count” framework developed by Hancock et al (1998 and 1999)

The study strategically homed into examining overall patterns in morbidity and mortality, through an exploratory approach. This indicator, rather than the other four, was seen as the most effective choice available given certain limitations.

The study also looked at determinants of community health other than contaminated air/water/soil. It also looked at processes that are likely to aid community health. These determinants and processes of the “Indicators that Count” framework (See figures 3 and 4), were checked across the study and proposed control locations to reach the closest match. This helped us zero in on Musapet, Ramojipally, Uthloor and Veerojipally from Shankarampet ‘A’ Mandal as areas of the control group.

DETERMINANTS	Sustainability	Water Consumption; Waste production and reduction; Ecosystem Health; Local production of resources
	Viability	Air Quality; Water quality; Toxics production and use; Soil contamination; Food chain contamination
	Liveability	Housing quality; Density and land use in the built-environment; Smoke-free space; Noise pollution; Community safety and security
	Conviviality	Family safety and security; Sense of neighbourhood/place; Social support networks; Charitable donations; Demographics
	Equity	Economic disparity; Housing affordability; Discrimination and exclusion; Access to power and Control
	Prosperity	Diverse economy; Local Control of business; Employment/unemployment; Quality of employment; Traditional economic activity indicators
	Education	Early childhood development; Education attainment/school quality; Adult literacy; Lifelong learning
PROCESSES	Governance	Volunteerism/Associational life; Citizen Action/civic ness; Human and civil rights; Voter turnout; Perception of political leaders and government services; Health public policy

Figure 4: Indicator and elements of "Indicator that Count" framework (text in **bold** signifies criteria that have been observed in the current survey)

The details of the study and control locations selected for the research were:

MEDAK	STUDY	Patancheru	Chitkul
			Kistareddypet
			Pashamahilaram
			Pocharam
			Sultanpur
		Jinnaram	Bonthapally
			Guddapotaram
			Khazipally
		Kohir	Digwal
	CONTROL	Shankarampet 'A'	Musapet
			Ramojipally
			Uthloor
			Veerojipally

Figure 5: Details of the Study and Control locations

7. Training of Researchers/ Interviewers

A team of 10 researchers, a research coordinator and a principal investigator were involved in the process of field investigations and primary data collection. The team consisted of male and female researchers to build a rapport with the respondents. The team had a 3 day in-house training with the help of doctors and environmentalists. They were introduced to the problems of people living in industrial areas. They were also briefed about Greenpeace and its campaigns on the environmental front. During the second day of this session, a fundamental overview on epidemiology was given.

The Eloor Health Study was highlighted as a case study. Finally the questionnaire was discussed and model exercises were held to acquaint the researchers with the questionnaire, and the procedure and ethics driving it.

8. Sampling

Sample Size: The Study analysed a sample of 10,874 people from 9 villages in the study group and 4 villages in the control group. Of these 8,925 were from the study group and 1,949 from the control group. The details of the sample size from each group are as follows: -

Study

- Bonthapally: 1322
- Chitkul: 1574
- Digwal: 1404
- Guddapotaram: 509
- Khazipally: 670
- Kistareddypet: 628
- Pashamahilaram: 672
- Pocharam: 987
- Sultanpur: 1159

Control

- Muspaet: 707
- Ramojipally: 349
- Uthloor: 508
- Veerojipally: 385

In each of the villages in the study and control locations care was taken to ensure that sample size equated the total population of the village on a ratio of 1:3 as recommended by epidemiological sciences.

The method of sampling followed was stratified random sampling. The sampling exercises were done in community meetings where the grampanchayat representatives and other people of the community, picked lots consisting of house numbers to arrive at a random sample for the survey. This process was well documented. A sampling ratio of 1:3 was obtained. This was followed by interaction with villagers as to why the study was being conducted.

9. Pilot Survey

This was done in all villages on the first day of sampling. Its aim was to understand the difficulties involved in the fieldwork, and to provide some hands on experience for the researcher. It was useful in gauging the enthusiasm and participatory levels of the people in the communities. It gave researchers a feel for whether the people were comfortable in disclosing personal information or not. It also helped in understanding the manners and customs of the people of the chosen communities, which was required to make the study a pleasant exercise. The pilot survey helped in arriving at the conclusion that all preparations thus far had been adequate, and no further amendments needed to be made to the study design.

10. The Actual Field Survey

The Greenpeace team started active field based work after the pilot survey. A team of 10 interviewers set out for 45 days of data collection, when the exploratory questionnaire was used to survey individuals in the study and control group locations. On field supervision, debriefings, feedback and constant monitoring were part of the process. The data was simultaneously fed into the computer after being verified by the research co-ordinator. The information gathered, was entered on a day-to-day basis, and collated in a computer database. The database would be analysed later, for various diseases and disease sets.

At the end of this phase, information about 10,874 individuals was gathered across the study and control groups in Medak.

Ethnographic interviews.

*During the field study, ethnographic information was collected from individuals classified according to age and occupation using open questionnaires. This involved a series of common-sense open questions to a group of people at the study locations who were local inhabitants before the industries came up*¹¹

11. Medical Verification

Greenpeace had initiated an alliance with Occupational Health and Safety Centre (OHSC)– Mumbai and the Community Health Cell, who had prior

experience in epidemiological research. The broad framework was of Greenpeace taking the primary role in the field-based research. The OHSC subsequently performed the medical verifications of primary data collected, using a questionnaire that was arrived at jointly. A team of doctors from OHSC and Lokmanya Tilak Medical College (LTM) joined the field-study for medical verifications of respiratory illnesses at Medak. The doctors followed up and verified the diagnosed illnesses of the people documented in the study. They looked for medical documents to confirm the diagnosis of individuals suffering from specific diseases in the primary data collection process. These individuals were further classified into cases where there were no confounding factors that could have been responsible for the illness. The team of doctors visited these persons and tests were done to verify their illnesses of the respiratory and other system disorders. They also examined medical records of cancer symptoms, allergies of skin, and birth defects. These investigations further confirmed the findings of the study by validating the data from the first field investigation.

Limitations

Prior to the field investigations and as the study was being conducted there were a few limitations identified in the study module.

- The study might not examine in detail the range of health problems faced by the workers of the polluting industries who mostly reside outside villages that fall under the purview of the field investigations.
- The health study took place during the harvest season and so a segment of the population could not be interviewed as they were out in the fields.
- A certain section of the sampled population was relatively new to the area. Also there were the problems of migrating and drifting sections of population, which made the study incomplete in a way, with respect to the idea of a completely random sample.
- Similarly, there were also instances where personal information like monthly income was not revealed.

The questionnaire was designed in an exploratory fashion to understand and document the possible synergistic effects of a mixture of toxic chemicals on human health. Data on morbidity and mortality prevalence was collected. Documented diseases were classified and analysed. 9 villages from the study and 4 from the control were included for this research. Information on 10,874 individuals was generated. Findings on respiratory illnesses and cancers were medically verified by a team of doctors from OHSC and LTM.

Footnotes

¹ Dr. A.Kishan Rao (Aug 2001) Hell on Earth

² See Appendices 12, 14 and 15 for information on toxic contamination at Medak.

³ See Appendix 13 for detailed information on previous health studies undertaken.

⁴ Howard CV (1997) Synergistic effects of chemical mixtures - Can we rely on traditional toxicology? *The Ecologist*; 27(5);192-5

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⁵ Norstrom R.J., M. Simon, D.C.G. Muir. (1988). Organochlorine contaminants in arctic marine food chains: identification, geographical distribution and temporal trends in polar bears. *Environ. Sci. Technol.* 22:1063-1071

⁶ The report can be downloaded from www.greenpeaceindia.org

⁷ See Appendix 1 for a copy of the questionnaire

⁸ Dr. A.Kishan Rao(Aug 2001) Hell on Earth

⁹ See Appendix 13 for information on previous health studies undertaken.

¹⁰ The framework presents a logical progression from inputs to processes of change to outputs. The inputs are determinants of health. Next education and governance are related to processes of change which underpin community health. Finally, population health outcomes include measures of both positive health and negative health.

¹¹ See Appendix 11 for details

ANALYSIS AND FINDINGS

Analysis

Firstly, the data was classified under six age groups from 0 to 61 and above. The data was then further classified on the basis of sex and percentage of illnesses etc. After grouping into these three categories, the data was then analysed for individual diseases and disease sets. Subsequently an analysis was done on mortality rates.

The health related responses of the respondents traversing a wide spectrum were recorded, stored and sorted using a customised software management system, designed and developed in Access. Manual calculations along with Access were used to reach the figures on prevalence percentages, incidence, statistical significance and overall patterns. Most of these findings have been projected on graphs for easy reading.

The analysis was restricted to simple percentage analysis, followed by calculation of the Odds-ratio. This involved segregating raw data in an order prescribed in the disease index (refer to Appendix 1 for more details).

Findings

Once these divisions were made, the data was tested for consistency and significance using the χ^2 tests and odds ratio tests to determine their statistical significance. Analysed data was then projected in a graphical format for easy understanding, which was done with simple office software coupled with manual computation techniques.

The results of this study demonstrate that all body systems without exception are adversely affected in the study areas as opposed to the control locations. It is clear that the cocktail of poisons in the water and air of the study villages have considerably affected the health and well being of the local population.

The analysis of the data collected at Medak District has shown that there is an overwhelming difference in incidence of many systemic maladies across the study group as compared to the control group as detailed below:

- Cancer incidence is greater in the study group at statistically significant rates. While 11 cases of incidence were reported in this group, no such case was reported in the sampling set in the less exposed group.
- While 16 cases of heart diseases recorded in the study group, no such case is noticed in the control group.
- The occurrence of asthma and bronchitis is 4 times higher in the study group.
- One in every eleven persons in the study group is afflicted with diseases of the muscoskeletal system and connective tissue.
- The presence of diseases of skin and subcutaneous tissue in study group is at least two times higher than the less exposed group.

Medical verifications were performed using the lung function tests (spirometry) on a random sample of the study and control populations. These confirmed the preliminary findings. 73.6% of the people tested in the study group were found to have affected lungs as compared to the control group where only 32.5% were affected. The chi square test also proves that this difference is highly significant.

DISCUSSIONS AND CONCLUSIONS

It is clear that the nature of illnesses spreads across practically all body systems in an almost unpredictable manner. This is clearly due to the fact that there is a cocktail of chemicals present in the air, soil and water. A chemical crisis is an obvious reality for the communities in these areas.

The Pollution Control Board with vast resources at its disposal has failed to intervene and come up with strategies, which protect the community and the environment from toxic contamination. Its very existence is called into question by its manner of functioning, which uses public money with a total lack of transparency.

These findings have implications on industrial planning policies, locally and globally. The paradigm of designing industrial estates recklessly, with no regard for the effects on public and environmental health needs to change. Industries of this kind, must be allowed to exist only in the rare exception, when they are designed in a manner where all chemicals used are self contained, using closed loop systems. A policy of zero-discharge must be effectively implemented. The new planning paradigm must accommodate clean production technology as an integral part.

Waiting for further solid evidence of chemical effects on health will mean risking further irreversible damage to health, and especially to the health of children. The reality today is that we are exposed to tens of thousands of chemicals, which simply didn't exist on the planet until a few decades ago. There are no tools for analysing the toxicity of the complex mixture to which these communities are being exposed. When there are a complex group of chemicals in your air and water it becomes almost impossible to predict and remedy human diseases that may be caused by them, not to mention the near impossibility of treatment and clean up of contaminated air and water. That leaves us with only a generalised approach to safety through hazard reduction, i.e. reduction in exposure, using a precautionary approach.

In light of the evidence presented in this report, it is imperative that the regulators and polluting industries immediately take up, the following recommendations:

- * State and industries must provide immediate health assistance to and long term medical rehabilitation of, the community at Medak**
- * The government must declare a state of chemical crisis in the area with immediate effect**
- * Full disclosure of chemicals in the industrial products, processes and wastes generated at Medak. Comprehensive information about the health effects of these chemicals to be made available to the communities.**
- * Zero discharge of toxic effluents into water bodies with immediate effect**
- * Shift to clean production must be made**
- * All contaminated sites must be cleaned up immediately**
- * Companies must ensure that all workers have access to medical records**
- * Companies must accept complete responsibility and liability for their past actions and compensate affected persons.**

The case of Medak is a classic illustration of chemicals out of control. These chemical contaminants have become a ubiquitous feature of the everyday lives of people in the district. They are in present in the land, air and water. Perhaps the most unsettling factor is that these toxins may remain chronic contaminants into the foreseeable future.

The modern mantra of 'greenwash' of industries, so typically exemplified at Medak, manipulates the definition of environmentalism and sustainable development to ensure that trade and environmental agreements are shaped, if not dictated by their business agendas. This investigative study highlights the acute need for these industries to exercise a precautionary approach, ie. a shift from the assumption that the environment has the capacity to receive and render harmless, such a vast quantity and variety of toxic pollutants. So far, affected communities have been asked to prove the severity of contamination in their locality, and deleterious health effects experienced by them. The onus must however be shifted to the industries to demonstrate that any proposed activity on their part is not likely to harm the environment and human health. The approach of prevention of toxic inputs must be adopted, rather than the current prevalent notion of attempted control of contaminants.

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APPENDIX 1 : COPY OF THE QUESTIONNAIRE FOLLOWED BY THE DISEASE INDEX

_____ Identification Number (Area Code+ Interviewer code+ Ward Number+ House Number)

_____ DATE

_____ TIME

_____ Number of Family Members

_____ Address-Phone Number: _____

_____ What is the total monthly income of the family?

NAME OF FAMILY MEMBER	AGE	SEX	Ky Infmt	OCCUPATION	EDUCATION # of yrs	Over all Health	DOCTOR-DIAGNOSED HEALTH PROBLEM				Perceived Health Problem			Habits? Smoking/ Drinking/ Chewing-tobacco- CT n/y / Snuff-SN n/y / Tobacco-paste- TP n/y		
			Y / N				1	2	3	4	1	2	3	S n/y	D n/p	
M1)																
M2)																
M3)																
M4)																
M5)																
M6)																
M7)																
M8)																
Deceased Member:	age	sex	Year of Death	Occupation	Educat- - ion	Over- all Health	Cause of death?				Any chronic disease?			Anyaddictive habits?		
D1)																
D2)																

N / Y _____ Do you spray pesticides in the home? If yes what is the number of rounds of spraying in a year?

N / Y _____ Do you burn your household wastes at the home? If yes how many times do you burn it in a year?

N / Y _____ Protected water supply?

If 'N' source a) Well b) Borewell c) Tank d) Stream / River

A) _____ Colour of water : Normal / Change of colour

B) _____ Odour : Less / Smelly

C) _____ Turbidity : Y / N

D) N / Y _____ Transparency
 N / Y _____ Do you cultivate your own vegetables?
 If 'N' source a) Village Shops b) Nearby Market c) City
 _____ Ventilation : Adequate / Inadequate

How would you rate your overall Health?

A: Excellent, seldom if ever, sick. B: Good, occasionally sick, no major health problems but not ideal health, C: Fair, sick more than most people; limited in a few activities,

D: Poor, gets sick often, illness limits many activities. E: Very poor or bad, always sick, Chronic Illness limits all activities.

Have you been diagnosed for any disease/health problem by a doctor? Any other perceived diseases and symptoms?

What are your current or past habits?

S (n)/(y): Smoking n=number of cigarettes/bidis per day/ y= number of years of smoking,

D (n)/(p): Drinking n= number of days per week/p= number of pegs in one session

CT (n)/(y): Chewing Tobacco, n=no of times a day/ y= no of years of chewing;

SN (n)/(y): Snuff, n=no of times a day/ y= no of years of use

TP (n)/(y): Tobacco Paste: n=no of times a day/ y= no of years of use

<p><i>A: Asthma, AL: Allergies, AD: Allergic Dermatitis, ATD: Attention Defects, ADR: Allergic to Drugs, ART: Arthritis, ANM: Anemia, AC-R: Accident Road, AC-F: Accident Factory., APX : Appendicitis</i></p>	<p><i>B: Bronchitis, BD: Blood Disease, BRD: Birth Defects, BS: Breathlessness sudden, LBP: Blood Pressure, HBP: High Blood Pressure, BR: Breathlessness regular, BP: Back Pain.</i></p>
<p><i>C: Cancer, CB: Cancer of the Breast, CT: Cancer of the testicles, CPR: Cancer of the Prostrate, CL: Cancer of the Lungs, CBL: Cancer of the Bladder, CUDT: Cancer of the Upper Digestive Tract, CLDT: Cancer of the lower Digestive Tract, CST: Soft Tissue, CAS: Angiosarcoma, CA: Cardiac Arrest, CP: Chest Pain, CNT: Contraceptive Pills/ implants /injections, CC: Cervical Cancer, CNF: Confusion, CS: Severe Cough, CCS: Severe Cough & Cold, CTR : Cataract, CHP : Chicken Pox. CLS : Cholesterol</i></p>	<p><i>D: Diabetes, DP: Depression, DZ: Dizziness, DH: Diarrhea, DNP: Dental Problem, DY : Dysentery</i></p>
<p><i>E: Endometriosis, EP: Early onset of Puberty, ED: Erectile Dysfunction, EL: Epilepsy, EFL: Early Foetal Loss, EP: Eye Pain, EO: Eye Operation, ES : Eosonophilia, G: Gall Bladder Stone</i></p>	<p><i>HL: Hearing Loss, HR: Headaches Recurring, H: Headaches, HD: Heart Disease, HP:Hepatitis, HN : Hernia, HBP : High Blood Pressure</i></p>
<p><i>I: Infection, IE: Infection of the Ear, IT: Infection of the throat, IL: Infection of the Lungs, IC: Infection-Common Cold, IO: Other infection, INF: Infertility, IRT: Irritation, IA: Induced Abortions, IMN: Immunisation, ID: Indigestion.</i></p>	<p><i>J: Jaundice, K: Kidney Failure, KS: Kidney Stone</i></p>
<p><i>F: Fibroid in the Uterus, FR: Fever recurring, FCR: Cold & Fever recurring, FRT : Fracture</i></p>	<p><i>L: Leukemia, LD: Liver Disease, LGY: Lethargy, LSC: Low Sperm count: LGS: Lymph Gland Swelling, LP: Leg Pain, LBP : Low Blood Pressure</i></p>
<p><i>M: Migraine, MP: Menstrual Problems, ML: Memory Loss, MN: Menorrhagea, MA; Missed Abortions, MD: Mental Disease, MR : Malaria</i></p>	<p><i>N: Nasal Septum Perforation, NS: Nausea</i></p>
<p><i>O: Obesity, OP: Osteoporosis</i></p>	<p><i>P: Paralysis, PS: Paralysis-Stroke, PCOS: Poly-cystic Ovarian Syndrome, PLS: Piles, PM: Psychiatric Morbidity, PU: Prolapse Uterus, PH : Physically Handicapped</i></p>
<p><i>R: Rheumatism, RP: Reproductive illness, RTI: Reproductive Tract Infection</i></p>	<p><i>SD: Skin Disease, SW: Shuffling when walking, STD: Sexually Transmitted Diseases, SU: Suicide Urge, STU: Stomach Ulcers, SNS: Sinusitis, SI: Stress Incontinence, SP: Surgical Procedures? SPN: Stomach Pain, SMP : Small Pox</i></p>
<p><i>T: Thyroid problem, TB: Tuberculosis, TH: True Hermaphrodite, TY : Typhoid</i></p>	<p><i>U: Urinary Tract Dysfunction, UMM: Uncontrolled Muscle Movements, UT: Undescended Testis, UR : Uterus Removal</i></p>
<p><i>VDE: Vomiting with direct exposure, VL: Vision Loss, V: Varicose Vein Dysfunction</i></p>	<p><i>W: Weakness, WZ: Wheezing</i></p>

APPENDIX 2: STUDY OF EFFECT ON LUNG FUNCTION IN VILLAGES EXPOSED TO INDUSTRIAL POLLUTION

It is a known fact that air pollution from industries affect lung function (respiratory systems). Lung function tests are a good tool to study this effect. Lung function tests measure the volume of air forcefully exhaled by a person in the mouthpiece of a lung function test meter after inhaling air initially. Forced expiratory volume in the first second (FEV1) means the volume of air exhaled forcefully in the first second after exhalation starts. This parameter is known to be impacted primarily by air pollution. Some dusts cause fibrosis in lungs (e.g. asbestos, silica). These dusts have more effect on the total capacity of lungs than effect on FEV1.

We studied effect on FEV1 in exposed villages and in non-exposed villages. A portable ventilometer (SPIRO DOC) was used. Dr. S. R. Kamat's equations and tables were used for the predicted values of FEV1. Sex and age, two important variables are considered in the equations themselves. Separate stratification on the basis of age and sex is not needed to see the effect on FEV1, if height is within the normal range.

We labelled persons having FEV1 below the 60% of predicted values as being severely affected. Persons having FEV1 in the range of 60 to 80% of the predicted values were labelled as affected but not severely. All the persons having FEV1 above 80% of the predicted values were labelled as being non-affected.

Smoking also affects FEV1. To neutralise effect of smoking for sake of comparison of exposed villages to unexposed villages, smokers were subtracted from affected as well as unaffected. We see the effect in Table 4. We see that actually the percentage of affected people increases in the exposed villages among the non-smokers. There are smokers who are yet not affected in both types of villages. These figures we see in Table 3.

Environmental asthma is known to be present in polluted areas. For the suspected asthmatic persons, the lung function test was repeated after administering broncho-dilator asthelin pump. Increase in FEV1 equal or more than 15% was used as a criterion for asthma, as given by Carl Zenz. Family history was probed. **One person reported that their mother is known to have suffered in her youth. This was labelled as familial asthma. Even in this case it is possible that the mother started suffering after industrialization. To be conservative we labelled it as familial asthma.**

Sample:

For testing of lung function 44 persons from exposed villages and 35 persons from unexposed villages were randomly selected among persons who complained of some respiratory problem. The lung function test could not be satisfactorily administered in some cases because of difficulty in communication or in grasping instructions, or due to severe respiratory problems which made it impossible for the subject to undergo the test. The test was administered to an acceptable ratio of exposed to unexposed in the range of 1.15 to 1. Six results from exposed population and one from unexposed, were not considered for analysis due to certain limitations. Where the doctor clearly commented on the problem of incapacity due to respiratory problems, the result was accepted for analysis as severely affected. One instance of a report of pleural effusion and non-performance was also not taken for analysis (one of the six above). The following tables list the findings. Results of test of significance (chi-square) are given at the end.

Tables of lung function test in Patancheru area:

Table 1. Lung function affected in exposed and unexposed villages:

Villages		FEV1 Severely Affected	FEV1 Affected, but not severely	Total lung function (FEV1) affected	Total non-affected	Total tested for lung function
Exposed	Males	08	11	19	09	28
	Females	03	06	09	01	10
	Total	11	17	28 (73.6%)	10	38
Unexposed	Males	04	06	10	16	26
	Females	02	00	02	06	08
	Total	06	06	12 (35.2%)	22	34
Total			40	32	72	

Odds ratio=2.08>2

ASTHMA:

Increase in FEV1 equal or more than 15% after broncho-dilator.

Table 2.

	Familial asthma	Environmental asthma	No asthma	Total
Exposed	01(smoker)	07(18.4%); (3 smokers)	31	38
Unexposed	00	01(2.9%); (Non-smoker)	33	34
Total		08	64	72

SMOKERS:

Table 3.

All smokers are males.

	Affected smokers		Affected Smokers	Unaffected Smokers		Unaffected Smokers
	Heavy	Non- Heavy	Total	Heavy	Non- Heavy	Total
Exposed Villages	06	03	09	02	04	06
Un- Exposed Villages	03	02	05	05	02	07
Total 27			14			13

Number of affected and non-affected smokers is almost the same.

Effect among non- smokers.

Table 4.

Villages		FEV1 Severely Affected	FEV1 Affected, but not severely	Total Lung function (FEV1) affected	Total non-affected	Total tested for Lung function
Exposed	Males	02	08	10	03	13
	Females	03	06	09	01	10
	Total	11	17	19 (82.6%)	04	23
Unexposed	Males	01	04	05	09	14
	Females	00	00	00	01	00
	Total	01	04	07 (31.8%)	10	14
Total				26	19	45

Odds ratio= 2.5>2

Significance

Chi-square test shows that number of affected persons is significantly higher in exposed villages ($P<0.01$) (Table1). The difference is significant also among non-smokers at $P<0.01$ (Table 4).

APPENDIX 3: FOLLOW UP MEDICAL INVESTIGATION OF CARCINOMA QUESTIONNAIRE

1. _____ *identification Number (Area Code+ Interviewer code+ Ward Number+ House Number+ follow up number- (two digits)*
2. _____ *date*
3. _____ *AGE*
4. *Male/Female* _____ *SEX*
5. *Type of Cancer* _____
6. *Organ affected* _____
7. *TNM Stage*
8. *In which year was it detected?* _____
9. *How was it detected?*
10. *Local doctor*
11. *Senior doctor in a major hospital*
12. *Pathology confirmation*
13. *Was surgery performed?*
14. *Was chemotherapy administered?*
15. *Was radiotherapy administered?*
16. *Is there pain at present?*
17. *Is there bleeding from the site?*

**APPENDIX 4: FOLLOW UP INVESTIGATION OF RESPIRATORY
DISABILITY USING PULMONARY FUNCTION TESTING QUESTIONNAIRE**

1. _____ Identification Number (Area Code+ Interviewer code+ Ward Number+ House Number+ follow up number- (two digits)
2. _____ Date
3. _____ Age
4. Male/Female _____ Sex
5. Y/N _____ Do you smoke? Y/N Did you smoke earlier?
6. _____ S (n)/(y): Smoking n = number of cigarettes/bidis per day/y = number of years of smoking
7. Y/N Do you get up due to cough?
8. Y/N Is the problem for more than 2 months?
9. Y/N Is the problem for more than 2 years?
10. Is there a particular season when the problem is faced?
11. Y/N Is the cough with expectoration?
12. Y/N Are you suffering due to asthma?
13. Y/N Are you diagnosed to be asthmatic?
14. Y/N Is there a family history of asthma?
15. Y/N Have you associated this problem with any cause?
16. What is the cause you have identified?
17. What is the medication you take for asthma?
18. What is the frequency of medication?

Breathlessness

Do You become breathless while:

19. Climbing staircase
20. Walking at usual speed
21. Walking for even 100 steps/performing activities of daily living
22. Even at rest
23. GRADE OF BREATHLESSNESS: _____

READINGS OF LUNG FUNCTION TEST

Sr. No.	FEV1	FVC	PEFR	MEFR	Selected
1.					
2.					
3.					
4.					

AFTER BRONCHODILATOR

Sr. No.	FEV1	FVC	PEFR	MEFR	Selected
1.					
2.					
3.					
4.					

24. FEV1 _____ % of predicted;
25. FVC _____ % of predicted
26. COMMENTS

APPENDIX 5: LIST OF CHARTS TRANSCRIBED INTO GRAPHS

Chart 1 : Epilepsy

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	6	493	1.2	3	487	0.6	0	116	0	0	122	0
6 - 12 years	4	732	0.5	4	688	0.5	0	157	0	0	149	0
13 - 19 years	2	668	0.2	1	721	0.1	0	130	0	0	134	0
20 - 35 years	7	1503	0.4	3	1446	0.2	3	287	1.0	0	334	0
36 - 60 years	0	896	0.0	2	821	0.2	0	220	0	0	201	0
61+ years	3	248	1.2	1	222	0.4	0	56	0	0	43	0

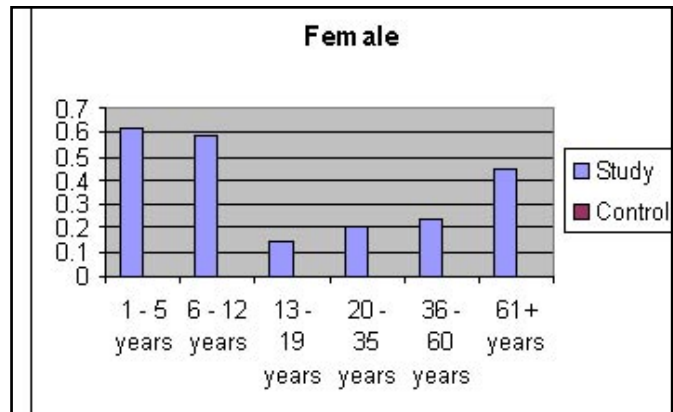
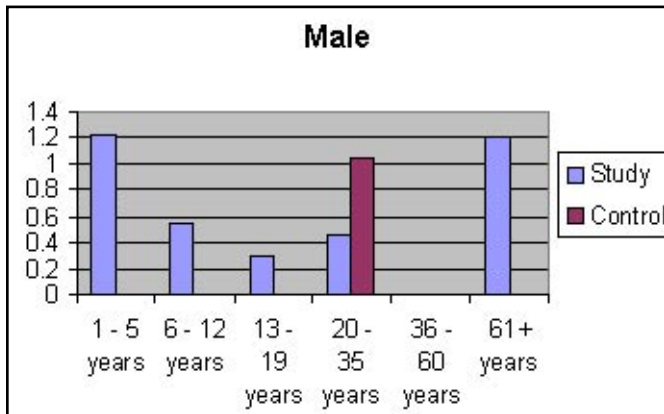


Chart 2 :Paralysis

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	1	493	0.2	0	487	0	0	116	0	0	122	0
6 - 12 years	0	732	0.0	1	688	0.1	0	157	0	0	149	0
13 - 19 years	1	668	0.1	1	721	0.1	0	130	0	0	134	0
20 - 35 years	2	1503	0.1	1	1446	0.0	0	287	0	1	334	0.2
36 - 60 years	12	896	1.3	5	821	0.6	1	220	0.4	0	201	0
61+ years	5	248	2.0	4	222	1.8	0	56	0	0	43	0

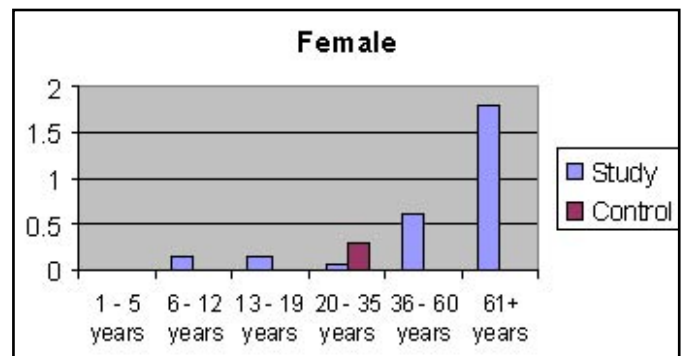
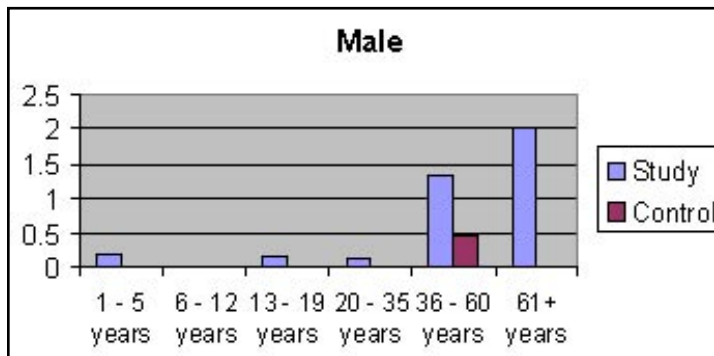


Chart 3 : Heart Disease

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	0	493	0	0	487	0.0	0	116	0	0	122	0
6 - 12 years	1	732	0.1	1	688	0.1	0	157	0	0	149	0
13 - 19 years	1	668	0.1	0	721	0.0	0	130	0	0	134	0
20 - 35 years	2	1503	0.1	2	1446	0.1	0	287	0	0	334	0
36 - 60 years	5	896	0.5	3	821	0.3	0	220	0	0	201	0
61+ years	1	248	0.4	0	222	0.0	0	56	0	0	43	0

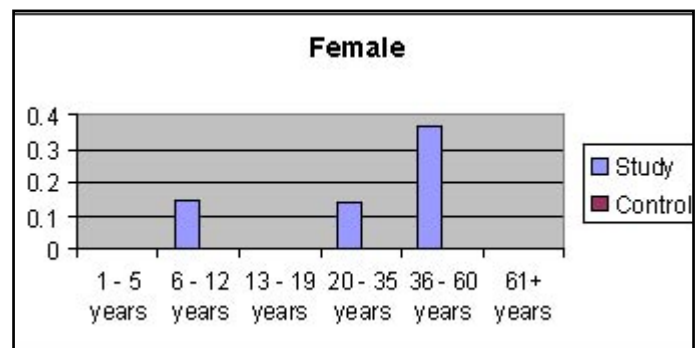
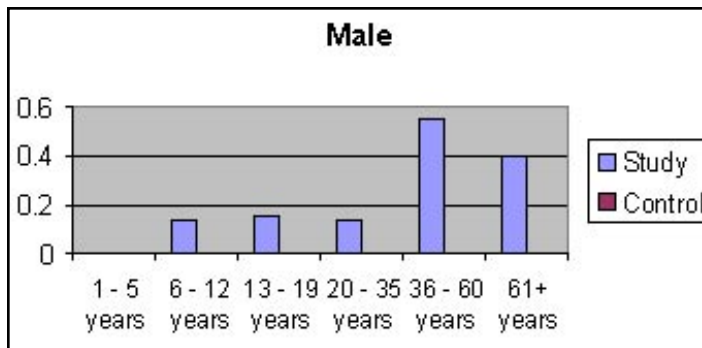


Chart 4 : Bronchitis

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	1	493	0.2	1	487	0.2	0	116	0	0	122	0
6 - 12 years	2	732	0.2	4	688	0.5	0	157	0	0	149	0
13 - 19 years	2	668	0.2	0	721	0.0	0	130	0	0	134	0
20 - 35 years	8	1503	0.5	7	1446	0.4	2	287	0.6	0	334	0
36 - 60 years	16	896	1.7	12	821	1.4	0	220	0	0	201	0
61+ years	10	248	4.0	2	222	0.9	1	56	1.7	0	43	0

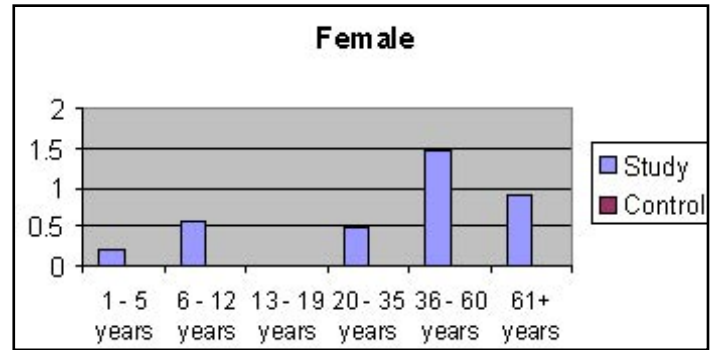
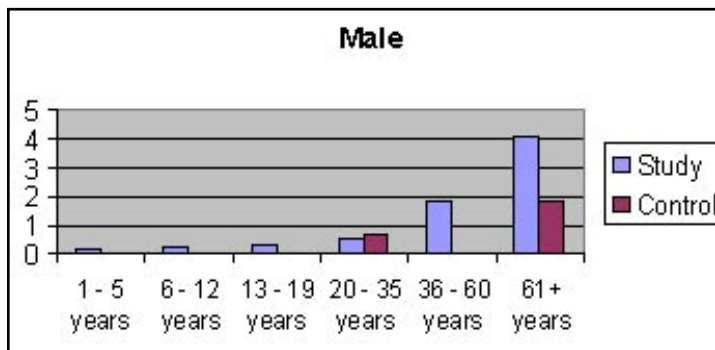


Chart 5 : Asthma

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	Female%
1 - 5 years	2	493	0.4	1	487	0.2	0	116	0	0	122	0
6 - 12 years	5	732	0.6	0	688	0	0	157	0	1	149	0.6
13 - 19 years	4	668	0.5	2	721	0.2	0	130	0	0	134	0
20 - 35 years	14	1503	0.9	11	1446	0.7	1	287	0.3	0	334	0
36 - 60 years	16	896	1.7	14	821	1.7	2	220	0.9	0	201	0
61+ years	18	248	7.2	5	222	2.2	1	56	1.7	0	43	0

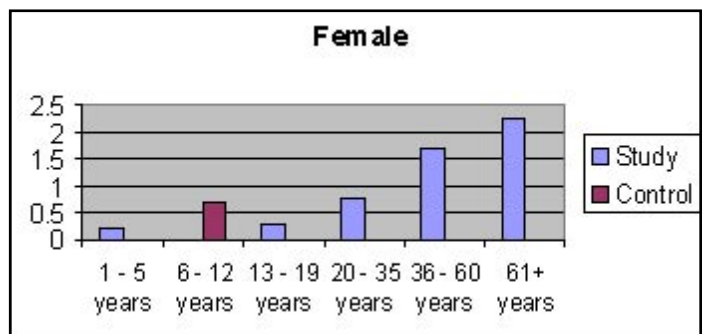
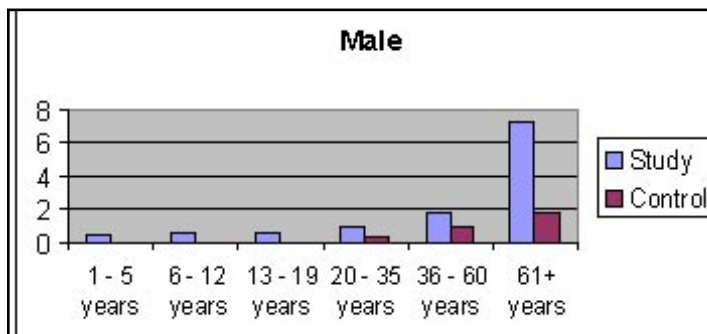


Chart 6 : Allergic Dermatitis

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	2	493	0.4	5	487	1.0	1	116	0.8	0	122	0
6 - 12 years	4	732	0.5	4	688	0.5	0	157	0	0	149	0
13 - 19 years	3	668	0.4	3	721	0.4	1	130	0.7	0	134	0
20 - 35 years	13	1503	0.8	3	1446	0.2	1	287	0.3	0	334	0
36 - 60 years	6	896	0.6	4	821	0.4	1	220	0.4	0	201	0
61+ years	4	248	1.6	1	222	0.4	0	56	0	0	43	0

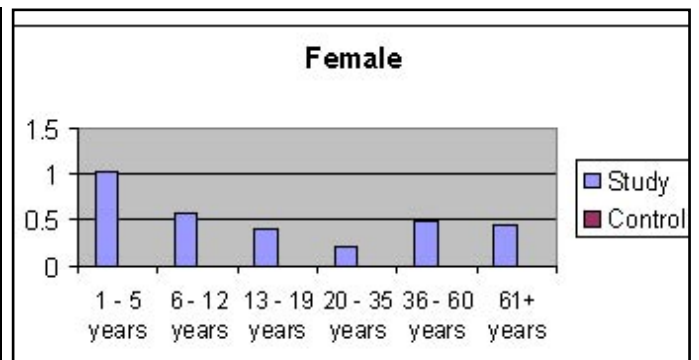
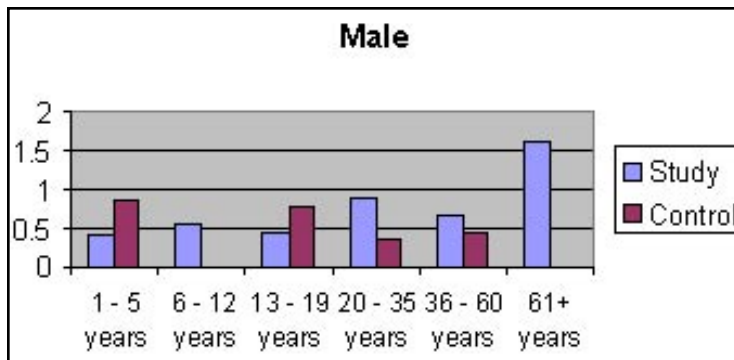


Chart 7 : Arthritis

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	1	493	0.2	2	487	0.4	0	116	0	0	122	0
6 - 12 years	5	732	0.6	7	688	1.0	0	157	0	1	149	0.6
13 - 19 years	13	668	1.9	14	721	1.9	1	130	0.7	0	134	0
20 - 35 years	95	1503	6.3	119	1446	8.2	2	287	0.6	9	334	2.6
36 - 60 years	212	896	23.6	257	821	31.3	11	220	5	22	201	10.9
61+ years	80	248	32.2	75	222	33.7	8	56	14.2	8	43	18.6

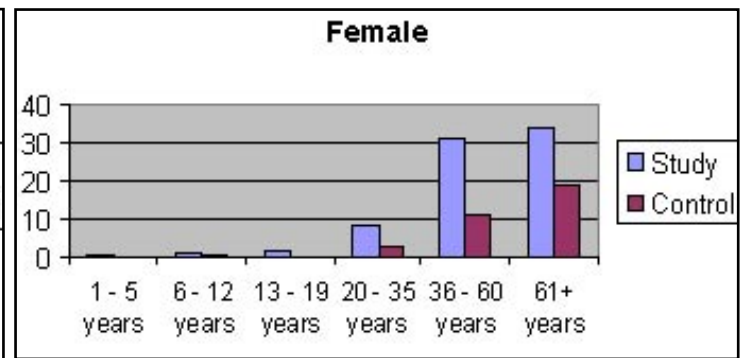
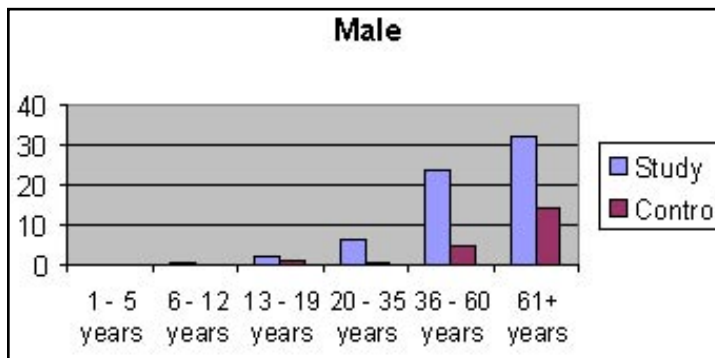


Chart 8 : Skin Diseases

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	6	493	1.2	4	487	0.8	0	116	0	0	122	0
6 - 12 years	4	732	0.5	9	688	1.3	1	157	0.6	0	149	0
13 - 19 years	5	668	0.7	4	721	0.5	1	130	0.7	0	134	0
20 - 35 years	7	1503	0.4	6	1446	0.4	1	287	0.3	0	334	0
36 - 60 years	7	896	0.7	3	821	0.3	1	220	0.4	1	201	0.4
61+ years	3	248	1.2	0	222	0	0	56	0	0	43	0

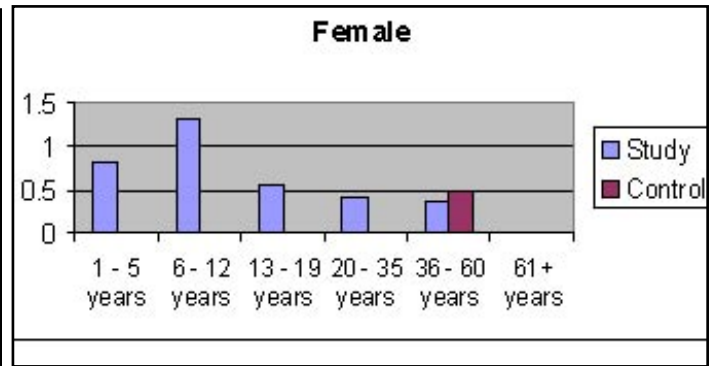
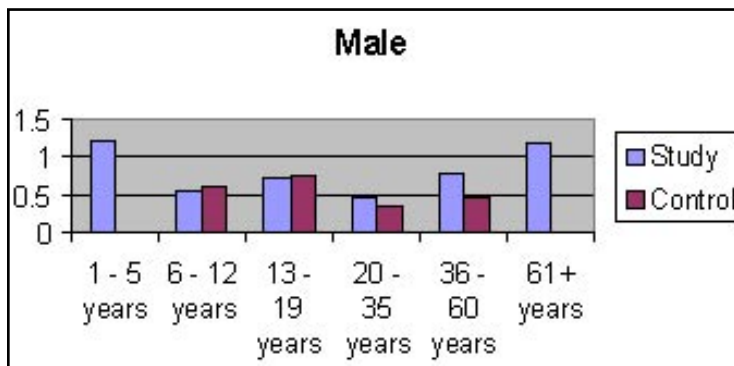


Chart 9 : Recurring Headaches

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	0	493	0	0	487	0	0	116	0	0	122	0
6 - 12 years	8	732	1.0	9	688	1.3	0	157	0	0	149	0
13 - 19 years	19	668	2.8	31	721	4.2	1	130	0.7	0	134	0
20 - 35 years	50	1503	3.3	98	1446	6.7	2	287	0.6	3	334	0.8
36 - 60 years	37	896	4.1	57	821	6.9	0	220	0	5	201	2.4
61+ years	9	248	3.6	10	222	4.5	0	56	0	0	43	0

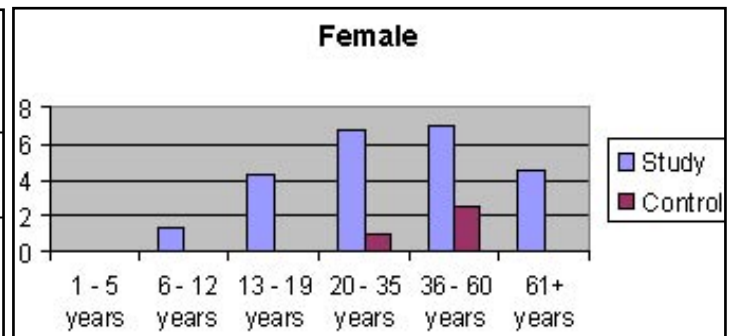
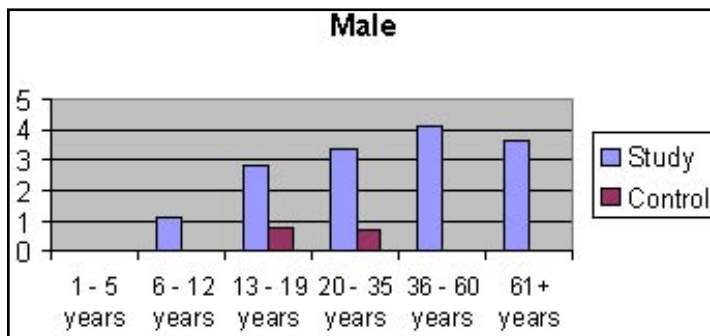


Chart 10 : High Blood Pressure

Age Group	STUDY						CONTROL					
	Male	total pop male	male%	Female	total pop female	female%	Male	total pop male	male%	Female	total pop female	female%
1 - 5 years	0	493	0	0	487	0	0	116	0	0	122	0
6 - 12 years	0	732	0	1	688	0.1	0	157	0	0	149	0
13 - 19 years	0	668	0	0	721	0	0	130	0	0	134	0
20 - 35 years	4	1503	0.2	6	1446	0.4	0	287	0	1	334	0.2
36 - 60 years	12	896	1.3	33	821	4.0	3	220	1.3	3	201	1.4
61+ years	8	248	3.2	7	222	3.1	1	56	1.7	0	43	0

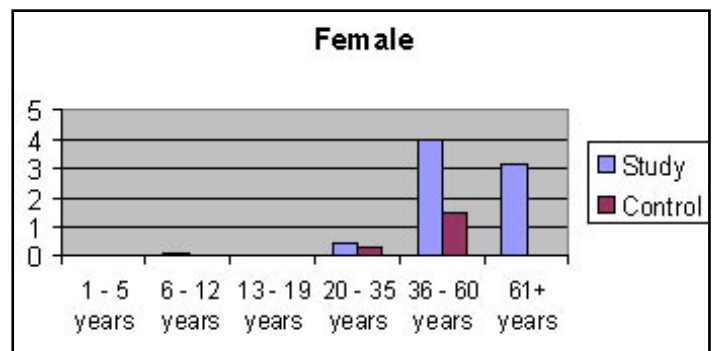
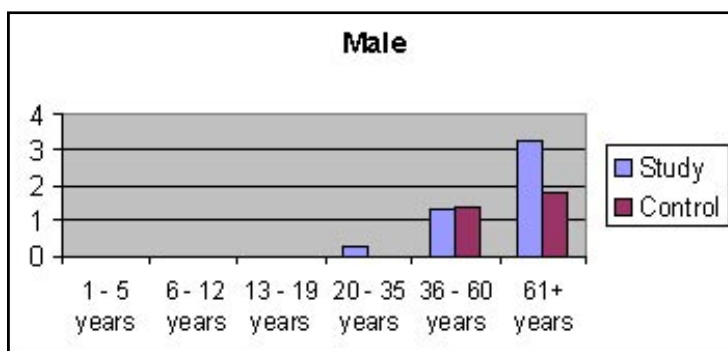


Chart 11 : Cancer Mortality at Study and Control – Medak, 1994 – 2003

Year of Death	Study	Total dec. popn.	Percentage	Control	Total dec. popn.	Percentage
1994	0	12	0	1	9	11.11
1995	1	18	5.5	0	2	0
1996	1	38	2.6	0	8	0
1997	4	37	10.81	0	6	0
1998	4	43	9.30	0	5	0
1999	5	34	14.70	0	13	0
2000	1	52	1.92	0	7	0
2001	1	28	3.57	0	7	0
2002	1	52	1.92	0	15	0
2003	2	53	3.77	0	9	0

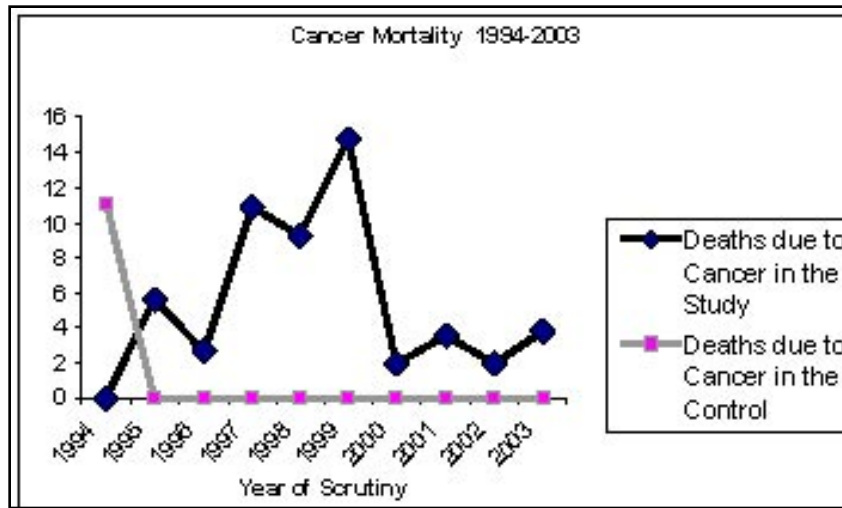


Chart 12 : Neoplasms

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female- Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female- Control Affected	Total Population- Female	% Female
1-5 years	0	493	0	1	487	0.2	0	116	0	0	122	0
6-12 years	0	732	0	0	688	0	0	157	0	0	149	0
13-19 years	1	668	0.1	0	721	0	0	130	0	0	134	0
20-35 years	3	1503	0.1	3	1446	0.2	0	287	0	0	334	0
36-60 years	1	896	0.1	2	821	0.2	0	220	0	0	201	0
61+ years	0	248	0	0	222	0	0	56	0	0	43	0

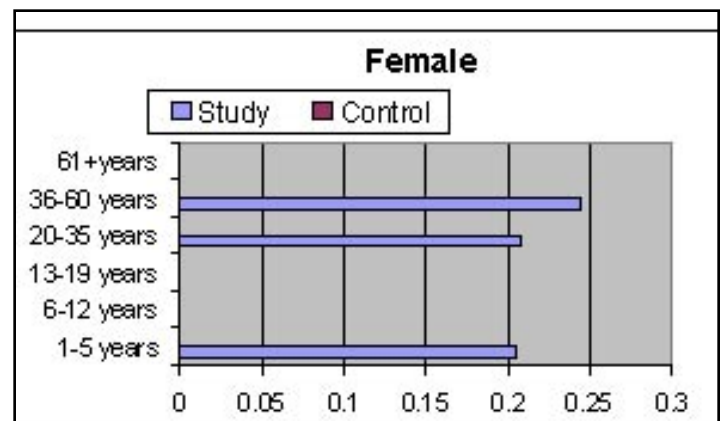
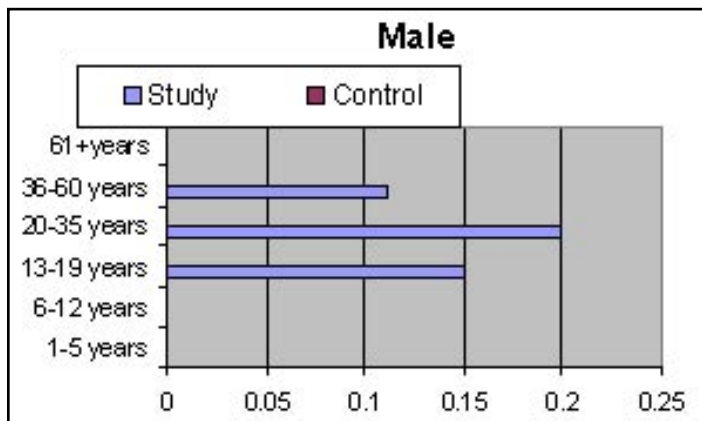


Chart 13 : Disease of Blood and Blood forming organs

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female- Study Affected	Total Population- Female	% Female	Male Control Affected	Total Population- Male	% Male	Female- Control Affected	Total Population- Female	% Female
1-5 years	5	493	1.0	4	487	0.8	0	116	0	1	122	0.8
6-12 years	7	732	0.9	7	688	1.0	1	157	0.6	0	149	0
13-19 years	10	668	1.4	13	721	1.8	0	130	0	1	134	0.7
20-35 years	41	1503	2.7	69	1446	4.7	0	287	0	3	334	0.8
36-60 years	52	896	5.8	59	821	7.1	9	220	4.0	5	201	2.4
61+ years	22	248	8.8	18	222	8.1	2	56	3.5	1	43	2.3

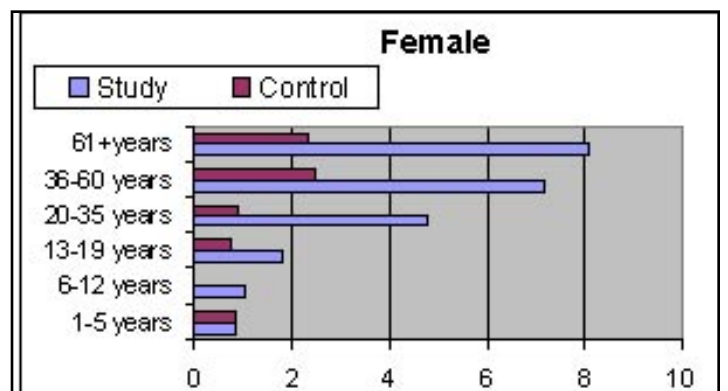
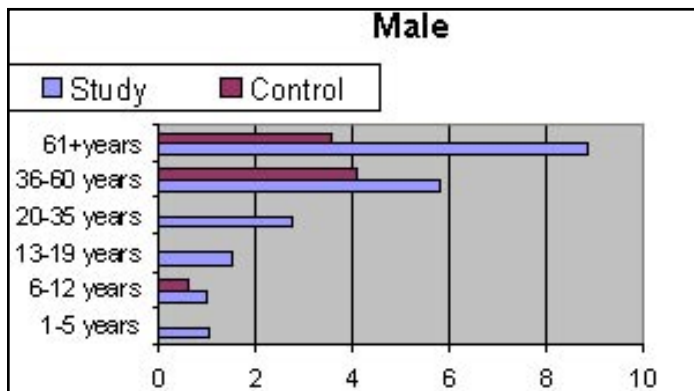


Chart14 : Endocrine, Nutritional and Metabolic Diseases

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female Control Affected	Total Population Female	% Female
1-5 years	1	493	0.2	3	487	0.6	2	116	1.7	0	122	0
6-12 years	6	732	0.8	22	688	3.1	1	157	0.6	0	149	0
13-19 years	20	668	2.9	17	721	2.3	1	130	0.7	3	134	2.2
20-35 years	54	1503	3.5	51	1446	3.5	5	287	1.7	6	334	1.7
36-60 years	46	896	5.1	16	821	1.9	4	220	1.8	3	201	1.4
61+ years	10	248	4.0	7	222	3.1	3	56	5.3	2	43	4.6

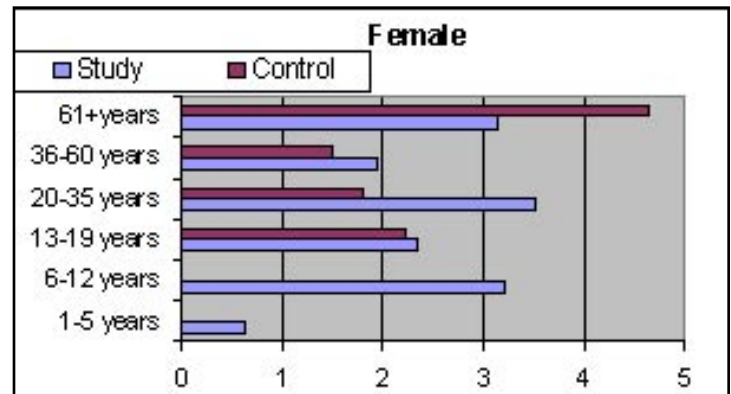
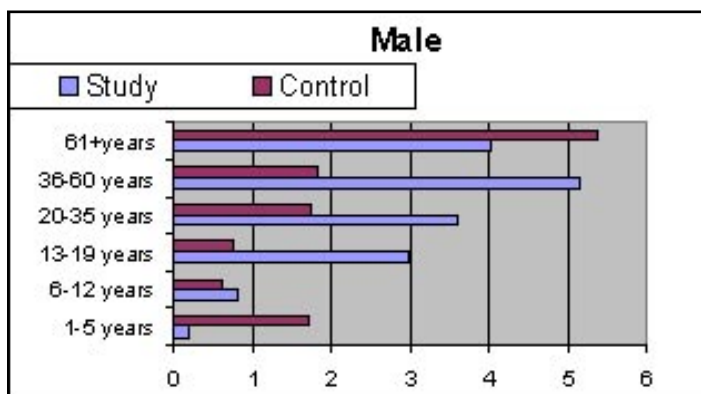


Chart 15 : Diseases of the Nervous System

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female- Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female- Control Affected	Total Population Female	% Female
1-5 years	7	493	1.4	3	487	0.6	0	116	0	0	122	0
6-12 years	2	732	0.2	5	688	0.7	0	157	0	0	149	0
13-19 years	3	668	0.4	3	721	0.4	0	130	0	0	134	0
20-35 years	9	1503	0.5	4	1446	0.2	3	287	1.0	1	334	0.2
36-60 years	13	896	1.4	8	821	0.9	1	220	0.4	0	201	0
61+ years	8	248	3.2	5	222	2.2	0	56	0	0	43	0

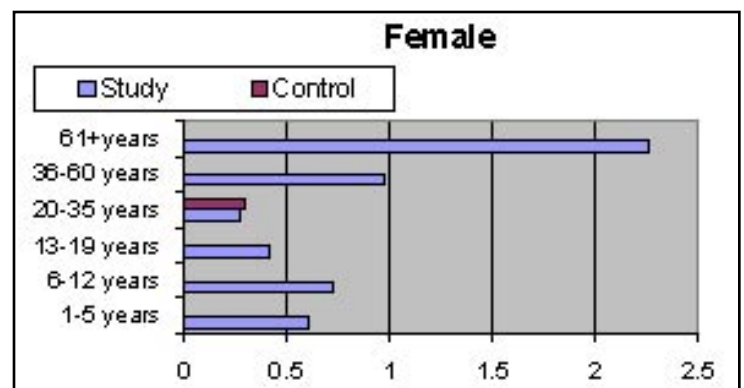
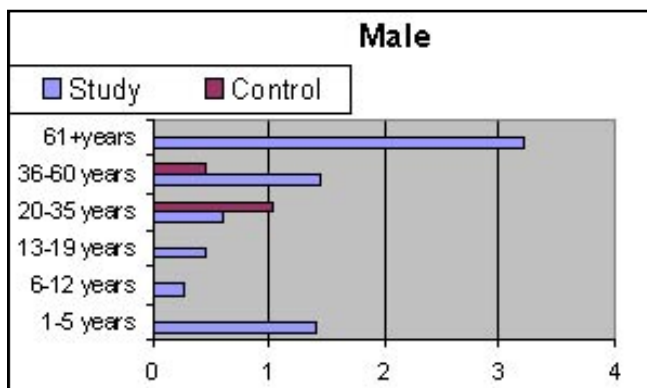


Chart 16 : Diseases of the Circulatory System

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female- Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female- Control Affected	Total Population Female	% Female
1-5 years	0	493	0	0	487	0	0	116	0	0	122	0
6-12 years	4	732	0.5	2	688	0.2	0	157	0	0	149	0
13-19 years	5	668	0.7	2	721	0.2	1	130	0.7	0	134	0
20-35 years	18	1503	1.1	18	1446	1.2	3	287	1.0	1	334	0.2
36-60 years	23	896	2.5	18	821	2.1	2	220	0.9	2	201	0.9
61+ years	5	248	2.0	6	222	2.7	1	56	1.7	0	43	0

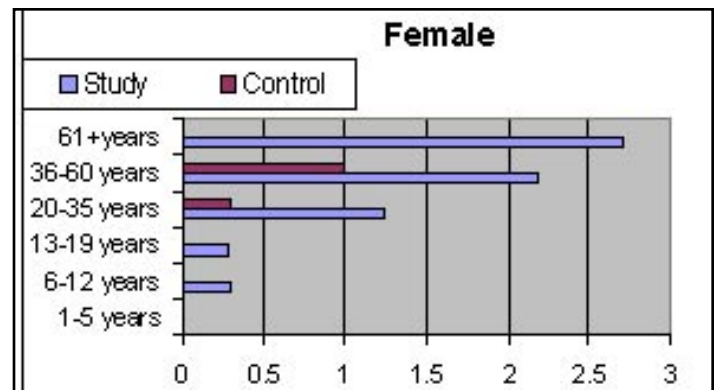
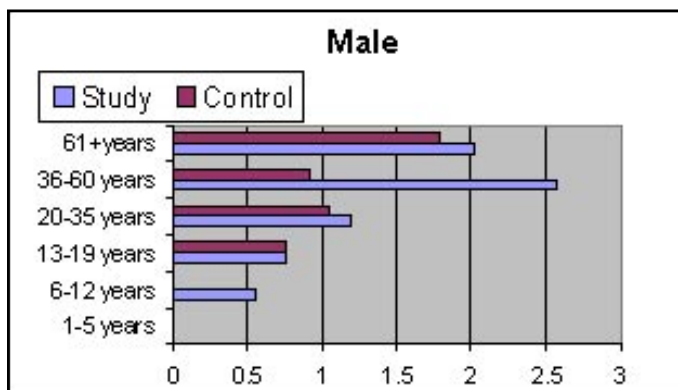


Chart 17 : Diseases of the Respiratory System

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female-Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female-Control Affected	Total Population Female	% Female
1-5 years	23	493	4.6	24	487	4.9	0	116	0	2	122	1.6
6-12 years	30	732	4.0	24	688	3.4	0	157	0	1	149	0.6
13-19 years	21	668	3.1	12	721	1.6	0	130	0	0	134	0
20-35 years	75	1503	4.9	49	1446	3.3	7	287	2.4	1	334	0.2
36-60 years	84	896	9.3	50	821	6.0	7	220	3.1	3	201	1.4
61+ years	50	248	20.16	12	222	5.4	4	56	7.1	1	43	2.3

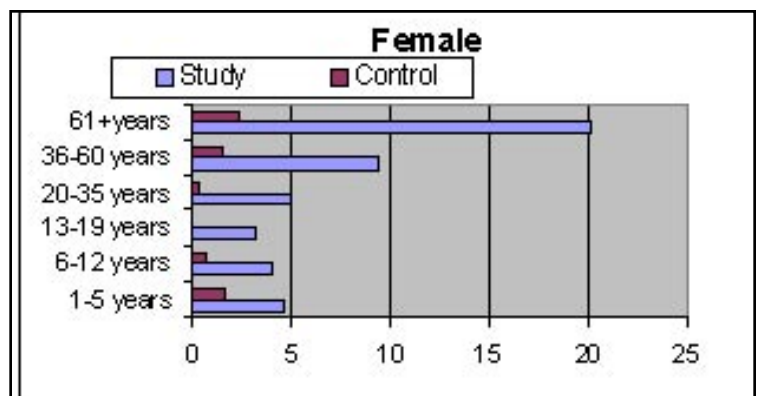
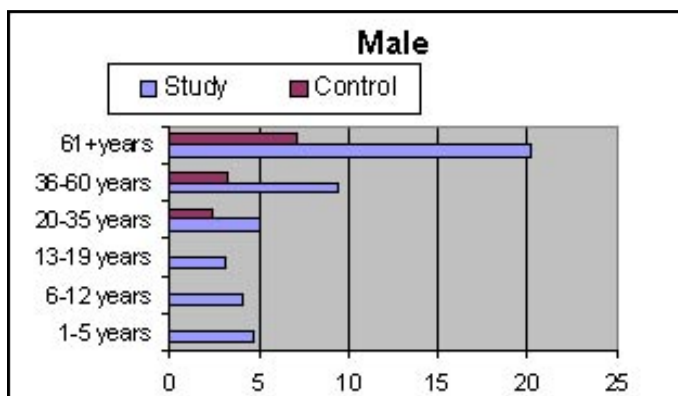


Chart 18 : Diseases of the Digestive System

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female-Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female-Control Affected	Total Population Female	% Female
1-5 years	2	493	0.4	4	487	0.8	1	116	0.8	0	122	0
6-12 years	12	732	1.6	10	688	1.4	0	157	0	0	149	0
13-19 years	13	668	1.9	2	721	0.2	1	130	0.7	0	134	0
20-35 years	36	1503	2.3	27	1446	1.8	5	287	1.7	5	334	1.4
36-60 years	32	896	3.5	21	821	2.5	5	220	2.2	1	201	0.4
61+ years	7	248	2.8	6	222	2.7	1	56	1.7	0	43	0

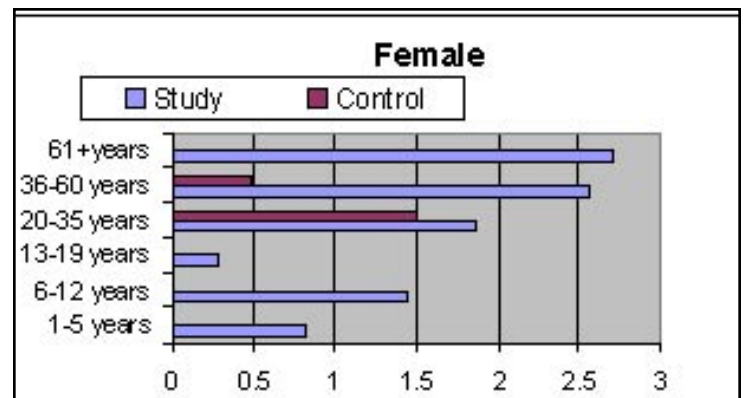
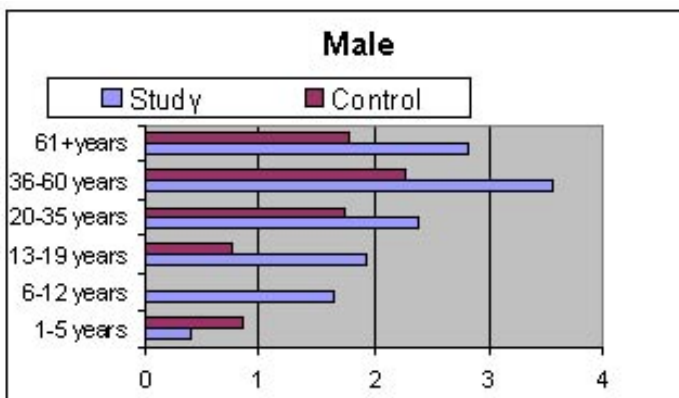


Chart 19 : Diseases of the Skin and Subcutaneous Tissue

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female-Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female-Control Affected	Total Population Female	% Female
1-5 years	8	493	1.6	10	487	2.0	1	116	0.8	0	122	0
6-12 years	8	732	1.0	12	688	1.7	1	157	0.6	0	149	0
13-19 years	8	668	1.1	6	721	0.8	2	130	1.5	0	134	0
20-35 years	21	1503	1.3	9	1446	0.6	2	287	0.6	0	334	0
36-60 years	13	896	1.4	7	821	0.8	2	220	0.9	1	201	0.4
61+ years	7	248	2.8	1	222	0.4	0	56	0	0	43	0

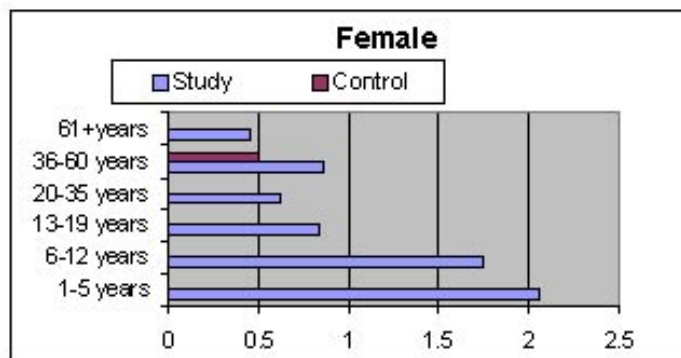
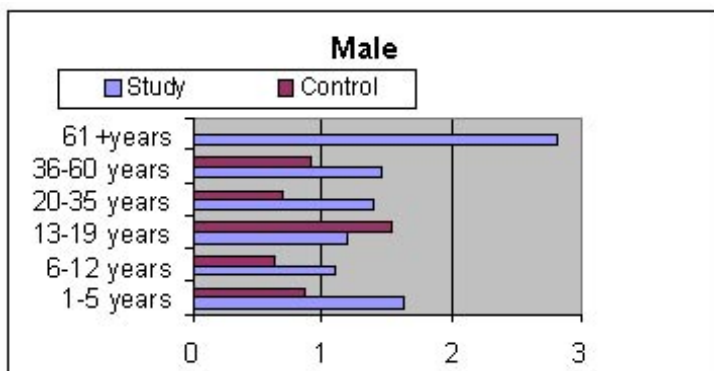
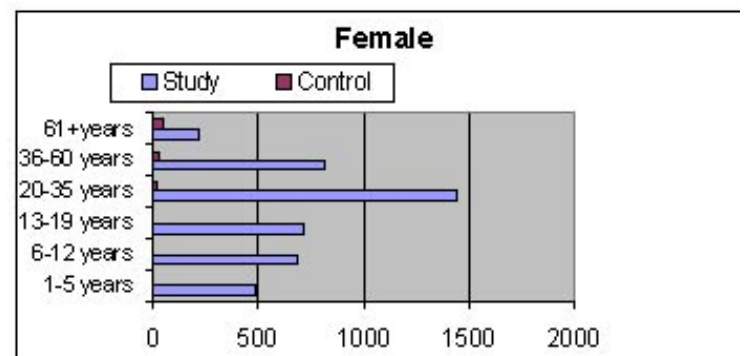
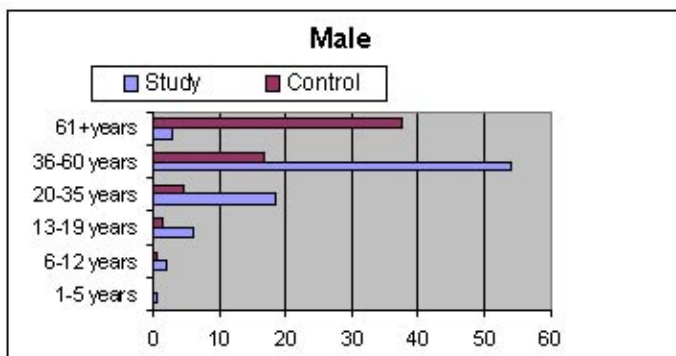


Chart 20 : Diseases of the Musculoskeletal system and Connective Tissue

Age Group	STUDY						CONTROL					
	Male Study Affected	Total Population Male	% Male	Female- Study Affected	Total Population Female	% Female	Male Control Affected	Total Population Male	% Male	Female- Control Affected	Total Population Female	%
1-5 years	2	493	0.4	4	487	0.8	0	116	0	0	122	0
6-12 years	16	732	2.1	17	688	2.4	1	157	0.6	2	149	1.3
13-19 years	41	668	6.1	61	721	8.4	2	130	1.5	2	134	1.4
20-35 years	282	1503	18.76	451	1446	31.18	14	287	4.8	46	334	13.77
36-60 years	485	896	54.12	572	821	69.67	37	220	16.81	61	201	30.34
61+ years	7	248	2.8	180	222	81.08	21	56	37.5	20	43	46.51



APPENDIX 6: DISEASE INVESTIGATION - CATTLE DEATH

Postmortem Certificate (Source: Veterinary Hospital, Jinnaram Mandal) Dated: 20.08.2003

Disease Suspected: Chemical Toxicity

POSTMORTEM CERTIFICATE

Post mortem Certificate

P.M. No: 10/2003 Dated: 20-8-2003

1. Name & Address of the farmer } Sri. Balugesi puthainah
S/O Balainah
R/o. chetta pottasram
Jinnaram (M)
Madak (Dist)

2. Kind of Animal died : She Buffalo.

3. Date of death : 20.8.2003

4. Date of P.M. Conducted: 20.8.2003.

5. Post mortem lesions :

Liver	Congested.	
Lungs	Normal	
Rumen		
Reticulum	} Full of cud	
Omasum		} Black discoloration of mucosa
Abomasum		
Intestines	Congested.	
Lymph nodes	Normal	

6. Grossed Symptoms: Anoxia, No protein.

7. Disease Suspected: Chemical toxicity ?

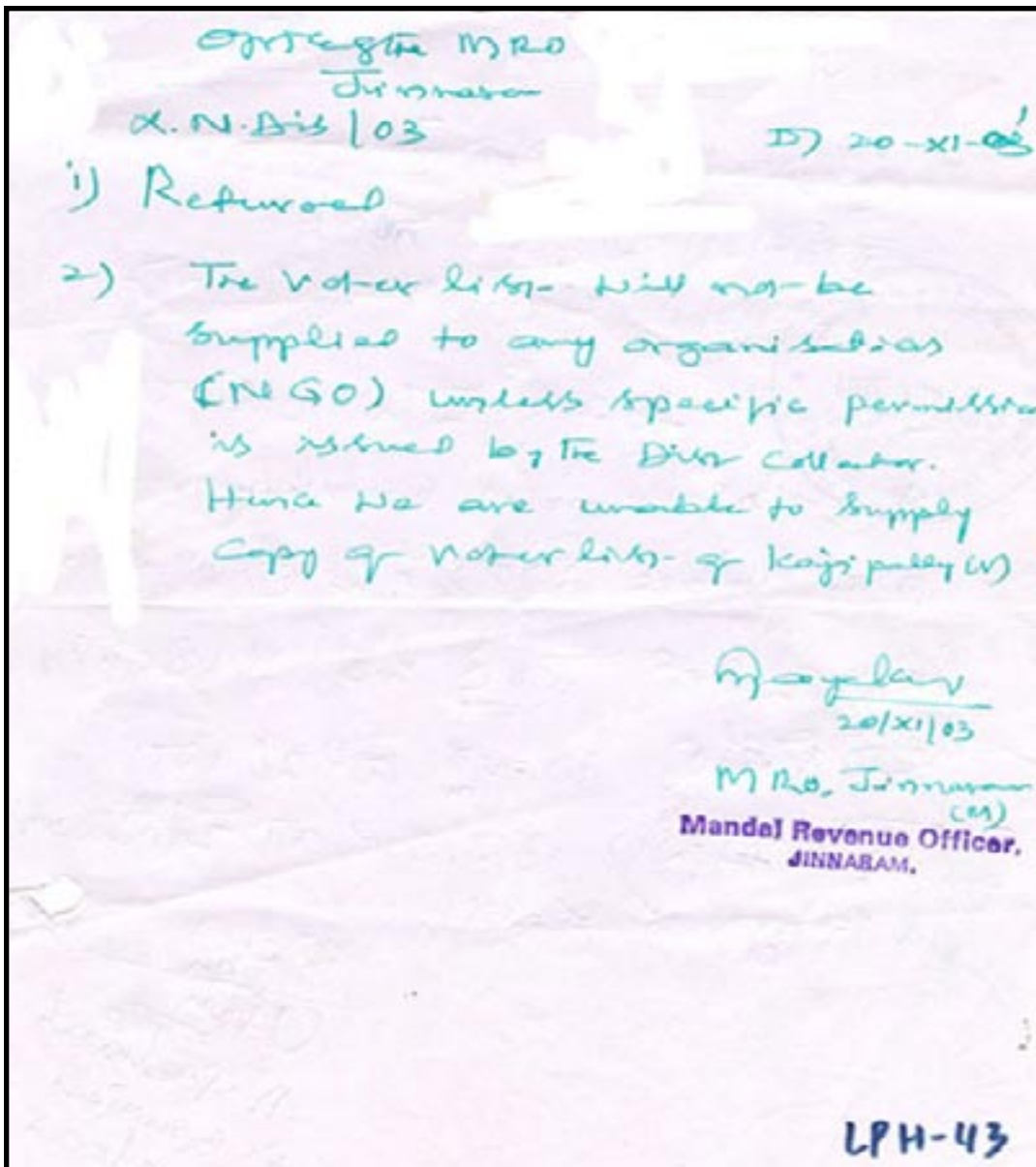
8. Not medico legal case.

[Signature]
20/8/03
Veterinary Asst Surgeon
Veterinary Dispensary
JINNARAM, Dist. Madak A.P.

We got similar reports of livestock deaths; from the same veterinary hospital. The reason stated in the laboratory report is suspected insecticide poisoning and chemical toxicity.

APPENDIX 7: WHOSE DOCUMENT IS IT?

We had to walk into the office of the MRO Jinnaram to get the voters list after several phone calls and visits. The MRO, Jinnaram cooperated with us after getting a phone call from the District Collectors' office.



APPENDIX 8: LAWYERS SPEAK

M.C.Mehta - Senior Advocate, Supreme Court

Patancheru is really a sad story, nothing much has changed on the ground, even after court intervention. In 1988, when I visited the place I was shocked to see the state of toxicity in the region. The prime necessity and the source of life, water was taken away from people. The lakes and streams were full of toxic wastes. Agricultural crops were withering away. The people of Patancheru got some relief after court's intervention, in the name of drinking water, compensation. The court has done what it can in its own capacity. Now it's for the government machinery to enforce the court's order and look after the implementation; they have failed in their duty. They lack responsibility. The Pollution Control Board along with the industry is the cause of suffering for the people of Patancheru. So many theses have been written, PhD's done about the state of the region, but the plight of the people are same as 1988. Eco-restoration should take place in Patancheru. The concerned authorities and agencies should act.

Niroop Reddy - Supreme Court Lawyer, involved in the Patancheru Legal battle

"Patancheru industrial pollution by major export oriented pharmaceutical units is a classic example of corporate social irresponsibility and a symptom of a faulty development model, where farmers have been displaced from their traditional habitat and livelihood without any alternative resettlement. If industrial activity is not to have an adverse impact on the ecology – land, water, air and human health- then the standards prescribed in the rules under the Environment Protection Act, 1986 have to be of such an order, so as to contain the effluents and emissions in a comprehensive manner. The criteria pollutants in USEPA for effluents are 85 in number, whereas in India it is 13 and for emissions in the USEPA is about 55 and in India it is 5 in number. The classic example is of coke where it could get away simply because there is no standard for potable water in India."

APPENDIX 9 : DOCTORS AND HEALTH CARE PROFESSIONALS

SPEAK

This section documents the testimonies and observations made by doctors and health care professionals, who as part of the study were involved in medically verifying the findings of the study in the study and control locations.

Dr. Aparna -Ex-Lecturer, Department of Obstetrics and Gynaecology, Gynaecology Endoscopic Surgeon, Lokmanya Tilak Municipal college and General Hospital

I still shudder at the thought of the nasty chemical smell that pervaded the air in Khazipally, like a sickening miasma, sucking all cheer from the lives of the hapless villagers. Not a day goes by when I don't feel a twinge of regret and guilt over the strong urge that overwhelmed me when I first set foot into Sultanpur: the urge to run away, the urge to return back to the familiar environs of Hyderabad, full of modern flyovers, steel and chrome towers which, for long I had deluded myself, where testament to the relentless "progress" India was making towards becoming a "developed" nation. I am glad I didn't act on the urge. The next five days were a revelation for me in more ways than one. Those five days of walking door to door, meeting people, sharing their pain and looking into their hopeful eyes have transformed me irrevocably. I realized, albeit with a great degree of embarrassment, that we, the aware, opinionated, extremely educated young citizens of the country are completely blind to the greatest criminal activity of all that is going on right under our very noses: the rape and the destruction of our land, our rivers and our groundwater because of the greed and the irresponsibility of a few rogue companies.

And what pains me the most is the realization that somewhere each one of us is responsible for this relentless destruction of our environment. We choose to keep quiet and turn a blind eye just because it suits our pockets to do so. In our myopic viewpoint of the world and conventional notions of success, we do not care about sustainable development because that would mean bringing about a sea change in the ideology of the very companies, which we have upheld all our lives as role models of entrepreneurial zeal, good corporate governance and as sources of great jobs which will help us "arrive" in society. And in a company which is the true beacon of the new, mint-fresh globalized capitalist India and its remarkably effervescent pharmaceutical sector, any efforts spent on proper waste disposal and treatment of toxic effluents are perfectly dispensable. After all, this great Indian "economic war" is being fought solely on the underpinning of low costs of production. Sustainable development means greater costs, lower profit margins, higher prices and lower salaries. Drug companies can ill-afford to waste money on processes that would make even a minor dent on profit margins. So what if the surrounding fields have fallen fallow and a few thousand people have lost their source of livelihood and so what if a few people have "allegedly" contracted chronic illnesses (the reports of illnesses anyways never get validated). All this is just "collateral damage", a necessary price that has to be paid in the path towards "growth" and a thriving economy. Anyways, the managerial cadre of these companies and the rest of us (the middle class citizens of the country who, in our eyes, are the only ones who truly matter) live in cities where there are great supermarkets in which we can buy the best of organic farm produce and where we have easy access to bottled pure, mineral water completely free of the arsenic, barium and the rest of the many chemicals which the drug companies in Medak district expel with complete and unabashed impunity into the stream and lake waters. And many of these drug companies are actually so called "socially responsible." There are so many beautiful and moving articles in the Bombay Times and similar supplements that sing paeans about the many charitable acts of the Piramals, the Reddy's etc.

But this distorted reasoning misses the very crux of the matter, the very crux of the point being made by environmentalists all over: any economic victory that rides piggy back on the destruction of our environment, the destruction of the habitat and source of livelihood of many is necessarily pyrrhic. How long will it take for our apathy to rebound on us? How long will it take for the great Manjira waters, which supply the whole of Hyderabad to get polluted? How long will it take for the groundwater and the pure streams of our country, which form the source of all our bottled water to get irreparably polluted? We choose to ignore the warning signs only at our own peril. What kind of India have we created in which poor villagers (like the ones in Digwal) have to fight a court battle for two years only to earn the right to get clean drinking water: water which is the fundamental right of all and not the preserve of a few. What kind of people are we that we cannot empathize with the plight of the poor farm labourers who are being squeezed from all sides. It was heartbreaking to hear the same stories being repeated in every village I visited: barren fields forcing farm labourers to search for odd jobs in the city. Not only was there no security of a steady income, most families I visited had a string of health complaints ranging from headaches to major illnesses, adding greatly to their financial burden. The insensitive public health system had also forced many to visit private doctors and to take crippling loans from moneylenders to pay for their medical bills. There was a feeling of desperation which was very difficult for even me, a doctor who has seen a great deal of pain, illness and death in her line of work, to take. And the irony of the entire situation was that the root cause of the illnesses was the apathy and the lack of accountability of the very drug companies whose function it is to manufacture drugs, ostensibly to help people recover from illnesses. How can the corporate bigwigs of these companies resolve this irony in their minds and function with a clear conscience: the irony of saving lives on the one hand and destroying others in the process of doing so.

What kind of a lesson are we teaching our children: that it is okay to steal from the environment and strip poor people of their livelihood for the development of the already developed. What kind of a world are we, the present generation, leaving behind for them? A world, in which global warming and polluted rivers and deforestation will wreak havoc and ruin countless lives. Why should they be made to pay a heavy price for our apathy and callousness? It is time to act before it is too late. It is time to wake up and smell the bacon. It is time to take responsibility and learn to value the beauty and life sustaining nature of Mother Earth. Each one of us can make a difference and the time to do so is now, before it is too late.

Dr Murlidhar V, Dr Ashwini, Dr Deepali, Dr Archana
Lokmanya Tilak Municipal College and General Hospital, Mumbai

- Incidence of cancer in the affected area is significantly higher than in the control area. Senior surgeons from Mumbai validated the incidence of cancer. This is an underestimation because; we did not add the cancer incidences, which were detected in hospitals and nursing homes and autopsy data. It was based on house-to-house survey with validation of pathology reports of all cancer detections in a year.
- Lung function tests were affected significantly ($p < 0.01$), both FEV1 and FVC of the affected population as compared with the control group.
- Environmental Asthma was validated in a few cases but due to logistic problems, could not be confirmed by lung function tests in a larger population.
- Allergic contact dermatitis, which was validated by doctors from Mumbai, was significantly more in the study group.
- The other medical conditions like mental health, gastrointestinal conditions etc. pointed to a possible higher incidence in the affected population, but a medically validated comment cannot be made, at present, hence there is a need for a more elaborate and validated study preferably with governmental health infrastructure.
- Local medical facilities are very inadequate and people spend a sizable percent of their income on private, mostly irrational treatment. Only when it comes to the final advanced stages, they are shifted to a major hospital in big cities like Hyderabad.
- It is urgently required to upgrade local government medical facilities and provide free medical treatment to people of the affected communities.

Dr. Kishan Rao, Private Medical Practitioner and Activist
Yashodhara Hospital, Patancheru

Indiscriminate dumping of chemicals and toxics into the environment at Patancheru and surrounding villages has made life miserable for the people. Most of them are hapless villagers suffering silently for the last 20 years. I have seen a blue baby, a blind child, a disabled girl due to congenital anomalies, and young lady losing 11 pregnancies and her motherhood. 80% of the people are suffering from multitoxics syndrome. The medical fraternity has no answer to cure or to stop these toxics entering into the womb of mother.

APPENDIX 10: OFFICIALS SPEAK

The District Judge, Medak at Sangareddy in his Report submitted to Supreme Court through the High court dated 27.01.96

“It is unfortunate that the State owned Andhra Pradesh Industrial Infrastructure Corporation (A.P.I.I.C) which is in charge of day to day operations of CETP (Common Effluent Treatment Plant), in utter disregard of the provisions contained in the Environment (Protection) Act, 1986 and its Rules, is discharging such partially treatment effluent into the stream Nakkavagu. The industrialists have very cleverly entrusted the management to the State owned A.P.I.I.C in order to escape themselves from the penal provisions of the Environment (Protection) Act, 1986 and its rules.”

Deputy Director, Ground Water Department at Sangareddy, Medak district in a report submitted on 24.01.1996 to Director Ground Water Department, Hyderabad (Memo No. 12-4-92/ Hd. 6/93. dt. 15.7.1993)

“My survey confirms that Nakkavagu and Pamulavagu catchment areas are polluted and level of pollution are very high causing danger to lives of man, animals and agricultural activity.”

Tishya Chatterjee, Ex-Member secretary, AP Pollution Control Board (APPCB) in an article published in Down to Earth 31st August 1999.

It is common knowledge in Patancheru that most of the 400 industrial units cannot treat effluents properly and that they dump them in the open or inject them directly into the ground. “We caught Paks Trade, a Patancheru-based company, for pumping arsenic-laced effluents into borewells,” says Tishya Chatterjee, member secretary, AP Pollution Control Board (APPCB). “We have also found high levels of cadmium in the groundwater samples in AP’s industrial areas,” he adds. Chatterjee points out that there are several other industrial units that also indulge in such practices, but there are no clear-cut rules to stop such polluters. An NGRI study found high levels of strontium in the groundwater.

ITW Signode, another Patancheru-based company, was discharging toxic, strontium-laced effluents into a nearby drain. “We located this industry and closed it,” says Chatterjee. A study by the groundwater department of the state government confirms that the pollution level is very high and has endangered human lives, animals and agricultural activity. “The common effluent treatment plants (CETPs) at Patancheru and Bollaram do not work up to the required efficiency. So, effluents with TDS levels of more than 20,000 mg/l are only treated up to 8,000-9,000 mg/l levels. And many a time, these CETPs discharge the effluents in the nearby streams without treatment,” Chatterjee reveals.

APPENDIX 11 : ETHNOGRAPHY

This information shared here is being done so with the prior consent of the concerned respondents.

Name: Gangamma, Age: 75 years, Sultanpur

“Earlier crops used to grow well but after the factory came in, the yield reduced considerably. For the last 15 years, fields have not been providing any substantial yield for the farmers’ consumption. She says that it is a common fact that children are born with defects and illnesses and adolescents suffer body aches and bone related problems unlike in the earlier days. Respiratory illnesses like asthma are common. Now there are no fields to go back to and youngsters do not have as much strength to do any work.”

Name: Sailu, Age: 60 years, Khazipally

Sailu who works as a labourer in a paddy field says, “ 20 years back there was good water and the fields were flourishing now there is no such produce and the young boys are not in a position to do any proper work. The industries around Khazipally Lake have been dumping effluents into the lake and the lake is now unrecognisable. The foul smell is unbearable.”

Name: Syed Razzak Age: 80 years Khazipally

Razzak was born in Khazipally and has been living here ever since. For the last 15 years, the tamarind tree growing opposite his house does not produce any tamarinds. Khazipally Lake has been polluted completely and that was the area’s main source of water for irrigating fields. Earlier, he used to get about 30 bags of paddy from 1 acre and so in 2 seasons he used to get around 60 bags. That number has now come down to about half now. There were different kinds of fish in the lake. The whole village was self - sufficient. They were able to sell around about 20 bags, apart from keeping enough for their consumption. There is no water in the wells now. Their livestock have also perished because of the contaminated water. The trees in the forest near by have dried up because of the concentration of chemicals in the soil and very few animals are now found.

Name: G. Saraswati Age: 32 years, Gandigudam

“The Gandigudam cheravu used to be our main source of daily life. The drinking water for villagers as well the livestock, the fishermen’s fish, the washermen, the quality time spent by children, the irrigation of 100 acres of land, everything is gone because of the contamination by industrial effluents. The main source of contamination is Khazipally industrial area, where the effluent is released, which joins the Khazipally Lake, which links to Gandigudam cheravu. Before the industries came, we used to have healthy crop yield. We used to grow sufficient rice for our family. The entire field is barren now. We are not getting anything since 12 years. Now the bore water is also contaminated. In past few years, we have seen livestock deaths, which has severely affected the livelihood of the villagers. The tank is full of chemicals now. The foul smell has brought constant unknown diseases in the area. We suffer continuously from headache, burns in eyes, body ache, weakness, water release from eyes and skin diseases. We did protest at different points of time. We carried the dead buffalo to the district collector’s office in the lorry last month. We have been complaining to the PCB for years. But nothing has changed. Things have to change now. The company’s effluent should not come in Gandigudam cheravu. And the lake should get remediated. If we stop contaminating further, we will get back our fields in 2-3 years.”

When asked if the company gets closed, what about the livelihood of the workers inside, Saraswati says, “The land, which are barren now, and the lake that is dead now will bring back livelihood to them, which will be healthy and more sustaining.”

Name: Puli Raju Age: 21 years, Gandigudam

“I used to be a farmer till about five years back, effluents from the nearby industrial area contaminated my land, degraded the water used for irrigation, and this area has lost its fertility. The Gandicheru (a tank) used to provide drinking water to four nearby villages Gandhi Guda, Dayara, Sultanpur, and Kistareddy pet. Now the tank’s water is so polluted that if anyone consumes its water he or she is sure to fall sick immediately. Many of us suffer from chronic diseases, many have weak vision, and stomach problems are also very common.”

Name: Mallaiah, Age: 80, Pocharam

Mallaiah aged 80; a resident of Pocharam says that their health has been adversely affected after the establishment of the industries. They are suffering from arthritis, stomach pains and mouth ulcers. They cannot walk properly. Their fields are also affected due to the chemical water. The crop yield has reduced. Chemicals have polluted underground water to the depth of 30 feet. Mosquitoes have increased due to the smells. In one bore, only “chemical water” comes, the colour of the water is black. During the nights at around 11 p.m. the industries release smoke, due to which they get severe headaches and coughs. The water has also affected their livestock, there have been deaths reported.

Name Geetamma, Age: 65, Pocharam

Geetamma a resident of Pocharam feels the establishment of the industries has affected their health. They now suffer from skin diseases, stomach pains, arthritis and tumours in the stomach. Crop yields have also reduced. Winds bring along with them the smoke, which has been released by the industries, which has been responsible for frequent headaches. The villagers fought with the government, for which the government had sanctioned money for lands affected. In her house, Kumar aged one and half years old has

been suffering from vomiting and diarrhoea since he was born, and Pentaiah who is 25 yrs old suffers from stomach pain and associated breathlessness.

Name: Mallaiah, Age: 60, Pocharam

Mallaiah a resident of Pocharam says that they had excellent health until the industries were established. With the establishment of the industries, their health has been deteriorating especially since the last 15 yrs. They now suffer from bronchitis, back pain, arthritis and skin diseases. Crop yields have reduced drastically. The chemicals from the industries pollute underground water that may be tapped within 30 feet. In the night between 6 p.m. and 10 p.m. industries release smoke causing severe headaches and vomiting in the people around here.

Name: S. K. Sahib Hussain, Age: 70, Pocharam

According to Hussain when he came to Pocharam in 1995 with his family there was little development. He used to drink water from the bore which was beside his home. The general health of the people and cattle was good. Vegetables were available cheaply. Now he feels that the pollution levels have increased and this he has attributed to the factories. He feels the high levels of pollution to be the cause for the diseases they suffer from. Visits to the doctor are frequent. The underground water is polluted with the chemicals used by the industries. He also adds that though the incidence of serious diseases is low, many people suffer from general diseases such as blood pressure, body pains, stomach pains, arthritis and so on.

Name Durgaiah, Age: 82, Ganapatiguda

"In those days there was a huge growth in the crops. There was tremendous cultivation and we used to make nice profits. Seasons were on time. There was little development in the village. There were very few houses, people stayed in their farms. The major source of water for the village was the Nakkavagu (stream), Pamulavagu, Kuntla bavi (well) and nadim bavi. Water from these sources was used for drinking and bathing purpose. After the factories were established the water has become dirty, the colour of the water is black and the fish in the water are also dying. Cattle that drank this water also died. With pollution people suffer from many diseases, diseases that don't get cured even after frequent visits to the doctor. I don't know when we will get salvation from this pollution and diseases."

Name: Veera Swamy Goud, Age: 54, Pocharam

"It was the then Prime Minister Indira Gandhi's wish to make Patancheru an industrial area of Andhra Pradesh. But before the factories were established, the seasons were on time, and the profits that we could earn from farming were also good. There were no major diseases; the average health of the villagers was good. The only prevailing disease was the common cold, which was due to the change in the seasons. In 1978 the factories were established, with which started our doom days. Pollutants were released in the Nakkavagu and Pamulavagu to which loss of aquatic life maybe attributed. Crops no longer grow here. The only crop that grows is rice. All other crops dry due to the polluted underground water. The underground water smells a lot. Fruit bearing trees have flowers, which dry due to air pollutants such as ash, mica and so on. Trees no longer bear fruits or flowers."

Veera Swamy Goud also mentions that 'Dexo' a factory releases a chemical, which is yellow in colour into the Nakkavagu. Novo pan releases asbestos, ash etc in the air. He also added that the Effluent Treatment Plant (ETP), where more than 300 to 500 lorries come, does not treat the chemical waste and releases the untreated chemical water into the Nakkavagu at night.

Name: Kishtaiah, Age: 90, Pocharam

Kishtaiah a resident of Pocharam says that until the factories were established the crop yield was good and groundwater was used for drinking. With the establishment of the industries the crop yield has reduced. In fact they have stopped cultivation of crops. The underground water being polluted is no longer used for drinking purpose. He says if the regular supply of Manjira water was stopped then their condition would worsen. He is suffering from severe cough, vision loss, swollen legs, pain in the legs and arthritis. His son Anthaiah who is working in 'Biological E Ltd' is also suffering with arthritis and pain in the legs. The livestock has been affected due to the polluted water.

Name: Rayagiri, Yadi Reddy, Age: 64, Bachiguda

Rayagiri informs us of the smell in the air during the nights between 6-7 p.m. He says that the Pamulavagu water is black in colour. Before the industries were established they used that water for drinking purpose. Now they no longer do so, as they develop skin diseases suddenly. They don't use the water for their buffaloes either. They no longer cultivate their own lands. In fact they have abandoned their lands because of the polluted water. An industrialist had come and paid five thousand per acre when Dr. Kishan Rao had filed a case against them. He felt that they were healthy before the industries started their work in their village, now their health has deteriorated. Bollaram, Gandigudam chemicals, pollutes Nakkavagu. They suffer from many diseases such as psychiatric morbidity, recurring headaches, asthma and anaemia. When they walk in the water they develop skin diseases. Once they tried to meet the chief minister Chandra Babu Naidu, but he ordered the police to lathi charge. Loss of cattle has been reported.

Name: Kishtaiah, Age: 53, Bachiguda

The village environment was good. The water in the Pamulavagu, the chief water resource, was used for drinking purpose. The water

was also used for livestock. Before the industries were established they never visited any doctor. Home remedies were resorted to and they were effective. Since the industries started their work, he feels the villagers' health has been affected. They suffer from many diseases, which don't get cured even after frequent visits to doctors and after having followed their prescriptions. Cattle die after drinking the water from the stream, which is totally black and sometimes white. A different colour could be noted each day. Bore water anywhere in the village is not without an oil slick. He feels polluted water is the cause for all the diseases they contract.

Name: G. Shankaraiah, Age: 60, Pocharam

Shankaraiah a resident of Pocharam says everything is polluted. Crops have failed, and since agriculture is their main source of income, their standard of living has fallen. He says the well water was used for drinking purposes, but now the water in the well is acidic and yellow in colour. He also adds that the water has a bad smell. The bore water is also polluted; as a result there is no source of drinking water except the Manjira water, which is supplied by the government. He says if this water supply was to stop then they would face a lot of trouble for drinking water. With regards Manjira water supply he says that during the rainy season the water supplied to them was polluted as the pipelines get damaged due to the rains, so people suffer from various diseases. The smell of the pollutants released by the factories comes during the night. This problem was much more perceptible earlier, until there were protests. With regards agriculture he says the yield has reduced. They manage to grow paddy but that paddy when consumed leads to various diseases, as it is grown using polluted water. Other crops don't grow. Rice is another crop which is grown, but then quality has reduced.

Name: K. Bala Narasimha, Age: 39, Kistareddypet

Bala Narasimha, a resident of the village for the last 39 years is the Sarpanch of the village. He says before 1985, that is, before the industries had started their activities in their village, the crop yield was good and the produce was nutritious and tasted good. The villagers drank the underground water. Cattle and other livestock were healthy. After the factories were established, this is no longer the case. Most people in the village have lost their sense of smell. He says that effluents from factories in his village, such as the AP metals engineering, Dr. Reddys labs etc, got mixed with the groundwater. Their most important source of water Posamudram was the most affected. The crop yield has reduced and the size of the seed in the husk has reduced. Now they no longer use that water. After the government order, 14 villages of Patancheru are getting their daily water supply, however Kistareddypet is not supplied Manjira water by the government. The same is done by a social welfare organization, 'Sri Sai Baba organization' (BHEL). He says in 1986 the scientists from ICRISAT warned them that the men would become sterile in the next 20 years when the poison would have entered their body. In Khazipally the effect of pollution from the factories is more than in Bollaram as the villages are on a lower plane and the wastes readily mix with the ground water. He says the villagers mostly suffer from arthritis, back pain, loss of memory, and removal of the uterus, skin diseases, allergies, birth defects, respiratory diseases, fits and paralysis. He feels the increase in the number of mosquitoes could be attributed to the factories and their operations, which has increased the number of malaria cases in the village.

Name: K. Sattamma, Age: 65, Kistareddypet

Sattamma says that before the industries were established they drank water from the lakes, well, streams etc. she says they were very strong then. Cow dung was the only manure they used for their fields. The crop yield was good. Now however there is no increase in yield even with so many fertilizers and pesticides available. She says they used to walk to the Patancheru market, and walk back home. When the factories were first established, she says everything was normal for the first few years. Later the aquatic life was lost due to the chemicals released by the industries in Bollaram. She says, "paisalu neelala paduthe, paisa kanpichedi kani ippudu manishi kuda kanupichadu." (If a paisa fell into the water it could be seen, now however even a human being wouldn't be visible). The main crop that is grown in her village is rice. Last year due to poor rains the yield was poor, however this year the crop was good. She feels the pesticides and other chemicals they use are also responsible for the diseases they suffer from. She says people were generally strong then, now however a person is equivalent to a person aged 85 in her time.

Name: Narasimha, Age: 65, Kistareddypet

Narasimha says when he was a teenager the crop yield was good, and to his knowledge there were only two seasons when the yield would be low. And this was due to the poor rains. He says in one season they couldn't store a single grain, and they would eat 'Busa Vadlu' (rice which grows along the banks of the river). Sometimes they would have nothing to eat. The other season was better, though there were no rains they didn't face many problems. The cattle were healthy. He says they drank water from the lake, and in those days the water was very clean, so clean that if a paisa was dropped it could be seen. The factories dumped their wastes into the lake and now the colour of the water is black. The crop yield has reduced and so has the income. He says in a season 75% of the crop is lost. He says MLAs and collectors had come to his village, but they did nothing to improve their lives. He says that they are losing their lives and doesn't know when god would help them.

Name: Yadaiah, Age: 60, Kistareddypet

According to Yadaiah he worked as a labourer at Bollaram IDA, he worked in a private company. In his lifetime he says he worked for 3 companies. Now he feels weak and hence can't work anymore. He has no income, as both his sons are dead. The death of his elder son was a case of suicide. He says his son Srinivas had no option as he was suffering from severe stomach pain. He had studied up to class 10, and worked as an accountant at the brick maker's house. He was 27 years old. He says when he was 15 years old, one worked even at the age of 70. But now, though he is only 60 years old he is unable to work because of the pollution.

APPENDIX 12: STATUS OF WATER CONTAMINATION

A.

- Effluents of the Industrial Development Areas (IDA) are discharged partly untreated into streams, underground water and ponds
- The effluents contain appreciable amounts of inorganic and inorganic chemicals and their by-products
- The CETPs in Bolaram and Patancheru let out their untreated effluents into Pamulavagu and Peddavagu polluting Nakkavagu, the main drainage system of the area.
- A cocktail of effluent chemicals pollutes the drainage system. – The Hazardous Committee in 1997, asks for research to deal with this.
- Irrigation tanks are used as effluent settlement tanks, the spill over joins Pamulavagu and Peddavagu
- Dispersal of contamination by interactions between surface water and the aquifer system

B.

- Six million litres of Water is drawn from Manjira water supply and consumed by the industries in the Patancheru area. A quantity of 5Mld of effluents is released into the natural streams without bringing them up to the outlet standards prescribed by the Environment Protection Act and Rules 1986.
- The CETP is discharging partially treated effluent into Nakkavagu. The water of the stream is not useful for irrigation – District Judge's observation dated 27.01.1996 submitted to the Honourable Supreme Court
- PETL and other industries are major contributors to the pollution in the area. All of them individually as well as cumulatively, are discharging almost untreated effluents into the stream, the main source of water supply to the residents of several downstream villages – CRE Report based on study carried by M/s Bhagvathi Ana Labs Limited, Consulting Environmental Engineers
- Pollution around the Patancheru, Bolaram industrial areas have increased during the past one and half decade due to discharge of effluents into surface water bodies.
- The Polluted surface water is strongly influencing the quality of groundwater as TDS and elements copper, arsenic, selenium and boron reach concentrations of 5 to 10 times the permissible limits
- Elements with extremely variable pH interacting with sediments, soil and rock (chemical weathering) to release heavy metals which add to the degradation of groundwater quality
- All the toxic elements (except Fe & B) are migrating in NW direction with the groundwater down stream, significantly affecting the quality of water in the Manjira River
- Arsenic in stream water near CETP as high as 40,000 ppb. The source is clearly industrial effluents not natural rocks.
- Peddavagu and Nakkavagu streams show high arsenic concentration of 5,000 ppb
- Groundwater has high concentration of arsenic
- Wells have 750 ppb of arsenic concentration, while the permissible limit is only 50 ppb.
- High levels of heavy metals in the ground water around Patancheru Industrial area were found, which was higher than the permissible WHO standards – Down To Earth 31st Aug 1999.
- Toxic effluents discharged into the aquifers and other surface water streams and water bodies up to 250 sq km, thus destroying the crops, flora, fauna of the surrounding areas which measure about 3000 acres

C.

Units in Patancheru and Bollaram discharge about five million litres of effluents everyday. A major part of the untreated effluents ultimately goes into nearby tanks and streams. A certain part is clandestinely disposed of in dry bore wells.

D.

Lakes Polluted	Khazipally, Gandigudam, Nagulal, Kistareddypet, Mukta Kanta, Aminpur, Bollaram, Saki, Muthangi, Isnapur, Chitkul, Lakadaram
Rivers and Drains Polluted	Bollaram near Sultanpur Village, Iskavagu, Nakkavagu, Pamulavagu, Peddavagu, Manjira upstream of Nakkavagu confluence
Contaminants	Arsenic - Surface and Groundwater upto 0.7 ppm (mg/L)
	Selenium - upto 0.038 ppm
	Strontium - upto 3.0 ppm
	Barium - upto 0.20 ppm
	Boron - upto 4.0 ppm
	Manganese - upto 1.5 ppm
	Nickel - upto 1.0 ppm
	Pesticides, Aldrin, Endosulphan, DDT, Phenol were highly concentrated in soil and water samples.

E. Safety of Fresh Water reservoir in the Study Area

Analysis of the hazards to fresh water reservoirs in the study area, indicated that the Manjira river and Nizam Sagar located in the northwest of the city are in grave danger of contamination emanating from Guddapotaram – Bolaram – Patancheru industrial axis, as they are located within 15 kms of the fresh water source. In case of Patancheru-Guddapotaram – Bolaram industrial area, the Nakkavagu River, which is one of the principal tributary of Manjira River, drains the area and is located at a distance of 5 kms. from Patancheru IDA . Although the area has a slope of < 1% from the industrial area towards Manjira river, the sediment load and contaminant flow poses a severe hazard to the Manjira water supply system. Similarly, while the two pharmaceutical industries located at Aroor are situated at a distance of 26 k. ms from Manjira reservoir, the industry at Digwal is within 13 kms of the reservoir indicating a hazard to the source of drinking water supply to Hyderabad.

REFERENCE:

**Europe and India Past Present and Future – Austrian Research Centre Seibersdorf*

**Toxic trace element pollution in groundwater around Patancheru and Bollaram Industrial Areas by Shivkumar, Pande and Biksham in 1996*

**Arsenic Pollution in Ground water’ at Patancheru IDA by Pradip K. Govil, NGRI. 2002*

**Lakes and Water Bodies have been polluted by the nearby industries. – CPCB, 1998 Report*

**Toxic Metals and Organic compounds: (NGRI Study, 1996-97)*

**Down to Earth, CSE publication; 31st August 1999.*

**GIS for environmental audit of Hyderabad Metropolitan region , Ranga Reddy & Medak districts of Andhra Pradesh, India, Dr.Kausalya Ramachandran, D.Sai kiran, M.Purnend & M.Kalpana*

**Central Research Institute for Dry land Agriculture*

APPENDIX 13: PREVIOUS HEALTH STUDIES FROM THE STUDY AREA

Title : Report of Fact Finding Committee

Constituted by the Hon'ble High Court in its order dated 25th September 2003 in W.P.No. 19661/02

Submitted to the court in March 2004.

The Terms of Reference States:

Study the adverse effect of pollution, caused by discharge of effluents by industries, on the health of inhabitants of the affected villages and suggest remedial measures required to be taken in this regard as also the proportion in which the cost thereof, if any, is to be borne by the polluting industries

Remarks

The Report says that the Chairman and members of the committee met the inhabitants of the effected villages and held discussions with them on their health status. They complained that some of them have developed skin rashes after handling the water for washing purposes .

In majorities of the areas visited by the committee, villagers complained that the medical facilities in the village are inadequate. Steps have to be taken to improve medical facilities in these areas.

Title : Status Report - Pollution and Actions Taken at RHC (Rural Health Centre) Patancheru Area

Author/Investigator : Dr. G. Nagaiah, Osmania Medical College, Hyderabad

Submitted to : The Additional Advocate General, A.P. High Court, Hyderabad

Remarks

"Morbidity Survey 1998"

The study team's report showed a general sickness rate of 25.49%. The report also showed higher morbidity was due to orthopaedic problems, followed by skin problems. The cause for diseases was to be established.

"Environmental Pollution and its effect on the health Nov-Dec 2000"

The study at Sultanpur village, conducted in Nov-Dec 2000 was taken up as a useful academic exercise for students, and helpful in the planning health interventions. The results of the study are in favour of the fact that heavy metals like arsenic, mercury, aluminium, etc. are the determinants of the clinical manifestations and symptoms. However, the study was insufficient at that stage as the size of the study population constituted only 0.93% of the total sample population distributed among 14 villages, who are also exposed to environmental hazards.

Title : Conservation and Management Plans for remediation of Asanikunta and Kistareddypet Cheruvu prepared by EPTRI Environment Protection; Training and Research Institute, Hyderabad.

December 1998 9.0 page 41

Remarks

The following problems are reported during the socio economic study in the surrounding of the Asanikunta and Kistareddypet Cheruvu

- Morbidity is high in villages around these lakes
- Skin diseases are common
- Malarial incidence is high
- Respiratory diseases, loss of sight and digestive problems are prominent
- Decrease in soil fertility
- It is reported that the livestock population is reducing day by day and their life span in these villages is found lesser on an average
- Milk yield of these buffaloes is found 2 ½ litres per day which is very less when compared to the average yield

Aquatic life in the water bodies is almost nil due to pollution

Title : Assessment of environmental health risk due to inorganic arsenic in the industrially contaminated areas of Hyderabad (A.P.), India.

Authors : Chandra Sekhar K, N. S. Chary, C. T. Kamala, and A. Kishan Rao

Abstract

Environment exposure of inorganic arsenic to humans was assessed by collecting clinical samples from the residents of the industrially contaminated area, Patancheru, Hyderabad. Arsenic levels in the clinical samples like blood, hair, nails, was measured by means of ICP-MS. Arsenic content of nails and hair were found to be higher than urine and blood. The nail concentration of arsenic in the range of 0.5-1.63 mg/kg and hair 0.3-0.94 mg/kg indicating longer exposure periods of arsenic. The main source of arsenic exposure is found to be contaminated waters (ground and surface) and also through the consumption of arsenic contaminated vegetables grown on the contaminated soils. It was further found that people consuming nutritious rich diet suffered least from the arsenic contamination than those who were malnourished.

APPENDIX 14: MEDAK IN THE NEWS - REPORTS AND INFORMATION FROM THE PAST

During the past two decades, the industries in the critically polluted mandals of Medak have disposed high volumes of chemical pollutants in the environment. The concentrations of the released pollutants in the region has been reported by the media, by committees set up by the Supreme Court and the Andhra Pradesh Court, by the APPCB, and by independent authorities and institutions. The following table presents a synopsis of some of the reports and reportage in last 2 decades.

The Hard Facts

1. The impact of paleo-channel on Groundwater contamination; K.Subrahmanyam, National Geophysical Research Institute, Hyderabad, P.Yadaiah, Geology Department, Osmania University, Hyderabad.

Received: 17 November 1999 Accepted: 14 March 2000

Amidst the granite terrain, the Nakkavagu has been identified as a paleo-channel (composed of clay –silt –sand); its presence in the area has immensely increased the spread of groundwater contamination. The transmissivity of the alluvial aquifer varies from 750 to 1315 m² /day. The adjoining granite has a transmissivity that varies from 30 –430 m² /day.

2. Shivkumar K, Pande AK, Biksham G (Dept Atom Energy, Atom Mineral Div, Civil Lines, Nagpur

1997

Study on abundance and distribution pattern of toxic trace elements indicates the quantitative aspect of pollution in the Nakkavagu Basin.

3. Assessment of contaminant migration in groundwater from an industrial development area, Medak District; By V.V.S. Gurunadha Rao, R.L.Dhar and K. Subrahmanyam; National Geophysical Research Institute (Council of Scientific Research), Hyderabad

Received 6 July 1999, accepted 7 June 2000

The degree of contamination is so intense that in some parts of the environment has become unsuitable for human living. The morbidity rate in the area is a shocking 80%, compared to the national average of 10%, all directly attributable to the industrial pollution. The chemical analysis of the treated effluent from the CETP was found to contain metals like arsenic, selenium and manganese (Dhar et al. 1998).

4. Contamination of soil due to heavy metals in the Patancheru industrial development area, Andhra Pradesh; P.K.Govil, G.L.N.Reddy & A.K.Krishna; NGRI, Hyderabad

Springer-Verlag 2001

The data reveals that soils in the area are significantly contaminated, showing two to three times higher levels of toxic elements than normal. Many heavy metals, such as Cr, V, Fe, As, Cd, Se, Ba, Zn, Sr, Mo and Cu, are present above the normal distribution in the soil. The heavy-metal loads of the soils in the study area are 240 mg/kg for Cr, 235 mg/kg for V, 1,350 mg/kg for Ba, 200 mg/kg for Cd, and 500 mg/kg for Cu. Most of the soils should be removed from agricultural production, and the area needs to be monitored regularly for heavy metal contamination.

5. 90.85 p.c. units in AP complying with water standards, says study by Special Correspondent, The Hindu

HYDERABAD, APRIL 4 2001

The A P Pollution Control Board (APPCB), quoting a study done by the Programme Evaluation Organisation (PEO) at the instance of the Planning Commission, has claimed that it is was one of the few PCBs in the country, which controlled pollution in an effective manner.

6. Disaster in the pipeline? By K. Venkateshwarlu , The Hindu

HYDERABAD, NOV. 13 2000

The State Government's decision to go ahead with the laying of a 18-km-pipeline to carry industrial effluents from Patancheru industrial area to the Sewerage Treatment Plant (STP) at Amberpet, has raised the hackles of city-based environmentalists who say that it amounts to "merely shifting pollution problem from one area to another."

7. Groundwater Polluted: Government Study on Ground Water Pollution: In compliance with Supreme Court Order

Survey conducted on 27-6-1996

From the samples collected in the field, it was clearly established that groundwater is not potable in 8 villages. Out of 16 villages, the groundwater in 11 villages was found to be polluted and the pollution is attributed to industrial activity as the discharge of Nakkavagu and Pamulavagu is colored and odoured. The source of pollution to groundwater is industrial effluent that is let into the 2 streams and affects groundwater body mostly during rainy seasons. On the whole the pollution areas fall within 100 to 500 metres on either side of Nakkavagu and Pamulavagu streams. There is evidence in the field that the crop yields are highly reduced and irrigation and cultivation have been abandoned on some lands.

8. Conservation and management plans for remediation KHAZIPALLY CHERUVU; Final Technical report, Jawaharlal Nehru technological university, Hyderabad

January, 1999

Soil Contamination: In this period of 10 years the area of the land available for cultivation has come down from 240 acres to 80 acres, a reduction of 66%, mainly due to introduction and influence of industrial effluents into Khazipally lake.

9. Study of Groundwater Pollution in Patancheru and Bolaram Industrial Development Areas, Medak District, A.P.; Sponsored by APPCB, Hyderabad; National Geophysical Research Institute, Hyderabad

Dec, 1998

The Study area covered about 160 sq km with more than 400 big and small pharmaceutical and chemical industries. The result shows high values of heavy metals in the groundwater like arsenic, strontium, barium, selenium, boron, manganese, nickel in the ground and surface water of the areas. Residual pesticides, Aldrin and Endosulphan, were also found.

It is well established that the high concentration of toxic metals are dangerous to human life and cause many diseases, which are called geochemical diseases. High concentrations of arsenic cause lung cancer, skin cancer and nickel is also a well-known carcinogen that causes cancer. Lead is known to increase the blood pressure in human beings.

10. Down to Earth, Centre for Science & Environment Publication

Paks Trade, a Patancheru-based company, was apprehended for pumping arsenic-laced effluent into the ground through bore wells. The DTE/IIT test conducted on a water sample from a hand pump in Pocharam village of Patancheru Industrial Area (PIA) in Medak district of Andhra Pradesh showed that the level of mercury was 115 times the permissible limit.

11. Government Study on Ground Water Pollution: In compliance with Supreme Court order.

Survey conducted on 27-6-1996

From the samples collected in the field, it was clearly established that groundwater is not potable in 8 villages. Out of 16 villages, the groundwater in 11 villages was found to be polluted and the pollution is attributed to industrial activity as the discharge of Nakkavagu and Pamulavagu is colored and odoured. The source of pollution to groundwater is industrial effluent that is let into the 2 streams and affects groundwater body mostly during rainy seasons. On the whole the pollution areas fall within 100 to 500 metres on either side of Nakkavagu and Pamulavagu streams. There is evidence in the field that the crop yields are reduced to a significant extent and some irrigation and cultivation have been abandoned on some lands.

12. Contamination of Urban India Environment by Hazardous Industries ; Kausalya Ramachandran, Senior Scientist; D. Sai Kiran. Research Associate; M. Kalpana and M. Purnendu, Project Associates; CRIDA (ICAR), Hyderabad

1997 GISdevelopment.net.

Scattered location of hazardous chemical industries in urban areas and meager availability of proper waste management system in Hyderabad, Bangalore, Chennai and Delhi, are the primary cause of non-point source pollution in these urban centres. ARCGIS was used in tandem with satellite data (IRS - 1D - LISS III& PAN merged data) to map location of hazardous industries in these urban areas and estimate the spread and direction of flow of contaminants. The pattern and extent of contamination of soil and water was mapped and quantified to facilitate the undertaking of remediation plans.

13. Investigation Report

Environment pollution caused by Patancheru and Bollaram industrial Estates in nearby villages of Medak district in Andhra Pradesh.
By: National Environmental Engineering Research Institute, Nagpur.

October 1991.

A detailed survey has been carried out by NEERI in Patancheru and Bollaram industrial Estates and in surrounding villages affected by pollution, including the river quality of Manjira after its confluence with Nakkavagu, which carries wastewater from both the estates.

Observations:

- Wastewater is highly polluting and must be treated.
- Samudram, an irrigation tank at Kistareddypet, has been totally spoiled by industrial discharge into it and now it looks like stabilization pond.
- The analysis of the data reveals that the wells, bore wells and even the Manjira river waters have been contaminated.

The incidence of disease and death has increased considerably. The data suggests that there is an increased rate of premature deaths.

NEERI Scientists were informed by the farmers of the affected villages that:

- Girls do not attain puberty at the proper age
- Married women cannot conceive
- Pregnant women deliver still born children
- There is high rate of infant mortality
- Deaths of cattle take place after drinking/coming in contact with the high-polluted wastewater causing economic losses.

14.A Study on the Environmental Pollution and its Effects on the Health Status of People of Sultanpu Village; Dept. Of Community Medicine, Osmania Medical College, Hyderabad

NOV. 2000

"2974 people examined and 690 people found to be suffering from symptoms of toxicity," states Dr. Rao in Hell on Earth.

1/4th of the population available for medical examination. Blood samples from some individuals with suspected heavy metal poisoning were taken.

15. Assessment of Environmental Health Risk Due to Inorganic Arsenic in the Industrially Contaminated Areas of Hyderabad;

Analytical Chemistry and Environment Sciences Division, Indian Institute of Chemical Technology and Yashodhara Hospital, Patancheru

The main source of arsenic exposure is found to be the contaminated waters (ground and surface) and also through the consumption of arsenic contaminated vegetables grown on contaminated soils. The concentration of arsenic in clinical samples clearly shows that there is a possible association of arsenic in blood, urine, hair and nail with age, sex and with concentration of arsenic in soil, water and vegetables.

16. Status Health Report on Health Problems and Remedial Measures Taken at Patancheru Area; From Dr. G. Nagaiah to The Additional

Advocate General, High Court, Osmania medical college

Morbidity survey, 1998.

Remarks of Chief Investigator:

The report of the sample study in October 1998 showed quantitative values of the health problems. The study lacked specificity of cause effectiveness.

Findings/ Observations

- Morbidity rate in this area shows an increasing number trend which is evident from past rate of 10.18% in 1991 Oct. which has risen to present rate of 25.49%
- In all the types of the diseases, the female population is experiencing higher morbidity.

17. Europe and India; Past, Present and Future; Austrian Research Centre Seibersdorf.

March 2001

Status of water contamination sources

- Effluents of the IDAs are discharged partly untreated into the streams, underground and into ponds
- The effluents contain appreciable amounts of inorganic and organic chemicals and their by-products.

18. GIS for Environmental Audit of Hyderabad Metropolitan Region, Ranga Reddy and Medak Districts of Andhra Pradesh, India;

Dr.Kausalya Ramachandran, D.Sai kiran, M.Purnend & M.Kalpana; Central Research Institute for Dry land Agriculture, Hyderabad

Safety of Fresh Water Reservoir in StudyAreas

Analysis of the hazards to fresh water reservoirs in the study area indicated that the Manjira river and Nizam Sagar located in the northwest of the city, are in grave danger of contamination emanating from Guddapotaram – Bolaram – Patancheru industrial axis as they are located within 15 k. ms of the fresh water source. In case of Patancheru-Guddapotaram – Bolaram industrial area, the Nakkavagu river, which is one of the principal tributaries of Manjira River, drains the area and is located at a distance of 5 kms. from Patancheru IDA. Although the area has a slope of < 1% from the industrial area towards Manjira river, the sediment load and contaminant flow poses a severe hazard to Manjira water supply system. Similarly, while the two pharmaceutical industries located at Aroor are situated at a distance of 26 k. ms from Manjira reservoir, the industry at Digwal is within 13 k. ms. of the reservoir indicating a hazard to the source of drinking water supply to Hyderabad.

Conclusion

Hazardous chemical industries pose a serious problem to soil, surface water bodies and groundwater aquifers in the study area. Creating facilities for safe disposal of hazardous waste is urgently required if the region has to be saved from irrevocable damage and decline. Treatment of solid waste and effluents requires strong efforts, both from polluters as well as the law enforcing agencies

APPENDIX 15: Water consumption and waste water generation by major polluting industries - Patancheru industrial complex

S.No	Industry	Raw material	Products	Water consumption	Waste water generation
1	Standard organics	Acetone, acetic acid, acrylonitrile, ammonia gas, benzene, caustic soda, dimethyl oxalate, ethyl acetate.	Sulpha-methoxazole (60T) Trimethoprim (15T) S o l b u t a n a m o l sulphate (0.4) T.H.B.Acid (10T)	240	130
2	Nova resins and chemicals	Formaldehyde (150T) Helamine (12) Urea (75T)	Aminoresins (450T)	4.6	1.0
3	Asian paints	NA	Paints and enamels (1250 T) Aerific Emulsion (67 T) Synthetic resins (234 T)	240	50
4	Reliable paper	Waste paper (288T) Bosin (3.6T) Alum (27.6T)	Craft paper (360 T)	50	30
5	Deccan drugs	Dimethyl oxalate Acetone, Hydroxylaminesulphate, Sodium, Sulphuric acid, Ammonia gas, chlorine, benzene, 3,4,5-trimethoxybenzaldehyde, acrylonitrile, sodium methoxide, Glanidine nitrate	Trimethoprim (105T)	35	20
6	Sri sai baba cellulose	Caustic dye (8T), Sulphuric acid (3T), common salt (1T) Cotton linters (78T)	Bleached cotton linters (35T)	150	130
7	R.K.Industrial Chemicals	NA	Barium carbonate (27T), Sodium sulphide (12T)	7	1(recycled)
8	National chemical industries	NA	Barium sulphide (60T)		
9	Quinn Chemicals	Acetone, acrylic acid, aerosol, ammonia, cascine, Caprolactum, cyclohexanol, castor oil, butyl acetate, butyl acrylate, ethyl acrylate, 2-E.H.A., Formate MC navyblue, Goldex (401), Direct Black, etc..	Leather finishing chemical (200T)	10	4.5
10	Sahney Paris Rhone	NA	Automobile engg. Goods (4000 items)	3	1
11	Surana strips (bhagyanagar metals)	NA	Cold rolled steel strips (420T)	3	1
12	Voltas chemical division	Ortho amino phenol (38 T), urea (25 T), Formalin (31 T), chlorine (60 T), ethyl alcohol (60 T), caustic soda, HCL (16.2 T), mallic anhydride, formaldehyde (47 T), Ethyl mercaptan (30 T), Methylene bromide (49 T), nitrogen (4.5 T) caustic soda (310 T), alcohol (75 T)	Phoslone (1009T), Malathion (125T), phorate (100T), Ethion (100T).	560	72
13	Reliance cellulose	Hosiary cuttings and raw linters (150 T), Caustic soda (60 T), chlorine gas (150 T), sulphuric acid (60 T), acetic acid	MCA (116T), Bleached cotton linters (35T), Cellulose powder (25 T)	500	400

14	Asrani tubes	Steel strips, cutting oil, HCL, Zinc chloride, ammonium chloride, molten zinc.	Steel tubes (MS & GI)	6	2.5
15	Novopan India	Urea- formaldehyde resin, melamine-formaldehyde resin, wood, binders, adhesives, sizing materials	Chip boards	66	7.0
16	Hical pharma	NA	Analgin 12 T	18	1.5
17	Venkatarama chemicals	NA	Chloro- pheric minimalate 4T	4	3
18	Charminar papers	Waste paper (270 T), alum (8T) resin (2.5 T), dye (0.1 T), chlorine.	Kraft paper	140	30
19	Ambuja Petro Chemicals	O-Xylene (900T), sulphuric acid (5T), sodium hydroxide, NaOH (3 T).	Phthalic anhydride (600 T), fumeric acid (45 T)	325	300
20	Deccan leathers	Raw sheep and goat skins, chromium salts, dyes oil and Grease, acetic acid, formic acid	Finished leather /skin (1 lakh hides)	200	190
21	Gromor chemicals	NA	Dextro propocryhydrochloride (2 T)	7	5
22	Ion exchange	NA	Water treatment chemicals (15 T)	10	5
23	Dexo lab chemicals	Sodium, methanol, Di Ethyl oxalate, Acetone, Sulphuric acid, Hydroxylamine sulphate, Ammonia, Caustic soda, chlorine, ethyl acetate, benzene, pyridine.	Sulpha methaoxazole (15 T)	30	20
24	Bhaghyanagar oil refineries	Raw groundnut oil and cotton oil (300 T), rice bran oil (60 T), neem oil (30 T), sodium silicate (15 T), Bleaching earth (7.5 T), Salt (3T).	Edible refined oil (300 T), soaps (150 T)	3.2	2.5
25	Qure drugs	p-chloro benzoic acid, thio-urea, thionyl chloride, acetamilide, nitric acid, sulphuric acid, ammonia, iron, Dimethyl sulphate, chloro formate.	Mebendazole (2 T)	25	15
26	N.S.L	HR steel strips (5200 T), HCL (180 T), cutting and lubricating oils	MS cold rolled strips (3500 T)	150	100
27	V.B.C ferro alloys	Quartz (2100 T), charcoal (1560 T), Iron ore (4800 T), Limestone (390 T), Coke (1600 T).	Ferro silicon (2200 T), pig iron (100 T)	10 (domestic) 20 (cooling)	10
28	Hindustan fluoro carbons	Anhydrous hydrofluoric acid, chloroform	Poly tetra fluoro- ethylene (45 T)	120	108
29	Ferro insulation	NA	Insulation boards	3	2

T – Tonne/month

**Source: APPCB (As presented in the Investigation Report of NEERI, Nagpur. October 1991

APPENDIX 16: TARGET ORGAN EXPOSURE - A COMPILATION FROM EXISTING LITERATURE

Name of Pollutant	Exposure Route	Symptoms	Target Organs	Medium/Reference
Arsenic	inhalation, skin absorption, skin and/or eye contact ingestion	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, [potential occupational carcinogen]	Liver, kidneys, skin, lungs, lymphatic system	Water, Soil/NGRI Report, 1998; Springer-Verlag 2001; Europe and India Past Present and Future
Chlorine	inhalation, skin and/or eye contact	Burning of eyes, nose, mouth; lacrimation (discharge of tears), rhinorrhea (discharge of thin mucus); cough, choking, substernal (occurring beneath the sternum) pain; nausea, vomiting; headache, dizziness; syncope; pulmonary edema; pneumonitis; hypoxemia (reduced oxygen in the blood); dermatitis; liquid: frostbite	Eyes, skin, respiratory system	Water/Europe and India Past Present and Future
Chromium	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; lung fibrosis (histologic)	Eyes, skin, respiratory system	Water, Soil/Springer-Verlag 2001; Europe and India Past Present and Future
Phenol	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose, throat; anorexia, weight loss; lassitude (weakness, exhaustion), muscle ache, pain; dark urine; cyanosis; liver, kidney damage; skin burns; dermatitis; ochronosis; tremor, convulsions, twitching	Eyes, skin, respiratory system, liver, kidneys	Water/NGRI Report
Selenium	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns	Eyes, skin, respiratory system, liver, kidneys, blood, spleen	Water, Soil/NGRI Report, 1998; Springer-Verlag 2001
Nickel	inhalation, ingestion, skin and/or eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Nasal cavities, lungs, skin	Water/NGRI Report, 1998; Europe and India Past Present and Future
Magnesite	inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory system; cough	Eyes, skin, respiratory system	Water/NGRI Report, 1998
Endosulphan	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation skin; nausea, confusion, agitation, flushing, dry mouth, tremor, convulsions, headache	Skin, central nervous system, liver, kidneys, reproductive system	Water/NGRI Report, 1998

Aldrin	inhalation, skin absorption, ingestion, skin and/or eye contact	Headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort); myoclonic jerks of limbs; clonic, tonic convulsions; coma; hematuria (blood in the urine), azotemia; [potential occupational carcinogen]	central nervous system, liver, kidneys, skin	Water/NGRI Report
Boron Oxide	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system; cough; conjunctivitis; skin erythema (skin redness)	Eyes, skin, respiratory system	Water/Europe and India Past Present and Future
Barium	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse, extrasystoles; hypokalemia	Eyes, skin, respiratory system, heart, central nervous system	Water/NGRI Report, 1998
Acetone	inhalation, ingestion, skin and/or eye contact	Irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	Eyes, skin, respiratory system, central nervous system	Patancheru a Hell on earth, 2001
Isopropyl Alcohol	inhalation, ingestion, skin and/or eye contact	Irritation eyes, nose, throat; drowsiness, dizziness, headache; dry cracking skin; in animals: narcosis	Eyes, skin, respiratory system	Patancheru a Hell on earth, 2001
Methylene dichloride	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]	Eyes, skin, cardiovascular system, central nervous system	Patancheru a Hell on earth, 2001
Cadmium	inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	respiratory system, kidneys, prostate, blood	Water, Soil/Springer-Verlag 2001; Europe and India Past Present and Future
Dioxane	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys	Patancheru a Hell on earth, 2001
Ethyl Alcohol	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects	Eyes, skin, respiratory system, central nervous system, liver, blood, reproductive system	Patancheru a Hell on earth, 2001
Ethyl Mercaptan	inhalation, ingestion, skin and/or eye contact	Irritation mucous membrane; headache, nausea; in animals: incoordination, lassitude (weakness, exhaustion); liver, kidney damage; cyanosis; narcosis	Eyes, respiratory system, liver, kidneys, blood	Air/ Patancheru a Hell on earth, 2001