IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399. Volume 4, Issue 1 (May. - Jun. 2013), PP 30-45
www.Iosrjournals.Org

Air Pollution in Punjab with Special Reference to Mandi Gobindgarh and Surrounding Areas: An analytical study

Dr. Shalini Gupta[1,] ChetanGupta[2]& Dr. D S Grewal[3]
1. Pro Vice Chancellor, DeshBhagat University, MandiGobindgarh, Punjab, India
2. Director Innovations, DeshBhagat University, Punjab, India
3. Dean R & D, DeshBhagat University, MandiGobindgarh, Punjab, India

I. Introduction

MandiGobindgarh in Fatehgarh Sahib District of Malwa region is the second biggest industrial town in Punjab. Its industry includes 89 induction furnaces, 38 cupola furnaces, 1 arc furnace, 247 steel rolling mills, 13 refractories and forging industry each and 3 lead extraction units. It stands the 17th most polluted industrial town in India. (The Tribune India: 9 Dec 2011) and is one among the list of 43 critically polluted industrial hubs of the country on which the ministry had imposed a moratorium. (Indian Express: 09 Dec 2012). The polluted air has affected almost all the population of MandiGobindgarhie. 155,416 persons in 2012. They are specially affected by high dust and smoke particulate pollutants through industrial units and smoke from vehicles and generators. The population showed a higher prevalence of symptoms of respiratory problems, angina and cardiovascular disease. The rural area around the city too stands polluted due to industrial smoke, dust and 'the burning of over 20 million tons of paddy husk by Punjab's farmers' triggered smog.' (Times of India 12 Dec 2012).

Need of the Study:

A study was conducted to find out the type and amount of air pollution in MandiGobindgarhtownship and surrounding areas to provide a base for taking counter measures to control and eliminate the various forms of pollution in an effort to make MandiGobindgarh and surrounding areas pollution free and the people saved from the pollution related diseases.

II. Literature Review

From the 1960s through 1980s several population-based studies were taken up in the industrialized countries and these investigations confirmed the adverse effects of air pollution on human health (Pope, 2000; Lave and Seskin, 1970). A series of epidemiological studies that followed in a short period of six years from 1989 to 1995 unveiled the role of particulate matter as the chief mediator of toxic effects of air pollution (Pope et al., 1995; Dockery et al., 1993; Schwartz and Dockery, 1992). This finding opened a flood gate of epidemiological and toxicological investigations on fine and ultrafine particulate air pollution. It became later obvious that besides respiratory diseases, air pollution adversely affect the cardio-vascular system of the body (Pope et al., 2004; Brook et al., 2004). It was found that long-term, repeated exposures to air pollution increases the cumulative risk of chronic pulmonary and cardio-vascular disease and even death (Pope et al., 2004; Brooket al., 2004; Pope et al., 2002; Clancy et al., 2002; Hoek et al., 2002). In fact, more deaths from air pollution occur due to cardio-vascular causes rather than pulmonary diseases (Pope et al., 2004).

The World Health Organization (WHO) has estimated that urban air pollution is responsible for approximately 800,000 deaths and 4.6 million lost life-years each year around the globe (WHO, 2002). The burden of ill-health is not equally distributed as approximately two-thirds of the deaths and lost life-years occur in developing countries of Asia.

In the last three decades, the number of motorized vehicles in India has increased 29-times, from 1.9 million in 1971 to 55.0 million in 2001 (Badami,2005). The increase was not uniform for all vehicle types: it was 7-fold for buses, 9-fold for trucks, 10-fold for car, Jeeps and taxis, but a remarkable 67-fold for two wheelers (Badami, 2005). Fuel and lubricating oil quality have also contributed significantly to transport air pollution in India. Indian gasoline have a high volatility, and the vast majority of gasoline vehicles are carbureted, not fuel-injected (Badami, 2005). Traffic congestion is yet another problem leading to high vehicular emissions. In Delhi for example, the average speed for public transport vehicles ranged from 12 to 20 km/hr in the 1990's (RITES, ORGO, 1994). Besides causing loss of time and productivity, traffic congestion increases fuel consumption and carbon monoxide and hydrocarbon emissions per vehicle-km by 200% or more (Faiz et al., 1992).

A study on pollution in MandiGobindgarh has been carried on by Punjab Pollution Control Board (PPCB: Action Plan: 2010). The ambient air quality monitoring analysis of last 7 years by it reveals that the annual average concentration of Respirable Suspended Particulate Matter (RSPM) is in the range of 214 – 272µg/m3 against annual average prescribed standard of 120 µg/m3 for industrial area, 60 µg/m3 for residential, rural and other areas, and 50 µg/m3 for sensitive area. (Table 1 annexure 1) So, the concentration of RSPM in ambient air is more than the prescribed limits as given in Table 2. In addition to the industrial air pollution, the other factors contributing towards the ambient air quality deterioration of MandiGobindgarh are:

i) Rapid increase in the vehicular density due to industrialization and commercialization.
ii) Haphazard growth of the industries in and around MandiGobindgarh along the link roads & tracks in agricultural land.
iii) Lack of proper infrastructure such as roads, green belts, buffer zones etc.

The report identified various bodies responsible for different actions in different areas of pollution control. These bodies included Punjab Pollution Control Board, Municipality, Police, PWD, Department of Forests, industries, transport, and local bodies and prepared an action plan.

A study by Manoj Kumar of Centre for Public Health, Panjab University, Chandigarh, into effect of air pollutants on respiratory morbidity in adults of MandiGobindgarh, a critically polluted city was published in July, 2012. Its results of multivariate logistic regression showed that after controlling the confounding variables, cough (OR = 1.59, 95% CI 1.21-2.12, P = 0.001), phlegm (OR = 1.56, 95% CI 1.17-2.07, P = 0.003), wheeze (OR = 1.50, 95% CI 1.04-2.17, P = 0.03), chronic bronchitis (OR = 2.23, 95% CI 1.10-4.53, P= 0.03) and obstructive defects (OR = 1.86, 95% CI 1.43-2.42, P = 0.001) were significantly higher amongst the residents of MandiGobindgarh. Adult population of MandiGobindgarh has significantly more chronic respiratory morbidity as compared to that of Morinda. It concluded that the level of TSP in the ambient air is responsible for the poor respiratory health in adults of MandiGobindgarh. The ultrafine particles are getting further affected by increasing vehicular density and gaseous and material objects from haphazard growth of industry.

Research Gaps

Though quite a number of studies are conducted on pollution and its effects only three studies have been found on MandiGobindgarh but these are covering only specific diseases. No detailed study on pollution in MandiGobindgarh and its perforation into surrounding areas have been found studied. None of the studies has covered the pollution in rural areas of the district or the adjoining rural areas of the industrial town. These studies have been carried out at micro scale but no study has yet been carried out on macro scale or nano-scale. The detailed impact of all types of pollution on health is also not studied so far. The major effect on air pollution and cause of diseases being nanoparticles; detailed studies of these nanoparticles with the help of advance microscopes like SPM, SEM and TEM still remains to be carried out.

Objective of the study:

1. To study the existence of air pollution in MandiGobindgarh and surrounding rural areas.
2. To find out the causes of various air pollutants in the area.
3. To measure the impact of air pollution on the population of the area.
4. To evaluate the measures adopted to control/eliminate these air pollutants
5. To find out solutions to these air pollutants and their effects
6. To create awareness among public about the causes and effects of air pollutants in the area.

Hypothesis

1. The Air in MandiGobindgarh town and its surrounding areas is highly polluted
2. Air pollution causes chronic diseases like Cardiovascular and respiratory problems in the area.
3. Air pollution in urban area is also impacting the surrounding rural area.

Delimitation

Area of the study will be the town of MandiGobindgarh and surrounding villages of Fatehgarh Sahib District with in 10 Kms of the town. In addition some samples were also obtained from other neighbouring villages to know the actual extent of impact. 397 samples were taken from industry and rural areas.

III. Methodology

Research Methodology adopted was exploratory in nature since very limited research has been carried out on air pollution in MandiGobindgarh and surrounding areas. The methodology involved the methods of observation and survey. Techniques used were questionnaire and camera in addition to personal observation. Observations of MandiGobindgarh and adjoining areas were conducted by the researcher in detail who has been the permanent resident of the area for the last 30 years. She visited most part of the area of research to find out

the exact details and established contacts with the samples for information. The important pollution sources were photographed with the help of institution's photographers. The survey was conducted through 10 questionnaires. Secondary data was provided by the Punjab Pollution Control Board and the medical Authorities. Both Primary and secondary data was made use of.

Data Collection through Questionnaire

The observations were further extended with 8 sets of questionnaires. In addition records from Medical authorities at MandiGobindgarh and Amloh were also obtained through 2 different questionnaires. The questionnaire to the general public and the rural areas was both in English and Punjabi since most of the population is Punjabi speaking. One questionnaire was given to Punjab Pollution Control Board, Patiala. The data and the information so collected through these 10 questionnaires were crosschecked for validity and reliability through cross checking because certain questions were meant for cross-check to check the reliability. Keeping in view the validity requirement, questionnaires were separately prepared for Industry management: industrial labour, farm management: farm labour, urban residents: rural residents respectively. To check the effect of the pollution and the remedial actions taken so far by various agencies; two questionnaires were given to medical authorities at MandiGobindgarh and Amloh and one to Punjab Pollution Control Board Patiala. Photography of prominent pollution sources was also obtained.

Samples

Samples were selected from among the residents of MandiGobindgarh (113) and over 20 villages (99) around to know their experience of pollution. Also samples were obtained from the persons involved with sources of pollution i.e., industry managements (45), industry labour (48), farmers (49) and farm labour (40). Observations of 397 observers through questions were thus obtained; about 98% of them having the experience of pollution in the area for more than 5 years. Out of these 207 samples were from MandiGobindgarh and 190 from adjoining villages. Samples were taken from male as well as female respondents. Samples were selected both from urban and rural areas.

Data Tabulation

The obtained and interpreted data was compiled in 10 Tables and 7 graphs.

Result and analysis

The results obtained through questionnaires were tabulated and analysed through Wilcoxon signed-rank test and chi square test. The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired difference test). It can be used as an alternative to the paired Student's t-test, *t*-test for matched pairs, or the *t*-test for dependent samples when the population cannot be assumed to be normally distributed. (1) Assumptions of the test are:

1. Data are paired and come from the same population.
2. Each pair is chosen randomly and independent.
3. The data are measured on an interval scale (ordinal is not sufficient because we take differences), but need not be normal.

Observations:

The researcher visited the entire area of MandiGobindgarh and adjoining villages to find the actual state of air pollution and found that the air in and around entire MandiGobindgarh area was heavily polluted. Smoke and emissions from the approximately 600 chimneys in Gobindgarh contain high levels of air pollutants. While looking at MandiGobindgarh Township, one can notice from miles, the smoke oozing out of the chimneys of factories. In rural areas around, one can see billowing smoke from vast rice and wheat fields where the rice stubble is being burnt in October -November and from wheat stubble in April-May. On NH1 and various roads connecting the town and the villages nearby one also can observe the unending lines of vehicles like trucks, buses, tractors, autos etc., and large size loaders billowing out smoke. This plus many other sources like burning furnaces, blurting pressure horns, dumped wastages in open, badly stagnated water cause immense pollution.

Most dangerous air pollution in the town area is due to the excessive suspended particles in the air. The breathing problems, asthma, bronchitis and tuberculosis are on the increase due to air pollution. Number of patients suffering from lung cancer has increased 1.5 times. Air pollution leads to nasal discharge, nasal itching, choking of throat, breathlessness and in many cases, people becoming asthmatic too. The problems like arthritis and angina are caused due to water pollution; the hearing is getting impaired due to noise pollution, especially

among the elderly. The effect of light pollution is seen on eye-sights of residents. The high density of population in and around MandiGobindgarh town has been identified, as one of the major sensitive receptors.

Air pollution adversely affects human health in subtropical climatic conditions of northern India. Breathing had become difficult due to excessive smoke billowing out of chimneys, the soot from chimneys falling on cloths of residents and travellers passengers by. Vehicles plying on National Highway No1 and on city roads have added heavily to the carbon. The dust particles in the air caused problem in the breathing. This dust is from the construction work going on National Highway No.1 and during the construction of buildings and bridges. The moving trucks and other vehicles also raise a lot of dust since the work on various roads is not yet complete and the vehicles move on un-metaled tracks. The scrap used for making ingots is also the cause of dust. Even in the rural area some industries were throwing out smoke in large quantity which spreads like a cloud towards most of the surrounding villages. In these villages the fire in the fields caused by stubble burning creates highly toxic gases, heat, smoke and soot. The soot and smoke are toxic by nature. Since the paddy and wheat are sown in bulk in this area, the impact of stubble burning is disastrous. The smoke spreads in the vast sky. The toxic gases from the burning paddy stubble cause breathing problems to children, asthma, ENT problems, TB, Cancer and many other serious diseases.

Traffic congestion is yet another problem leading to high vehicular emissions in MandiGobindgarh. Due to heavy construction work going on in the town, the average speed on NH1 for vehicles within 8-10 kms of the town ranged from 20 to 30 km/hr. Besides causing loss of time and productivity, traffic congestion increases fuel consumption and carbon monoxide and hydro-carbon emissions per vehicle-km by 200% or more (Faiz et al., 1992). Residents of slum households, who stay close to the road, tend to have more health problems due to poverty and are exposed higher than others outdoor exposures because they live in road-side slums. Exposure to indoor air pollution or other factors associated with poverty also increases the susceptibility of the poor to outdoor air pollution. Urban aerosols contain also combustion products.

The most damaging air quality of the city measured by PPCB was RSPM PM 2.5. However PPCB did not have instruments to measure at Nano level. Pollution check was carried out at only three points while area affected was entire town and surrounding villages. There were no proper records or log books for quality assessments. Records were not being maintained for days together. Semi quantitative visibility measurement existed. In hospitals Death Registration was also not found to be properly maintained. Data of causes of death is also not properly maintained. There was a lack of computerization of data as well.

In this context, better exposure monitoring techniques are needed. Equipment must be installed to carry out measurements of RSPM 2.5. There should be regular monitoring for all criteria for pollutants. Health effects of persistent pollutants and emerging pollutants must be well advertised and the vulnerable populations must be made aware of the dangers of pollution. Long term epidemiological & toxicological measures must be adopted and detailed studies should be carried out to measure pollution effects and data collected and computerized.

The rural areas are polluted most due to stubble burning; pesticides, excessive smoke from low chimneys of brick-kilns; vehicle traffic, generators for tube-wells and tractors. The burning of agricultural residue is the most important source of air pollution with the spread of gases like CH4, CO, NOx, SO2, and hydrocarbons. The burning of stubble also emits large amount of particulates that are composed of a wide variety of organic and inorganic compounds. About 70% of the rice residue produced in Punjab state is burnt in the fields, particularly after the harvesting of rice by combine harvesters. It is estimated that in Punjab about 14.2 million tons of rice straw is burned annually. This causes severe environmental pollution and health problems. In addition, increased agricultural mechanisation has added to this problem. Mining and quarrying activities also cause severe air pollution from dust.

Carrying out Environmental Impact Assessment (EIA) remains a problem. The researcher found that the major obstacles are the difficulties in obtaining reliable baseline data, the lack of access to modern technological tools like Global Positioning Systems and Geographical Information Systems, a shortage of quality laboratories and little public participation. Construction work on various road in the city and the villages around too has been a cause of pollution due to the burning tarcoal for layering on the road; specially the National Highway No.1

The researcher herself visited the entire area of MandiGobindgarh and adjoining villages to find out the actual state of pollution and also the action taken on the points by Punjab Pollution Control Board in the Action Plan 2010. The researcher found that entire MandiGobindgarh remains heavily polluted and found no improvement since 2010. Breathing had become difficult due to excessive smoke billowing out from chimneys and heavy vehicular flow on Highway No 1 and on city roads. Smoke, dust, heat, sound, water all were found to be heavily polluted. The dust particles in the air too caused problem in breathing. This dust arose from the construction work going on Highway No. 1 and construction of some houses. The moving trucks and other vehicles too raised lot of dust since the concrete work on various roads was not complete and the vehicles moved on un-metaled tracks. It is also coming out from the scrap being used for making ingots.

IV. Results, Discussions Analysis and Interpretations

All the primary sources i.e., observations, discussions, survey questionnaires, schedules and photography and the secondary sources; the report of Punjab Pollution Control Board, articles and news in local papers and the two field studies reveal that MandiGobindgarh and its surrounding areas are polluted which exceeds the national ambient air quality standards (NAAQS). All the air, land and water in the area are badly affected by the pollution. Air is excessively hot and dry due to furnaces. The major sources of pollution are as given in Table 2 and the particulate matter in Table 1 at annexure 1

The most prominent diseases due to air pollution are the respiratory, heart, skin and TB diseases. It is most astonishing that there were heart 4351 heart problems in 2011. As against this the diseases due to air pollution in rural areas (Amloh) are too less since it is not as affected as is MandiGobingarh. The comparison of various diseases in MandiGobindgarh and Amloh is given in tables 3-9 and graphs 1-7. Every one person among ten in MandiGobindgarh is sick by some air pollution related disease while the sickness ratio in Amloh (just 14 kms from MandiGobindgarh) is not even 0.5%. In urban area respiratory disease problems is 1000 times more; heart problems 400 times more and skin problem 300 times more in 2012 in MandiGobindgarh than Amloh. This is all due to heavy amount of air pollution in the area. The excessive particulate matter is a potential danger to the residents. Statistical analysis of these results was carried out to find out the z values between pollution and various diseases. The results of this analysis are given in the tables 9-13 at annexure 1

Analysis 1: From table 1 relationship between air pollution and respiratory, heart, skin and TB diseases in Urban Area MandiGobindgarh were compared through Wilcoxon Signed Ranks Test. The test showed a significant impact of air pollution on respiratory, heart, skin and TB diseases because of z value of 8.429 between air pollution and Respiratory diseases; z=6.455 between air pollution and heart diseases; z= 6.755 between air pollution and skin diseases; z=8.891 between air pollution and TB. All these values are well above z values 1.96, 2.58 and even 3. It showed that impact of air pollution on respiratory, heart, skin and TB diseases in urban area of MandiGobindgarh are very significant.

Analysis 2: From table relationship between air pollution and respiratory, heart, skin and TB diseases in Rural Area MandiGobindgarh were compared through Wilcoxon Signed Ranks Test. The test showed a significant impact of air pollution on respiratory, heart, skin and TB diseases because of z value of 9.110 between air pollution and Respiratory diseases; z=6.949 between air pollution and heart diseases; z=7.020 between air pollution and skin diseases; z=7.280 between air pollution and TB. All these values are well above z values 1.96, 2.58 and even 3. It showed that impact of air pollution on respiratory, heart, skin and TB diseases in rural area around MandiGobindgarh too is very significant.

Analysis 3: In Table 12 at annexure 1 Paired Samples Correlations is carried out between air and various diseases in urban area of MandiGobindgarh and found that significant correlation exists between air pollution and Respiratory diseases (.307); air pollution and heart diseases (.421); air pollution and TB (.535) and air pollution and skin disease (.550).

Analysis 4: In Table 13 at annexure 1 Paired Samples Correlations is carried out between air and various diseases in Rural area surrounding MandiGobindgarhand found that significant correlation exists between air pollution and Respiratory diseases (.408); air pollution and heart diseases (.409); air pollution and TB (.021) and air pollution and skin disease (.443).

The effect of pollution is much lesser pronounced in rural areas as given in tables at annexure 1

Hypothesis

Hypothesis 1 that **'**The Air in MandiGobindgarh town and its surrounding areas is highly polluted' is thus proved through observation, relationship established between diseases and air pollution through chi square relationship and analysis 1-4

Hypothesis 2 that "Air pollution causes chronic diseases like Cardiovascular and respiratory problems in the area" is also proved through analysis 1-4.

Hypothesis 3 that "Air pollution in urban area is also impacting the surrounding rural area" also stand proved through analysis 1-4.

This corresponds to the earlier report by Punjab Pollution Control Board in 2011 who initiated measures to control the pollution in which almost all the departments of the Government were involved. Results of the same are yet to be seen. The public however is not yet involved in making them aware of this monster of pollution and to take effective measures to save themselves from the serious ailments which is essentially needed.

Punjab Pollution Control Board is measuring particulate matter and gases at three places while the area is vast. Instruments are not available to measure particulate matter at nano scale which is the cause of major diseases. Hence better and expanded measurement of pollution must be resorted to. Smoke from chimneys being

the major source, measures are needed to filter the smoke coming out chimneys and using furnace oil which causes minimum pollution. GT road and over-bridges must be completed without delay and construction and road building work must be completed to reduce dust and heat. The quality of input in industry should also be improved and the junk received from foreign war zones should be discontinued.

Regulations are required to be refurbished to include the use of technologies capable of dramatically reducing the amount of smog-forming pollution and carbon monoxide coming from a vehicle's tailpipe. For patrol and diesel vehicles, precise engine and fuel controls, and evaporative emission controls must be strictly enforced. New cars have these more advanced versions of these technologies which can reduce smog-forming emissions from new vehicles by a factor of ten but the old vehicles which remain the major pollution creators have not been checked to the desired level. For diesel vehicles, engine controls have been able to reduce hydrocarbon and carbon monoxide emissions in new vehicles, but nitrogen oxide and toxic particulate-matter emissions remain very high. More advanced diesel-control technologies are under development, but it is unlikely that they will be able to clean up diesel to the degree already achieved in the cleanest diesel vehicles.

Among maximum pollution is seen from old vehicles. Added concerns surround the difference between new vehicle emissions and the emissions of a car or truck over a lifetime of actual use. Vehicles with good emission-control technology that is not properly maintained can become "gross polluters" that are responsible for a significant amount of existing air-quality problems. New technologies have also been developed to identify emission-equipment control failures, and can be used to help reduce the "gross polluter" problem.

Findings

This study has been able to cover the research gap of macro study of various pollutants and their effects and has also covered the environment in the adjoining rural areas. The detailed impact of all types of pollution on health has also been studied. Relationship to various chronic diseases to pollution has also not been established.

The study found MandiGobindgarh heavily polluted. The impact of pollution caused by the industry of MandiGobindgarh was also felt strongly in surrounding rural areas. Air, water and soil were found heavily polluted. The major source of air pollution in MandiGobindgarh arePolyaromatic hydrocarbons (PAHs), Carbon dioxide CO_2, carbon monoxide, oxides of oxygen (NOx), nitrogen oxides; sulphur oxides; tiny particles of solids, such as lead, arsenic, organic and elementary carbon from soot, alarming levels of Particulate Matter PM_{10}, PM $_{2.5}$ of aerodynamic diameter, benezene (C_6H_6), smog including ozone and carbon monoxide; industrial smoke, smoke from automobiles and heavy vehicles, generators and coal and firewood burning in *sigris* and *chullahs* in homes and offices during winter. Noise pollution is caused by pressure horns of vehicles, whistling trains, DJs in marriage places, homes and vehicles, Loudspeakers and other electronic equipment; Electronic pollution is from Mobile towers; High Tension wires, mobiles, TVs, radios, heat pollution from furnaces, burners, electric heaters, coal tar heating during road construction; dust is caused by Scrap loading and unloading, GT road construction work, crashers and heavy vehicular movement

Water is found stagnated in number of vacant plots. Untreated water consists of harmful chemicals and vehicle fluids i.e., motor oil, antifreeze, gasoline, air-conditioning refrigerants, and transmission, brake, hydraulic and windshield-wiper fluids. Soil is found polluted from chemicals, molted and grinded metal, untreated water, factory and domestic refuse and bio-waste

In rural areas air is polluted by particulate matter, CO_2, NOx from Stubble burning in fields, Tractors, tube wells run on diesel, brick kilns, generators, coal and firewood burning in *sigris* and chullahs in homes and offices during winters, wood, grass and *gobar* burning. Sound is found polluted by vehicles specially pressure horns, DJs in marriage places, homes and vehicles, Loudspeakers, mobiles TVs, radios; Heat is caused by burners, electric heaters, stubble, coal tar heating by road construction. Dust is caused by: Road construction work, crashers, vehicular movement, brick kilns, dust storms, suit, paddy and rice harvesting.

The effect of pollution is much lesser pronounced in rural areas than in urban areas. However the sickness increases in rural areas during paddy and wheat chaff burning due to toxity of the gases from chaff. The presence of all these pollutants is considered alarming and their prolonged exposure has led to various health ailments. Relationship between pollution and diseases like heart, TB, Skin, Gastro and Asthma which did not exist ten years before have now come in a big way. There were 4351 heart problems in 2011. According to the study one person in among every ten in MandiGobindgarh is sick by one or other disease while the sickness ratio in Amloh just 14 kms from MandiGobindgarh is not even 0.5%. For example respiratory disease problems are 1000 times more; heart problems are more by 400 times and skin 300 times more in 2012 in MandiGobindgarh than Amloh. This is all due to heavy amount of pollution in MandiGobindgarh. Effect of pollution is more pronounced in industrial area. The excessive particulate matter is a potential danger to the residents must be controlled at war footing. The pollution control by various government agencies is not much effective since the impacted diseases are continuously increasing. All citizens must be made aware of the pollution and its causes and effects and help the pollution control agencies to control the pollution religiously.

NGO's and religious institutions' must help to propagate the effects of pollution and stopping paddy burning and control over smoke from industry chimneys and plying transport. The study recommends that those who face heart, skin, lung and TB problems must move to safer and pollution free areas. The Government and the pollution Control agencies have to work harder than they are doing at present as the spread and increase of pollution is faster and even getting out of control. The citizens themselves have to be aware and stand against this demon to fight united before every one's life goes into danger Zone. Special care is needed to control the effect of pollution on heart and gastro diseases which are continuously increasing at an alarming rate. Study of nanoparticles also must be carried out to find out their effect on health. Since pollution has been ever increasing in MandiGobindgarh and fast spreading into the rural areas around it, it is recommended that all aspects of pollution and its health and quality of work life be studied in detail even at nano-scale.

The existence of pollution much more than the National level limits is a great cause of concern. This proves the hypothesis that pollution in MandiGobindgarh and surrounding areas are highly polluted. The study was able to find the type and amount of pollution in MandiGobindgarh in qualitative terms. However the quantitative measure of pollution requires a separate detailed study and special equipment at nano scale. This study will help the various authorities and the persons responsible to check pollution to go into more depth and to be more serious in controlling pollution since the diseases pertaining to heart, skin and lungs are of alarming proportion. All the objectives of the study are thus met by studying the pollution, its extent, causes and impact and evaluating the measure adopted to control the pollution. Solutions and suggestion have been provided to control the pollution and its effects in various fields and an awareness campaign has been started at DeshBhagat University level through lectures and demonstrations. The major effect on environmental pollution and cause of diseases being nanoparticles; these nanoparticles however still remain to be studied in detail with the help of advance microscopes like SPM, SEM and TEM.

V. Recommendations

Since the environment pollution in MandiGobindgarh is much more the limits laid down by national and international standards, there is an urgent requirement to take strong measures to check and control the pollution. An Environmental Impact Assessment (EIA) must be carried out and a dedicated team be detailed by Punjab Pollution Control Board to carry out assessment of pollution at least at the 10 identified points in the industrial area. A reliable base line data must be obtained through the use of Global Positioning System and Geographical Information Systems. Quality Laboratory must be setup to assess effect of particles at nano-scale. A dedicated effort be put up to make the public aware of the effects of pollution and public participation must be encouraged in reducing pollution at their homes and surrounding areas. The construction work specially at the G.T. road must be completed post haste and all the pending bridges be constructed to ensure smooth traffic, reduction of dust and the tar coal burning for layering on the road. The heights of chimneys must be increased as per the specifications and filter covers be constructed to ensure that the carbon particles are hindered from mixing into the air. The traffic control must be provided to ensure regular flow of traffic. Old and polluting vehicles must be banned. Regular pollution checks must be carried out on the vehicles. The quality of diesel and petrol being used in the vehicles should also be checked out at the petrol pumps. The scrap used in the furnaces must be checked for its quality and pollution creating scrap be banned. The quality of oil in furnaces must be improved. CNG must be introduced in large scale to reduce pollution from the furnaces and vehicles. The Govt. administration must coordinate the activities of Punjab Pollution Control Board. Municipality, Police, PWD, Department of Forest, Industries, Transport and local buddies and update the action plan. A policy must be framed and proper action plan must be prepared and circulated not only among the departments but also in industry and public to make them more aware.

The key to burning less fuel is making cars and trucks more efficient and putting that efficiency to work in improving fuel economy. The central and state government have set a fuel-economy standard for all passenger vehicles. However, these standards have remained mostly constant for the past decade. In addition, sales of lower-fuel-economy light trucks, such as SUVs, pickups, and minivans, have increased dramatically. As a result, on average, the Indian passenger-vehicle fleet actually travels less distance on a gallon of patrol than it did twenty years ago due to heavy congestion on roads. This has led to an increase in heat-trapping gas emissions from cars and trucks and to an increase in smog-forming and toxic emissions resulting from the production and transportation of fuel to the fuel pump. This trend can be reversed through the use of existing technologies that help cars and trucks go farther on a liter of fuel. These include more efficient engines and transmissions, improved aerodynamics, better tires, and high strength steel and aluminum. More advanced technologies, such as hybrid-electric vehicles that use a fuel engine and an electric motor plus a battery, can cut fuel use even further. These technologies carry with them additional costs, but pay for themselves through savings at the patrol pump. As more cars and trucks are sold and total annual mileage increases, improving pollution-control technology and burning less fuel continues to be vital, especially in rapidly growing urban areas. However, eliminating emissions from the tailpipe goes even further to cut down on harmful air pollutants.

Hydrogen fuel-cell and electric vehicles move away from burning fuel and use electrochemical processes instead to produce the needed energy to drive a car down the road. Fuel-cell vehicles run on electricity that is produced directly from the reaction of hydrogen and oxygen. The only byproduct is water—which is why fuel-cell cars and trucks are called zero-emission vehicles. Electric vehicles store energy in an onboard battery, emitting nothing from the tailpipe.

The hydrogen for the fuel cell and the electricity for the battery must still be produced somewhere, so there will still be upstream emissions associated with these vehicles. These stationary sources, however, are easier to control and can ultimately be converted to use wind, solar, and other renewable energy sources to come as close as possible to true zero-emission vehicles. The patrol and diesel fuel in use today contains significant amounts of sulfur and other compounds that make it harder for existing control technology to keep vehicles clean. Removing the sulfur from the fuel and cutting down on the amount of light hydrocarbons helps pollution-control technology to work better and cuts down on evaporative and refueling emissions.

Further large-scale reductions of other tailpipe pollution and CO_2 can be accomplished with a shift away from conventional fuels. Alternative fuels such as natural gas, methanol, ethanol, and hydrogen can deliver benefits to the environment while helping to move India away from its dependence on oil. All of these fuels inherently burn cleaner than diesel and patrol, and they have lower carbon content—resulting in less CO_2. Most of these fuels are also more easily made from renewable resources, and fuels such as natural gas and methanol help provide a bridge to producing hydrogen for fuel-cell vehicles.

Because we are still dependent on fossil fuels and the number of cars on the road is expected to rise further, a significant reduction in vehicular pollution requires more than gains in fuel efficiency. Measures that encourage us to drive less can help curb vehicular pollution and protect natural resources and public health. Alternatives that can reduce the number of vehicle-miles traveled include (a) Providing transportation alternatives to cars, including mass transit, bicycle, and pedestrian routes; (b) Promoting transit-oriented, compact developments in and around cities and towns; and adopting policies to improve existing roads and infrastructure. Condition of the roads is also very bad. This causes extra drag and pull; consuming more fuel and pressure. Better roads can save this extra pollution.

Individuals can also make a difference in the effort to reduce pollution from cars and trucks. How we drive and how we take care of our vehicles affects fuel economy and pollution emissions. Better medical facilities are needed to treat the patients of chronic diseases as TB, heart ailment, skin, breathing problems, allergy, gases, anemia, asthma etc.

In rural areas stubble burning must be strictly banned and smoke from brick kilns, generators and tractors must be reduced and action taken against the defaulters. The proper sewerages system and water outlets will save water stagnation. The use of fertilizers is required to be controlled immediately. An overall awareness campaign must be started through pamphlets and paper advertisements highlighting the dangers of environmental pollution and the precautions needed.

Recommendations for Further Research:

Since pollution has been ever increasing in MandiGobindgarh and fast spreading into the rural areas around it is recommended that all aspects of pollution and its health and quality of work life be studied in detail even at nano-scale. A few topics for future study include;

1. Environment pollution by Particulate matter at Nano scale: an analytical study.
2. Management of environment pollution in MandiGobingarh for better quality of work life.
3. A study into the diseases caused by pollution in MandiGobindgarh and suggesting alternatives.
4. A study into the impact of stubble burning on rural health in Punjab.
5. A study into automobile pollution and suggesting control measures in MandiGobindgarh.

Bibliography

[1]. Abbey DE, Burchette RJ, Knutsen SF, MacDonnel WF, Lebowitz MD, Enright TL. Long-term particulate and other air pollutants and lung function in non-smokers. *Am J RespirCrit Care Med* 158, 289-298, 1998.

[2]. Alfaro-Monaro E, Martinez L, Garcia-Cullar C, Bonner JC, Murray JC, Rosales SPDL, Osornio-Vargus AR. Biologic effects induced in vitro by PM10 from 3 different zones of Mexicocity. *Environ Health Perspect*, 110, 715-720, 2002.

[3]. Analitis A, Katsouyanni K, Dimakopoulou K, Samoli E, Nikoloulopoulos AK, Petasakis Y, Touloumi G, Schwartz J, Anderson HR, Cambra K, Forastiere F, Zmirou D, Vonk JM, Clancy

[4]. L, Kriz B, Bobvos J, Pekkanen J. Short-term effects of ambient particles on cardiovascular and respiratory mortality. *Epidemiol*, 17, 230-233, 2006.

[5]. Anderson HR, de Leon AP, Bland JM, Bower JS, Strachan DP. Air pollution and daily mortality in London: 1987-92. *BMJ*, 312, 665-669, 1996.

[6]. Aneja VP, Agarwal A, Roelle PA, Phillip SB, Tong Q, Watkins N, Yablonsky R. Measurements and analysis of criteria pollutants in New Delhi, India. *Environ Int*27, 35-42, 2001.

[7]. Arena VC, Mazumdar S, Zborowski JV, Talbott EO, He S, Chuang YH, Schwerha JJ. Aretrospective investigation of PM10 in ambient air and cardiopulmonary hospital admissions inAllegheny County, Pennsylvania: 1995-2000. *J Occup Environ Med.*, 48, 38-47, 2006.

[8]. Archer VE. Air pollution and fatal lung disease in three Utah counties.*Arch Environ Health*, 45, 325-334, 1990.
[9]. Aust AE, Ball JC, Hu AA, Lighty JS, Smith KR, Straccia AM, Veranth JM, Young WC. Particle characteristics responsible for effects on human lung epithelial cells.*Res Rep Health EffInst*110, 1-65, 2002.
[10]. Avol EL, Gauderman WJ, Tan SM, Loudon SJ, Peters JM. Respiratory effects of relocating to areas of different air pollution levels.*Am J RespirCrit Care Med* 164, 2067-2072, 2001.
[11]. Badami MG. Transport and urban air pollution in India.*Environ Menage*36, 195-204, 2005.
[12]. Balachandran S, Meena BR, Khillare PS. Particle size distribution and its elemental composition in the ambient air of Delhi. *Environ Int*26, 49-54, 2000.
[13]. Ballester F, Rodriguez P, Iniguez C, Saez M, Daponte A, Galan I, Taracido M, Arribas F, Bellido J, Cirarda FB, Canada A, Guillen JJ, Guillen-Grima F, Lopez E, Perez-Hoyos S, Lertxundi A, Toro S. Air pollution and cardiovascular admissions association in Spain: results within the EMECAS project, *J Epidemiol Community Health,* 60, 328-336, 2006.
[14]. Beaty TH, Newill CA, Cohen BH, Tockman MS, Bryant SH, Spurgeon HA.Effects of pulmonary function on mortality. *J Chronic Dis* 38, 703-710, 1985.
[15]. Becker S, Soukup JM. Exposure to urban air particulates alters the macrophage – mediated inflammatory response to respiratory viral infection. *J Toxicol Environ Health* 57, 445-457, 1999.
[16]. Barbone F, Bovenzi M, cavallieri F, Stanta G. Air pollution and lung cancer in Trieste, Italy. *Am J Ind Med*, 141, 1161-1169, 1995.
[17]. Basu C, Ray MR, Lahiri T. Traffic-related air pollution in Calcutta associated with increased respiratory symptoms and impaired alveolar macrophage activity. *J Environ Pollut*, 8,187-195, 2001.
[18]. Bates DV.Respiratory Function in Disease.3rd edn. WB Saunders. Philadelphia PA. 1989.
[19]. Behera D, Balamugesh T. Lung cancer in India. *Ind J Chest Dis Allied Sci*46, 269-281, 2004.
[20]. Bener A, Galadari I, al-Mutawa JK, al-Maskari F, Das M, Abuzeid MS. Respiratory symptoms and lung function in garage workers and taxi drivers. *J R Soc Health*, 118, 346-353, 1998.
[21]. Bendahmane DB. Air pollution and child health: Priorities for action. Environmental Health Project, Activity Report no. 38. Washington DC: US AID. 1997.
[22]. Block ML, Wu X, Pei Z, Li G, Wang T, Qin L, Wilson B, Yang J, Hong JS, Veronesi B. Nanometer size diesel exhaust particles are selectively toxic to dopaminergic neurons: the role of microglia, phagocytosis, and NADPH oxidase. *FASEB J*, 18,1618-1620. 2004.
[23]. Blomberg A, Krishna MT, Halleday R, Soderberger M, Ledin MC, Kelly FJ, Frew AJ, Holgate ST, Sandstrom T. Persistence air way inflammation but accommodated antioxidant and lung function responses after repeated daily exposure to nitrogen dioxide. *Am J RespirCrit Care Med*, 159, 536-543, 1999.
[24]. Bobak M, Leon D. Air pollution and infant mortality in the Czech Republic, 1986-1988. *Lancet*, 340, 1010-1014, 1992.
[25]. Brook RD, Brook JR, Rajagopala S. Air pollution: the 'Heart' of the problem. *CurrHypertens Rep*, 5, 32-39, 2003.
[26]. Brook RD, Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, Luepker R, MittlemanM,Samet J, Smith SC Jr, Tager I. Expert Panel on Population and Prevention Science of the American Heart Association. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation*, 109, 2655-2671, 2004.
[27]. Braun-Fahrlander C, Vuille JC, Sennhauser FJ, Keu U, Kunzle T, Grize L, Gasser M, Minder C, Schindler C, Varonier HS, Wuthrich B. Respiratory health and long-term exposure to air pollutants in Swiss school children. SCARPOL team. Swiss study on childhood allergy and respiratory symptoms with respect to air pollution, climate and pollen. *Am J RespirCrit Care Med* 155, 1042-1049, 1997.
[28]. Brauer M, Hoek G, Van Vliet P, Meliefste K, Fischer PH, Wijg A, Koopman LP, Neijens HJ, Kerkhif M, Heinrich J, Bellander T, Brunekreef B. Air pollution from traffic and the development of respiratory infections and asthmatic and allergic symptoms in children. *Am J RespirCrit Care Med* 166, 1092-1098, 2002.
[29]. Brunekreef B, Janssen NA, de Hartog J, Harssema H, Knape M, van Vliet P. Air pollution from truck traffic and lung function in children living near motorways. *Epidemiology*, 8, 298- 303, 1997.
[30]. Brunekreef B, Forsberg B. Epidemiological evidence of effects of coarse airborne particles on health. *EurRespir J*, 26,309-18, 2005.
[31]. Brook RD, Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, Luepker R, Mittleman M, Samet J, Smith SC Jr, Tager I. Expert Panel on Population and Prevention Science of the American Heart Association. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation* 109, 2655-2671, 2004.
[32]. Broor S, Pandey RM, Ghoh M, Maitreyi RS, Lodha R, Singhal T, Kabra SK. Risk factors for severe acute lower respiratory tract infection in under-five children. *Indian Pediatr*38, 1361-1369, 2001.
[33]. Burbacher TM. Neurotoxic effects of gasoline and gasoline constituents. *Environ Health Perspect*, 101, 133-141, 1993.
[34]. Burney PG, Laities LA, Perdrizet S, Huckauf H, Tattersfield AE, Chinn S, Poison N, Heeren A, Britton JR, Jones T. validity and repeatability of the IUATLD (1984) Bronchial Symptom Questionnaire: an international comparison. *EurRespir J* 2, 940-945, 1989.
[35]. Calderon-Garciduenas L, Osnaya N, Rodriguez-Alcaraz A, Villarreal-Calderon A. DNA damage in nasal respiratory epithelium from children exposed to urban pollution. *Environ Mol Mutagenesis* 30, 11-20, 1997.
[36]. Calderon-Garciduenas L, Reed W, Maronpot RR, Henriquez-Roldan C, Delgado-Chavez R, Calderon-Garciduenas A, Dragustinovis I, Franco-Lira M, Aragon-Flores M, Solt AC, Altenburg M, Torres-Jardon R, Swenberg JA. Brain inflammation and Alzheimer's-like pathology in individuals exposed to severe air pollution. *ToxicolPathol*32, 650-658, 2004.
[37]. Cassel EJ, Lebowitz M, McCarroll JR.The relationship between air pollution, weather and symptoms in an urban population.*Am Rev Respir Dis* 106, 677-683, 1972.
[38]. Castranova V, Ma JYC, Yang HM, Antonini JM, Butterworth L, Barger MW, Roberts J, Ma JKH. Effect of exposure to diesel exhaust particles on the susceptibility of the lung to infection. *Environ Health Perspect*, 109, 609-612, 2001.
[39]. Chase RM, Liss GM, Cole DC, Heath B. Toxic health effects including reversible macrothrombocytosis in workers exposed to asphalt fumes. *Am J Ind Med*, 25, 279-289, 1994.
[40]. Chakrabarty A, Sharma SC. Paranasal sinus mycoses. *Ind J Chest Dis Allied Sci*42, 293-304, 2000.
[41]. Chauhan A, Chatterjee A, Johnston SL. Acute Respiratory Infections. In; Effects of Air Pollution on Children's Health and Development, A review of the evidence. World Health Organization; Special Programme on Health and Environment, European Center for Environment and Health, Bonn pp 44-69, 2005.
[42]. Chauhan A, Johnston SL. Air pollution and infection in respiratory illness. *Brit Med Bull* 68, 95-112, 2003.
[43]. Chauhan AJ, Krishna MT, Frew AJ, Holgate ST. Exposure to nitrogen dioxide (NO2) and respiratory disease risk. *Rev Environ Health*, 13, 73-90, 1998.

[44]. Chattopadhyay BP, Alam J, Roychowdhury A. Pulmonary function abnormalities associated with exposure to automobile exhaust in a diesel bus garage and road. *Lung*, 18, 291-302, 2003.
[45]. Chestnut LG, Schwartz J, Savitz DA, Burchfiel CM. Pulmonary function and ambient particulate matter: epidemiological evidence from NHANES I. *Arch Environ Health*, 46;pp.135-144, 1991.
[46]. Chen Y, Yang Q, Krewski D, Burnett RT, Shi Y, McGrail KM. The effect of coarse ambient particulate matter on first, second, and overall hospital admissions for respiratory disease among the elderly. *InhalToxicol*, 17, 649-55, 2005.
[47]. Chhabra SK, Gupta CK, Chhabra P, Rajpal S. Risk factors for development of bronchial asthma in children in Delhi. *Ann Allergy Asthma Immunol*83, 385-390, 1999.
[48]. Chhabra SK, Chhabra P, Rajpal S, Gupta RK.Ambient air pollution and chronic respiratorymorbidity in Delhi.*Arch Environ Health* , 56, 58-64, 2001.
[49]. Chung A, Chang DP, Kleeman MJ, Perry KD, Cahill TA, Dutcher D, McDougall EM, Stroud K. Comparison of real-time instruments use to monitor airborne particulate matter. *J Air Waste ManagAssoc*51, 109-120, 2001.
[50]. Churg A, Brauer M, Avila-Casado MC, Fortoul TI, Wright JL. Chronic Exposure to High Levels of Particulate Air Pollution and Small Airway Remodeling. *Environ Health Perpect*. 111, 714- 718. 2003.
[51]. Cohen AR, Nikula K. The health effects of diesel exhaust: Laboratory and epidemiologic studies. In: Air pollution and health. Holgate ST, Samet JM, Koren HS, Maynard RL (eds).Academic Press, San Diego. pp. 707-735, 1999.
[52]. Cotes JE.Medical Research Council Questionnaire on Respiratory Symptoms.*Lancet*, 31, 1028, 1987.
[53]. Cropper ML, Simon NB, Alberini A, Sharma PK. The health effects of air pollution in Delhi, India. Policy Research Working Paper. The World Bank Development Research Group, 1860, 1-42, 1997.
[54]. Crosignani P, Tittarelli A, Borgini A, Codazzi T, Rovelli A, Porro E, Contiero P, Bianchi N, Tagaliabue G, Fissi R, Rossitto F, Berrino F. Childhood leukemia and road traffic: a population based case control study. *Int J Cancer*, 108,596-599, 2004.
[55]. Committee of the Environmental and Occupational Health Assembly (CEOHA) of the American Thoracic Society (ATS). Health effects of outdoor air pollution. *Am J RespirCrit Care Med* 153, 3-50, 1996.
[56]. Dassen W, Brunekreef B, Hoek G, Hofschreuder P, Staatsen B, de Groot H, Schouten E, Biersteker K. Decline in children's pulmonary function during an air pollution episode. *J Air Poll Con Asso*36, 1223-1227, 1986.
[57]. Dockery DW, Ware JH, Ferris BG Jr, Speizer FE, Cook NR, Herman SM. Changes in pulmonary function in children associated with air pollution episodes. *J Air Poll Control Asso*32, 937-942, 1982.
[58]. Dockery DW, Speizer FE, Stram DO, Ware JH, Spengler JD, Farris BG Jr. Effects of inhalable particles on respiratory health of children. *Am Rev Res Dis* 139, 587-594, 1989.
[59]. Dockery DW, Pope CA III, XU X .An association between air pollution and mortality in six U.S. cities.*N Eng J Med* 329, 1753-1759, 1993.
[60]. Dockery DW, Skerrett PJ, Walters D, Gilliland F. Development of lung function. In: *Effects of air pollution on children's health and development : A review of the evidence*. World Health Organization Special Programme on Health and Environment .European Centre for Environment and Health.Bonn, pp. 108-133, 2005.
[61]. De Paula Santos U, Braga AL, Giorgi DM, Pereira LA, Grupi VJ, Lin CA, Bussacos MA, Zanetta DM, do NascimentoSaldiva PH, Filho MT. Effect of air pollution on blood pressure and heart rate variability: a panel study of vehicular traffic controllers in the city of Sao Paulo, Brazil. *Eur Heart J* 26, 193-200, 2005.
[62]. Delfino RJ, Zeiger RS, Seltzer JM, Street DH, McLaren CE.Association of asthma symptoms with peak particulate air pollution and effect modification by anti-inflammatory medication use.*Environ Health Perspect*110A, 607-617, 2002.
[63]. Devlin RB, Ghio AJ, Kehrl H, Sanders G, Cascio W. Elderly humans exposed to concentrated air pollution particles have decreased heart rate variability. *EurRespir J Suppl*40, 76S-80S, 2003.
[64]. Dijkstra L, Houthuijs D, Brunekreef B, Akkerman I, Boleij JS. Respiratory health effects of the indoor environment in a population of Dutch children. *Am Rev Res Dis* 142, 1172-1178, 1990.
[65]. Donaldson K, Gilmour MI, MacNee W. Asthma and PM10. *Respir Res* 1, 12-15, 2000.
[66]. Don Porto Carero A, Hoet PH, Verschaeve L, Schoeters G, Nemery B. Genotoxic effects of carbon black particles, diesel exhaust particles and urban air particulates and their extracts on a human alveolar epithelial cell line (A549) and a human monocytic cell line (THP-1). *Environ Mol Mutagen* 37, 155-163, 2001.
[67]. Eastman A, Barry MA. The origin of DNA breaks: a consequence of DNA damage, DNA repair or apoptosis? *Cancer Invest* 10, 229-240, 1992.
[68]. Eroshina K, Danishevski K, Wilkinson P, McKee M. Environmental and social factors as determinants of respiratory dysfunction in junior schoolchildren in Moscow. *J Public Health (Oxf)* 26, 197-204, 2004.
[69]. ESMAP. Health impacts of outdoor air pollution. Urban Air Pollution.South Asia Urban Air Quality Management Briefing Note No.11, February 2003. Available at
[70]. <http://www.worldbank.org/sarurbanair>.
[71]. ESMAP.Energy Sector Management Assistance Programme. UNDP/World Bank. Urban Air Pollution.South Asia Urban Air Quality Management Briefing Note No.7, July 2002.Available at http://www.worldbank.org/sarurbanair.
[72]. Fletcher C, Peto R. The natural history of chronic airflow obstruction.*Br Med J* 1, 1645-1648, 1977.
[73]. Forastiere F, Galassi C, Biggeri A, Richiardi L, Baussano I, Simoni M, Viegi G; GruppoCollaborativo SIDRIA-2. The proportion of respiratory disorders in childhood attributable to preventable and not preventable risk factors.*EpidemiolPrev*29 (Suppl 2), 67-69, 2005.
[74]. Frye C, Hoelscher B, Cyrys J, Wjst M, Wichmann HE, Heinrich J. Association of lung function with declining ambient air pollution.*Environ Health Perspect*111, 383-387, 2003.
[75]. Gauderman WJ, McConnell R, Gilliland F. Association between air pollution and lung function growth in southern California children. *Am J RespirCrit Care Med* 162, 1383-1390, 2002 a.
[76]. Gauderman WJ, Gilliland F, Vora H, Avol E, Stram D, McConnell R, Thomas D, Lurmann F, Margolis HG, Rappaport EB, Berhane K, Peters JM. Association between air pollution and lung function growth in southern California children: results from a second cohort. *Am J RespirCrit Care Med* 166, 76-84, 2002 b.
[77]. Gauderman WJ, Avol E, Gilliland F, Vora H, Thomas D, Berhane K, McConnell R, Kuenzli N, Lurmann F, Rappaport E, Margolis H, Bates D, Peters J. The effect of air pollution on lung development from 10 to 18 years of age .*N Eng J Med* 351, 1057-1067, 2004.
[78]. Gilliland FD, McConnell R, Peters J, Gong H Jr. A theoretical basis for investigating ambient air pollution and children's respiratory health.*Environ Health Perspect*107, 403-407, 1999.
[79]. Gold DR, Litonjua A, Schwartz J, Lovett E, Larson A, Nearing B, Allen G, Verrier M, Cherry R, Verrier R. Ambient pollution and heart rate variability. *Circulation* 101, 1267-1273, 2000.

[80]. Golshan M, Mohammad –Zadeh Z, Khanlar- Pour A, Iran- Pour R. Prevalence of asthma and related symptoms in junior school children in Isfahan, Iran. *Monaldi Arch Chest Dis* 57, 17 – 22, 2002.

[81]. Graham MH. Psychological factors in the epidemiology of acute respiratory infection. MD thesis. Adelaide, South Australia: University of Adelaide, 1987.

[82]. Graham MH. The epidemiology of acute respiratory infections in children and adults: A global perspective. *Epidemiol Rev* 12, 149-178, 1990.

[83]. Guo YL, Lin YC, Sung FC, Huang SL, Ko YC, Lai JS, Su HJ, Shaw CK, Lin RS, Dockery DW. Climate, traffic-related air pollutants and asthma prevalence in middle-school children in Taiwan.*Environ Health Perspect*107, 1001-1006, 1999.

[84]. Gwaltney JM Jr, Hendley JO, Simon G, Jordon WS Jr. Rhinovirus infections in an industrial population. I. The occurrence of illness. *N Engl J Med* 275, 1261-1268, 1966.

[85]. Gwaltney JM. Epidemiology of the common cold.*Ann N Y AcadSci*353, 54-60, 1980.

[86]. Hajat S, Anderson HR, Atkinson RW, Haines A. Effects of air pollution on general practitioners consultations for upper respiratory diseases in London. *Occu Environ Med* 59, 294-299, 2002.

[87]. Harris JR, Magnus P, Samuelsen SO, Tamdes K. No evidence for effects of family environment on asthma; a retrospective study of Norwegian twins. *Am J RespirCrit Care Med* 156, 43-49, 1997.

[88]. Harrod KS, Jaramilo RJ, Rosenberger CL, Wang SZ, Berger JA, McDonald JD, Reed MD.Increased susceptibility RSV infection by exposure to inhaled diesel engine emissions. *Am J Respir Cell MolBiol*28, 451-463, 2003.

[89]. Hirsch T, Weiland SK, von Mutius E, Safeca AF, Grafe H, Csaplovics E, Duhme H, Keil U, Leupold W. Inner city air pollution and respiratory health and atopy in children. *EurRespir J* 14, 669-677, 1999

[90]. Hiura TS, Kaszubowski MP, Li N, Nel AE. Chemicals in diesel exhaust particles generate reactive oxygen radicals and induce apoptosis in macrophages. *J Immunol*163, 5582-5591, 1999.

[91]. Hoek G, Brunekreef B. Effects of low level winter air pollution concentrations on respiratory health of Dutch children. *Environ Res* 64, 136-150, 1994.

[92]. Hoek G, Brunekreef B, Goldbohm S, Fischer P, van den Brandt PA. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *Lancet* 360, 1203-1209, 2002.

[93]. Hogervorst JGF, de Kok TMCM, Briede JJ, Wesseling G, Kleinjans JCS, van Schayck CP. Relationship between radical generation by urban ambient particulate matter and pulmonary function of school children. *J Toxicol Environ Health Part A* 69, 245-262, 2006.

[94]. Holgate ST. Genetic and environmental interaction in allergy and asthma.*J Allergy ClinImmunol*104, 1139-1146, 1999.

[95]. Holgate ST. The epidemic of allergy and asthma.*Nature* 402, (Suppl. 6760), B2-B4, 1999.

[96]. Horak F Jr, Studnicka M, Gartner C, Spengler JD, Tauber E, Urbanek R, Veiter A, Frischer T. Particulate matter and lung function growth in children: a 3-year follow-up study in Austrian school children. *EurRespir J* 19, 838-845, 2002.

[97]. Hwang BF, Lee YL, Lin YC, Jaakkola JJ Guo YL. Traffic related air pollution as a determinant of asthma among Taiwanese school children. *Thorax* 60, 467-473, 2006.

[98]. Holland WW, Reid DD.The urban factor in chronic bronchitis *Lancet* 1, 445-448, 1965.

[99]. Hoppin JA, Umbach DM, London SJ, Alvanja MC, Sandler DP. Diesel exhaust, solvents, and other occupational exposures as risk factors for wheeze among farmers. *Am J ResirCrit Care Med* 169, 1308-1313, 2004.

[100]. Horak F Jr, Studnicka M, Gartner C, Neumann M, Tauber E, Urbanek R, Veiter A, Frischer T. The effect of inhalable dust particles (PM10) on lung function and respiratory symptoms of school children in lower Austria. [in German]. *WeinKlinWochenschr*112, 126-132, 2000.

[101]. Jedrychowski W, Flak E, Mroz E. The adverse effects of low levels of ambient air pollutants on lung function growth in preadolescent children. *Environ Health Perspect*107, 669-674, 1999.

[102]. Kamat SR, Patil JD, Gregart J, Dalal N, Deshpande JM, Hardikar P. Air pollution related respiratory morbidity in central and north-eastern Bombay. *J Assoc Physicians India* 40, 588-593, 1992.

[103]. Kienast K, Knorst M, Muller-Quernheim J, Ferlinz R. Modulation of IL-1 beta, IL-6, IL-8, TNF-alpha, and TGF- beta secretions by alveolar macrophages under NO2 exposure. *Lung* 174, 57-67, 1996.

[104]. Kilburn KH. Effects of diesel exhaust on neurobehavioral and pulmonary function. *Arch Environ Health* 55, 11-17, 2000.

[105]. Kim JY, Magari SR, Herrick RF, Smith TJ, Christiani DC. Comparison of fine particle measurements from a direct-reading instrument and a gravimetric sampling method.*JOccup Environ Hyg*1, 707-715, 2004.

[106]. Kjellman B, Gustafson PM. Asthma from childhood to adulthood. *Respir Med* 94, 454 – 465, 2000.

[107]. Knuiman MW, James AL, Divitini ML, Ryan G, Bartholomew HC, Musk AW. Lung function, respiratory symptoms and mortality: results from the Busselton Health Study. *Ann Epidemiol*9, 297-306, 1999.

[108]. Lahiri T, Roy S, Basu C, Ganguly S, Ray MR, Lahiri P. Air pollution in Calcutta elicits adverse pulmonary reaction in children. *Ind J Med Res* 112, 21-26, 2000.

[109]. Lave LB, Seskin EP. Air pollution and human health.*Science* 169, 723-733, 1970.

[110]. Lawther PJ, Waller RE, Henderson M. Air pollution and exacerbations of bronchitis. *Thorax* 25, 525-539, 1970.

[111]. Lee BE, Ha EH, Park HS, Kim H, Lee HJ, Lee YK, Lee SJ, Hong YC. Air pollution and respiratory symptoms of school children in a panel study in Seoul. *J Prev Med Pub Health* 38, 465-472, 2005.

[112]. Levy D, Gent M, Newhouse MT. Relationship between acute respiratory illness and air pollution levels in an industrial city. *Am Rev Respir Dis* 116, 167-173, 1977.

[113]. Lewne M, Nise G, Lind ML, Gustavsson P. Exposure to particles and nitrogen dioxide among taxi, bus and lorry drivers. *Int Arch Occup Environ Health* 79, 220-226, 2006.

[114]. Li N, Sioutas C, Cho A, Schmitz D, Misra C, Sempf J, Wang M, Oberley T, Froines J, Nel A. Ultrafine particulate pollutants induce oxidative stress and mitochondrial damage. *Environ Health Perspect*111, 455-460, 2003.

[115]. Li XY, Gilmour TS, Donaldson K, MacNee W. In vivo and in vitro proinflammatory effects of particulate air pollution (PM10). *Environ Health Perspect*105 (Suppl 5), 1279-1283, 1997.

[116]. Liard R, Neukirch F. Questionnaires: a major instrument for respiratory epidemiology. *EurRespir Mon* 15, 154-166, 2000.

[117]. Marano F, Boland S, Bonvallot V, Baulig A, Baeza-Squiban A. Human airway epithelial cells in culture for studying the molecular mechanisms of the inflammatory response triggered by diesel exhaust particles. *Cell BiolToxicol*18, 315-320, 2002.

[118]. Melia RJW, Florey C duV, Darby SC. Differences in NO2 levels in kitchens with gas or electric cookers. *Atmos Environ* 12, 1379-1381, 1978.

[119]. Meltzer EO. Allergic rhinitis: managing the pediatric spectrum. *Allergy Asthma Proc*27, 2-8, 2006.

[120]. Meyer RJ, Haggerty RJ. Streptococcal infections in families: factors altering susceptibility. *Pediatrics* 29, 539-549, 1962.

[121]. MoEF.Ministry of Environment and Forest, Government of India. White Paper On Pollution In Delhi With An Action Plan. New Delhi, 1997.

[122]. Mok JYQ, Simpson H. Outcome for acute bronchitis, bronchiolitis and pneumonia in infancy.*Arch Dis Child* 59, 306-309, 1984.
[123]. Namork E, Johansen BV, Lovik M. Detection of allergens adsorbed to ambient air particles collected in four European cities. *ToxicolLett*165, 71-78, 2006.
[124]. Oberdorster G. Pulmonary effects of inhaled ultrafine particles. *Int Arch Occu Environ Health* 74, 1-8, 2001.
[125]. Okeson CD, Riley MR, Fernandez A, Wendt JO. Impact of the composition of combustion generated fine particles on epithelial cell toxicity: influences of metals on metabolism. *Chemosphere* 51, 1121-1128, 2003.
[126]. Oliver C, Lewis PR, Stoward PJ. Histochemical methods for esterases. In Stoward P.J. and Pearse, A.G.E. (eds). Histochemistry, Theoretical and Applied Vol III, Churchill, Livingstone, London, pp. 607-618, 1991.
[127]. Oosterlee A, Drijver M, Lebret E, Brunekreef B. Chronic respiratory symptoms in children and adults living along streets with high traffic density. *Occup Environ Med* 53, 241-247, 1996.
[128]. Ostro B, Lipsett M, Mann J, Braxton-Owens H, White M. Air pollution and exacerbation of asthma in African-American children in Los Angeles. *Epidemiol*12, 200-208, 2001.
[129]. Osur SL. Viral respiratory infections in association with asthma and sinusitis: a review. *Ann Allergy Asthma Immunol*89, 553-560, 2002.
[130]. Pacheco KA, Tarkowski M, Sterritt C, Negri J, Rosenwasser LJ, Borish L. The influence of diesel exhaust particles on mononuclear phagocytic cell derived cytokines: IL-10, TGF-beta and IL-1 beta. *ClinExpImmunol*126, 374-383, 2001.
[131]. Pandey MR, Boleji JSM, Smith KR, Wafula EM. Indoor air pollution in developing countries and acute respiratory infection in children.*Lancet* 1, 427-429, 1989.
[132]. Payling-Wright G, Payling-Wright H. Etiological factors in broncho-pneumonia amongst infants in London. *J Hyg (Camb)* 44, 15-30, 1945.
[133]. Pearce N, Pekkanen J, Beasley R. How much asthma is really attributable to atopy? *Thorax* 54, 268-272, 1999.
[134]. Peters A, Wichmann HE, Tuch T, Heinrich J, Heyder J. Respiratory effects are associated with the number of ultrafine particles. *Am J RespirCrit Care Med* 155, 1376-1383, 1997.
[135]. Peters A, Dockery DW, Heinrich J, Wichmann HE. Short term effects of particulate air pollution on respiratory morbidity in asthmatic children. *EurRespir J* 10, 872 – 879, 1997.
[136]. Pierse N, Rushton L, Harris RS, Kuchni CE, Silverman M, Grigg J. Locally generated particulate pollution and respiratory symptoms in young children. *Thorax* 61, 216-220, 2006.
[137]. Pilotto LS, Douglas RM, Attewall R, Wilson SR. Respiratory effects associated with indoor nitrogen dioxide exposure in children. *Int J Epidemiol*26, 788-796, 1997.
[138]. Pio A, Leowski J, Ten Dam HG. The magnitude of the problem of acute respiratory infections. In: Douglas RM, Kerby-Eaton E, eds. Acute respiratory infections: proceedings of an international workshop. Adelaide, South Australia: University of Adelaide, 3-16, 1985.
[139]. Ponikau JU, Sherris DA, Kephart GM, Adolphson C, Kita H. The role of ubiquitous airborne fungi in chronic rhinosinusitis.*Curr Allergy Asthma Rep* 5, 472-476, 2005.
[140]. Pope CA III. Respiratory disease associated with community air pollution and a steel mill, Utah valley. *Am J Public Health* 79, 623-628, 1989.
[141]. Pope CA III, Dockery DW, Spengler JD, Raizenne ME. Respiratory health and PM10 pollution.A daily time series analysis.*Am Rev Respir Dis* 144, 668-674, 1991.
[142]. Pope CA III, Verrier RL, Lovett EG, Larson AC, Raizenne ME, Kanner RE, Schwartz J, Villegas GM, Gold DR, Dockery DW. Heart rate variability associated with particulate air pollution. *Am Heart J* 138, 890-899, 1999.
[143]. Pope CA III, Hill RW, Villegas GM. Particulate air pollution and daily mortality on Utah's Wasatch Front. *Environ Health Perspect*107, 567-573, 1999.
[144]. Pope CA III. Epidemiology of fine particulate air pollution and human health: biological mechanisms and who's at risk? *Environ Health Perspect*108, 713-72, 2000.
[145]. Pope CA III, Burnett RT, Thurston GD. Cardiovascular mortality and long-term exposure to particulate air pollution: epidemiological evidence of general pathophysiological pathways of disease. *Circulation* 109, 71-77, 2004a.
[146]. Pope CA III, Burnett RT, Thurston GD, Thun MJ, Calle EE, Krewski D, Godleski JJ. Cardiovascular mortality and long-term exposure to particulate air pollution: epidemiological evidence of general pathophysiological pathways of disease. *Circulation* 109, 71-7, 2004.
[147]. Pope CA III, Barnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD. Lung cancer, cardiopulmonary mortality, and long term exposure to fine particulate air pollution. *JAMA* 287, 1132-1141, 2002.
[148]. Raaschou-Nielsen O. Air pollution and childhood cancer. In: *Effects of air pollution on children's health and development : A review of the evidence*. World Health Organization Special Programme on Health and Environment .European Centre for Environment and Health.Bonn, pp. 138-161, 2005.
[149]. Rao NSN. Elements of health statistics. Tara Book Agency: Varanasi, p.87-101, 1989.
[150]. Ratageri VH, Kabra SK, Dwivedi SN, Seth V. Factors associated with severe asthma. *Indian Pediatr*37, 1072-1082, 2000.

Annexure 1

Table 1: Ambient Air Qualities in MandiGobindgarh

	Existing Microgram/ cubic meter	Critical limit Microgram/ cubic meter
SPM	890.3	291.3
NO_x	27.4	7.4
SO_2	29.6	8.6

Table 2: Air Pollution and its sources in MandiGobindgarh and surrounding areas

	Urban	Rural
Air	Polyaromatic hydrocarbons (PAHs), Carbon dioxide CO_2, carbon monoxide, oxides of oxygen (NOx), nitrogen oxides; sulphur oxides; tiny particles of solids, such as lead, arsenic, organic and elementary carbon from soot, alarming levels of Particulate Matter PM_{10}, PM $_{2.5}$ of aerodynamic diameter, benezene (C_6H_6), smog to include ozone and carbon monoxide; industrial smoke, smoke from automobiles and heavy vehicles, generators, coal and firewood burning in *sigris* and *chullahs* in homes and offices. Noise pollution by vehicles specially pressure horns, whistling trains, industry hooters, DJs in marriage places, homes and vehicles, loudspeakers; Coal tar heating during road construction dust-scrap loading and unloading, GT road construction work, crushers, vehicle movement	Particulate Matter, CO_2, NOx from stubble burning in fields, Tractors, tube wells run on diesel, brick kilns, generators, coal and firewood burning in *sigris* and chullahs in homes and offices, wood, grass, *gobar* burning. Sound polluted by vehicles pressure horns, DJs loudspeakers. Heat is caused by burners, electric heaters, stubble, coal tar heating by road construction; dust is caused by: Road construction work, Crushers, Vehicle movement, brick kilns, dust storms, suit, paddy and rice harvesting

Table 3: TB cases in MandiGobindgarh 2009-2012

TB Cases

00	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2009	15	19	81	16	23	33	19	18	15	17	12	21	289
2010	12	18	68	75	16	11	12	10	22	12	1	10	267
2011	14	15	32	33	34	32	24	28	26	19	18	18	293
2012	7	18	26	10	15	17	12	25	15	23	19	22	207
	48	70	207	134	88	93	67	81	78	71	50	71	1056

Graph 1: TB cases in MandiGobindgarh 2009-2012

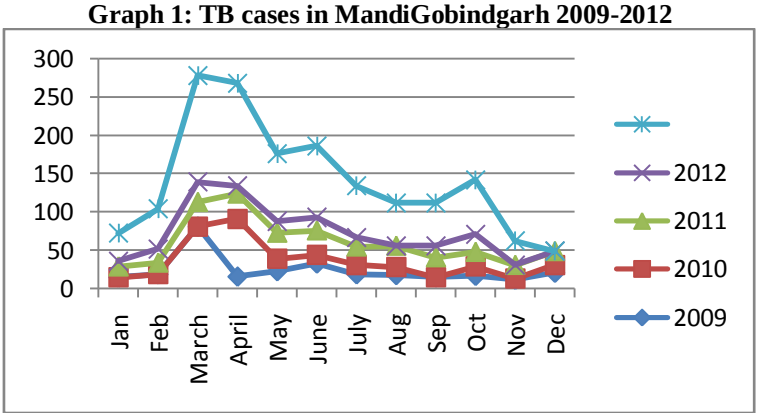

Table 4 and Graph 2: Heart diseases in MandiGobindgarh 2009-2012

Heart Diseases

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2009	13	17	18	17	19	18	22	17	11	9	15	20	196
2010	1	15	33	26	17	14	28	28	29	27	31	22	271
2011	23	24	28	144	222	485	962	960	213	651	639	622	4973
2012	593	962	1041	851	945	804	858	867	264	237	500	423	8345

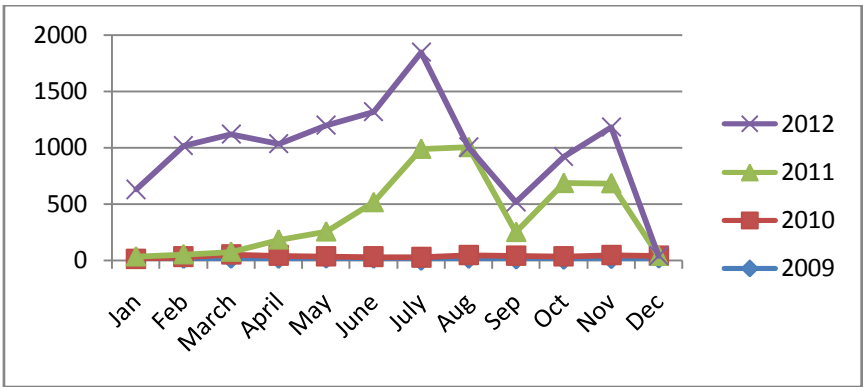

Table 5 and Graph 3: Skin Cases in MandiGobindgarh 2009-2012

Skin													
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	nov	Dec	Total
2009	2	2	4	4	10	9	0	2	7	6	8	5	59
2010	8	10	10	5	6	7	7	4	5	5	4	1	72
2011	1	3	4	4	3	7	5	4	4	5	3	4	47
2012	7	12	13	710	879	527	842	876	987	348	187	167	5555
	18	27	31	723	898	550	854	886	1003	364	202	177	5733

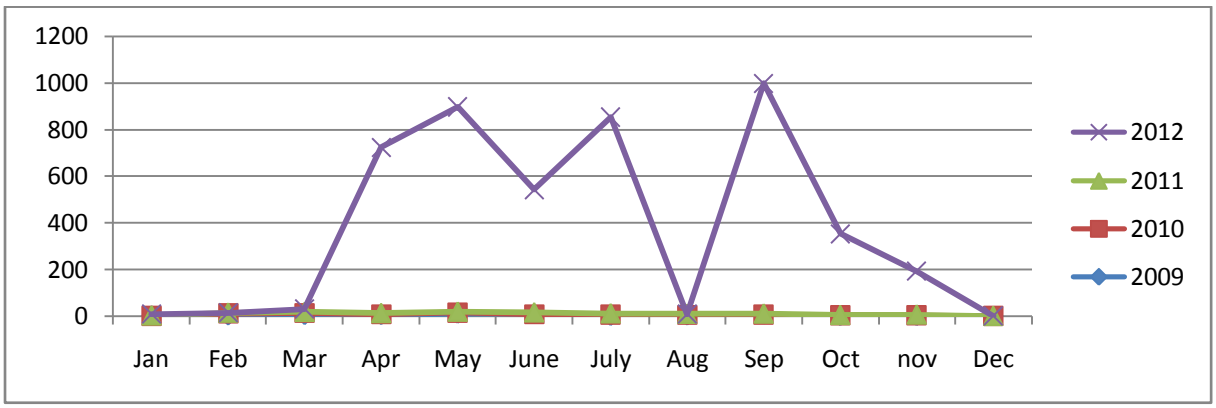

Table 6 and Graph 6: Respiratory diseases in MandiGobindgarh 2009-2012

Respiratory													
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	nov	Dec	Total
2009	695	974	1012	600	544	638	669	618	594	565	524	652	8085
2010	531	662	868	802	712	658	747	803	730	606	642	645	8406
2011	11	314	751	731	868	600	703	382	848	282	322	312	5812
2012	268	267	293	269	405	330	13	167	172	257	455	434	2274
	1505	2217	2924	2402	2529	2226	2132	1803	2344	1710	1488	1297	25577

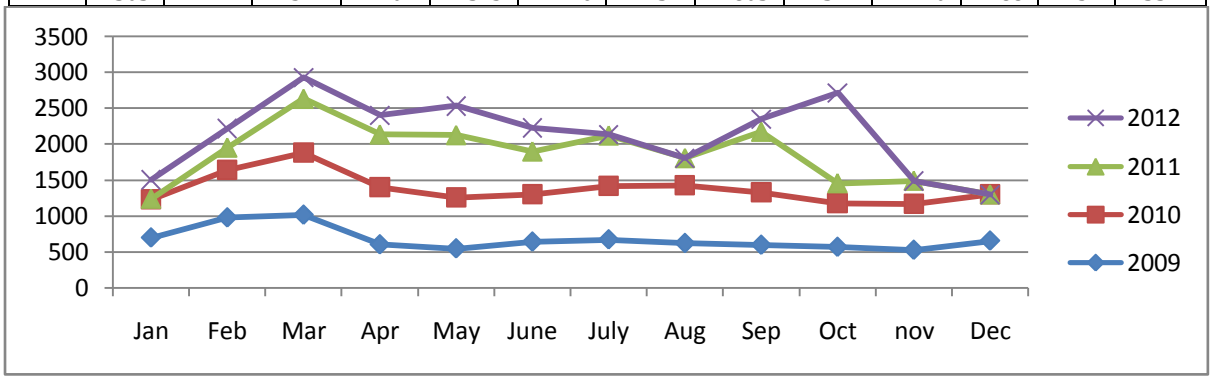

Table 7 and Graph 7: Asthama in MandiGobindgarh 2009-2012

Asthma													
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	nov	Dec	Total
2009	12	12	4	7	5	20	6	6	3	9	2	2	88
2010	7	5	8	6	3	2	2	2	8	9	3	29	84
2011	11	7	5	6	8	11	6	7	6	3	4	32	106
2012	3	3	5	7	12	18	397	8	7	7	681	432	1580
	33	22	27	26	28	51	411	23	24	28	690	495	1858

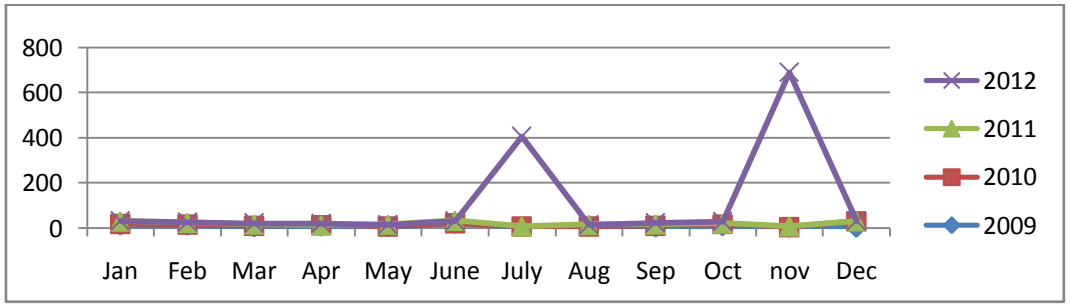

Table 8 Diseases in Rural Area Amloh

		Rural Sick Amloh					
	Total samples	Male		Female			Total
		0 to 60	61 to 80	0 to 20	21 to 40	41 to 60	
1	TB	6	3	1	1	1	12
2	Respiratory	1	1	0	0	1	3
3	Skin	6	4	2	0	3	15
4	Heart	9	4	1	2	4	20
5	Gastro	4	3	1	0	1	9
	G. Total	26	15	5	3	10	59

Table 9. Comparative study of Diseases in MandiGobindgarh& Rural Area Amloh

Sr	Disease	Urban Sick	Rural Sick
1	TB	1056	12
2	Respiratory	25577	3
3	Skin	5733	15
4	Heart	8345	20
	Total	40711	50

Table 10: Wilcoxon Signed Rank Test Statistics of relationship between air pollution and various diseases in Urban Area MandiGobindgarh

		N	Correlation	Sig.
Pair 1	Air & Respiratory	98	.083	.418
Pair 2	Air & Heart	98	.084	.409
Pair 3	Air & TB	98	.232	.021
Pair 4	Air & Skin	98	.078	.443

Table 11: Wilcoxon Signed Ranks Test giving effect of Air pollution on Diseases in Rural area

	TB - Air	Respiratory - Air	Skin - Air	Gastro - Air	Heart - Air
Z	-7.280[a]	-9.110[a]	-7.020[a]	-7.554[a]	-6.949[a]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

a. Based on positive ranks.

Table 12: Paired Samples Correlations between air and various diseases in urban area of MandiGobindgarh

		N	Correlation	Sig.
Pair 1	Air & Respiratory	113	.097	.307
Pair 2	Air & Heart	113	-.076	.421
Pair 3	Air & TB	113	.059	.535
Pair 4	Air & Skin	113	.057	.550

Table 13: Paired Samples Correlations between air and various diseases in Rural area surrounding MandiGobindgarh

		N	Correlation	Sig.
Pair 1	Air & Respiratory	98	.083	.418
Pair 2	Air & Heart	98	.084	.409
Pair 3	Air & TB	98	.232	.021
Pair 4	Air & Skin	98	.078	.443