Dhanya John “Impact of urbanization on sustainable environment in Kerala - a study based on Thrissur district.” Thesis. Research and Post Graduate Department of Economics, St. Thomas’ College (Autonomous), University of Calicut, 2019.

CHAPTER – 6

AN ANALYSIS OF THE IMPACT OF URBANIZATION ON ENVIRONMENTAL CONDITIONS OF SAMPLE HOUSEHOLDS

CHAPTER – 6

AN ANALYSIS OF THE IMPACT OF URBANIZATION ON ENVIRONMENTAL CONDITIONS OF SAMPLE HOUSEHOLDS

6.1 Introduction

Urbanization process has been associated with other important aspects such as economic, social and environment. It is commonly thought to be linked to air and water pollution, sprawl and the like. Based on the report of UN (2014), rapid and unplanned urban growth as well as urban expansion threatens sustainable development when the necessary infrastructure is not developed or when polices are not well – implemented. Unplanned or inadequately managed urban expansion leads to rapid sprawl, pollution, and environmental degradation, together with unsustainable production and consumption patterns. Main issues of urbanization emphasized by governments are urban poverty, solid waste disposal, housing for the poor, environmental protection, pollution, the rising crime rate, and so on (Brain, 2000).

In India, the rapid increase in urbanization has led to severe environmental degradation that undermines the environmental resource base upon which sustainable development depends. Urbanization affects the environment in many ways: its relation with discharge, of pollutants and generation of solid/liquid/gaseous wastes, secondly, its relation with the depletion of natural resources and its relation with the social costs of population explosion, pollution, poverty and sustainable development. With urbanization even the simple matter of waste disposal becomes a problem. The 'throw away' societies of cities generate the most trash disposal, which poses a major threat today. Hence, the country is facing serious environmental concerns in terms of air and water pollution, increasing carbon emissions, changing land use pattern solid waste generation and disposal, and poor sanitation amenities.

The environmental degradation in our country could be attributed to rapid growth of population, which adversely affects the natural resources and environment. Similarly,

the increasing population ultimately leads to increasing energy requirements which results in pollution. Thus pollution in the modern cities are caused by the overloading of the environment with noxious substances contained in our daily consumption and production activities, they are the effluents of affluence in one sense. Discarded in the air, land and water, they become the wrong thing in the wrong place at the wrong time. This is posing serious environmental problems and can retard the process of socio – economic development.

Degradation of the environment in Kerala due to urbanization takes many forms such as deterioration of water resources, pollution of air and water, solid waste generation and so on. Increase in population coupled with rapid urbanization, industrialization and consumerism, without due regard to environmental considerations, have led to extensive pollution of air, water and land. The raw materials consumed during these activities have resulted in the dwindling of non –renewable resources and accumulation of wastes. These wastes are indiscriminately disposed of and as a consequence the water, air and land become more polluted. Thus, the major environmental issues related with unplanned urbanization in Kerala are water pollution, air pollution, sound pollution, industrial pollution, vehicular pollution and problems related to deforestation and hospital waste disposal.

Due to excessive human activities vehicle pollution, sound pollution and industrial pollution have been increasing which results in reducing the green cover. Emissions of fluro carbons and carbon monoxide adversely affect the balance of atmosphere and which ultimately results in global warming. Increased level of carbon dioxide and resulting warm atmosphere adversely affects the health conditions of human beings. A study conducted by WHO revealed the fact that in Kerala, the levels of air pollution and water pollution are at a high level which is a clear indicator of environmental degradation of the state. The study concentrates on the fact that in the name of urbanization and development we are ignoring the basic requirement of clean and green environment for the survival of human race. The present study concentrates on the consequences of rapid urbanization in the form of air pollution, water pollution, noise pollution and solid waste pollution.

To examine the impact of urbanization on sustainable environment a study has been carried out in Thrissur city which is one of the most urban populated cities of the

state. About 225 households are selected as sample respondents from three zones such as the Central zone, Ayyanthole and Koorkancheri. In all these three zones, there are some slum dwellers too. The study tries to analyze the environmental living conditions of the household respondents and consequent health impacts with particular emphasis on water, air, noise and solid waste pollution. From the collected reliable information from the respondents with suitable questionnaire the study found that there is close association between the environmental degradation and rapid urbanization.

In order to analyze attitude and perception of the respondents regarding environmental degradation due to urbanization, this chapter has been categorized into several sections.

6.2 Environmental problems due to urbanization

6.2. (i) Water pollution due to urbanization

6.2. (ii) Air pollution due to urbanization

6.2. (iii) Solid waste pollution due to urbanization

6.2. (iv) Noise pollution due to urbanization

6.3 Method of economic valuation of environmental goods

6.4 Implications of the study.

6.2 Environmental Problems Due to Urbanization

The rapid rate of urbanization and development has negative impact on the environment. Urbanization affects the environment in many ways: firstly, its relation with discharge of pollutants, air quality is affected and leading to generation of solid/liquid/gaseous wastes; secondly, its relation with the depletion of natural resources, and its relation with the social costs of population explosion, pollution, poverty and sustainable development. Thus urbanization has resulted in increased pollution of land, water, air and other natural resources. It is not surprising that health risks have also increased.

The details of the environmental problems faced by the sample respondents are furnished in table 6.1.

Among the total sample respondents, 76 respondents admitted to have water pollution, 36 claimed to have air pollution, 48 respondents faced noise pollution and 38 responded to have solid waste pollution. The respondents from all the three zones have different perceptions towards different types of pollutions. Respondents who are affected by air pollution may not have problems of water pollution and other types of pollution and so on. Similar is the case with other types of pollutions and household responses.

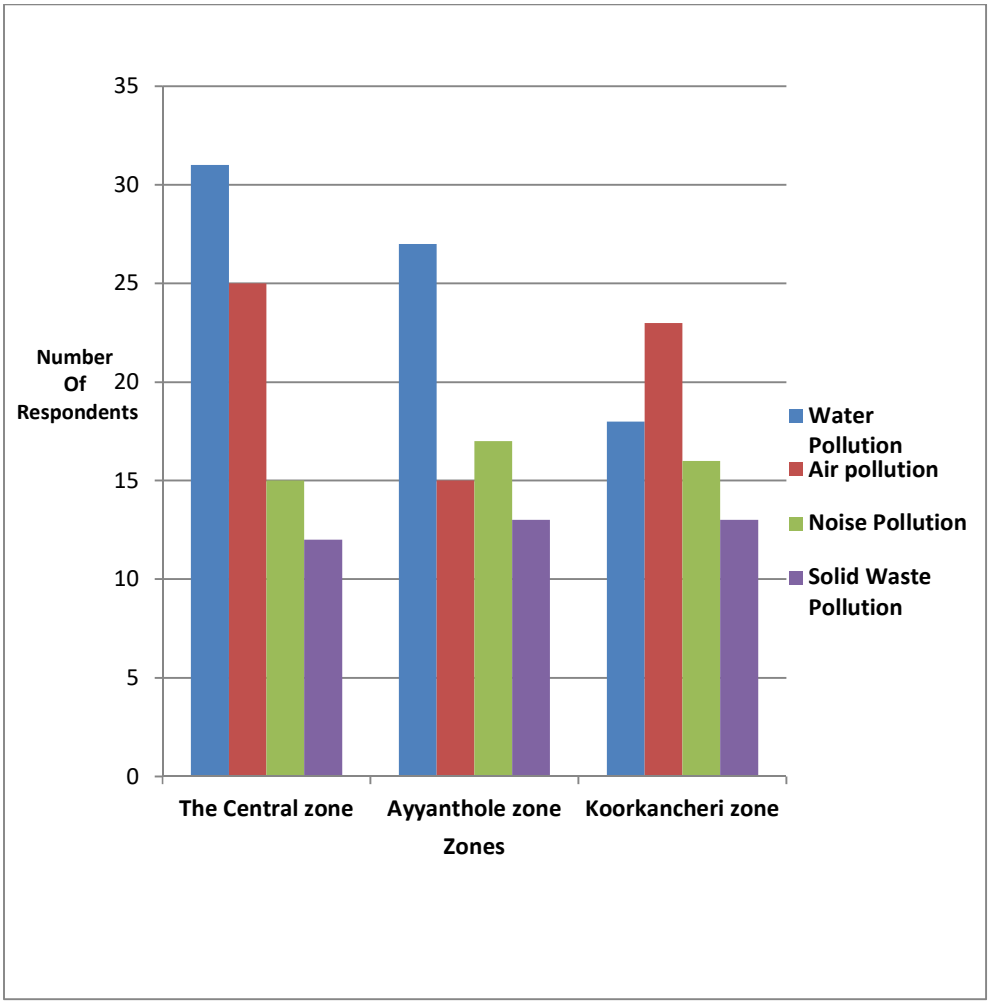
Table 6.1

Environmental Problems Due to Urbanization

Types of Pollution	Name of the Zone			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Water Pollution	31 (40.8) [37.3]	27 (35.5) [37.5]	18 (23.7) [25.8]	**76** (100.0) [33.8]
Air Pollution	25 (39.7) [30.1]	15 (23.8) [20.8]	23 (36.5) [32.8]	**63** (100.0) [28.0]
Noise Pollution	15 (31.2) [18.1]	17 (35.4) [23.6]	16 (33.4) [22.8]	**48** (100.0) [21.3]
Solid Waste Pollution	12 (31.6) [14.5]	13 (34.2) [18.1]	13 (34.2) [18.6]	**38** (100.0) [16.9]
Total	83 (36.9) [100.0]	72 (32.0) [100.0]	70 (31.1) [100.0]	**225** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.1Environmental Problems Due to Urbanization



The table 6.1 also shows that out of 76 respondents, who are affected by polluted water, 40.8 percent are from the Central zone, 35.7 percent respondents are from Ayyanthole zone and 23.7 percent are from Koorkancheri zone. Similarly respondents who are affected by air pollution are 39.7 percent from the Central zone and 36.5 percent from the Koorkancheri zone and remaining 23.8 percent are from Ayyanthole zone. Out of 225 respondents, 48 respondents are facing problems of noise pollution among which 35.4 percent are from Ayyanthole zone, 33.4 percent are from Koorkancheri zone and 31.2 percent are from the Central zone. Similarly, solid waste pollution affected respondents are higher in both Ayyanthole and Koorkancheri zones (34.2 percent) followed by the Central zone (31.6 percent).

In the central zone, 37.3 percent respondents are affected by water pollution, 30.1 percent are affected by air pollution, 18.1 percent are affected by noise pollution and

14.5 percent are having problems due to solid waste pollution. In the Ayyanthole zone, major pollution is water pollution. It is found that 37.5 percent respondents are affected by this. In Koorkancheri zone, higher percentage of pollution is marked in air pollution (32.8) percent respondents. Hence, it can be concluded that, there are severe environmental problems faced by the household respondents due to urbanization. There may be variations in different types of pollutions in different locations. For example, water pollution is higher in the Central zone and Ayyanthole zone, air pollution is higher in the Central zone and Koorkancheri zone, noise pollution is higher in all the zones and solid waste pollution is almost at the same level in all the three zones. Thus due to urbanization, there is environmental problems like water pollution, air pollution, noise and solid waste pollutions which adversely affects the living and health conditions of the households.

A cross-sectional analysis, which attempted to compare income levels of the sample respondents and environmental pollution magnitude are exhibited in table 6.2.

Table 6.2

Environmental Pollution at Different Income Levels of the Households

Types of Pollution	Annual Income (In Rupees)			**Total**
	Less than 1,00,000	1,00,000-2,00,000	More than 2,00,000	
Water Pollution	35 (46.0)	24 (31.6)	17 (22.4)	**76** (100.0)
Air Pollution	27 (42.8)	24 (38.1)	12 (19.1)	**63** (100.0)
Noise Pollution	27 (56.2)	14 (29.2)	7 (14.6)	**48** (100.0)
Solid Waste Pollution	19 (50.0)	14 (36.8)	5 (13.2)	**38** (100.0)
Total	**108** (48.0)	**76** (33.8)	**41** (18.2)	**225** (100)

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.

A combined analysis of environmental pollution at different income levels of the households in the study area is furnished in the table. Households having the income category of less than 1,00,000 rupees per annum are facing higher percentage of different types of pollutions. Among the respondents of this income level 56.2 percent are facing noise pollution, 50.0 percent are admitted to have solid waste pollution and46.0 and 42.8 percent respondents have water and air pollution problems respectively. The respondents with Rs.1,00,000-2,00,000 annual income found to have more of water and air pollution problems. The higher income category respondents (more than 2 lakhs rupees per annum) are comparatively having lower pollution problems than respondents with lower income levels.

6.2. (i) Water Pollution due to Urbanization

Water and air are the most indispensable fundamentals that nature has provided to sustain life on earth. It is a free gift of nature upon which all living things are depended. Water bodies include for example lakes, rivers, oceans, aquifers and ground water. Water has a great self generating capacity that can neutralize the polluting interventions carried out by humans. Due to human activities water bodies are contaminating which is leading to water pollutions. Water pollution results when contaminants are introduced into the natural environment. However, if human activities continue uncontrolled and unscientific exploration of water resources, its self generating capacity will fail which will results in deteriorating the quality of existing water resources.

Mainly the sources of water pollution are agricultural pollution, industrial pollution, domestic pollution, hydrocarbon pollution and sea water pollution. In the state the main source of water pollution is rapid urbanization and population pressure. About 90 percent of water pollution problems usually occur in urban areas. The growth of urban population leads to demand for more water for domestic as well as industrial use and treatment of wastes. Water pollution in urban areas is mainly due to domestic sewage and industrial/hospital/other effluents. The polluted water and its usage is the main cause for water borne diseases in urban areas. There may be seasonal variations in water pollution and availability of water. But commonly the urban areas are suffering from desecration of quality of water.

Figure 6.2 Photographs of Water pollution in Sample City

On the basis of the reference given by Kerala State Pollution Control Board (KSPCB) biological water quality criteria of region can be specified as given in the table 6.3.

Table 6.3

Biological Water Quality Criteria

Indicator Colour	Water Quality Class	Water Quality Characteristic
Blue	A	Clean (**Very good)**
Light Blue	B	Slight Pollution (**Good**)
Green	C	Moderate Pollution (**Bad**)
Orange	D	Heavy Pollution (**Very Bad**)

Source: Kerala State Pollution Control Board, 2013.

The quality of water is classified under 4 classes A, B, C, and D which are representing the characteristics of clean, slight pollution, moderate pollution and heavy pollution. Based on the above criteria the respondent's perception towards quality of water in the urban area is furnished in table 6.4. The responses towards quality of water are marked in 4 categories.

Table 6.4

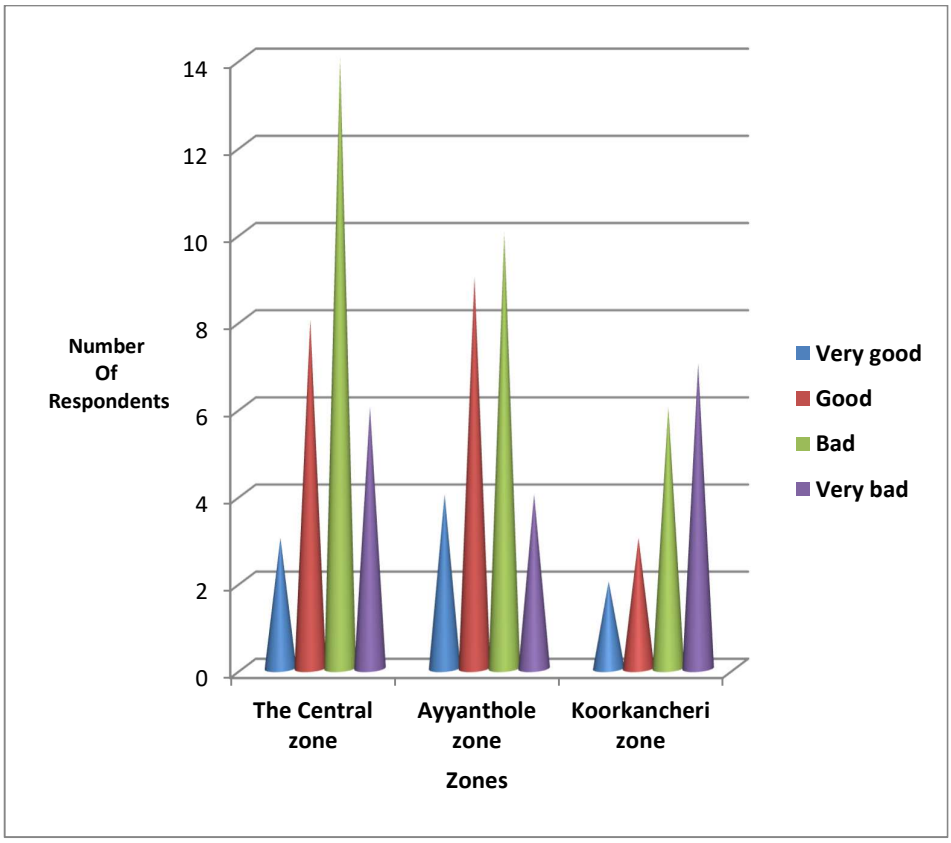
Quality of Water According to the Locations

Zones	Quality of Water				**Total**
	Very good	Good	Bad	Very Bad	
The Central zone	3 (9.7) [33.3]	8 (25.8) [40.0]	14 (45.2) [46.7]	6 (19.3) [35.3]	**31** (100.0) [40.8]
Ayyanthole zone	4 (14.8) [44.4]	9 (33.3) [45.0]	10 (37.1) [33.3]	4 (14.8) [23.5]	**27** (100.0) [35.5]
Koorkancheri zone	2 (11.1) [22.3]	3 (16.7) [15.0]	6 (33.3) [20.0]	7 (38.9) [41.2]	**18** (100.0) [23.7]
Total	**9** (11.8) [100.0]	**20** (26.3) [100.0]	**30** (39.5) [100.0]	**17** (22.4) [100.0]	**76** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicate column percentage.

Figure 6.3

Quality of Water According to the Locations



Out of 76 respondents, 9 respondents admitted water quality as very good, 20 respondents considered the water quality as good, 30 admitted that water quality is bad and 17 respondents admitted water quality as very bad. In other words 39.5 percent respondents are having bad quality water. Only 11.8 percent respondents are accessing very good quality water. Due to the poor maintenance of the drainage system, the waste water frequently get mixed up with the existing water resources. This is the main reason for deteriorating the quality of water in the study area.

In the slum areas of three zones, it is observed that there is severe problem of very bad quality of drinking water. These areas are besides the drainage or sewage system and it ultimately results in pollution of existing water. About 38.9 percent respondents marked the water quality as very bad in Koorkancheri zone. In Ayyanthole zone, 37.1 respondents categorized water quality as bad and in Central zone, 45.2 percent

respondents admitted water quality as bad. In non-slum areas, there is superiority of water quality. Similarly, respondents of high income category are having accessibility of very good quality water. Hence, there is significant relationship between the quality of water and the nature of locations namely slum and non-slum areas.

Lack of proper waste water drainage and sewage system is the main reason for quality deterioration of existing water resources in urban areas. The most important source of water for households is dug wells. But improper drainage system of urban areas results in polluting the wells. Similarly the attitude of people towards waste disposal in water bodies also makes deterioration in the quality of water resources. Industrial wastes, constructions wastes, vehicle lubrication system losses, hospital wastes etc. are the main sources of waste water in urban areas.

Water pollution ultimately results in health problems of the households. Due to water contamination, the respondents are affected by number of diseases. The responses towards water borne diseases are marked in table 6.5.

Table 6.5

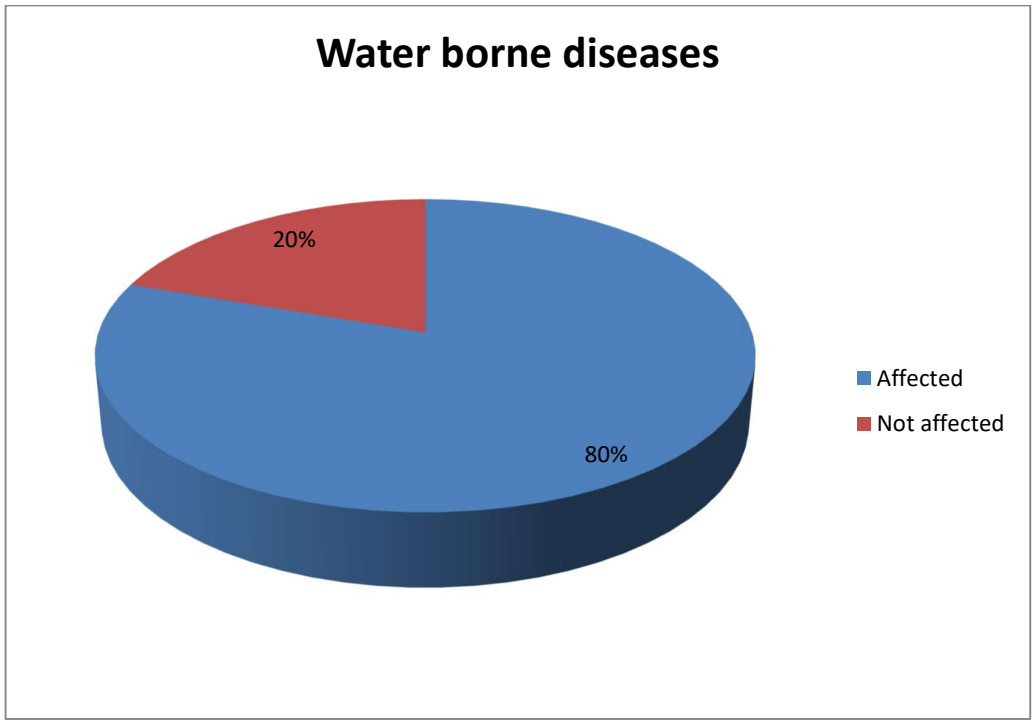
Responses towards Water Borne Diseases

Water Related Diseases	Name of Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Affected	26 (42.6) [83.9]	20 (32.8) [74.1]	15 (24.6) [83.3]	**61** (100.0) [80.3]
Not Affected	5 (33.3) [16.1]	7 (46.7) [25.9]	3 (20.0) [16.7]	**15** (100.0) [19.7]
Total	**31** (40.8) [100.0]	**27** (35.5) [100.0]	**18** (23.7) [100.0]	**76** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.4

Responses towards Water Borne Diseases



The table and the figure show that 80.3 percent respondents related with water pollution are affected by waterborne diseases. Only 19.7 percent respondents are not affected by these kinds of diseases. Among the 3 zones, water borne diseases are higher in the Central zone as well as in Koorkancheri zone compared to the Ayyanthole zone. The incidence of water borne diseases is found to be higher in the slum areas of all the 3 zones. It is interesting to note that 25.9 percent respondents of the Ayyanthole zone are not affected by water borne diseases. The higher percentage of affected respondents is in the Central zone (42.6 percent). Therefore, the data shows that water borne diseases are higher in slum areas compared to non-slum areas. Water contamination leads to water borne diseases among the households. There are health impacts due to water pollution.

Water contamination leads to several diseases in the study area. Some of the prominent water borne diseases affected by the respondents in the study area represented in table 6.6. Drinking contaminated water can lead to waterborne diseases

such as Cholera, Diarrhoea, Typhoid fever, Hepatitis A and E, and other diseases like Malaria, Dysentery, Filariasis, E.coli infection etc. These diseases are mainly found in slum areas rather than non-slum areas. Among the water borne diseases, Diarrhea is found as prominent in household respondents (34.4 percent). Similarly 18.0 percent households are suffered from Hepatitis A and E, 29.5 percent respondents had Typhoid fever and so on. Some of the respondents have other diseases like Malaria, Filariasis, Vibrio illness etc. The zone wise analysis shows that, incidence of Diarrhoea is higher in the Central zone (57.1 percent), Cholera is found higher in Koorkancheri zone (57.1 percent), Typhoid fever is higher in Ayyanthole zone (38.9 percent) and so on. Hence, almost all diseases are reported in sample areas due to water pollution in those areas.

Table 6.6

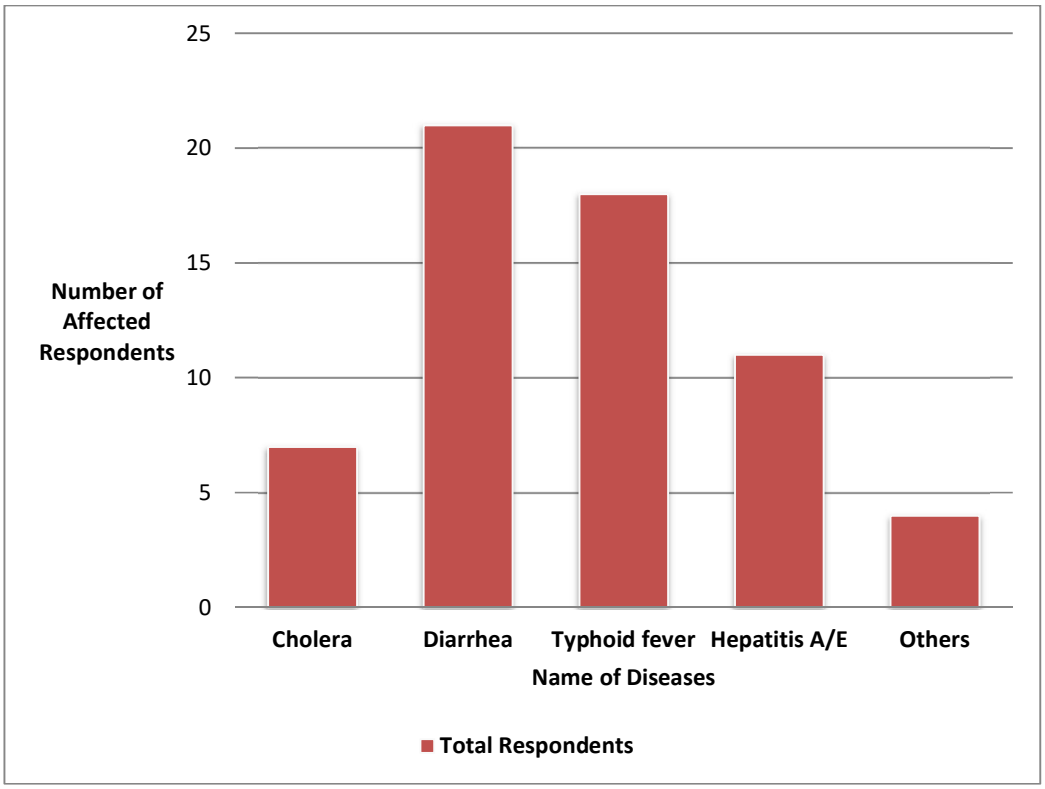
Name of the Water Borne Diseases Affected by the Respondents

Name of Diseases	Name of Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Cholera	2 (28.6) [7.7]	1 (14.3) [5.0]	4 (57.1) [26.7]	**7** (100.0) [11.5]
Diarrhoea	12 (57.1) [46.1]	6 (28.6) [30.0]	3 (14.3) [20.0]	**21** (100.0) [34.4]
Typhoid fever	6 (33.3) [23.1]	7 (38.9) [35.0]	5 (27.8) [33.3]	**18** (100.0) [29.5]
Hepatitis A/E	5 (45.4) [19.2]	4 (36.4) [20.0]	2 (18.2) [13.3]	**11** (100.0) [18.0]
Others	1 (25.0) [3.9]	2 (50.0) [10.0]	1 (25.0) [6.7]	**4** (100.0) [6.6]
Total	**26** (42.6) [100.0]	**20** (32.8) [100.0]	**15** (24.6) [100.0]	**61** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.5

Name of the Water Borne Diseases Affected by the Respondents



The spread of waterborne diseases will lead to higher health cost for the respondents. It is estimated that out of the total earnings of the household respondents a sizable amount has to be spend for medical treatment. This amount may differ in seasonal variations. For example in rainy seasons the incidence of water borne diseases is higher compared to summer season. The estimation of monthly cost incurred by respondents due to water pollution is represented in table 6.7.

About 14.7 percentage respondents incurred a monthly cost of less than 500 rupees for medical treatment of waterborne diseases.Among the respondents 29.5 percent had to spend 500 – 1000 rupees, 40.9 percent respondents incurred 1000 – 1500 rupees, and 14.9 percent respondents spend more than 1500 rupees monthly for medical treatment due to water borne diseases. The cost is found to be higher in the slum areas of Koorkancheri as well as the Central zone. Among the high income group the expenses for medical treatment due to water contamination is marginal. Mainly the

cost is incurred on treatment for fever especially in rainy seasons. In the Ayyanthole zone, 50.0 percent respondents incurred a cost of 1000 – 1500 rupees for health treatment.

Table 6.7

Monthly Cost incurred on Water Borne Diseases

Total Cost in Rupees	Name of the Zones			**Total Respondents**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 500	4 (44.4) [15.4]	1 (11.2) [5.0]	4 (44.4) [26.7]	**9** (100.0) [14.7]
500 - 1000	8 (44.4) [30.8]	7 (38.9) [35.0]	3 (16.7) [20.0]	**18** (100.0) [29.5]
1000 – 1500	10 (40.0) [38.4]	10 (40.0) [50.0]	5 (20.0) [33.3]	**25** (100.0) [40.9]
More than 1500	4 (44.4) [15.4]	2 (22.2) [10.0]	3 (33.4) [20.0]	**9** (100.0) [14.9]
Total	**26** (42.6) [100.0]	**20** (32.8) [100.0]	**15** (24.6) [100.0]	**61** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Hence, the data shows that due to deterioration in quality of available water, the residents of slum areas in the city are affected more in two grounds. Firstly, due to increased health problems; and secondly, due to low income and high health expenses. In order to avoid these problems, the authorities of the urban area should be more responsible to provide good quality water to the residents and ensure the quality regularly through efficient monitoring. This will reduce the recurring expenditure on health and will reduce economic burden of the residents.

To analyze the variances in water borne diseases in three sample zones ANOVA is used. This method is viewed to verify the differences in sample zones in the spread of water borne diseases as it leads to economic issues of the households. The result is exhibited in table 6.8.

Table 6.8

ANOVA (Water- Borne Diseases)

Source of Variation	Sum of Sq. between samples	D.f	Mean Sq. between Samples	F
The Central Zone	31	7	3.7	1.96
Ayyanthole Zone	29	9	3.2	1.74
Koorkancheri Zone	29	8	3.6	1.98

Source: Survey Data

The results of the ANOVA method clearly implied that the F ratio is significantly low in all the cases. This shows that, there are no significant variations in water borne diseases in all the three sample zones. Hence, all the sample zones have similar health impacts due to water pollution.

Hence, the analysis of urbanization and water pollution concludes that there is higher level of water pollution in urban areas where there is high population density. The quality of available water is not satisfactory and because of unscientific sewage and drainage system, water resources are found contaminated. This water contamination influences badly upon the residents in the form of waterborne diseases. For meeting the expenses on waterborne diseases households need to spend sizable amount of money which leads to economic burden for the households. Thus urbanization in an unplanned manner is leading to water pollution and related health and economic issues in the state.

6.2. (ii)Air Pollution Due to Urbanization

The quality of air in Indian cities is a major environmental concern. Recent studies show that India's air pollution is in a critical level compared to other countries of the world. Fuel burning vehicles including trucks, jeeps, cars, trains and airplanes emit harmful gases which causes immense amount of pollution. WHO conducted a study about the air pollution index in cities all over the world and revealed that, 13 of the world's 20 cities with the highest annual levels of air pollution are in India (WHO, 2016). Accelerating growth in the transport sector, booming construction industry, and growing industrial sector are responsible for worsening air pollution in India. Dust & construction, waste burning, transport sector, diesel generator, industries,

domestic cooking are the main contributors of India's air pollution. Among them, dust & construction contribute about 45% to the pollution in India, which is followed by waste burning (WHO, 2016).

Vehicles and industries are mainly responsible for the deterioration of air quality in Kerala. It is found that among the main sources of air pollution, vehicular exhausts have become a major source of air pollution in sample areas of Thrissur city. The consumption of petroleum products in vehicles, industries and burning of plastic wastes by households in the open space results in emission of air pollutants in large quantities. These emissions are of two forms- solid particles (SPM) and gaseous emissions (SO_2, $NO_2$and Co etc.). Health problems such as asthma, chronic bronchitis, heart diseases, TB, Cancer and oxygen deficiency in blood are contributed mainly byhigh levels of air pollution. The attitude of the respondents towards air pollution and related issues are analyzed in this section.

Figure 6.6

Photographs of Air Pollution in Sample City

The household respondents who are affected due to polluted air are having related health issues. Table 6.9 shows the number of air pollution affected respondents in 3 zones of the city.

Table 6.9

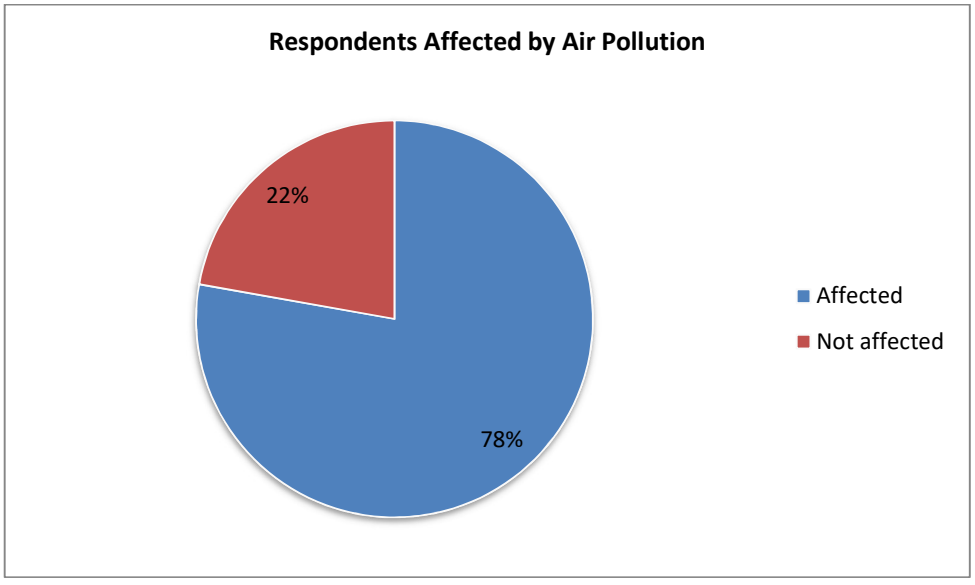
Total Number of Respondent Affected by Air pollution

Air pollution	Name of the Zones			**Total Respondents**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Affected	19 (38.8) [76.0]	12 (24.5) [80.0]	18 (36.7) [78.3]	**49** (100.0) [77.8]
Not affected	6 (42.8) [24.0]	3 (21.4) [20.0]	5 (35.8) [21.7]	**14** (100.0) [22.2]
Total	**25** (39.7) [100.0]	**15** (23.8) [100.0]	**23** (36.5) [100.0]	**63** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.7

Total Number of Respondent Affected by Air pollution



The respondents who are affected by air pollution are 49 (77.8%) and 14 respondents are not affected by polluted air. Out of the 25 respondents of the Central zone who are

responded towards air pollution, 19 (76.0%) are affected by polluted air. Out of the 15 respondents of the Ayyanthole zone, 12 (80.0%) are admitted to have affected due to air pollution. Similarly, out of the 23 respondents of Koorkancheri zone, 18 (78.3%) have problems due to air pollution.

It is worthwhile to mention that out of the 63 respondents 77.8% have admitted to have air pollution problems. Among them 38.8 percent respondents are from the Central zone, 24.5 percent are from the Ayyanthole zone and 36.7 percent are from the Koorkancheri zone. Hence, the study reveals that most of the respondents who are affected by air pollution are residing in the Central zone and Koorkancheri zone. The households in these zones are concerned about air pollution. This is due to the emissions from large number of vehicles in these areas. The discharge of vehicular harmful gases is inhaled by the residents and causes serious health issues.

The main contributors or agents of air pollution in there zone are represented in table 6.10.

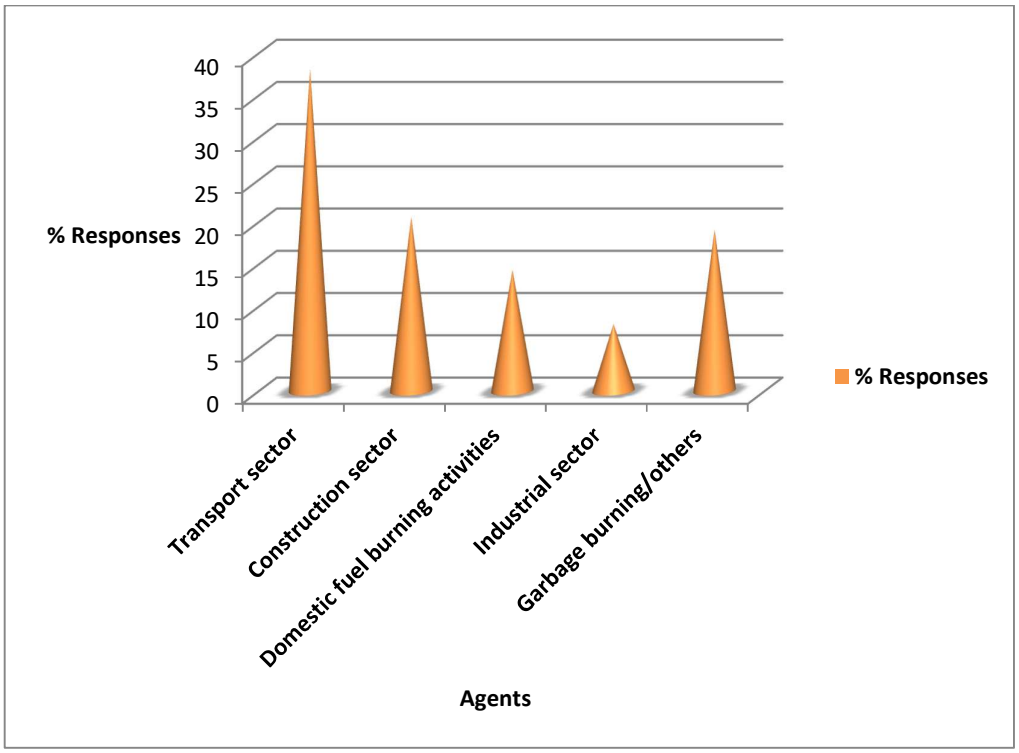
Table 6.10 Main Contributors of Air Pollution

Agents for air pollution	Name of Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Transport sector	10 (41.7) [40.0]	4 (16.6) [26.7]	10 (41.7) [43.5]	**24** (100.0) [38.1]
Construction sector	2 (15.4) [8.0]	4 (30.8) [26.7]	7 (53.8) [30.4]	**13** (100.0) [20.6]
Domestic fuel burning activities	4 (44.4) [16.0]	2 (22.2) [13.3]	3 (33.4) [13.0]	**9** (100.0) [14.3]
Industrial sector	2 (40.0) [8.0]	2 (40.0) [13.3]	1 (20.0) [4.3]	**5** (100.0) [7.9]
Garbage burning /others	7 (58.3) [28.0]	3 (25.0) [20.0]	2 (16.7) [8.8]	**12** (100.0) [19.1]
Total	**25** (39.7) [100.0]	**15** (23.8) [100.0]	**23** (36.5) [100.0]	**63** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.8

Main Contributors of Air Pollution



The table shows that main contributors of polluted air are transport sector, construction activities, domestic fuel burning activities, industrial sector and garbage burning. Among them, transport sector occupies the top position in polluting the air by its emission of harmful gases to the environment. 38.1 percentage respondents considered transport sector as the chief agent of air pollution. 20.6 percent respondents consider construction sector responsible for air pollution, 19.1 percent considered garbage burning as the main agent of air pollution, 14.3 percent considered domestic fuel burning activities as the main contributor of polluted air and 7.9 percentage respondents considered industrial sector as the chief agent of air pollution.

In the sample area there are vegetable markets, bust stations, hospitals, some industrial units and other institutions. Due to failure of proper waste treatment, the wastes including plastic garbage are burned openly in roadsides and public places. Similarly existence of large number of public as well as private vehicles results in traffic congestion and are leading to high emissions of carbon monoxide.

The table 6.10 also shows that in the zone wise analysis, the respondents in large numbers from the three zones are admitted that the transport sector is the chief contributor of air pollution. In the Ayyanthole zone, construction sector is considered as the main agent of air pollution. 26.7 percent respondents admitted that construction activities are responsible for air pollution. Similarly, in the Koorkancheri zone, most of the respondents, that is, 43.5 percent and 30.4 percent articulated that air is polluted due to transport sector and construction sector respectively. Hence, it can be concluded that air pollution is the main environmental issue of urbanization which is contributed by transport sector and other urban amenities.

The pollution of air is a serious issue of urban life as it is influential in increasing the air related diseases. Polluted air is a life threatening one as it is leading to morbidity. Table 6.11 shows some of the airborne diseases affected by the respondents in sample areas.

Table 6.11

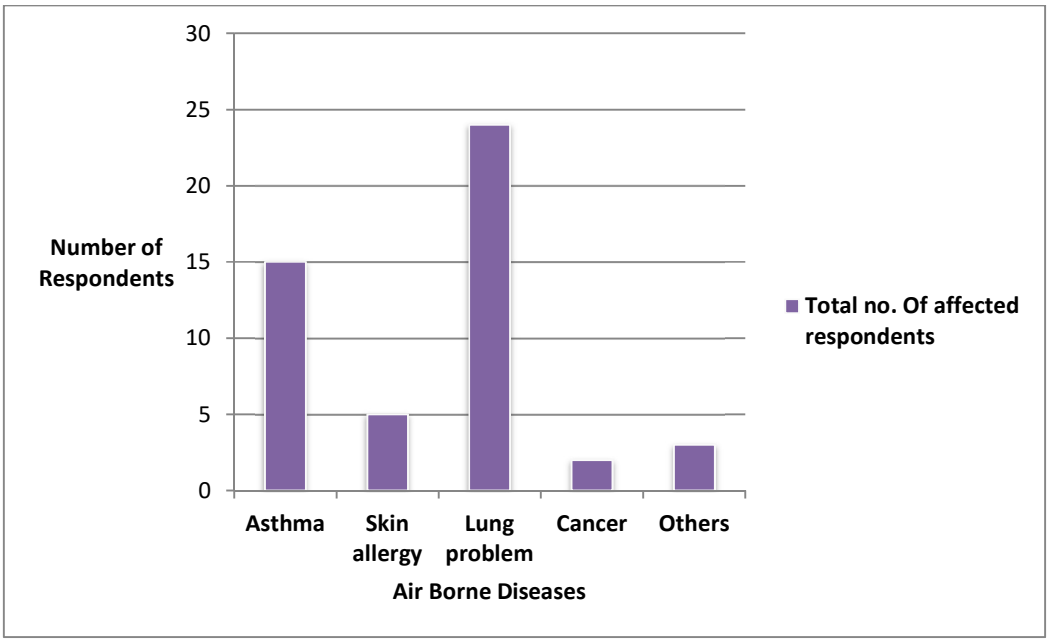
Name of the Air Borne Diseases Affected by the Respondents

Diseases	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Asthma	7 (46.7)	3 (20.0)	5 (33.3)	**15** (100.0) [30.6]
Skin Allergy	2 (40.0)	1 (20.0)	2 (40.0)	**5** (100.0) [10.2]
Lung Problem	8 (33.3)	7 (29.2)	9 (37.5)	**24** (100.0) [48.9]
Cancer	-	1 (50.0)	1 (50.0)	**2** (100.0) [4.1]
Others	2 (66.7)	-	1 (33.3)	**3** (100.0) [6.2]
Total	**19** (38.8)	**12** (24.5)	**18** (36.7)	**49** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.9

Name of the Air Borne Diseases Affected by the Respondents



The table 6.11 highlights that the respondents in sample areas are affected by diseases like Asthma, Skin Allergy, Lung problems, Cancer and other diseases due to polluted air. Due to the existence of carbon monoxide, Sulphur dioxide, nitrogen oxides and particulate matter, the air is worsening day by day and inhaling this polluted air leads to morbidity. Among the 49 respondents who are affected by air pollution, 48.9 percent have lung problems, 30.6 percent have Asthma, 10.2 percent have skin allergy, 4.1 percent have reported cancer and 6.2 percent have other related diseases.

Among the zones, Ayyanthole and Koorkancheri zones have higher incidence of cancer. This is because of the existence of waste dumping ground. In the Central zone, Asthma and lung problems are higher in respondents. The lung problems and Asthma are mainly found in the areas where there is existence of high level of particulate matter and carbon monoxide. Among the Asthma patients, 46.7 percent are from the Central zone and 33.3 percent are from the Koorkancheri zone. Hence, it can be concluded that there is relationship between air pollution and growing diseases in the sample areas.

The main contributors of air borne diseases in the city are CO, SO_2, NO_2, PM (Particulate Matter) and RSPM (Respirable Suspended Particulate Matter). In order to

analyze the health impacts of air pollution, the study concentrated to estimate the composite of air pollution in the city. Based on the state environment report and report of the pollution control board, the main air pollutants of the city are Carbon Monoxide (CO) which accounts for 64.4%, Sulphur Dioxide (SO_2) which accounts for 20.7%, Nitrogen Oxides (NO_2) which accounts for 2.9%, Particulate Matter (PM) which accounts for 6.9% and Ozone (O_3) which contributes 5.1% (State Pollution Control Board, 2016) . This data reveals the fact that, Carbon Monoxide dominates in the air pollutants which has been emitted by the motor vehicles in the sample area.

In order to find out the economic costs of air borne diseases or health impacts of air borne diseases, two concepts or methods are used in many countries. They are Work Loss Day Analysis (WLD), Dose – Response studies and Cost of Illness approach.

Work Loss Day (WLD):- The estimate of work loss day is an appropriate method to assess the impact of polluted air on health in the form of morbidity. This method is successfully used in USA during 1980's. To find out the association between morbidity and WLD the study took into consideration WLD for employed people and Restricted Activity Days (RAD) for the combined sample of adults and other non workers. Findings of the study revealed that, one percent increase in particulates would lead to an increase in WLD by about 0.45% and RAD by 0.31% for all people in the age group of 18-65 years. The results of the study proved thatthe association between air pollution and health impacts is stronger in developing countries compared to developed countries (Ostro, 1983).

Cost of Illness Approach:- Cropper (1982) employed Cost of Illness (COI) approach as an alternative for valuing morbidity. This approach uses estimates of the economic costs of health care and lost output up to recovery or death. COI comprises the sum of direct costs; which includes hospital treatment, medical care, drugs and so on and indirect costs, which is the value of output lost (wage rate X lost hours or imputed wage for home services).

Among the three estimates WLD is used to find out the impact of air pollution on working loss day of the respondents. This is represented in table 6.12. On the basis of the analysis 39.7 percent respondents lost their work less than 50 days in a year due to air pollution which consist of 44 percent in the Central zone, 32 percent in Koorkancheri zone and 24 percent in Ayyanthole zone. 25.4 percent respondents lost

their work for 50 -75 days which accounts for 43.7 percent in the Central zone, 25.0 percent in Ayyanthole zone and 31.3 percent in Koorkancheri zone. Similarly, it is estimated that 28.6 percent respondents who are affected by air pollution lost their work for 75 – 100 days in a year comprising of 44.5 percent in Koorkancheri zone, 33.3 percent in the Central zone and 22.2 percent in the Ayyanthole zone.

Table 6.12

Work Loss Days (Air Pollution) of the Respondents

WLD/year (Air)	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 50	11 (44.0) [44.0]	6 (24.0) [40.0]	8 (32.0) [34.8]	**25** (100.0) [39.7]
50 – 75	7 (43.7) [28.0]	4 (25.0) [26.7]	5 (31.3) [21.7]	**16** (100.0) [25.4]
75 – 100	6 (33.3) [24.0]	4 (22.2) [26.7]	8 (44.5) [34.8]	**18** (100.0) [28.6]
More than 100	1 (25.0) [4.0]	1 (25.0) [6.6]	2 (50.0) [8.7]	**4** (100.0) [6.3]
Total	**25** (39.7) [100.0]	**15** (23.8) [100.0]	**23** (36.5) [100.0]	**63** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

The table also shows that 6.3 percent of the affected respondents lost their work for more than 100 days in a year. Hence, it can be concluded that the work loss days are comparatively higher in the Central as well as Ayyanthole zones. Due to increase in work loss day the respondents face huge economic crisis in meeting their day to day expenses. Thus health issues contributed by air pollution, influence badly on economic levels of the households.

The cost of air pollution implies the cost which has been incurred by the respondents for medical treatments due to air borne diseases. The particulars of the cost incurred

by the respondents towards averting their diseases in different locations are explained in table 6.13.

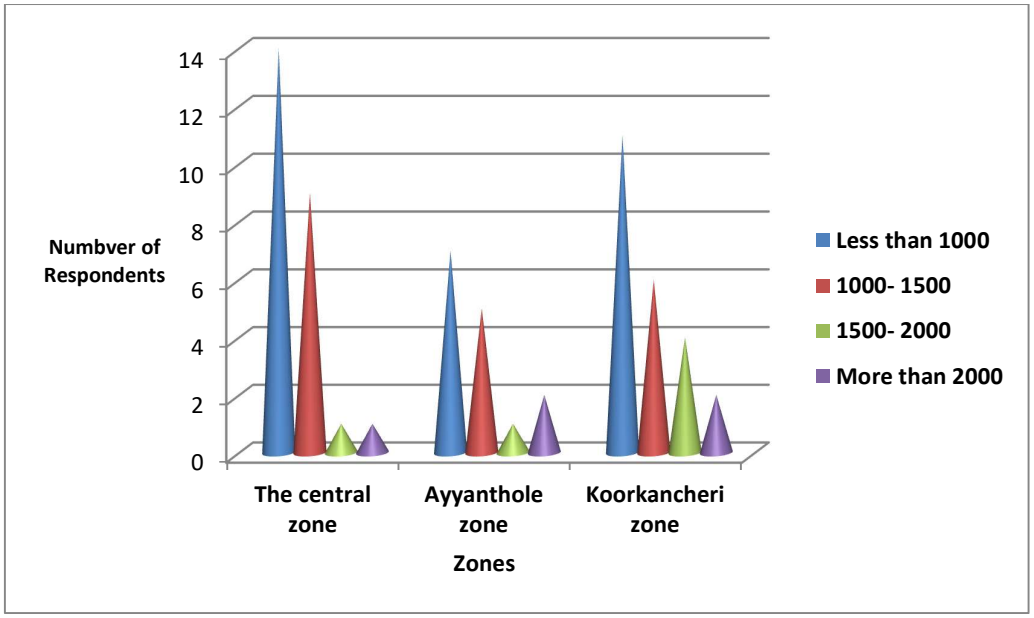
Table 6.13 Monthly Cost incurred on Air Borne Diseases

Total Cost in Rupees	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 1000	14 (43.7) [56.0]	7 (21.9) [46.7]	11 (34.4) [47.8]	**32** (100.0) [50.8]
1000 - 1500	9 (45.0) [36.0]	5 (25.0) [33.3]	6 (30.0) [26.1]	**20** (100.0) [31.7]
1500 – 2000	1 (16.7) [4.0]	1 (16.7) [6.7]	4 (66.6) [17.4]	**6** (100.0) [9.6]
More than 2000	1 (20.0) [4.0]	2 (40.0) [13.3]	2 (40.0) [8.7]	**5** (100.0) [7.9]
Total	**25** (39.7) [100.0]	**15** (23.8) [100.0]	**23** (36.5) [100.0]	**63** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.10

Monthly Cost incurred on Air Borne Diseases (In Rupees)



The impact of air pollution is mainly upon the health status of people. A significant portion of the total income of the households is diverted towards meeting the medical expenses to avoid the diseases from pollution. It is observed that out of the total respondents who are affected by the air pollution, 50.8 percent pay out less than 1000 rupees per month, among this 43.7 percent are from the Central zone, 34.4 percent are from Koorkancheri zone and 21.9 percent are from the Ayyanthole zone. 31.7 percent respondents spend Rs. 1000 – 1500 monthly which consists of 45 percent from the Central zone, 30 percent are from the Ayyanthole zone. Similarly 9.6 percent respondents spend an amount of Rs. 1500 – 2000 per month and 7.9 percent spend more than 2000 rupees as medical expenses due to air pollution. The cost incurred as health issues are found higher in congested areas of slums of the Central as well as Koorkancheri zones. Hence, there is a need for higher expenditure on health issues due to polluted air. Thus there is negative impact of urbanization on environment as it leads to air pollution and related to health as well as economic issues.

Table 6.14 shows the allocation of expenditure/cost on different air borne diseases due to polluted air. The main diseases in the sample areas and the monthly cost incurred on each of them are furnished in the table.

Table 6.14

Monthly Cost of Air pollution and Air Borne Diseases

Cost in Rupees	Diseases Due to Air Pollution					**Total**
	Asthma	Skin Allergy	Lung Problem	Cancer	Others	
Less than 1000	6 (33.3)	3 (16.7)	6 (33.3)	2 (11.1)	1 (5.6)	**18** (100.0)
1000-1500	3 (15.0)	2 (10.0)	15 (75.0)	-	-	**20** (100.0)
1500-2000	3 (50.0)	-	2 (33.3)	-	1 (16.7)	**6** (100.0)
More than 2000	3 (60.0)	-	1 (20.0)	-	1 (20.0)	**5** (100.0)
Total	**15** (30.6)	**5** (10.2)	**24** (48.9)	**2** (4.1)	**3** (6.2)	**49** (100.0)

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.

Out of the total respondents who are adversely affected by air pollution spend an amount varies from less than 1000 rupees to more than 2000 rupees monthly on treatment of diseases like Asthma, Lung problem, Skin allergy, Cancer etc. 20 respondents spend 1000 – 1500 rupees monthly out of which 75 percent are suffering from lung problems, 15 percent have asthma and 10 percent have skin allergy problems. Similarly cost incurred on cancer treatment is prevailing in the sample areas. 18 respondents spend less than 1000 rupees as monthly cost of air pollution diseases, 6 respondents pay an amount of Rs, 1500 – 2000 as a cost on treatment of diseases like asthma, lung problem and other related diseases. This, it is clear that along with health issues, the household respondents have to face economic issues due to air pollution in urban areas. Thus unplanned urban development adversely related to environment.

In order to find out variances in air borne diseases in sample areas ANOVA method is applied. The method is used to study the differences in three sample zones in the spread of diseases due to air pollution. The result is given in the table 6.15.

Table 6.15

ANOVA (Air- Borne Diseases)

Source of Variation	Sum of Sq. between Samples	D. f	Mean Sq. between Samples	F
The Central Zone	30	6	4.2	2.19
Ayyanthole Zone	28	8	3.5	1.96
Koorkancheri zone	26	7	3.7	2.85

Source: Survey Data

The Analysis of Variance in air- borne diseases in three sample zones shows that, the F ratio is significantly low in all the cases. Therefore, on the basis of the analysis it is found that there are no significant variations in air borne diseases in three sample zones. Hence, all the sample areas represent similar health impacts due to air pollution.

In short, the urban areas are under the threat of air pollution which is harmful to the living organisms. The emission of gases to the environment contributed by massive vehicular population adversely affects the air and brings health issues to human

resources. Similarly, construction activities, industrial sectorgarbage disposal and waste burning by households and other agents of air pollution contribute a large amount of pollution particles and gases to the environment. This makes the pollution level beyond the limit. The health impact of air pollution is higher in the state expenditure as medical expenses on such diseases enhances economic burden. This contribute economic burden to the households. Hence, the aim of sustainability (ecological, social and economic) is found to be unfulfilled.

Hypothesis Testing on Water and Air Pollution

For the purpose of hypothesis testing the monthly cost incurred on different diseases due to water and air pollution is considered.

Null Hypothesis (**Ho**):

The lower rate of water and air pollutions, leads to the higher amount of health cost in the sample areas.

Alternative Hypothesis (**H_1**):

The higher rate of water and air pollutions, leads to the higher amount of health cost in the sample areas.

Table 6.16 represents chi-square test value on water and air borne diseases and cost of these diseases incurred by the respondents in the form of medical expenses.

Table 6.16

Chi-square Test of Water and Air Pollution Diseases and Health Cost

Tests	Value	df	Asymp. Sig. (2-sided)
Pearson chi- square	52.021	12	.000
Likelihood Ratio	53.807	12	.000
Linear – by- linear Association	7.823	1	.005
No. of valid cases	110		

Note:a 10 cells (50.0%) have expected count less than 5. The minimum expected count is .60.

The test of hypothesis reveals that the calculated chi-square value of (52.021) cost of air pollution and diseases are greater than the tabulated value at one percent level of

significance. Therefore, null hypothesis is rejected and alternative hypothesis is accepted. That means the higher rate of water and air pollution leads to the higher amount of health cost in the sample areas of Thrissur District.

Inshort, the above analysis of water pollution and air pollution based on the household responses highlights the fact that there are water and air pollution in the urban areas with severe health impacts. The influence of health issues are found in the economic condition of the households. Hence, the impact of urbanization on sustainable environment is found to be negative in cities.

6.2.(iii) Solid waste Pollution Due to Urbanization

Unscientific urbanization brings waste as an inevitable by-product of human activities. Urbanization and improved standard of living increase the amount and complexity of solid waste. The generation of municipal solid waste may be either during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, or other human activities including municipal, agricultural and special. Increasing levels of solid waste result in degradation of the urban environment. Harmful impact on environment undermines sustainable development and this ultimately affects the people residing in that area. The present study tries to analyze the density of solid waste population due to urbanization of solid waste the responses from the sample areas.

Figure 6.11 Photographs of Solid Waste Pollution in Sample City

Municipal solid wastes are the most visible form of pollution. Thousands of tons of solid wastes one generated in the city from various sources. But a smaller percentage is properly collected and treated. The waste management system of the city is not functioning properly. Because of this, the amount of solid waste is mounting up day by day. The methods which are usually used for disposing waste pose serious threat to environment and human health, particularly to those living in slum areas. The responses of the households towards the causes for increasing solid waste in the city are given in table 6.17.

Table 6.17

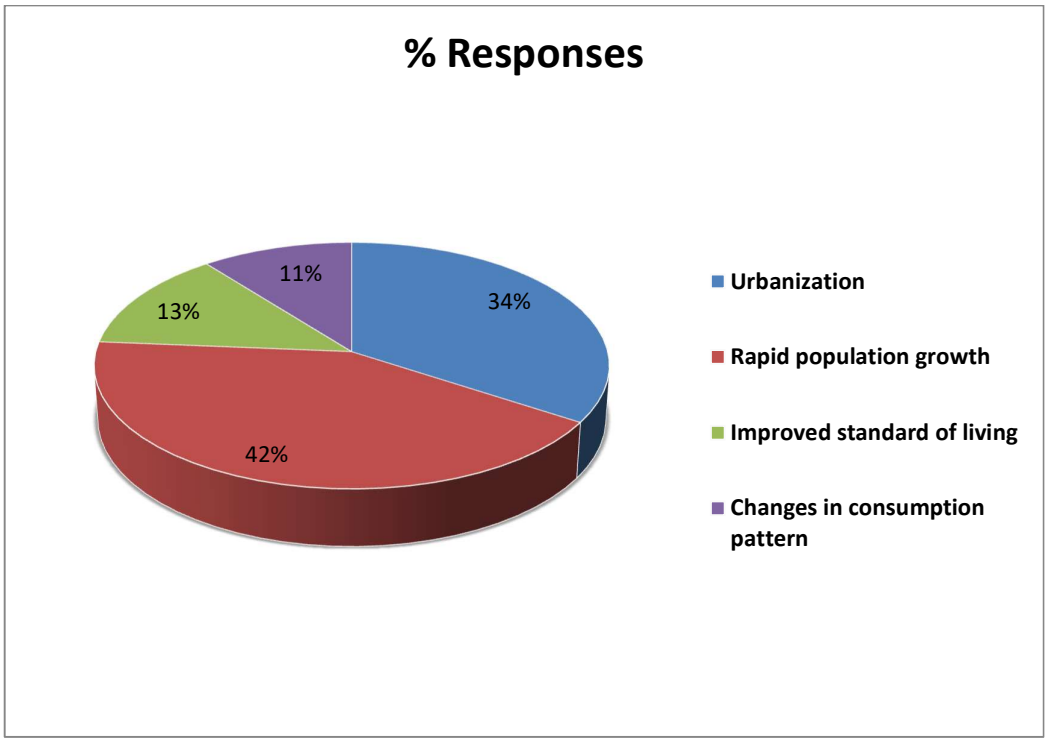
Causes for Increasing Municipal Solid Waste

Causes	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Urbanization	3 (23.0) [25.0]	5 (38.5) [38.5]	5 (38.5) [38.5]	**13** (100.0) [34.2]
Rapid population growth	7 (43.7) [58.4]	5 (31.3) [38.5]	4 (25.0) [30.7]	**16** (100.0) [42.1]
Improved standard of living	1 (20.0) [8.3]	2 (40.0) [15.4]	2 (40.0) [15.4]	**5** (100.0) [13.1]
Changes in consumption pattern	1 (25.0) [8.3]	1 (25.0) [7.6]	2 (50.0) [15.4]	**5** (100.0) [10.6]
Total	**12** (31.6) [100.0]	**13** (34.2) [100.0]	**13** (34.2) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.12

Causes for Increasing Municipal Solid Waste



Among the causes for increasing municipal solid wastes, 42.1 percent respondents consider rapid population growth as the major cause in which 43.7 percent are from the Central zone, 31.3 percent are from the Ayyanthole zone and 25.0 percent are from the Koorkancheri zone. Similarly 34.2 percent respondents consider urbanization as the chief cause for mounting up of solid waste among which 38.5 percent each are from the Ayyanthole and Koorkancheri zone and 23 percent are from the Central zone. Out of the total respondents who consider municipal solid waste pollution as the main environmental pollution, 13.1 consider improved standard of living of the people as the main source of solid waste generation and 10.6 respondents admit that changes in the consumption pattern of the people are responsible for solid waste generation. Hence, it can be calculated that urbanization, rapid urban population growth, improved standard of living, and changes in consumption pattern are responsible for increasing the level of solid waste in urban areas.

Table 6.18 is furnished with the details of sources of solid waste generation in sample areas. The responses of the households are marked in percentages.

Table 6.18

Major Sources of Solid Waste Generation in the Sample Area

Sources	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Households	5 (38.4) [41.7]	4 (30.8) [30.8]	4 (30.8) [30.8]	**13** (100.0) [34.2]
Construction activities	1 (12.5) [8.3]	5 (62.5) [38.5]	2 (25.0) [15.4]	**8** (100.0) [21.0]
Shops & Markets	3 (27.2) [25.0]	3 (27.2) [23.1]	5 (45.6) [38.5]	**11** (100.0) [28.9]
Hospitals/Marriage halls/Institutions	2 (40.0) [16.7]	1 (20.0) [7.6]	2 (40.0) [15.3]	**5** (100.0) [13.2]
Others	1 (100.0) [8.3]	-	-	**1** (100.0) [2.7]
Total	**12** (31.6) [100.0]	**13** (34.2) [100.0]	**13** (34.2) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

In the study area major sources of solid waste generation are households, construction activities, shops and markets, hospitals, marriage halls, institutions and other activities like street sweeping, slaughter houses etc. Among these sources, household sector is considered as the major source by 34.2 percent respondents in which 38.4 percent are from the Central zone, 30.8 each are from the Ayyanthole zone and Koorkancheri zone. The city is having higher number of shops and markets and hence the waste generated by these are considered as the major source by 28.9 percent respondents among which 45.6 percent are from the Koorkancheri zone and 27.2 percent each from the Central zone and the Ayyanthole zone. 21 percent respondents consider construction activities as the main source of solid waste pollution. Similarly, 13.2 percent respondents claim upon institutions, hospitals and marriage halls for creating solid waste pollution. Thus, generation of solid waste is severe problem in urban areas

whether it is from household sector or others. The huge amount of wastes which are dumped in the open places of the city are not treated or disposed properly.

Major threat of solid waste pollution is upon the resident households in the form of diseases which are given in table 6.19.

Usually, diseases such as breathing problem, irregular fever, various types of allergies, typhoid, malaria, lung infections are the different types of diseases associated with solid waste pollution. Improper disposal of wastes will bring lung problems or breathing problems to a large extend. Solid wastes are the chief sources of several types of bacteria and mosquitoes which create fever, malaria, typhoid and allergies. Out of the total respondents in solid waste pollution, 28.9 percent are suffering from breathing problems, 26.3 percent have irregular fever, 18.5 percent have lung infections, 15.8 percent respondents have allergies and 10.5 percent have typhoid/malaria.

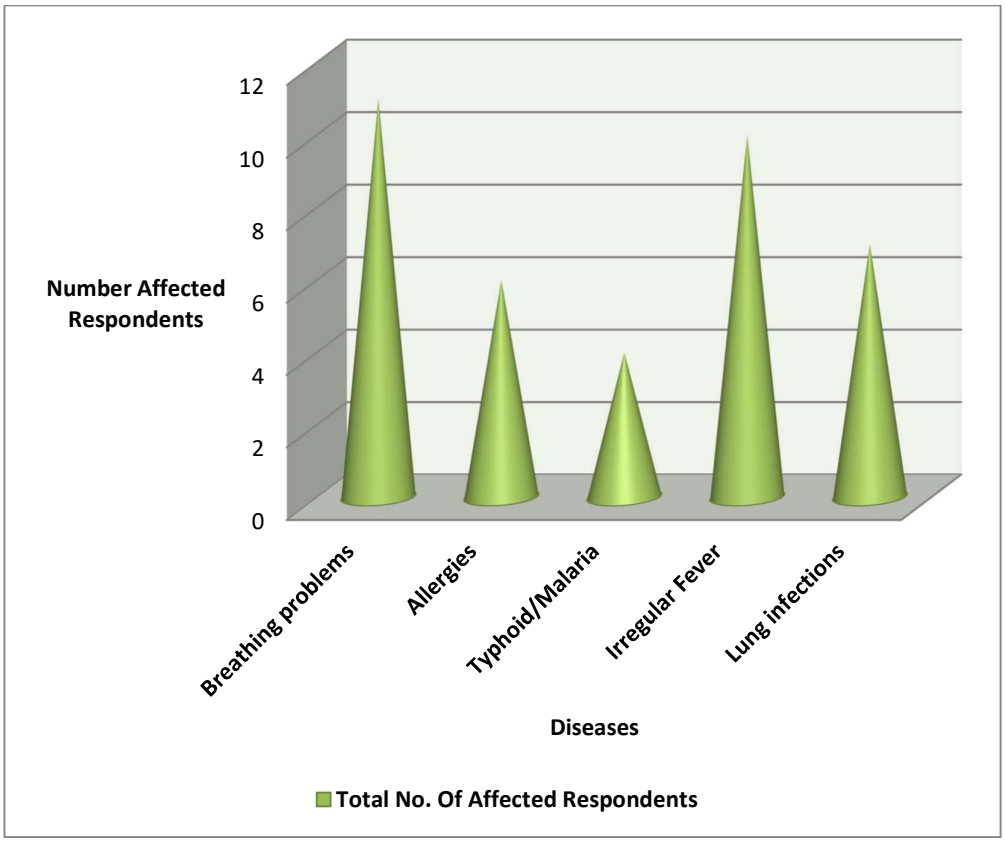
Table 6.19
Major Diseases Due to Solid Waste Pollution

Diseases	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Breathing Problems	3 (27.3) [25.0]	3 (27.3) [23.1]	5 (45.4) [38.5]	**11** (100.0) [28.9]
Allergies	3 (50.0) [25.0]	1 (16.7) [7.7]	2 (33.3) [15.4]	**6** (100.0) [15.8]
Typhoid /Malaria	1 (25.0) [8.3]	3 (75.0) [23.1]	-	**4** (100.0) [10.5]
Irregular Fever	4 (40.0) [33.4]	2 (20.0) [15.4]	4 (40.0) [30.7]	**10** (100.0) [26.3]
Lung Infections	1 (14.3) [8.3]	4 (57.1) [30.7]	2 (28.6) [15.4]	**7** (100.0) [18.5]
Total	**12** (31.6) [100.0]	**13** (34.2) [100.0]	**13** (34.2) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.13

Major Diseases Due to Solid Waste Pollution



The zone wise analysis shows that in all the 3 zones, common diseases due to solid waste pollution are irregular fever, breathing problems lung infections etc. The incidence of these diseases is found higher in slum areas of the city where the amount of solid wastes is higher. The wastes on a large amount are dumped in open spaces and market places without the consideration of its health impacts. Thus there is close association between solid waste pollution and diseases.

The main impact of diseases due to solid waste pollution is the working loss days of the households. The number of WLD in 3 zones is given in table 6.20.

The table shows that among the total respondents who are affected by the solid waste pollution, 34.2 percent lost their work in between 35 – 45 days in a year which consist of 38.4 percent respondents from Koorkancheri zone, 30.8 percent each from the Central as well as the Ayyanthole zone. Likewise 26.3 percent respondents have working for less than 25 days in a year 21.1 percent have work loss for 25 – 35 days

and 18.4 percent respondents have loss of work days for more than 45 days. The data shows that because of these working loss days the income of the households reduces on the one hand; the cost needed to incur on meeting the medical expenses of diseases creates heavy economic burden on the other. Hence, the increasing solid waste generation and pollution leads to increasing number of work loss days of the households in urban areas.

Table 6.20

Work Loss Days of the Respondents Due to Solid Waste Pollution

WLD / Year	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 25	3 (30.0) [25.0]	3 (30.0) [23.1]	4 (40.0) [30.8]	**10** (100.0) [26.3]
25 – 35	3 (37.5) [25.0]	2 (25.0) [15.3]	3 (37.5) [23.1]	**8** (100.0) [21.1]
35 – 45	4 (30.8) [33.3]	4 (30.8) [30.8]	5 (38.4) [38.4]	**13** (100.0) [34.2]
More than 45	2 (28.6) [16.7]	4 (57.1) [30.8]	1 (14.3) [7.7]	**7** (100.0) [18.4]
Total	**12** (31.6) [100.0]	**13** (34.2) [100.0]	**13** (34.2) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

The annual cost incurred by the households on diseases due to solid waste pollution is highlighted in table 6.21.

Out of the total respondents of solid waste pollution, 31.6 percent spend less than Rs. 5000 annually as medical expenses due to waste generation in which 33.3 percent respondents are from the Central zone, 41.7 percent are from the Koorkancheri zone and 25 percent are from the Ayyanthole zone. 28.9 percent incur a cost of Rs. 7500 – 10000 annually among which 42.8 percent are from Koorkancheri, 28.6 percent each from the Central as well as the Ayyanthole zone.

Similarly, 21.1 percent respondents spend more than 10000 rupees annually and 18.4 percent spend 5000 – 7000 rupees for medical treatment. It is interesting to note that the Koorkancheri zone has shown higher percentage in medical expenses. This is due to higher level of solid waste pollution in that area. In the Central zone, 33.3 percent respondents spend less than 5000 rupees annually and 25 percent respondents spend Rs.7500-100000 annually for medical expenses. In the Ayyanthole zone major percent of the respondents spend an amount of rupees 7500-100000 annually for medical treatment due to solid waste pollution. Hence, there is higher amount of cost on health issues with higher level of solid waste pollution. The cost incurred due to solid waste pollution in all the three zones is higher which makes heavy economic burden on the households.

Table 6.21 Annual Cost Incurred on Solid Waste Pollution

Cost in Rupees	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 5000	4 (33.3) [33.3]	3 (25.0) [23.1]	5 (41.7) [38.4]	**12** (100.0) [31.6]
5000 – 7500	2 (28.6) [16.7]	2 (28.6) [15.4]	3 (42.8) [23.1]	**7** (100.0) [18.4]
7500 – 10000	3 (27.3) [25.0]	5 (45.4) [38.4]	3 (27.3) [23.1]	**11** (100.0) [28.9]
More than 10000	3 (37.5) [25.0]	3 (37.5) [23.1]	2 (25.0) [15.4]	**8** (100.0) [21.1]
Total	**12** (31.6) [100.0]	**13** (34.2) [100.0]	**13** (34.2) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.14

Annual Cost Incurred on Solid Waste Pollution (In Rupees)

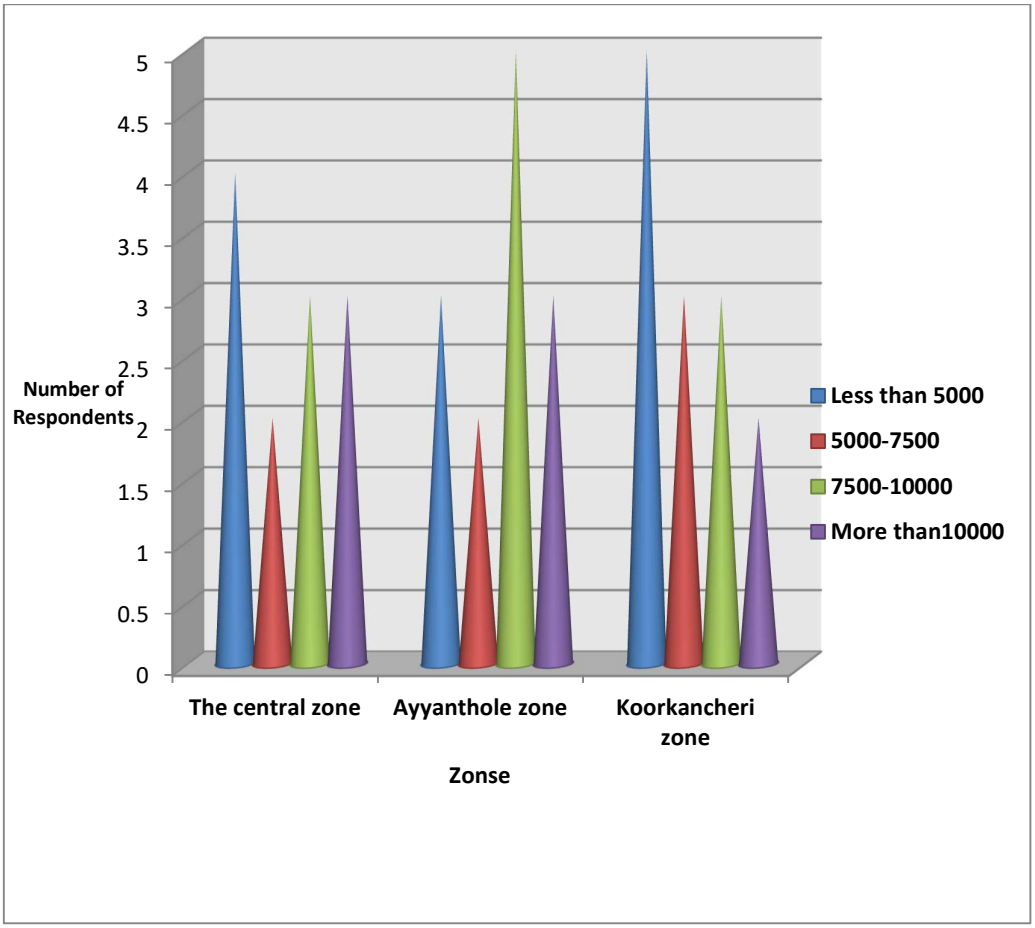


Table 6.22 shows a comparative analysis between the annual cost incurred in the form of medical expenses due to solid waste to pollution and the work loss days of the respondents.

The respondents who spend more than 10000 rupees annually have income loss due to working loss days for more than 45 days (87.5 percent). Similarly, 31.6 percent respondents who spend less than 5000 rupees annually have WLD ranging between less than 25 and 25 – 35 days annually. 28.9 percent respondents incur a cost of Rs, 7500- 10000 and loss their working days for 35 – 45 days annually.

Table 6.22

Annual Cost of Solid Waste Pollution and WLD of the Respondents

Cost in Rupees	Work Loss Days (Solid Waste)				**Total**
	Less than 25	25 -35	35 -45	More than 45	
Less than 5000	10 (83.3) [100.0]	2 (16.7) [25.0]	-	-	**12** (100.0) [31.6]
5000- 7500	-	5 (71.4) [62.5]	2 (28.6) [15.4]	-	**7** (100.0) [18.4]
7500 - 10000	-	-	11 (100.0) [84.6]	-	**11** (100.0) [28.9]
More than 10000	-	1 (12.5) [12.5]	-	7 (87.5) [100.0]	**8** (100.0) [21.1]
Total	**10** (26.3) [100.0]	**8** (21.1) [100.0]	**13** (34.2) [100.0]	**7** (18.4) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Thus, the impact of solid waste pollution on households is very severe in the sense that it creates economic loss in the form of medical expenses and working loss days along with several health issues. These issues are found to be larger in slum areas where there are congested living conditions with limited facilities.

In short, the amount of municipal solid wastes in cities is mounting up day by day which are not suitably disposed by the authorities. These huge amounts of solid wastes are dumped in road sides, water resources and other land areas without any consideration of environment. The ultimate result is solid waste pollution and subsequent health and economic issues. The households of the sample area have

serious health issues due to this pollution. In order to promote a healthy living condition environment should be protected by avoiding such pollution. Then only urban development with sustainability is possible and this will be helpful to the future generations.

6.2. (iv) Noise Pollution Due to Urbanization

The sounds which are not pleasant to hear are called noises and an excess of noise in the outdoor leads to 'Noise Pollution'. The increasing ambient noise levels in public places from various sources like construction activity, vehicular horns, loud speakers, sound producing instruments, fire crackers, industrial activities, public address systems and sounds other mechanical devices is unhealthy to the people as it adversely affects the physiological as well as psychological conditions. According to the WHO guidelines for a sound sleep, the noise in a room should not exceed 30 dBA. It should not exceed 35 dBA in a class room for maintaining better concentration. If the noise level exceeds more than prescribed level on a continuous basis, it may harm physical as well as mental health of the people.

Usually people and authorities are much concerned about air pollution water pollution and solid waste pollution. But noise pollution is not taken seriously; in fact noise pollution is serious concern as it affects health conditions seriously. Hence, the study is an attempt to find out the noise pollution aspects in sample zones with special attention to health aspects of households.

Figure 6.15

Photographs of Noise Pollution in Sample City

The causes of noise level pollution are many. Table 6.23 shows the major causes responsible for noise pollution in the sample areas.

Table 6.23

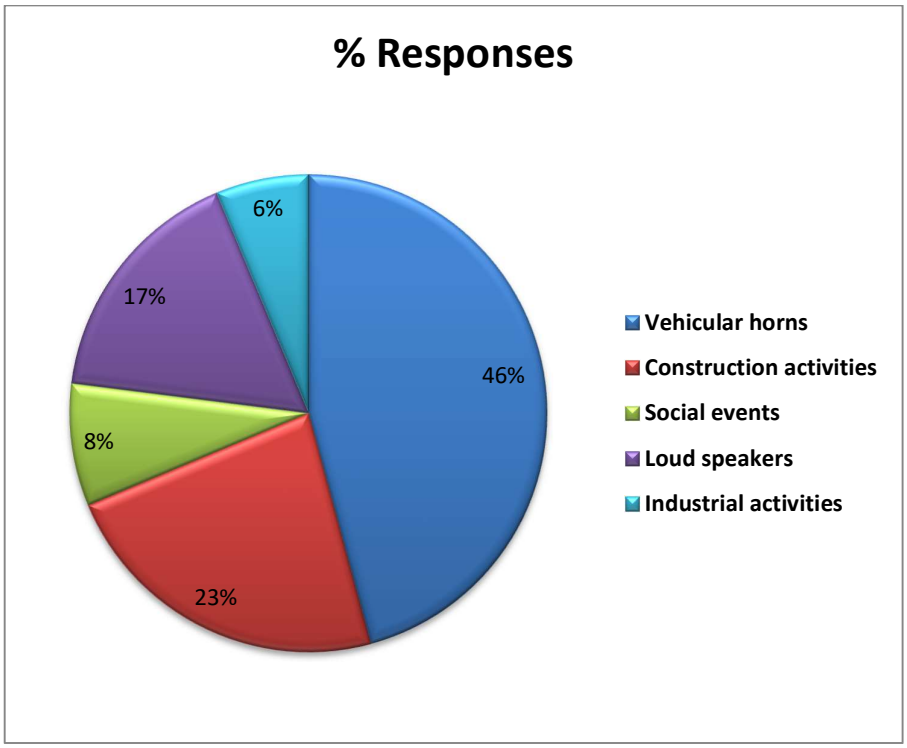
Major Causes for Noise Pollution

Causes	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Vehicular horns	6 (27.3) [40.0]	9 (40.9) [52.9]	7 (31.8) [43.7]	**22** (100.0) [45.8]
Construction activities	4 (36.4) [26.7]	5 (45.4) [29.4]	2 (18.2) [12.5]	**11** (100.0) [22.9]
Social Events	2 (50.0) [13.3]	-	2 (50.0) [12.5]	**4** (100.0) [8.3]
Loud speakers	3 (37.5) [20.0]	1 (12.5) [5.9]	4 (50.0) [25.0]	**8** (100.0) [16.7]
Industrial activities	-	2 (66.7) [11.8]	4 (33.3) [6.3]	**3** (100.0) [6.3]
Total	**15** (31.2) [100.0]	**17** (35.4) [100.0]	**16** (33.4) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.16

Major Causes for Noise Pollution



Out of 48 respondents 45.8 percent argued that noise pollution is due to vehicular horns in the city. This seemed to be true because major roads of the city are narrow and congested. 22.9 percent respondents viewed construction activities as the major source of noise pollution among which 36.4 percent are from the Central zone 45.4 percent are from the Ayyanthole zone and 18.2 percent are from the Koorkancheri zone. 16.7 percent respondents considered the use of loudspeakers in many occasions as the reason for noise pollution in the city. Similarly, 8.3 percent of the respondents viewed social event and related celebrations as the major cause for noise pollution and 6.3 percent of the respondents considered industrial activities as the major source of noise pollution in the city. Hence the reasons for noise pollution are many, and the impact of such noise pollution is upon the urban households in the form of health issues.

Increased levels of noise create health issues like hearing problems, cardiovascular issues, sleeping disorders etc. The detailed analysis of such issues is given in table 6.24.

Table 6.24

Health Issues Due to Noise Pollution

Health Issues	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Hearing Problems	4 (36.4) [26.7]	5 (45.4) [29.4]	2 (18.2) [12.5]	**11** (100.0) [22.9]
Cardio Vascular Issues	4 (50.0) [26.7]	1 (12.5) [5.9]	3 (37.5) [18.8]	**8** (100.0) [16.7]
Sleeping Disorders	3 (15.8) [20.0]	7 (36.8) [41.2]	9 (47.4) [56.2]	**19** (100.0) [39.6]
Other issues like hyper tension & high stress levels	4 (40.0) [26.6]	4 (40.0) [23.5]	2 (20.0) [12.5]	**10** (100.0) [20.8]
Total	**15** (31.2) [100.0]	**17** (35.4) [100.0]	**16** (33.4) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Major health issues related with noise pollution are sleeping disorders, hearing problems, cardio vascular issues, hyper tension, high stress level etc. Among these issues 39.6 percent respondents considered sleeping disorders as the major health issue in which 47.4 percent are from Koorkancheri zone, 3.6.8 percent are from the Ayyanthole zone and 15.8 percent respondents are from the Central zone. Similarly, 22.9 percent have hearing problems due to noise pollution, 20.8 percent respondents

have issues like hypertension and high stress levels, and 16.7 percent respondents have cardio vascular issues.

The zone wise analysis shows that, in the Central zone major health issues are hypertension & high stress level issues where 26.6 percent respondents have such issues. In the Ayyanthole zone major problem is sleeping disorders (41.2) and in Koorkancheri zone it is the same issue (56.2). Hence, the households have several health issues due to unpleasant sound or noise pollution in the city.

Table 6.25 shows the response of the households respondents in respect of the level of noise pollution.

Table 6.25

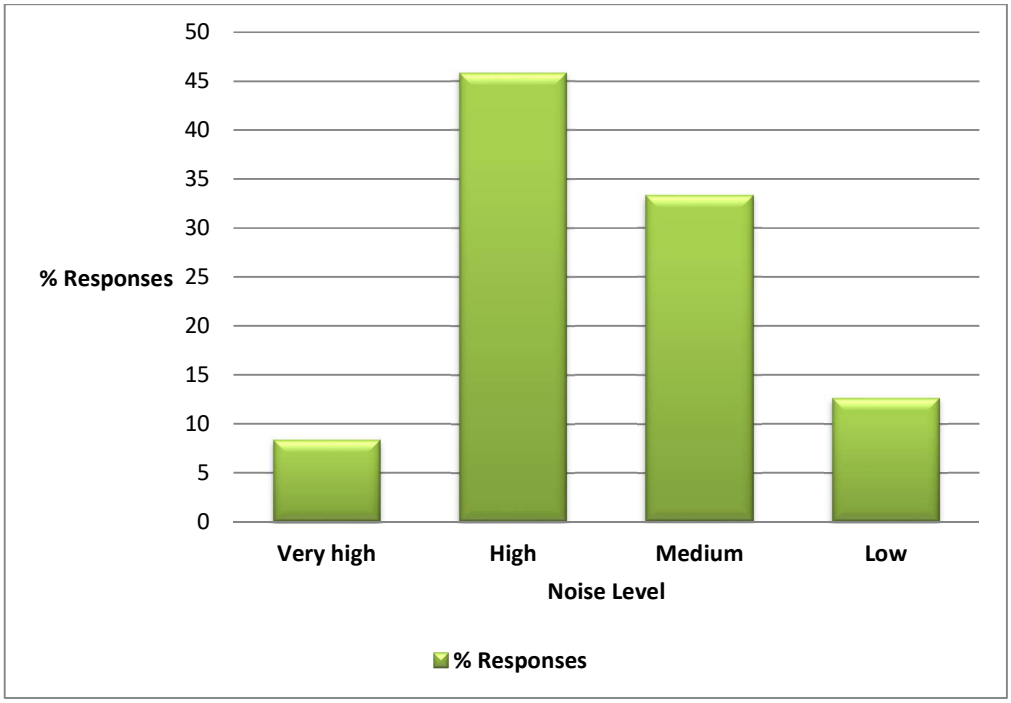
Level of Noise Pollution in the Sample Areas

Noise Level	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Very high	3 (75.0) [20.0]	-	1 (25.0) [6.2]	**4** (100.0) [8.3]
High	8 (36.4) [53.3]	9 (40.9) [52.9]	5 (22.7) [31.2]	**22** (100.0) [45.8]
Medium	3 (18.7) [20.0]	6 (37.5) [35.3]	7 (43.8) [43.8]	**16** (100.0) [33.3]
Low	1 (16.7) [6.7]	2 (33.3) [11.8]	3 (50.0) [18.8]	**6** (100.0) [12.6]
Total	**15** (31.2) [100.0]	**17** (35.4) [100.0]	**16** (33.4) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.17

Level of Noise Pollution in the Sample Areas



It is estimated that, 45.8 percent respondents out of 48 respondents reported the noise level as high in the city, 33.3 percent considered noise pollution level as medium, 12.6 percent respondents considered the noise level as low and 8.3 percent respondents viewed very high level of noise pollution in the city. In the zone wise analysis, the respondents from all the three zones reported noise pollution level in the range of medium to high levels as major percentage comes under this category. In short, the noise pollution exists in the city whether it is very high or high or medium. This adversely affects the healthy living conditions of the households.

Table 6.26 represents annual work loss days of the respondents due to noise pollution.The major impact of noise pollution is increasing working loss days of the respondents due to several health issues. 54.2 percent respondents who are affected by noise pollution lost their work for less than 50 days annually in which 38.5 percent are from the Ayyanthole zone, 34.6 percent are from Koorkancheri zone and 26.9 percent are from the Central zone. 25 percent respondents lost working days in between 50 - 75 days annually among which 41.7 percent are from Ayyanthole zone, 33.3 percent are from Koorkancheri zone and 25 percent are from the Central zone. Similarly, 20.8

percent respondents had working loss days for more than 75 days per annum out of which 50 percent respondents are from the Central zone, 30 percent are from the Koorkancheri zone and 20 percent are from the Ayyanthole zone. In the central zone 46.7 percent respondents had working loss days for less than 50 days. 58.8 percent respondents of the Ayyanthole zone 56.3 percent of the Koorkancheri zone had WLD for less than 50 days.

Table 6.26

Work Loss Days of the Respondents Due to Noise Pollution

WLD/Year	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 50	7 (26.9) [46.7]	10 (38.5) [58.8]	9 (34.6) [56.3]	**26** (100.0) [54.2]
50 -75	3 (25.0) [20.0]	5 (41.7) [29.4]	4 (33.3) [25.0]	**12** (100.0) [25.0]
More than 75	5 (50.0) [33.3]	2 (20.0) [11.8]	3 (30.0) [18.7]	**10** (100.0) [20.8]
Total	**15** (31.2) [100.0]	**17** (35.4) [100.0]	**16** (33.4) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Due to increasing levels of noise pollution, households are suffering from several health issues and this ultimately leads to increased amount of cost incurred on health issues which is represented in table 6.27.

The Annual cost of illness due to noise pollution shows that 18 respondents (37.6) out of 48 respondents spend Rs. 5000-7500 annually towards the treatment of disease among which 44.4 percent are from the Koorkancheri zone, 27.8 percent each from

the Central as well as the Ayyanthole zone. 22.9 percent respondents spend more than 10000 rupees annually as the lost of illness due to noise pollution out of which 45.4 percent are from the Central zone, 27.3 percent respondents each from the Ayyanthole and Koorkancheri zones. 10 respondents (20.8) spend an amount of Rs.7500-10000 per annum as the health cost of noise pollution. 18.7 percent respondents spend less than 5000 rupees annually in order to meet the cost of health issues due to noise pollution.

Table 6.27

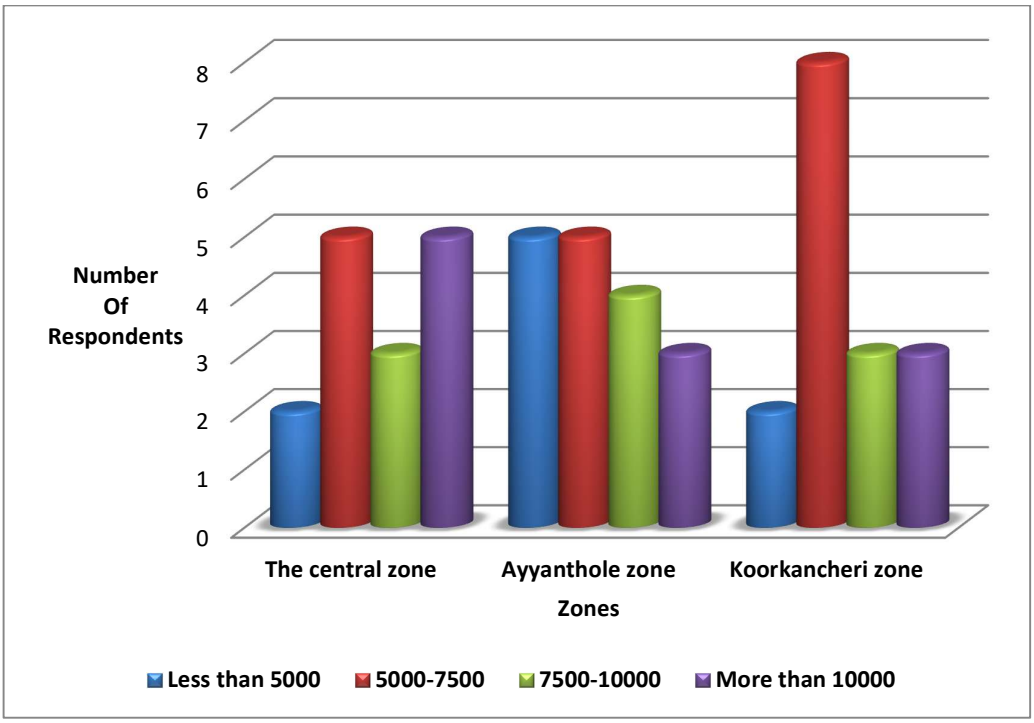
The Annual Cost Incurred Due to Noise Pollution (In Rupees)

Cost of Illness (In rupees)	Name of the Zones			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 5000	2 (22.2) [13.4]	5 (55.6) [29.4]	2 (22.2) [12.6]	**9** (100.0) [18.7]
5000 – 7500	5 (27.8) [33.3]	5 (27.8) [29.4]	8 (44.4) [50.0]	**18** (100.0) [37.6]
7500 – 10000	**3** (30.0) [20.0]	**4** (40.0) [23.5]	**3** (30.0) [18.7]	**10** (100.0) [20.8]
More than 10000	**5** (45.4) [33.3]	**3** (27.3) [17.7]	**3** (27.3) [18.7]	**11** (100.0) [22.9]
Total	**15** (31.2) [100.0]	**17** (35.4) [100.0]	**16** (33.4) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

Figure 6.18

The Annual Cost Incurred Due to Noise Pollution



The table also shows that in the Central zone 33.3 percent respondents spend more than 10000 rupees annually as the cost of illness and another 33.3 percent spend Rs.5000-7500/annum in order to meet health expenses. In the Ayyanthole as well as Koorkancheri Zones, major portion of the respondents spend Rs. 5000-7500 annually for medical treatment due to noise pollution.

Table 6.28 represents a comparative analysis of annual cost of noise pollution and working loss days of the respondents. Increased number of work loss days implies increased cost of illness in the sample areas.

The table represents that cost of illness is closely associated to working loss days of the respondents as these shown an increasing trend due to noise pollution. Out of the 48 respondents 54.2 percent respondent had lost their work for less than 50 days and at the same time they spend a huge sum annually as the cost of illness. Similar is the

case with other household respondents too. This shows the heavy economic burden upon the households due to noise pollution in the city.

Table 6.28

Annual Cost of Noise Pollution and WLD of the Respondents

Cost in Rupees	Work Loss Days (Noise)			**Total**
	Less than 50	50-75	More than 75	
Less than 5000	9 (100.0) [34.6]			**9** (100.0) [18.7]
5000-7500	17 (94.4) [65.4]	1 (5.6) [8.3]		**18** (100.0) [37.6]
7500-10000		10 (100.0) [83.4]		**10** (100.0) [20.8]
More than 10000		1 (9.1) [8.3]	10 (90.9) [100.0]	**11** (100.0) [22.9]
Total	**26** (54.2) [100.0]	**12** (25.0) [100.0]	**10** (20.8) [100.0]	**48** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

In short, the noise level in the city is high enough to influence health conditions of the resident households adversely. The level of noise in the city is in between the range of moderate to high which hinders peaceful living in the city. The major sources of noise pollution are transport sector and construction activities. The congested roads in the city lead to unpleasant vehicular horns. Because of such issues the health conditions of the households worsens day by day in the form of hearing problems, sleeping disorder and hyper stress and tension. This leads to increase the cost of illness and loss of working days which creates economic imbalance. Thus noise pollution like

other form of pollution adversely influences the environment and health in urban areas.

Hypothesis Testing on Solid Waste Pollution and Noise Pollution

For the purpose of testing of hypothesis related with solid waste pollution and noise pollution, annual cost of illness due to these pollutions is considered.

Null Hypothesis (**H_0**):

Thehigher levels of solid waste pollution and noise pollution, do not lead to the higher amount of health cost in the sample areas.

Alternative Hypothesis (**H_1**):

TheHigher levels of solid waste pollution and noise pollution, lead to the higher amount of health cost in the sample areas.

Table 6.29 represents the chi-square test value of health cost due to diseases by increasing levels of solid waste pollution and noise pollution.

Table 6.29

Chi- square Tests of Solid Waste and Noise Pollution and Health Cost

Tests	Value	df	Asymp.sig (2- sided)
Pearson's chi-square	216.826	6	.000
Likelihood Ratio	223.878	6	.000
Linear-by-Linear Association	102.379	1	.000
No. of valid cases	86		

Note: a 1 cell (8.3%) has expected count less than 5. The minimum expected count is 4.33.

It is evident from the table 6.29 that the calculated chi-square value (216.826) of the health cost due to solid waste pollution and noise pollution is greater than the tabulated value at one percent level of significance. Hence, the null hypothesis is rejected and alternative hypothesis is accepted, which implies that there is a close association between the health cost and pollution due to mounting solid waste and

noise levels. It means that the cost of illness increases with increase in solid waste and noise pollution.

Thus, the city is not free from environmental issues in the form of mounting solid wastes and increasing levels of noise. The health impacts contributed by these pollutions are having negative impacts upon the economic and living conditions of the households. Hence, proper protective measures needed to be implemented to overcome the detrimental impacts of pollution.

6.3. Method of Economic Valuation of Environmental Goods- The Contingent Valuation Method (CVM)

Environmental goods and services are often treated as public goods to some extent; and hence the excessive and careless use of such goods leads to environmental impacts. In order to protect the environmental goods from harmthe valuations of environmental goods are necessary. Methods based on economic theory have been devised widely to assign monetary values to environmental goods and services. Based on these values decision making can be made easier about a project related to environment. In other words, economic valuation is used to estimate economic benefits or costs associated with environmental quality such as air pollution, water pollution, solid waste pollution or noise and environmental amenities, such as aesthetic views or proximity to recreational sites etc. Thus economic valuation techniques are applied to the more human environment such as water, air, solid waste generation and noise.

Methods of valuation of environmental goods and services may broadly be classified into two categories- (1) Pecuniary and (2) Non- pecuniary. Pecuniary valuation methods obtain the 'Money equivalent' of these goods and services. While non-pecuniary methods may use any numeraire for valuation. Pecuniary methods usually use the concept of willingness to pay for valuing environmental goods (Mishra S.K. 2006). Willingness to pay (WTP) indicates individuals preferences for a good in question related to the environmental goods. Individual's preferences are identified by asking people how much they are willing to pay in order to maintain quality of environmental goods.

Environmental valuation methods are ultimately relying upon individual preferences. These are divided into two approaches direct methods and indirect methods. Direct methods are based on expressed preferences elicited though questionnaire surveys. Contingent valuation method is the direct method of valuation.

In other words, the most suitable method to determine willingness to pay is contingent valuation method (CVM). Contingent valuation methods are used to determine willingness to pay for improved quality of water, improved quality of air, reducing noise level and improved disposal of solid waste generation in urban areas. In short, contingent valuation method is a questionnaire based valuation technique whereby willingness to pay are directly obtained from the respondents with respect to a specific good.

A CVM study involves interviews with the participants, which can be undertaken as face to face, mail or telephone based. CVM study usually stars with informing the participate about the environmental resources in focus (such as water quality, air quality, reduction in noise level, proper solid waste disposal) along with information about the proposed change in the environmental resource and the procedure to be used to finance the proposed change in environmental resource. On the basic of such information the respondents are asked about willingness to pay or to accept compensation in order to avoid an environmental damage (Dr. Torben Holvad, 2000).

Questions concerning willingness to pay can be structured in many ways which include;

- Open ended
- Dichotomous choice
- Bidding games
- Payment card based forms

Here bidding games are used for approximating the willingness of household to pay for an environmental good. Single bid games, also known as the single – open ended is used to know the willingness of the household respondents. This is where the responds is asked to mention the amount he or she is willing to pay for a service described by the interviewee. The main factors affecting WTP are demographic

information such as age, gender, income, education and other information regarding the quality of water, air quality, noise level, and reducing solid wastes and associated health risk.

Thus, contingent valuation method involves informing the respondent about the prevailing environmental situation and then informs him, her about a change. The individual is asked to valve a particular change in environmental condition in future hypothetical scenario. Hence CVM have the advantages over the other methods of environmental valuation such as the Travel Cost and Hedonic Pricing techniques. The method can be used to quantify some types of benefits, such as non-use or passive use benefits, which lie outside the scope of travel-cost and hedonic pricing studies (Hanemann, 1994).

6.3. (i) Respondent's Attitude Towards Willingness to Pay for Improvement in Quality of Water

Increased amount of water pollution in sample areas tempted towards a study of willingness to pay for improved quality of water. Almost all the respondents in the sample area revealed then preferences and willingness to pay for attaining improved quality of water. This is represented in table 6.30.

Table 6.30

Willingness to Pay for Improved Quality of Water in the Sample Areas

Name of the zone	Willingness to pay		**Total**
	Yes	No	
The Central Zone	25 (80.6)	6 (19.4)	**31** (100.0)
Ayyanthole Zone	22 (81.4)	5 (18.6)	**27** (100.0)
Koorkancheri Zone	16 (88.9)	2 (11.1)	**18** (100.0)
Total	**63** (82.9)	**13** (17.1)	**76** (100.0)

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.

The table shows that out of 76 respondents who are responded towards water pollution are shown their opinion about attaining quality of water. It is estimated that 82.9 percent respondent are expressed their willingness to pay for the quality of water and the remaining 17.1 percent respondents are not willing to pay any amount for the quality of water. This may be due to the fact that these groups have facilities to attain quality water from various water sources.

While considering the area or location of residence, it is found that the major issues related with water pollution are in slum areas compared to non-slum areas. The residents of slum areas are willing to pay more for improved quality of water than the non slum residents. Hence, poor people are willing to pay more in this matter than the rich. Water pollution is associated with many health risks in the form of diseases. So the willingness to pay for improved water quality is aimed to avoid such health risks. In all the 3 sample zones more than 80 percent of the respondents are willing to pay for quality of water, viz, 80.6 percent of the Central zone, 81.4 percent of the Ayyanthole zone and 88.9 percent of the Koorkancheri zone. The Koorkancheri zone represents large number of slum population. Hence, more willingness to pay for water quality is found in that zone.

Bidding Amounts

Bidding amounts are used for approximating the willingness of household to pay for an environmental good. Here the bid amounts are used for improved quality of water supply. These amounts are finalized after carefully examining the socio-economic characteristics of the households like age, gender, income, education etc. This is because, these background informationhave greater influence upon the willingness to pay though bid amounts. The selection of bidding amounts in the 3 sample zones through the responses of the respondents in respect of their willingness to pay is given in table 6.31.

Table 6.31

Bidding Amounts for Improvement in Quality of Water According to the Sample Zones

Bid amounts (In Rupees)	Name of the Zones			**Total**
	The Central Zone	Ayyanthole Zone	Koorkancheri Zone	
Less than 200	11 [44.0]	7 [31.8]	7 [43.7]	**25** [39.7]
200-250	5 [20.0]	2 [9.1]	1 [6.3]	**8** [12.7]
250-300	7 [28.0]	7 [31.8]	6 [37.5]	**20** [31.7]
More than 300	2 [8.0]	6 [27.3]	2 [12.5]	**10** [15.9]
Total	**25** [100.0]	**22** [100.0]	**16** [100.0]	**63** [100.0]

Source: Survey Data
Note: Figure in the square brackets indicates column percentage.

The bid amount for improve quality of water supply ranges from Rs.200 to Rs.300 per month containing a total of four bid amounts having an interval of Rs. 50. Various levels of bid amounts are shown in the table. Out of 63 respondents who are willing to pay for maintaining water quality, 39.7 percent are willing to pay an amount of less than 250 rupees per month, 31.7 percent respondents are willing to pay in between 250-300 rupees per month, 15.9 percent are willing to pay more than 300 rupees per month and 12.7 percent are willing to pay in between 200-250 rupees per month. Similarly, 44 percent respondents of the Central zone are willing to pay less than 200 rupees per month and only 8 percent of them are willing to pay more than 300 rupees. In the Ayyanthole zone, 31.8 percents respondents are willing to pay less than 200 rupees per month and another 31.8 percent of them are willing to pay an amount in between Rs.250-300 per month. Similar is the case with the Koorkancheri zone when 43.7 percent respondents are willing to pay less than 200 rupees and 12.5 percent of them are willing to pay more than 300 rupees per month. The respondents from the slum areas have shown more willingness to pay towards improved water quality.

The Logit Regression Model

In Contingent Valuation Method, the Logit regression model is used to obtain the willingness to pay for household for an improved water supply. The logit model is

used to determine the mean willingness to pay of households for improved water quality and the factors influencing their willingness to pay. The logit model is based mainly on the cumulative probability function and it deals with a dichotomous dependent variable on a well established theoretical background. Logit regression model is a uni/multivariate technique which allows for estimating the probability that an event will occur or not through prediction of a binary dependent outcome from a set of independent variables (Roopa, 2000). The logit model was adopted since the Ordinary Least Square (OLS) procedure was not appropriate particularly when the dependent variable is dichotomous.

To obtain the mean WTP of the households for an improvement in the quality of water, the responses of the households to the willingness to pay question were regressed on the prices they were asked to pay for the improved service. The coefficients estimates obtained were then used to calculate the mean willingness to pay of the households (Adepoju&Omonona B T, 2009).

The logit regression model is specified as;

$$P_i = E\left(y=\frac{1}{x^t}\right) = \frac{1}{1+e^{-\beta 0+\beta 1 x 1}}$$

Where;

Pi = Probability that Yi = 1

Xi = Set of independent variables.

Y= Dependent variable

β0 = Intercept which is constant

β1 = Coefficient of price that the households are willing to pay for improved water quality

The mean willingness to pay of the households for improved water quality service is then calculated using the formula derived by Hanemann (1989). The formula is given as;

$$\text{Mean WTP} = \frac{1}{|\beta 1|} \text{ in } (1+\exp \beta 0)$$

Where β1 and β0 are coefficient estimates obtained from the logistic regression and mean WTP is the mean willingness to pay of households for improved water quality service.

Factors Influencing Willingness to Pay of Households

In order to identify the factors influencing the willingness to pay of households for better quality water supply, the household's responses to the willingness to pay question are regressed on the household willingness to pay potential and other selected socio-economic characteristics of the households. The regression logit model is specified as;

$$Y = \frac{1}{1+exp^{Z}}$$

Where Y = the response of the household to the willingness to pay question which is either 1 if 'Yes' or O if 'No'. The variable Z is defined in equation as;

$$Z = \beta 0+\beta 1x1+\beta 2x2+\ldots\ldots+\beta 6x6$$

Where β0 is a pure constant and the parameter β1……..β6 are the coefficients of the explanatory variables x_1……x_6.

The X variables are represented as;

X_1=Age (Yrs)

X_2 = Literacy

X_3 = Size of the family (Number)

X_4 = Annual Household income (Rs)

X_5 = Savings (Rs)

X_6 = Health cost on water diseases (Rs)

The Chi-square and the Pseudo-R square were used to measure the goodness of fit of the model. On the basics of these, the determinates of WTP for improved quality of water services or the logit analysis of the factors that determine the willingness to pay for improved water quality is expressed in tables 6.32 and 6.33.

Table 6.32

The Logit Regression Model (Improvement in Water Quality)

	Coefficient	Std. Error	Z	p-Value
Const	9.27553	3.72560	2.4895	0.01277**
X1	0.359267	0.0136517	2.6318	0.00851***
X2	17.501	7.2518	2.4136	0.01579***
X3	4.87914	1.92306	2.5372	0.01116**
X4	0.740132	0.280826	2.6354	0.00840***
X5	24.6704	9.36065	2.6355	0.00841***
X6	0.0113316	0.00519996	2.1792	0.02392**

Source: Survey Data
Note: Observations 1-76 (n = 63)
Missing or incomplete observations dropped = 13

Dependent variable: WTP

Table 6.33

The Regression Model (Logit) Related to WTP for Improved Water Quality

Mean dependent var.	0.876291	S.D. Dependent var	0.330961
MC Fadden R- Squared	0.726943	Adjusted R-Squared	0.534112
Log likelihood	9.912859	Akaike criterion	33.82570
Schwarz = criterion	51.84874	Hannan-Quinn	41.11337

Note: Percentage of cases correctly predicted = 99.0 %
F (beta'x) at mean of independent var. = 0.331
Likelihood ratio test: Chi-square (6) = 52.7897 (0.000)
** indicates 5 percent level of significance.
*** indicates 1 percent level of significance.

The above test results implied that age, literacy, size of the family, household income, savings and health cost on water pollution diseases significantly influence the willingness to pay for improved water quality services at 5 and 1 percent levels of significance. It is observed that age literary levels income and savings are positively related to WTP for improved quality of water supply services at 1 percent level of significance whereas size of the family and health cost on waterborne diseases are positively related to the willingness to pay for quality water services at five percent level of significance. This implies that size of the family is influencing the willingness

to pay as big households will be will be willing to pay relatively less due to the associated high running cost (Income constraints). Similarly, literacy and income levels positively influence the WTP of the households.

Hence, the results reveal that 0.726 is the MC Fadden R^2 a probability of households WTP for improved quality of water supply which means that more than 72 per cent of the changes in the willingness to pay for improved water supply. The likelihood of paying for improved water supply increases by 9.91. The Schwarz-criteria is accounted for 51.84. Hence the model implies that there is a close association between the willingness to pay and improved quality of water supply. The respondents are ready to pay an amount for better water quality in urban areas. The Chi-square value accounts for 52.7897 at one percent level of significance. Hence, the water quality is positively related to the willingness to pay at percent level of significance.

6.3. (ii) Respondents Attitude Towards Willingness to Pay for Quality of Air

The respondents of the urban area are willing to pay for attaining fresh or quality air to breathe as they have experienced the health risks associated with polluted air. The study reveals the fact that increasing vehicular populations and subsequent gas emissions is the major source of air pollution in the sample area. The respondents are willing to pay for using alternative sources of transport system like public transport system instead of using their own vehicles to reduce air pollution and associated health risks.

Table 6.34 highlights the willingness of the household respondents to pay for improved quality of air in the urban area. Out of 63 respondents who are affected by air pollution, 49 (77.8 percent) are willing to pay for better quality of air. The table shows that 38.8 percent respondents from the Central zone, 36.7 percent from the Koorkancheri zone and 24.5 percent from the Ayyanthole zone are willing to pay for attaining better air quality.

Table 6.34

Willingness to Pay for Better Quality of Air in the Sample Areas

Name of the Zone	Willingness to Pay		**Total**
	Yes	No	
The Central zone	19 [38.8]	6 [42.8]	**25** [39.7]
Ayyanthole zone	12 [24.5]	3 [21.4]	**15** [23.8]
Koorkancheri zone	18 [36.7]	5 [35.8]	**23** [36.5]
Total	**49** (77.8) [100.0]	**14** (22.2) [100.0]	**63** (100.0) [100.0]

Source: Survey Data
Note: Figure in the square brackets indicates column percentage.
Figure in the parenthesis indicates row percentage.

The bid amounts for improved quality of air are represented in the table 6.35. The bid amounts in this environmental good is finalized after carefully examining the socio-economic conditions of the household respondents. The bid amount for air quality ranges from Rs.200 to Rs.300 per month containing a total of four bids having an interval of Rs. 50. Out of 49 respondents who are willing to pay to better air quality, 38.8 percent are willing to pay less than 200 rupees per month, 28.6 percent respondents are willing to pay in between 250-300 rupees per month, 22.4 percent are willing to pay more than 300 rupees per month and 10.2 percent are willing to pay 200-250 rupees per month. In the Koorkancheri zone the respondents showed their willingness to pay 250 rupees to more than 300 rupees per month. In the Central as well as in the Ayyanthole zone, most of the respondents are willing to pay less than 200 rupees per month.

Table 6.35

Bidding Amount for Better Quality of Air According to the Sample Zones

Bid amounts (In Rupees)	Name of the Zone			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 200	8 [42.1]	5 [41.7]	6 [33.3]	**19** [38.8]
200-250	3 [15.8]	1 [8.3]	1 [5.6]	**5** [10.2]
250-300	5 [26.4]	4 [33.3]	5 [27.8]	**14** [28.6]
More than 300	3 [15.8]	2 [16.7]	6 [33.3]	**11** [22.4]
Total	**19** [100.0]	**12** [100.0]	**18** [100.0]	**49** [100.0]

Source: Survey Data
Note: Figure in the square bracket indicates column percentage.

Factors Influencing the Willingness to Pay of Households and the Logit Regression Model for Better Quality of Air

To identify the factors influencing the willingness to pay for better air quality, the household responses to the WTP questions are regressed against the households WTP potential and other socio-economic characteristics of the households. The logit regression model was used to obtain the willingness to pay for better quality of air by the households applied here is the same as mentioned in the earlier section and the factors influencing the willingness to pay are;

X1= Age (Yrs)

X2 = Size of the family (Numbers)

X3 = Household Income (Rs)

X4= Health cost on airborne diseases (RS)

X5 = Savings (Rs)

X6= Education level

The logit regression model based on these factors for improved air quality is represented in tables 6.36 and 6.37.

Table 6.36 The Logit Regression Model (Better Air Quality)

	Coefficient	Std. Error	Z	p- Value
Const	0.305114	2.34071	0.1304	0.89629**
X1	1.32117	1.35601	0.9743	0.32994***
X2	0.533568	0.359637	1.4836	0.13791***
X3	2.84520	2.78291	1.0423	0.29714***
X4	0.00385907	0.001428	2.7026	0.00686***
X5	0.00690050	0.00446072	1.5467	0.12188**
X6	1.30433	0.625803	2.0843	0.03713**

Source: Survey Data
Note: Observation 1-63 (n=49)
Missing or incomplete observations dropped = 14
Dependent Variable: WTP

Table 6.37

The Logit Regression Model for Better Quality of Air

Mean dependent var.	0.937007	S.D. dependent var.	0.243914
MC Fadden R – Squared	0.266789	Adjusted R-squared	0.032643
Log-Likelihood	21.89410	Akaike Criterion	57.78820
Schwarz criterion	77.69756	Hannan-Quinn	65.87713

Note: Percentage of cases correctly predicted = 94.5%
F (beta'x) at mean of dependent var = 0.243
Likelihood ratio test: Chi-square (6) = 15.9327 (0.0143)
** Indicates 5 percent level of significance
*** Indicates 1 percent level of significance.

The logit regression model specified above implies that there is high association of willingness to pay by the households and improvement in the quality of air in the

urban areas. The association of improved air quality and willingness to pay is represented bythe Chi-square value which is 15.9327 at one percent level of significance. Mean and S.D. of dependent variables are given as 0.937007 and 0.243914 respectively. The model implies that the factors like size of the family and savings of the households do not have significant influence on the willingness to pay for improvement in the quality of air.The log-likelihood for paying significant improvements in the quality of air represents the value of 21.89. All other factors like age, household income, health cost on airborne disease & education level have positive and direct influence upon the willingness to pay of the households towards improved air quality. To reduce the traffic congestion and vehicular emissions which is helpful to improve the quality of airthe household respondents have been expressed their readiness to use public transport system instead of private vehicles.

6.3. (iii) Respondents Attitude towards Willingness to Pay for Better Solid Waste Management

Unplanned or unscientific solid waste disposal in urban areas can lead to health issued due to water and sanitation related diseases and land pollution. Similarly, burning of solid wastes leads to air pollution and related health issues. Thus dumping of solid wastes in open areas in cites adversely affects the healthy living conditions of the resident household. Hence, the households are agreed to pay for better waste management in cities or they are willing to pay for suitable waste management services.

The table 6.38 represents the willingness to pay of the households for better waste management system.The table shows that out of 38 respondents who are affected by solid waste pollution, 84.2 percent are willing to pay for better waste management system, which comprises 37.5 percent respondents from the Central zone, 34.4 percent from the Ayyanthole zone and 28.1 percent from the Koorkancheri zone. The respondents or the Central zone are willing to pay more than other two zones for improved solid waste management services.

Table 6.38

Willingness to Pay for Better Solid Waste Management in the Sample Areas

Name of the Zone	Willingness to Pay		**Total**
	Yes	No	
The Central zone	12 [37.5]	-	**12** [31.6]
Ayyanthole zone	11 [34.4]	2 [33.3]	**13** [34.2]
Koorkancheri zone	9 [28.1]	4 [66.7]	**13** [34.2]
Total	**32** (84.2) [100.0]	**6** (15.8) [100.0]	**38** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

The bidding amounts for better waste management in urban areas suggested by the household respondents based on dichotomous choice are represented in table 6.39.The bid amounts for improved solid waste management in urban areas are finalized after carefully examining the socio economic characteristics of the households. The bid amount for better solid waste management starts from less than 200 to more than 300 rupees per month containing a total of four bids having an interval of Rs.50.

Out of the total respondents who are willing to pay an amount towards better solid waste management, 59.4 percent are willing to pay less than 200 rupees per month comprising 42.1 percent respondents from the Central zone, 31.6 percent from the Ayyanthole zone and 26.3 percent from the Koorkancheri Zone. 18.7 percent respondents are willing to pay in between 200-250 rupees per month in which 50 percent are from the Ayyanthole zone, 33.3 percent are from the Koorkancheri zone and 16.7 percent are from the Central zone. Similarly, 9.4 percent respondents are willing to pay 250-300 rupees per month and 12.5 percent are willing to pay more than 300 rupees per month for better waste management & treatment services. Hence, there are variations in the bid amounts in the sample zones. These variations may be due to the intensity of solid waste pollution in the sample zones.

Table 6.39

Bidding Amounts for Better Solid Waste Management According to the Sample Zones

Bid Amounts (In Rupees)	Name of the Zone			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 200	8 (42.1) [66.7]	6 (31.6) [54.5]	5 (26.3) [55.6]	**19** (100.0) [59.4]
200-250	1 (16.7) [8.3]	3 (50.0) [27.3]	2 (33.3) [22.2]	**6** (100.0) [18.7]
250-300	1 (33.3) [8.3]	1 (33.3) [9.1]	1 (33.3) [11.1]	**3** (100.0) [9.4]
More than 300	2 (50.0) [16.7]	1 (25.0) [9.1]	1 (25.0) [11.1]	**4** (100.0) [12.5]
Total	**12** (37.5) [100.0]	**11** (34.4) [100.0]	**9** (28.1) [100.0]	**32** (100.0) [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

The Factors Influencing the Willingness to Pay of Households and the Logit Regression Model for Better solid Waste Management

Here,the household responses to the WTP question are regressed against the households WTP potential and other social economic characteristic of the household for identifying the factors influencing the willingness to pay for better quality of waste disposal services.The Logit regression model andthe methods used in this are the same as in the earlier sections of environmental goods- water and air.

The 'X' variables influencing the willingness to pay are represented as;

X1 = Age (Yrs)

X2 = Household family size (numbers)

X3 = Literacy levels

X4 = Household income (Rs)

X5= Health cost due to solid waste pollution (Rs.)

X6 = Working day loss

The logit regression model based on these factors for better waste management services is represented in tables 6.40 and 6.41 respectively.

Table 6.40

The Logit Regression Model (Waste Management)

	Coefficient	Std. Error	Z	p-Value
Const	12.1146	5.07115	2.3890	0.01691***
X1	1.22330	0.486044	2.5167	0.01184***
X2	1.44738	0.667324	2.1688	0.03009**
X3	0.167232	0.407769	0.4104	0.01173***
X4	3.20976	1.55991	2.0573	0.03963**
X5	7.64085	2.20296	0.3469	0.72872**
X6	0.571234	0.344262	1.6594	0.09705***

Source: Survey Data
Note: Observations 1-38 (n = 32)
Missing or incomplete observations dropped = 6
Dependent Variable: WTP

Table 6.41
The Logit Regression Model for Better Waste Management System

Mean dependent var.	0.870965	S.D. dependent var.	0.337975
MC Fadden R-Squared	0.354874	Adjusted R-squared	0.0611268
Log-Likelihood	15.38089	Akaike criterion	44.76190
Schwarz criterion	59.65180	Hannan – Quinn	50.60803

Note: Percentage of cases correctly predicated = 87.1 %
f (beta'x) at mean of independent var. = 0.336
Likelihood ratio test: Chi-square (6) = 16.9212 (0.0096)
** Indicates 5 percent level of significance
*** Indicates 1 percent level of significance

The logit regression model represented here shows that there is high association of WTP and improvement in waste management system in urban areas. The Chi square value (16.9212) at one percent level of significance represents the association of WTP of the households based on the determinates and the improvements in quality of solid waste management services. The log-likelihood for better waste management through

willingnessto pay is increased by 15.38. Factors like literacy level, size of the family, household income, and health cost due to solid waste pollution have positive influence upon WTP for improved waste disposal. Other determinants like age, size of the family and working loss days do not show significant influence upon WTP for quality improvements in waste treatment services.

6.4. (iv) Respondents Attitude Towards Willingness to Pay for Reduction in Noise Pollution

The city life is usually associated with unpleasant noise from many sources. Motor vehicles, construction activities, use of loud speakers in many occasions, social events and industrial activities are responsible for noise pollution. Each and every household revealed then opinion to reduce the noise pollution level to a particular limit so as to reduce the health issues of such pollution. The study concentrated to attain the opinion of respondents regarding the status of noise level and to estimate the willingness to pay by the household towards reduction in noise level to a certain limit which is not unhealthy.

Table 6.42 represents the willingness to pay of the households for a particular degree of noise reduction in sample areas.

Table 6.42 Willingness to Pay for Reduction in Noise Pollution

Name of the Zone	Willingness to Pay		**Total**
	Yes	No	
The Central zone	9 (60.0)	6 (40.0)	**15** (100.0)
Ayyanthole zone	15 (88.2)	2 (11.8)	**17** (100.0)
Koorkancheri zone	15 (93.8)	1 (6.2)	**16** (100.0)
Total	**39** (81.2)	**9** (18.8)	**48** (100.0)

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.

The table shows that out of 48 respondents who are affected by noise pollution and related health issues, 81.2 percent are willing to pay for noise reduction services. In the Central zone, 60 percent respondents are willing to pay for nose reduction. Similarly, 88.2 percent respondents from the Ayyanthole zone and 93.8 percent

respondents from the Koorkancheri zone also are willing to pay an amount for noise reduction activities to reduce noise pollution.

The aim of noise pollution reduction activities is to reduce the level of unpleasant noise and to maintain a normal noise level. The bid amounts of Contingent Valuation Method, for maintaining normal level of noise by reduction in noise pollution in the sample areas are represented in table 6.43.

Table 6.43

Bidding Amounts for Noise Reduction According to the Sample Zones

Bid Amounts (In Rupees)	Name of the Zone			**Total**
	The Central zone	Ayyanthole zone	Koorkancheri zone	
Less than 200	6 (24.0) [66.7]	9 (36.0) [6.0]	10 (40.0) [66.7]	**25** (100.0) [64.1]
200-250	2 (33.2) [22.2]	2 (33.3) [13.3]	2 (33.3) [13.3]	**6** (100.0) [15.4]
250-300	-	2 (66.7) [13.3]	1 (33.3) [6.7]	**3** (100.0) [7.7]
More than 300	1 (20.0) [11.1]	2 (40.0) [13.3]	2 (40.0) 13.3	**5** (100.0) [12.8]
Total	**9** (23.2) [100.0]	**15** (38.4) [100.0]	**15** (38.4) [100.0]	**39** 100.0 [100.0]

Source: Survey Data
Note: Figure in the parenthesis indicates row percentage.
Figure in the square brackets indicates column percentage.

The bid amounts similar to the case with other environmental goods are confirmed after carefully examining the socio-economic characteristics of the households. The bid amounts for maintaining a normal noise level in the sample area starts from less than 200 rupees to more than 300 rupees per month containing a total of four bids having a interval of Rs.50. Our of 39 respondents who are willing to pay for noise education, 64.1 percent are willing to pay an amount of less than 200 rupees per month, among which 40 percent respondents are from the Koorkancheri zone, 36 percent are from the Ayyanthole zone and 24 percent are from the Central zone. 15.4

percent respondents are willing to pay an amount in between 200-250 rupees per month. 7.7 percent respondents are willing to pay an amount of 250-300 rupees per month and the remaining 12.8 percent respondents are willing to pay more than 300 rupees per month for reduction in noise level. Hence, the study shows that in all the 3 sample zones, most of the respondents are willing to pay the minimum level of bid amounts for maintaining a normal noise level.

Factors Influencing the Willingness to Pay of Households and the Logit Regression Model for Reduction in noise pollution

The Logit Regression Model was used to obtain the mean willingness to pay for noise reduction by the households and to maintain a normal noise level. The logit model is based on the cumulative probability function and it deals with dichotomous dependent variables on a well established theoretical background. To identify the factors influence the willingness to pay for noise reduction and to maintain a normal and pleasant noise level, the household responses to the WTP questions were regressed against the households WTP potential and other socio economic characteristics of the household. The logit regression model is the same as mentioned in the case of other environmental goods and the factors influencing the willingness to pay are;

X1 = Age (Yrs)

X2 = Annual Income (Rs)

X3 = Savings (Rs)

X 4 = Health cost due to noise pollution (Rs)

X5 = Working loss days

The logit regression model based on these influencing factors for better reduction in noise level is represented in tables 6.44 and 6.45.

Table 6.44 The Logit Regression Model (Noise Reduction)

	Coefficient	Std. Error	Z	p-Value
Const	0.542829	1.99797	0.2746	0.78377*
X1	0.0594681	0.0388211	1.5316	0.12553***
X2	0.00133401	0.0626054	0.0214	0.98300**
X3	0.444593	2.08683	0.0214	0.98300**
X4	0.000439172	0.0009069	0.4845	0.62813***
X5	0.148755	0.0342512	4.3430	0.00001**

Source: Survey Data
Note: Observations 1-48 (n=39)
Missing or incomplete observations dropped = 9
Dependent variable: WTP

Table 6.45

The Logit Regression Model for Reduction in Noise Level

Mean dependent var.	0.800001	S.D dependent var	0.402121
McFadden R-Squared	0.631623	Adjusted R-squared	0.505411
Log-likelihood	17.51191	Akaike criterion	47.02380
Schwarz criterion	62.34706	Hannan-Quinn	53.21557

Note: Percentage of cases correctly predicted = 94.6%
f (beta' x) at mean of independent vars. = 0.403
Likehood ratio test: Chi-square (5) = 60.0523 [0.0000]
**Indicate 5 percent level of significance
*Indicates 10 percent level of significance
***Indicates 1 percent level of significance

The logit analysis of the factors determining the willingness to pay the household regarding the reduction in noise level to a considerable normal level implies that age, annual income, health costs and number of working loss days have significant influence upon the willingness to pay of the households. The saving factor has not showed much influence upon the willingness to pay in this matter. The result shows that the R^2 on probability of household's willingness to pay for noise reduction is 0.631 which implies that, more than 63 percent of the changes in the willingness to pay for noise reduction in the sample areas. The mean and S.D. of dependent variable are given as 0.800001 and 0.402121 respectively. The log likelihood in the case of noise level is marked as 17.51191. Similarly, the Chi-square value accounts for 60.0523 at one percent level of significance. This implies that there is close association between the willingness to pay and reduction in noise level. Hence, the households are willing to reduce the use of private vehicular horns, fire crackers

during festivals, sound polluting loud speakers etc. in order to reduce the noise level and are willing to pay for using the public transport systems and other services for better environmental conservation. Thus along with the citizens the authorities should adopt proper environment friendly services in urban areas.

6.4. Implications of the Study

The analysis of the urbanization and environmental conditions in Thrissur District with special consideration to household living conditions implies that the city life is associated with many environmental issues. The Environmental goods such as water, air and land are influenced adversely due to unplanned or unscientific urbanization. Growing urban population without much consideration of environment leads to high amount of pollution. The study of environmental conditions conducted in 3 main zones of the district when there is presence of much urbanization and some amount of slum population reveals that, out of the total respondents 33.8 percent respondents are facing the problem of water pollution, 28 percent have air pollution problems, 21.3 percent have noise pollution related issues and 16.9 percent are facing solid waste pollution.

All these forms of pollution badly, influence the health conditions of the households in the form of diseases. Growing diseases in urban areas resulted in growing health expenditure and loss of work days. This ultimately created economic issues. The ANOVA applied in the study to know whether any variances in samples in three zones in case of health impacts due to major pollutions in the area such as water and air pollution revealed that there are not much significant variations in the sample zones. Thus, the impact of urbanization on sustainable environment in Kerala implies a worse relationship, where there is high amount of environmental issues with high urbanization. The unplanned urbanization without much consideration of ecology is the serious issue that Kerala is facing since last three decades like other cities of the nation. The rural urban migration results in congested city life and associated deterioration of the quality of environmental goods.

During the study almost all the household respondents have positively reacted towards adopting environmental conservation methods. The contingent valuation method which is adopted for economic valuation of environmental goods (land, water, air) implies household's willingness to pay towards environment friendly methods.

Households are willing to pay for improved quality of water and air, proper waste management services and reduction in noise pollution levels. For this, the authorities should come forward with suitable environmental conservation methods which will enhance the positive attitude of people towards protecting environment in urban areas. Only then, the aim of sustainable urban life is fructified.