CHAPTER ONE

INTRODUCTION

Chapter One

Introduction

1.1 Prologue

Environment is everything that is around us. It can be living or non-living things. It includes physical, chemical and other natural forces. Living things live in their environment. They constantly interact with it and adapt themselves to conditions in their environment. In the environment there are different interactions between animals, plants, soil, water, and other living and non-living things (https://simple.wikipedia.org/wiki/Environment).

Environmental quality is a set of properties and characteristics of the environment either generalized or local, as they impinge on human beings and other organisms. It is a measure of the condition of an environment relative to the requirements of one or more species and or to any human need or purpose. It is a general term which can refer to varied characteristics that related to the natural environment as well as the built environment, such as-air, and water purity and pollution, noise and the potential effects which such characteristics may have on physical and mental health caused by human activities. (Mitra, 2000)

It may be observed the state of environmental; quality is worsening from a global to a local scale. In a synthesis of global data, the United Nations Environment Programme has intensively catalogued environmental assaults across the six different major regions of the globe. And it finds that, overall, damage to the planet is happening more rapidly than before, through slights ranging from air pollution, to the proliferation of human and toxic waste, to water scarcity and climate change.

For North America, there was an anomaly in that air quality is not getting worse — it's getting better. However, the same can't be said for water scarcity, or for the effects of climate change.

West Asia — which includes the Middle East — is suffering from desertification and major water supply concerns.

Asia and the Pacific, where air pollution is again worsening, even as booming populations and prosperity are driving more waste accumulation, which is polluting water supplies. Water-related diseases and unsafe water contribute to 1.8 million deaths annually and 24.8 million disability-adjusted life years in the region according to United Nations Environment Program (UNEP, 2019).

If we look into a national scale, we see the present environmental condition of Bangladesh is not at all equilibrium. Severe air, water and noise pollution are threatening human health, ecosystems and economic growth of Bangladesh. Air pollution caused due to increasing population, burning fossil fuels, industrialization and associated motorization. The water pollution caused due to industrialization. The underground water of Bangladesh has been polluted due to arsenic. The inhabitants of major cities of Bangladesh are also exposed to high level of noise pollution.

Environmental degradation of Bangladesh is also caused due to poverty, over-population and lack of awareness on the subject. It is manifested by deforestation, destruction of wetlands, soil erosion and natural calamities.

Bangladesh is also marked by severe scarcity of land resources. The population is increasing and per capita land resource is decreasing gradually. Almost all the major city corporations and Pourasavas are facing over population problems. Therefore, the environmental condition of each and every city corporations and Pourasavas are deteriorated daily. This deterioration aggressively touched to Dhaka and surrounding Pourasavas. For that understanding Savar Pourasava was consider as the study area. Through this study, we can assess the current state of environment in a local or micro scale.
The environmental quality of Savar Pourasava is changing day by day because of increasing population, establishment of more industry, land filling, rapid urbanization and transportation and so on. Industrialization has been identified as one of the major drivers of environmental degradation. The industries in Savar area include garments, textile miles, leather goods, metal products, electronic goods, paper products, chemicals and fertilizers and miscellaneous products (Khan et al., 2011).

In the study area the industries discharge waste water with heavy metals, toxic chemicals, dissolved lime, chromium sulfate, alkali, hydrogen sulfide, sulfuric acid, bleach, dyes, oil, formic acid, suspended solids, organic matter, pesticides, polychlorinated biphenyls (PCBs), dioxins, poly-aromatic hydrocarbons (PAHs), petrochemicals, phenolic compounds and microorganisms (Fakayode, 2005).

1.2 **Background of the Study**

According to Treshow (1970) environment as environment include all the factors and forces prevailing internally and externally or around and in the plants and animals. The Environment literally means the surrounding or the sum total of all surroundings of living organism, including natural forces and other living things which provide conditions for development and growth as well as of danger and damage. The environment is the aggregate of all those things and set of conditions which directly or indirectly influence not only the life of organisms but also the communities at a particular place.
It includes all light, moisture, wind, temperature, soil, organisms, pollutants, insecticides, pesticides, radioisotopes and man. When the environment includes non-living things like soil, water, and wind and temperature, etc., and forces of nature like solar radiation, gravity and molecular energy, it is known as Physical Environment. On the other hand, when it includes all living things that affect the organisms, it is known as biotic environment.
Broadly speaking, the complete environment of the earth can be divided into four sub-divisions- Atmosphere, Lithosphere, Hydrosphere and Biosphere'. (Narayanan, 2011).

"Environmental quality is a state of environmental conditions in environmental media, expressed in terms of indicators or indices related to environmental quality standards''.(Glossary of Environment Statistics, 1997).

"An environmental quality standard is a limit for environmental disturbances, in particular, from ambient concentration of pollutants and wastes, that determines the maximum allowable degradation of environmental media." (Glossary of Environment Statistics, 1997)

The quality of environment really means the quality of life. Nothing less it is, at its heart a social phenomenon-social because man is the focus of concern. All that is done by technology to clean his psycho-chemical environment, and all that is done to elaborate the health effects, must sub serve the longer goal of man's enjoyment of life. It is therefore, the public environment and it is no secret man today faces an environment hostile to his aspirations for a better life. Within the system we call environment quality, many legitimate demands are made on its inner values-by conservationists by Industrialists and so onto recondite, this conflicting claims is the essence of the national environmental policy, clearly the final answer lies in the adherence to laws governing the use of those resources-But laws which are carefully enacted, wisely enforced and fairly interpreted.

A nation generally blessed with the quality of life is now clamoring for the quality of life. This is especially true of the disposed. Thus, in shaping our environment for the enhancement of life, the interaction of technology and humanity should be at its core, the relationship is obvious.

Therefore, we have seen that the concept of environment may include both physical and human aspects and therefore parameters of environmental quality has to be set accordingly while assessing the Savar Pourasava's environmental quality.

Savar Pourasava is located about 26km from the capital city of Dhaka which is 20th megacity of the world. Dhaka city is now over populated for it's limited space, that's why people are interested to migrate to places near the Dhaka city with various urban facilities.

The study tries to answer some vital questions regarding the overall state of the environment of Savar Pourasava.

What was the environmental quality of Savar Pourasava in the past and what is the present environmental quality. If there are any changes, what are the reasons for changing?

How the natural environment such as-surroundings air, water (underground & surface) is changing and how these are polluted? While the study tries to identify the main causes of the degrading environment of Savar Pourasava, it is seen that migration to the periphery areas of Dhaka has caused a major influx into the Savar region. Urbanization of Dhaka is closely linked to the rural displacement triggered by the government's structural adjustment policies and concentration of wealth and employment in urban centers. In addition, natural disasters and vulnerabilities through climate change displace millions of

population in the coastal areas who migrate to the city and mostly take shelter in the urban peripheries to escape from poverty. Thus, Dhaka's urban periphery has sprung up as rings of urban poverty in recent decades. Most of the new migrants to the city take shelter in the peripheries like Savar due to easily available low cost housing. In addition, the urban poor from the city centre are increasingly being forced out to the peripheries due to increasing demand for land for urban development in the city centre. The new urban poor living in the peripheries are economically marginalized due to exclusions from the formal sectors of the economy. People's perception regarding key urban environmental parameters is very important for studying the environmental quality. People's perception regarding urban environmental problems in savar upazilla was presented in the study by (Islam et al; 2013).

The result from study by Islam et al 2013 depicts that 67% of the respondents report the problems of flash flood and drainage congestion, 68% water pollution, 79% air pollution, 63% water and sanitation, 73% garbage disposal system, 79% traffic congestion and 36% open space/recreation facilities.

Therefore, we have tried to assess the overall definition of environment and also tried to identify the major environmental drivers of the Savar Pourasava in light of the definitions.

1.3 Aims and Objectives

The study aims at assessing environmental quality of Savar Pourasava and the detail objectives are following:

- To assess the land use change of Savar Pourasava between 1980-2017 and investigate its impacts on environmental quality
- To assess the water quality and pollution of Savar Pourasava
- To assess the air quality and pollution of Savar Pourasava
- To assess the sound quality and pollution of Savar Pourasava
- To assess the soil quality and pollution of Savar Pourasava
- Finally to assess the industrial pollution of Savar Pourasava
- To assess the overall environmental quality of Savar Pourasava

1.4 Details of the Study Area

The present study area is the Savar Pourasava. The detail of the study area is given below:

1.4.1 General Description

Savar Pourasava is located at the north-western side of Dhaka City and on the Dhaka – Aricha Highway. Savar Paurasava was established in 1991. It covers an area of 13.54 sq.km*. But in 1991, the total area of the Pourasava was 24.07 sq.km and in 2001, the area was chronologically changed and covered 38.00 sq.km.

The number of household were 15,163 in 1991 and 2001 it were in more than double and number of household were 30,386; in 2011, the number of household were rapidly increased and it turned in 75,902. The total population of the Pourasava as enumerated in 2011 census is 2,96,851 of which 1,57,018 are males and 1,39,833 are females but in 2001 the population was 1,27,540 and the male–female ratio was 68,491-59,049. In 1991 the total population was 77,216 and males-females ratio was 41,508-35,708.

Form these data it can be said that the population growth is highest in the pourasava.
The literacy rate of the pourasava is 74.9% but the literacy rate was in 1991 was 46.6% and in 2001 it was 67 %.

It consists of 9 wards and 56 mahallahs. (BBS, 2001). There are three Colleges, four High Schools, nine Primary Schools, five Madrasas, thirty Six Kindergartens and one College of Christology. There are also 65 Mosques, 22 Temples, 02 Churches. Savar Pourasava has 137 Industries and one Pouro-Supermarket.

* Source: BP and H Census 2011, BBS

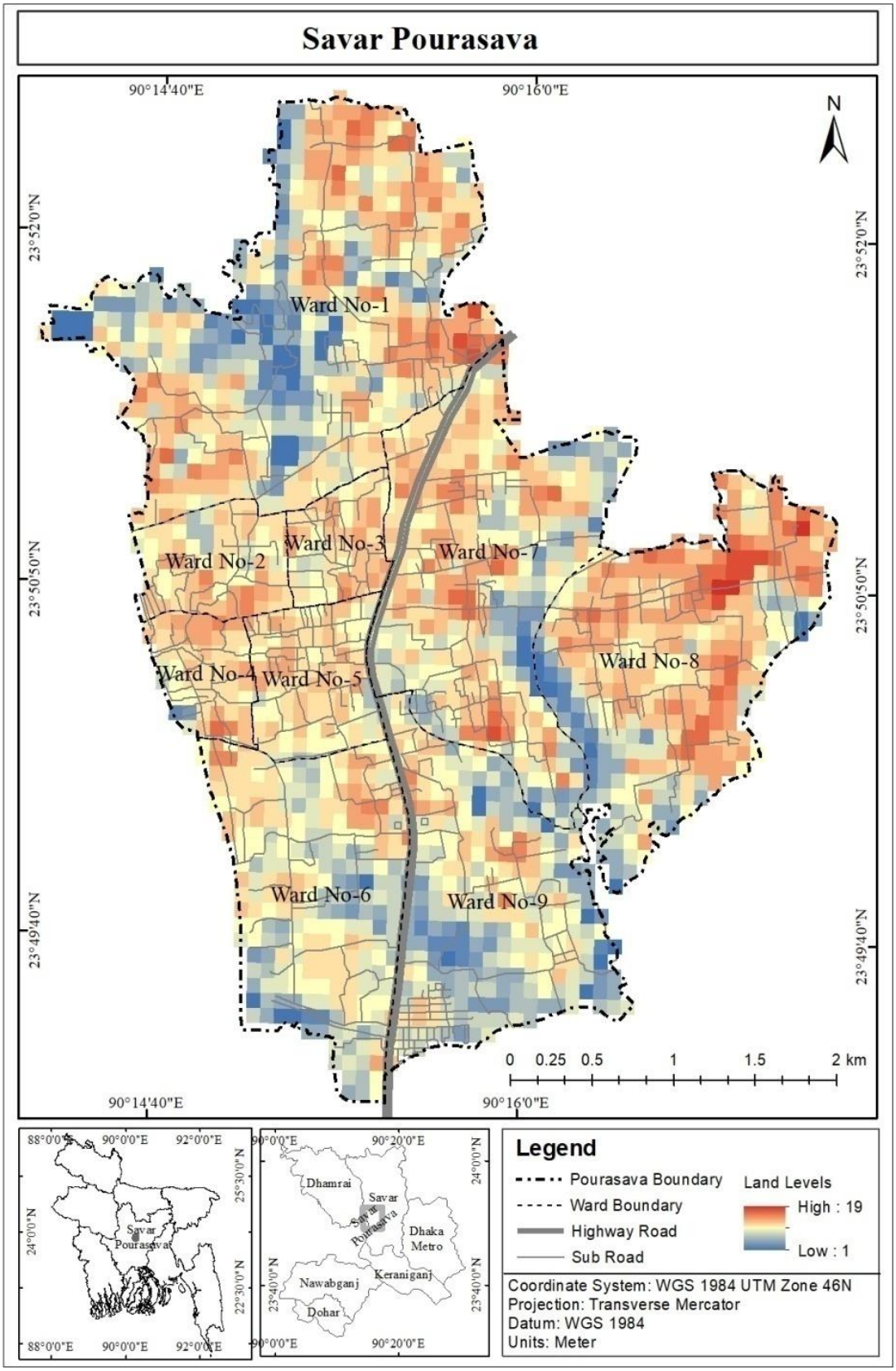
Table 1.1: Basic Facts of Savar Pourasava

Basic Facts of Savar Pourasava			
Items	1991	2001	2011
Area (sq. km.)	24.07	38.00	13.54
Household	15,163	30,386	75,902
Population (Both sex)	77,216	1,27,540	2,96,851
Male	41,508	68,491	1,57,018
Female	35,708	59,049	1,39,833
Literacy Rate (7+years)	46.6	67.0	74.9

Source: BP and H Census 2011, BBS

1.4.2 Geographical Location

Savar Pourasava is situated between 23°44' and 24°02' N Latitude and 90°11' and 90°22' E Longitude.(Figure-1.1)



Source: Field Survey, 2018

Figure 1.1: Study Area (Savar Pourasava)

1.5 Rationality

The study aims at assessing the environmental conditions in a periphery region to the central megacity Dhaka. This is because, Dhaka is now over populated and also one of the most polluted megacities in the world. A significant portion of the people has to migrate to places near the Dhaka city because of affordable urban facilities, employment, communication system and so on. Therefore, in order to assess this phenomenon, a Pourasava which is adjacent to Dhaka and also has good transportation networks must be selected for the study. Savar is one of the most well connected areas to the capital Dhaka.

It is also in close proximity to other major urban centers such as Munshiganj, Narayanganj, Gazipur, Tongi and therefore the people living in Savar may also avail the facilities from these areas. Therefore, people want to migrate here because of it's suitable location, economic condition and also for comparatively better environmental quality to Dhaka megacity. Yet, this notion of better environment quality in the periphery of Dhaka is changing with time. It has been highlighted in different literatures that the environmental quality of Savar Pourasava is declining due to various factors such as Industrialization, Population growth, Transportation, Chemical waste, Land filling, Sewerage and Garbage etc..

Therefore, studies need to be conducted in order to portray the current state of environment in the Pourasava. In the current circumstances, how we ensure a sustainable green environment with a large population growth at Savar Pourasava is a challenge. Therefore, the major changes in environmental parameters and there root causes and also the gradual change must be highlighted.

Periphery areas of Dhaka are overall facing deteriorating environmental conditions and this study focuses on SavarPourasava has one of the most prominent centers where environmental change can be noticed. The numbers of studies on this issue are mostly absent and therefore this study will try to fill up the gap in research.

1.6 Limitations of the Study

The study faces several limitations. Information regarding the Pourasava's solid waste management and allocation of resources within Pourasava was not readily available. The study has not been able to address most of the stakeholders due to time constraints. Entire waste category was not considered in this study. The study concentrated onlyonnon-hazardous solid waste generated from different sources especially the household solid waste in Savar Pourasava area.

While conducting the field study, the negligence and lack of cooperation of the Pourasava officers was noticeable and therefore it was difficult to collect secondary data. It was also difficult to make the respondents aware of the environmental parameters as most of them didn't have basic knowledge about the environment.

1.7 Conclusion

Various scholars have defined the term environment in there own ways as portrayed in this chapter, but we realize that environment encompasses a wide array of both physical and human parameters. The urban sprawl of Dhaka has led to increased industrialization and urbanization in sub-urban or periphery regions of the megacity. This has also led to the deterioration of the environment in these areas. Therefore, the Savar Pourasava is one such area with increasing levels of industrialization and urbanization and also degrading environmental quality. Therefore, due to its close proximity with Dhaka, Savar Pourasava has been selected as the study area. Migration patterns and also people's general perception has been used as justifications for portraying the dynamic condition of the Pourasava.

CHAPTER TWO

LITERATURE REVIEW

Chapter Two

Literature Review

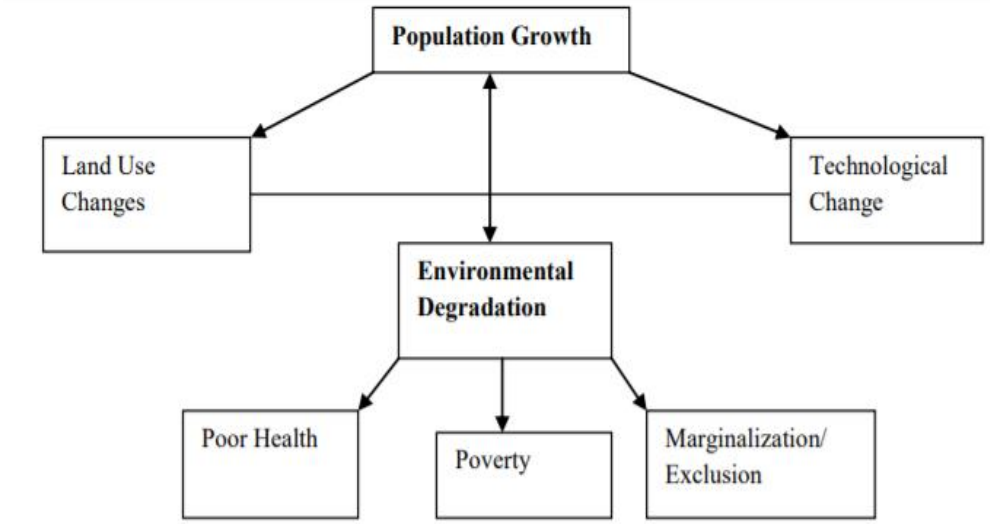
Literature Review

As a developing country, Bangladesh has to face various challenge to ensure a balance environmental sustainability and development. River quality, sound urban air, deforestation, household and hazardous waste are some of the major serious and worrying environmental problems faced by the country, Globally, Bangladesh is one of the countries most affected by pollution and environmental hazards risks. Therefore Bangladesh must act now to tackle environmental degradation and pollution, especially in its cities. (World Bank, 2018).

Due to pollution and environmental degradation in urban areas. Pollution has reached an alarming level; in 2015, it caused about 80,000 deaths in cities. The country loses about $6.5 billion, which is about 3.4 percent of 2015 Gross Domestic Product (GDP). (World Bank, 2018).

Across Bangladesh, 28 percent of all deaths are from diseases caused by pollution, compared to a 16 percent global average. The country has been grappled with a series of environmental deterioration by means of land encroachment at forest, destruction of wetlands and inland fisheries, surface and groundwater pollution, soil nutrient depletion, inland salinity intrusion, natural calamities like floods, cyclones, tidal surges and tornadoes have resulted in severe socioeconomic and environmental damage (MoEF, 1992).

Environmental degradation simply means overall lowering of environmental qualities because of adverse changes brought by human activities. The relationship as it stands today between man and environment is that man's dominance over nature and that of overexploitation and misuse of environment to the extent that it is now degraded (Zinatunnessa, 2001).



Source: Reza, 2016

Figure 2.1: Relationship Between Environmental Degradation and Population Growth

In Bangladesh, one of the key challenges for environmental protection lies in controlling the over whelming growth of population in all major cities, including the sub-urban cities such as Savar Pourasava. According to several authors it is established that increasing population has detrimental impacts on the environment. According to Ehrlich and Holdren (1971), the total impact of human population on environment can be determined as a function of several factors such as follows:

Environmental Impact = (Population size) × (Per capita affluence level) × (Impact from the technologies used to achieve that level of per capita affluence)

Therefore, we realize that population growth along with other associated variables play a vital role in determining the overall environmental impact. On top of the overwhelming pressure that is imposed

by population, there are several other miss-management and over-exploitative actions that poses great challenges to Bangladesh. Improper solid waste management, one such instance of mis-management, contributes greatly to river pollution. Solid waste management is regarded as one of the most immediate and serious issues for any Pourasava in Bangladesh. Solid wastes in Savar municipality can be characterized as highly biodegradable and contain high moisture content. It was observed that, more than 90% of the total waste contains biodegradable materials, 5% of plastics and polythene, 0.5% glass and ceramics and 0.5% metals (Rahman et al; 2011)

Savar Pourasava authority is the only responsible organization for management of generated solid wastes with its infrastructures for collection, separation and disposal of solid waste generated within the our savar area. The peripheral cities are turning out to be the next hubs of pollution. One of the most prominent impacts maybe seen in the Savar Pourasava. Solid waste generation had reached to the value 51, 016 kg/day on the basis of per capita waste generation 0.40 kg /day. Savar Pourasava authority is the only responsible organization for solid waste management (45% of total generated wastes) of its nine wards (17.15 km^2). Waste minimization, segregation of wastes, door to door waste collection, participation of Community Based Organizations (CBOs), composting, energy generation and sanitary land filling were integrated to manage about 75% of the total generated solid wastes." (Shahriar, 2011)

Transportation also remains as one of the most critical components of the environment. The environmental impact of transport is significant because transport is a major user of energy, and burns most of the world's petroleum. This creates air pollution, including nitrous oxides and particulates, and is a significant contributor to global warming through emission of carbon dioxide. Within the transport sector, road transport is the largest contributor to global warming (Wikipedia, 2019)

The mode of transportation is a good indicator as the higher the use of private transport, greater the impact on the environment. The transportation systems of Savar Pourasava has been studied by several authors (Lutfur et al., 2009; Islam et al., 2009; Mamun, 2009)

In Savar Pourasava, modal choice by commuters varies with commuter's socio economic background and demographic characteristics. It also varies with the services that are provided by the various modes operating in the study area. The land use characteristics also affect the travel behavior pattern of commuters in the study area. The attitude and preference of commuters towards modes are also varied from each other. It is seen that there is wide use of petrol run automobiles in the study area, therefore, this public mode is also seen to cause air pollution. Measures to reduce fuel demand and improve traffic conditions are also critical to ensuring a net emission reduction and should be used as a complement to technical measures (Wei-Jei et al., 2017; Xue-Yan et al., 2017; Nan-Shan, 2017).

While assessing the overall quality of the environment, we must consider all the possible sources of pollution. Water pollution is one of the significant dangers to general wellbeing of Savar Pourasava. Drinking water quality is inadequately overseen and checked.

In Bangladesh, total environment, as well as economic growth and developments, are all highly influenced by water. In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal waste water, runoff pollution from chemical fertilizers, vehicle emission pollutants, pesticides, etc. (Bhuiyan et al. 2011)

Bangladesh positions at number 86 among 142 countries with respect to drinking water quality. Drinking water sources, both surface and groundwater are debased with coliforms, harmful metals and pesticides all through the nation. Different drinking water quality parameters set by WHO are every now and again not followed. Human wastes, transfer of civil and mechanical wastes and aimless use of agrochemicals in agribusiness are the principle factors affecting the water quality. Microbial and substance contaminations are the primary elements work solely or in mix for different general medical issues (Amrar and Avijjit, 2017)

Various research indicate that the water of all rivers around Dhaka City is highly polluted during the dry season, except for water of the River Sitalakhya. The important water quality parameters in the dry and wet seasons, when compared with earlier values, indicate that the degree of pollution of these rivers is gradually increasing with time (Sohel et al., 2003)

The main rivers flowing around Dhaka are Buriganga, Turag, Dhaleswari. Shitalakya and Bangshi. It is observed that around 40% of industries of Bangladesh including tannery, textile and dying, chemical, plastic, fertilizer are located within greater Dhaka and surrounded by these rivers (Faisal et al., 2004)

Bangshi River is one of the most important rivers in Savar Municipality in respect to irrigation, fisheries, transportation, recreational uses and so on. The water of Bangshi River is undergoing continuous changes in terms of quality. The degradation of water quality of Bangshi has aggravated at an alarming rate as a result of increasing industrialization, urbanization and development activities. Bangshi River receives millions of litter of sewages, domestic wastes, industrial and agricultural effluents (Kabir, 2014)

(Momtaz et al., 2012) show that the surface of quality of the DEPZ industrial area of Savar revealed that all the chemical constituents, except a few, were beyond the recommended limit for various uses. The lowest content of DO (0.10 mg/L) and highest content of BODs (895 mg/L) in point source waterbody indicate that the industries were releasing large amount of oxygen demanding organic wastes which subsequently affected all the studied water body.

Therefore, considering different locations in and around Savar Pourasava, we can see that the level of water pollution is in a very critical condition. Air pollution is one of a variety of manmade environmental problems in the Savar Pourasava as other key urban populated areas of the Bangladesh.

Air pollution is a pressing issue in our country as Bangladesh ranks 169th (out of 178 countries) at the Environmental Performance Index for Air Quality (APT, 2016). The main sources of air pollution include emission from faulty vehicles, especially diesel run vehicles, brick kilns and dust from roads and construction sites and toxic fumes from industries (Haque et al., 2017)

Air pollution may be defined as an atmospheric condition in which various substances are present at concentrations high enough above their normal ambient levels to produce a measurable effect on people, animals, vegetation or materials. 'Substances' refers to any natural or manmade chemical elements or compounds capable of being airborne. These may exist in the atmosphere as gases, liquid drops, or solid particles. It includes any substance whether noxious or benign; however, the term 'measurable effect' generally restricts attention to those substances that cause undesirable effects. (Islam, 2014)

Air quality has deteriorated both due to human activities, and natural phenomenon such as wind-blown dust particles etc.

There are two major sources of air pollution in Bangladesh, vehicular emissions and industrial emissions. Recently, air pollution has received priority among environmental issues in Asia, as well as in other parts of the world.

A study showing the state of air quality in Dhaka city stated that the yearly averages of PM_{10} and $PM_{2.5}$ were significantly high. The mean values were greater than the Bangladesh and WHO air quality standards. The pollution level of PM_{10} and $PM_{2.5}$ was highly significant, indicating high pollution in Dhaka. By contrast, analysis of other pollutants, such as NO_2, SO_2, CO, and O_3, showed a low annual average, less than the quality standards of Bangladesh and WHO (Motalib et al., 2015)

Due to increase of PM_{10} and $PM_{2.5}$, people lose lung function and suffer from chronic respiratory and cardiovascular diseases while nitrogen dioxide increase risks of bronchitis and pneumonia. Nitrogen dioxide causes respiratory infection. Carbon monoxide reduces delivery of oxygen into the human body, creates severe headache and decreases visual perception and manual dexterity. Around 75% of the ingested lead is deposited in bones and tissues causing irreversible brain and kidney damage. Growing nervous system of young children is particularly vulnerable. (Islam, 2014)

The other urban areas i.e. Chittagong, Khulna, Bogra and Rajshahi have much lesser health problem related to urban air pollution. The International Atomic Energy Agency (IAEA) stated in its News

Briefs that pollution levels of lead in Bangladesh are among the world's highest during dry season, according to Bangladesh Atomic Energy Commission (BAEC), with levels falling during periods of medium and heavy rainfall. The volume of poisonous particles in the city air has reached far beyond the permissible level for human body in recent years.(Islam, 2014)

Another type of pollution that must be considered is soil pollution. Soil pollution, influenced by both the natural and anthropogenic factors, significantly reduces environmental quality.

A study on the soil pollution in Dhaka city showed that soils from tannery waste (TW), metal workshop (MW) and electric waste (EW) sites were heavily contaminated by hazardous elements especially Ni, Cu, As, Cd and Pb (N70% samples exceeded the Dutch soil quality target value). The study also confirmed that metal concentrations in urban soils of Bangladesh were varied with different land-use (Islam et al., 2015).

Heavy Metal contamination in the water bodies around Dhaka city is a major concern. Several studies have shown that the concentration of heavy metals in the water is higher than the allowable limits. According to a study on the water bodies around Dhaka city by Rahman et al 2013, the concentration of six heavy metals (Pb, Cd, Ni, Cr, Zn, and As) out of eight in water samples, are higher than the WHO (1993) recommended guideline for drinking water. Discharges of industrial, agricultural wastes and of municipal sewage water appear as the major sources for water quality deterioration in this study area. The elevated levels of these heavy metals could ultimately contaminate the cultivated crops, fish and thus making them toxic for human consumption.The study also investigated the impacts on sediments in the water bodies. The average heavy metal concentrations in the sediments are lower than the PEL with exception of Cr. The sediment samples show a low degree of contamination by heavy metals and low potential ecological risk level.

Another study by Ahmed and Goni 2009, on heavy metal pollution estimated the concentrations of Cu, Zn, Pb, Cr, Cd, Fe, and Ni in different parts of industrial areas in Bangladesh. The order of metal contents was found to be Fe > Cu > Zn > Cr > Pb > Ni > Cd in contaminated irrigation water, and a similar pattern Fe > Zn > Ni > Cr > Pb > Cu > Cd was also observed in arable soils. After comparison with established parameters set by WHO and SEPA, mean concentration of Cu, Fe, and Cd in irrigation water and Cd content in soil were much above the recommended level. Cd exhibited elevated content in vegetables around industrial areas. Uptake and translocation pattern of metal from soil to edible parts of vegetables were quite distinguished for almost all the elements examined.

We can conclude that studies show literatures prove that there is high possibility for aggravation of different levels of pollution in Savar Pourasava in the near future. Therefore, study to justify environmental quality is crying need.

CHAPTER THREE

METHODOLOGY

Chapter Three

Methodology

3.1 Introduction

The study has been broadly divided into several stages which may divided into primary data collection and secondary data analysis. This research is conducted by primary data collection from the field and also data from various secondary sources. For primary data collection, questionnaire survey is conducted with scientific process. Spatial analysis is conducted by satellite image processing, Landsat images have been acquired from Glovis Earth Explorer and analyzed using ERDAS imagine and ArcGIS software. Beside this, several tools and technique have been used to process and analyze through MS word, MS excel and SPSS software. The detail study is based on following methods and techniques are following:

3.2 Secondary Data Collection

Relevant secondary information from various sources such as – statistics, reports, articles and census documents etc. are also collected, reviewed and analyzed. This secondary data and information are collected from various organizations like Bangladesh Space Research and Remote sensing Organization (SPARRSO), Department of Forest and Environment, Bangladesh Bureau of Statistics (BBS), Agriculture Information Service (AIS), Ministry of Agriculture in Bangladesh.

3.3 Primary Data Collection

The method of the present study involves a multistage complex analytical process of analysis and experimentation. To fulfill the objectives of the study the primary data were collected from the field survey. The field survey and sampling method are given below:

3.3.1 Field Survey

Based on predesigned questionnaire, the researcher interviewed selected respondents. During field survey, the researcher also observed the environmental condition of and took photographs to capture the peculiarity of the areas. The researcher also focused indigenous knowledge and wisdom of the people regarding environment quality. The survey was conducted between December 2017 to June 2018.

3.3.2 Sampling Method

Random sampling technique was used to select the respondents. 30 respondents were chosen from each of the 9 wards of the Pourasava and therefore spatial distribution was maintained. Total 267 respondents are randomly selected from different age group, occupation group at the study areas.

3.3.3 Sample Size Determination

In order to perform a random sampling procedure, the first step was to calculate a statistical sample size which would be representative of the whole population in the study area.

Sample size is the minimum sample size you need to estimate the true population proportion with the required margin of error and confidence level. Note that if some people choose not to respond they cannot be included in your sample and so if non-response is a possibility your sample size will have to be increased accordingly. In general, the higher the response rate the better the estimate, as non-response will often lead to biases in your estimate.

$$\mathrm{n} = \frac{N * X}{\mathrm{X} + (\mathrm{N} - 1)}$$

Where,

n = sample size

N= Total population size

$X = Z_{\alpha/2}^2 * p*(1-p) / MOE^2$

$Z_{\alpha/2}$ is the critical value of the Normal distribution at $\alpha/2$ (e.g. for a confidence level of 95%, α is 0.05 and the critical value is 1.96)
MOE is the margin of error, p is the sample proportion,

Source: Daniel WW (1999). Biostatistics: A Foundation for Analysis in the Health Sciences. 7th edition. New York: John Wiley & Sons.

3.3.3. a Margin of error

The margin of error is the level of precision you require. This is the plus or minus number that is often reported with an estimated proportion and is also called the confidence interval. It is the range in which the true population proportion is estimated to be and is often expressed in percentage points (e.g., ±2%). Note that the actual precision achieved after you collect your data will be more or less than this target amount, because it will be based on the proportion estimated from the data and not your expected sample proportion. In our research the margin of error was fix 6%.

3.3.3. b Confidence level

The confidence level is the probability that the margin of error contains the true proportion. If the study was repeated and the range calculated each time, you would expect the true value to lie within these ranges on 95% of occasions. The higher the confidence level the more certain you can be that the interval contains the true proportion.

Therefore, for our survey, we estimated the typical sample size using the following formula:

$$\mathrm{n} = \frac{N * X}{\mathrm{X} + (\mathrm{N} - 1)}$$

(i) N (Population of the Pourasava (2014))= 296851

(ii) Margin of error: 6%

(iii) Confidence Level: 95%

Therefore,

The ideal sample size calculated for the research was= **267 samples**

3.4 Data Analysis

The data collected from the field were processed and analyzed though computer using mainly SPSS (Statistical Package for Social Science), M S Excel Program. Maps are produced using GIS tools and cartographic techniques.

3.5 Satellite Image Processing

In order to assess the land use change in the Savar Pourasava, Landsat images were downloaded from USGS Earth Explorer.

Landsat MSS, TM and OLI sensor images were downloaded for the years, 1980, 1991, 2000, 2011 and 2017. The individual images were downloaded from USGS. The individual bands were combined together using layer stacking in ArcGIS. The images were corrected using image correction procedures such as haze correction, noise correction and atmospheric correction.

The Normalized Difference Vegetation Index (NDVI) was estimated by using the following formula

$$\text{NDVI}=\frac{NIR-Red}{NIR+Red}$$

Then unsupervised classification method was used for classifying the landuse in ERDAS Imagine software. After that, a supervised classification by the researcher on the unsupervised product.

The results, specially change of landuse were then analyzed in ArcGIS 10.6 environment.

3.6 Technique of Environmental Quality Analysis in Savar Pourasava

Two separate techniques were used to analyze the environmental quality of savar pourasava. These are :

(a) Weighted Overlay using Equal Weighted Method
(b) Weighted Overlay using Causal Factors

3.6. a Weighted Overlay Using Equal Weighted Method

In order to assess the severity of individual types of pollution and overall pollution was weighed according to ward-wise data of environmental quality of the savar pourasava.

There was a question regarding the severity of particular types of pollution, where the respondents were asked to rate the severity in a 1 to 5 scale, where 1 represented lowest level of severity and 5 represented highest level of severity.

The ward wise level of severity was then assessed. This information was then added to the ward-wise map of the Pourasava.

In order to assess the overall severity of pollution, a weighted overlay was conducted using air, water, sound and soil pollution. All the different types of pollution were assigned & equal weights for geospatial analysis. The result of geospatial analysis was then portrayed in a map.

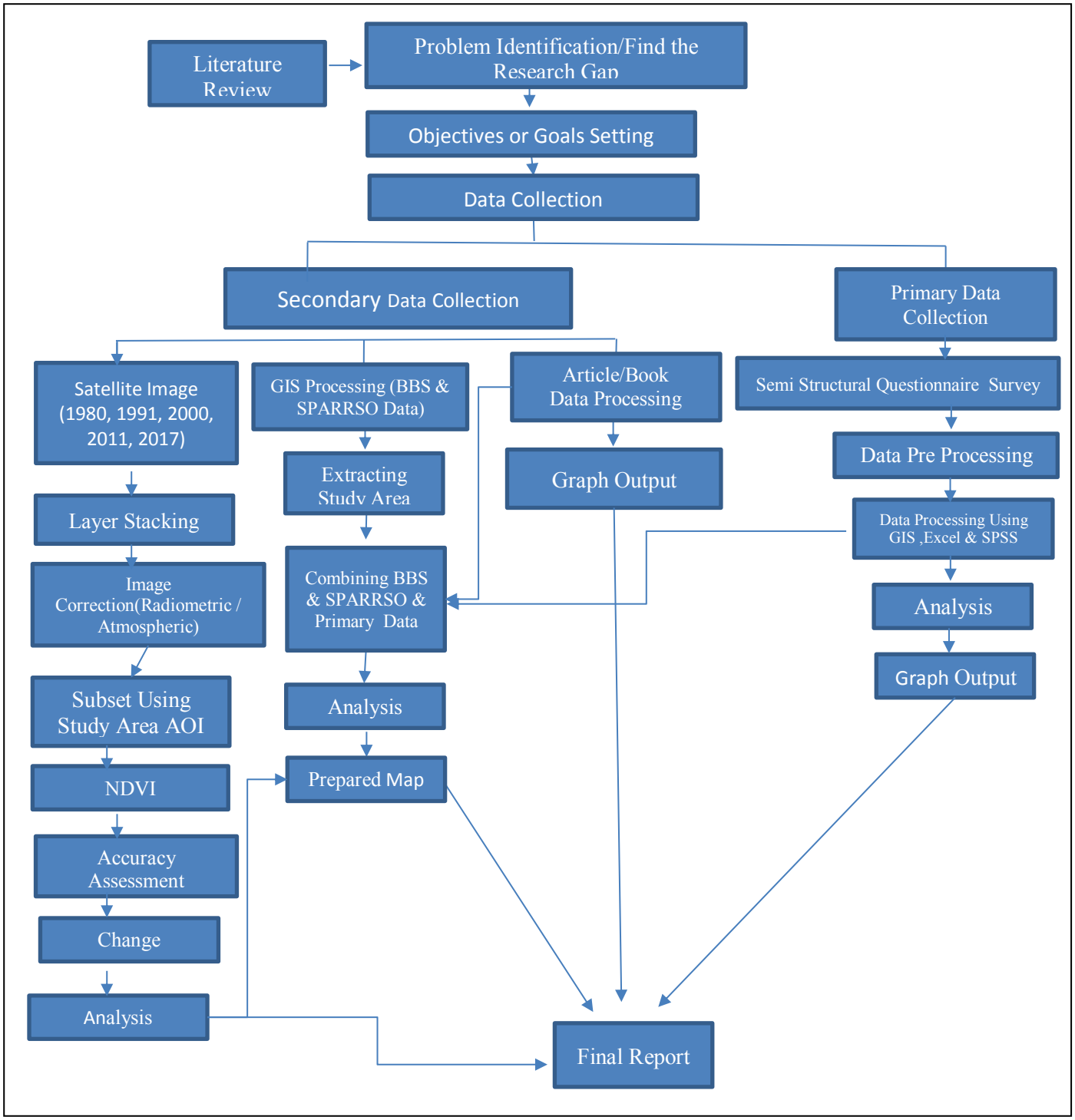
3.6. b Weighted Overlay Using Causal Factors

The quality of the environment was assessed by using equal weighted method, but the causes was not addressed simultaneously. Therefore, the causal relationship between environmental qualities as factors behind this is very important, that was addressed using weighted Overlay of the causal factor**.**

Therefore, the different types of causes of particular types of pollution were therefore used to assign the severity weights. The severity was assessed in a 1 to 5 scale where 1 represented low severity and 5 represented very high severity.

The respondents were asked to assign the severity of particular causes of the different types of pollution and later, weights were assigned to the particular causes of pollution.

This gave us final weighted severity maps of different types of pollution as well as the overall pollution severity map.



Source: Field Survey, 2018

Figure 3.1: Method of the Study (Work Flow)

3.7 Justification of Methodology

The study used a set of methodological approaches aimed at incorporation of social parameters obtained from the questionnaire survey with the geospatial analysis that was conducted.

The questionnaire technique used was the best method for registering people's perception regarding the data. It is often perceived that the importance of the perception of people is very important for getting an overall idea about the severity of pollution. The structure of the questionnaire was designed as such that both structured and non-structured responses could be reported. Further, the questionnaire was designed as such that the key weights for the Weighted Overlay analysis could be done. The sampling technique was used to estimate the number of population that must be considered to ensure that the findings are representative of the whole population.

Estimation of landuse from satellite imagery analysis is a vital component of the research. In this case the NDVI index has been used to classify landuse to ensure that the landuse obtained is through an unsupervised process. Temporal change in landuse is estimated to ensure that there is both spatial and temporal reflections of the changes in landuse.

The weighted overlay technique is used in this study for overlay analysis because it is the most widely accepted method. Here, we used two different types of weighted overlay techniques, i.e. equal weight and weights from the causal factors survey. Therefore, the people's perception on the severity and the overall severity irrespective of people's perception was compared. This is a novel approach that has been used in this study.

Therefore, the methodologies used in this technique has been designed to spatially reflect the people's perception on the severity of various types of pollution. Subsequently, landuse dynamics has been incorporated to find out actual changes that are driving such pollution.

CHAPTER FOUR

THEORETICAL FRAMEWORK OF ENVIRONMENTAL QUALITY

Chapter Four

Theoretical Framework of Environmental Quality

4.1 Introduction

Now a days, the word environment is often being used by almost all people around us, on television and in newspapers. Everyone is speaking about the protection and pre-serration of environment. Global summits are being held regularly to discuss environmental issues. During the last hundred years, the mutual relationship among environment, social organization and culture has been discussed in sociology, anthropology and geography. All this shows the increasing importance of environment. Besides, it is a fact that life is tied with the environment. The credit of beginning the study of human ecology in the field of sociology goes to Park and Burgess. There exists a close relationship between man and environment. On the one hand man is born in environment and establishes harmony with environment. On the other hand man tires to control his environment and change it according to his requirements. Hence it requires an understanding of the environment of which man is a part. (Mondal, 2018)

4.2 Components of the Environment

The term environment has been derived from a French word "Environia" means to surround. It refers to both abiotic (physical or non-living) and biotic (living) environment. The word environment means surroundings, in which organisms live. Environment and the organisms are two dynamic and complex component of nature. Environment regulates the life of the organisms including human beings. Human beings interact with the environment more vigorously than other living beings. Ordinarily environment refers to the material sand forces that surrounds the living organism. (Gupta, 2018).

Different authors have defined the term environment according to their own perspectives.

According to P. Gisbert, "Environment is anything immediately surrounding an object and exerting a direct influence on it."

According to E. J. Ross "Environment is an external force which influences us."

According to Saravanan et al 2004, Components or segments of environment are given below:

1. Atmosphere – the sphere of air.

2. Hydrosphere – the sphere of water.

3. Lithosphere – the sphere of soil, rock, etc.

4. Biosphere – the sphere of living organisms.

But it can be roughly divided into two types such as

(a) Micro environment and

(b) Macro environment.

It can also be divided into two other types such as:

(a) Physical and

(b) Biotic environment.

4.3 Influential Factors of Environmental Quality

4.3.1 Industrial Pollution

4.3.2 Water Pollution

4.3.3 Sound pollution

4.3.4 Air pollution

4.3.5 Soil Pollution

4.3.1 **Industrial Pollution**

Industrial pollution is the pollution which can be directly linked with industry. This form of pollution is one of the leading causes of pollution worldwide. There are a number of forms of industrial pollution. Industrial pollution can also impact air quality, and it can enter the soil, causing widespread

environmental problems. Industrial activities are a major source of air, water and land pollution, leading to illness and loss of life all over the world. The World Health Organization estimates that outdoor air pollution alone accounts for around 2% of all heart and lung diseases, about 5% of all lung cancers, and about 1% of all chest infections. (Srivastava, 2007)

Industrial pollution is the release of wastes and pollutants generated by industrial activities into the natural environments including air, water, and land. Additionally, industrial pollution is linked to the degradation of the natural environment. Industrial pollution impacts the environment in multiple ways and has grave consequences on human lives and health. At the same time, industrial pollution can adversely damage plants, kill animals, cause ecosystem imbalance, and degrade the quality of life. Leading industries such as power stations, steel mills, sewage treatment plants, heating plants, and glass smelting among other production, processing and manufacturing companies are the contributors to industrial pollution. They release smoke, effluents, material wastes, toxic byproducts, contaminated residues, and chemical consumer products that eventually end up in the environment thereby causing pollution. (Muralikrisna and Manickam, 2017)

According to Madaan (2018), the various causes of industrial pollution are as follows:

4.3.1.a Toxic Chemicals

The toxic chemicals used by industries in processing and manufacturing are the biggest contributors to industrial pollution. These substances are a threat to attaining quality life and are hazardous to human health and the environment. Industrial facilities across the world generate more than 25 million tons of toxic chemicals as production-related wastes and pollutants. These toxic chemical pollutants are released into the environment resulting in various forms of pollution. (Alexander, 1995)

4.3.1.b Industrial Consumer Products

Industrial end products such as electronics, car parts, plastics, metals, and chemical utilities such as petroleum, paints, sprays, and cleaning solvents created for human consumption are a major cause of pollution. All these industrial products at some point in their lifetime become obsolete, and a good number of them end up in landfills or water bodies thus causing land and water pollution respectively. Besides, these consumer products contain poisonous chemical elements which can have an adverse effect on the human and animal health, and plant life. (Freeman et al., 1992)

4.3.1.c Hazardous Waste Streams

Hazardous waste streams treatment is for the most part not done efficiently in the majority of industries. The industrial waste stream contains numerous chemical substances that are defined in terms of reactivity, ignitability, toxicity and corrosively. As such, the waste generated is always somewhat hazardous and coupled with the lacking waste management systems, the environment is periodically exposed to high scores of industrial waste pollution. In particular, water streams are the ones that negatively suffer from such trends. Long-term discharge of hazardous waste streams into water cause severe health problems and reduces water quality. (Mmereki et al., 2016)

4.3.1.d Greenhouse Gas Emissions

Carbon dioxide (CO2) gas is highly known as a greenhouse gas due to its ability to absorb thermal radiation leading to global warming and climate change. Industrial energy use during production emits high scores of carbon dioxide gas into the atmosphere, making it a leading source of CO2 emission. CO2 emissions around the world arise from energy use in commercial, production, processing, and power producing industries combined. Although carbon dioxide emissions from industries have reduced in the past decade, industries remain a major contributor of CO2 and other greenhouse gases into the atmosphere. (Philander, 2008)

4.3.1.e Existence of Numerous Small Scale Industries

In the recent years, the number of small-scale industries and manufacturing activities has been doubling at a fast rate. The major challenge for small scale industries is that they want to operate, but with limited capital. Per se, they opt for crooked and dangerous means of manufacturing in order to maximize output at the expense of observing environmental laws. In most cases, they operate illegally thereby promoting illegal dumping. Consequently, they release huge loads of toxic pollutants and dangerous chemicals into the environment. (Mwang'ombola, 2003)

4.3.1.f Degradation and Depletion of Natural Resources

Industries need a consistent supply of fresh raw materials used to produce their respective final products. As a result, scores of raw materials including metals, minerals, trees, and oils are extracted from beneath the earth thereby depleting the resources at the same time degrading land and water resources. Lands are left bare or destroyed owing to deforestation or clearance of vegetation cover to pave the way for industrial raw material extraction.

Raw material extraction also causes pollution to the soil, air, and water, either through the extraction processes or when the toxic compounds of the materials are released into the environment. For instance, oil spills during oil extraction have led to the widespread death of marine birds, fish, mammals and amphibians. (Ashby, 2013)

4.3.1.g Use of Outdated Technologies

A number of industries still utilize technologies of the past in their production processes instead of embracing cleaner and green technologies. This is one of the causative factors of industrial pollution in the contemporary era. Use of outdated technologies merely generates large quantities of harmful wastes into the environment. (Porter and Linde, 1995)

4.3.1.h Deficient Institutionalization of Anti-pollution Policies

In many countries, especially developing nations, industrial pollution activities are above the bar due to lax anti-pollution policies. As an outcome, industries have continued to pollute the environment with impunity thereby affecting the lives and health of many people. Similarly, plants and wildlife have been badly affected in these regions. Notable cases are in particular nations in Asia and North America where industries have persistently released toxic wastes and poisonous gases into the environment. (Pettersson and Söderholm, 2014)

4.3.1.i Lack of Effective Industrial Land use Planning

Industrial sprawl is a major problem in most industrial townships. Most industrial townships are set up without considering proper land use planning such that it has made it difficult to manage wastes and utilize production energy efficiently. As a result, it has given rise to improper damping and continued emission of toxic gases. (Ahmed and Dinye, 2011)

4.3.2 Water pollution

Water pollution is the presence of some inorganic, organic, biological, radiological, physical foreign substance in the water that tends to degrade its quality. Normally water is never pure in a chemical sense. It contains impurities of various kinds of dissolved minerals (Ca, Mg, Na, and salts), Suspended matters (Clay, silt, sand) and microbes. These are natural impurities derived from the atmosphere, catchment areas and the soil. They are in very low amounts and normally do not pollute water. All these substances when present in small quantities do not cause any harm and may even have some positive effects in in improving the water quality. However if their concentration increases substantially, they affect adversely the water quality and make the water unfit for use. The polluted

water is turbid, unpleasant, bad smelling, unfit for drinking, bath and washing and incompatible in supporting life. (Narayanan, 2011)

4.3.2.a Sources of Water pollution

Water pollutants are from: (a) natural (b) anthropogenic sources and they may originate from a point source or from a dispersed source.

(a) Natural sources are meteorological and geographical like volcanic activity and earthquakes, land slide and stream runoff, dissolved minerals, aquatic growth and decay.

(b) Anthropogenic sources are domestic, municipal sewage and other sanitary discharge, and agriculture and industrial waste, mining waste and leachates and products from other human related activities. Radioactive substances and heat also water pollutants (Narayanan, 2011)

4.3.2.b Causes of Water pollution

Much of the pollution is due to anthropogenic activities like discharge of sewage, effluents and wastes from domestic and industrial establishments, particulate matter and meals and their compounds due to mining and metallurgy and fertilizer and pesticide runoffs from agricultural activities.

4.3.2.c Factors That Affect Water Quality

Throughout the history, the quality of water has been an important factor in determining the growth of civilization and welfare of human settlements. Some of the factors that affect the quality of water are suspended and dissolved solids (both inorganic and organic), Biological substances, pH, Biological oxygen demand (BOD) and (Chemical oxygen demand), at present many industrially produced toxic substances pose the greatest hazard to the quality of water (Novotny 1994, Narayanan, 2011)

Table 4.1: Physical Characteristics of Water Polluted Due to Human Activities

Parameter/ Pollutant	Source	Effect
Color	Dissolved Inorganic and organic particulate matter	Deterioration of water Quality; unaesthetic; hazardous chemicals detrimental to health
Inert particulate	Mining and sewage sludge	Turbidity; exclusion of sunlight; detrimental aquatic life
Mining	Mining waste; asbestos; sand and dust; sulfur-bearing particulate	Stream contamination; leaching silt; and hazardous compounds
Nutrients	Domestic, agricultural, mining and industrial	Acid-mine drainage, Eutrophication of water bodies
Odor	Decay of organic matter; sewage	Unhealthy & unhygienic and health hazard
Petrochemicals	Oil drilling and transport	Hydrocarbon detrimental to all organisms; oil spillage in high seas; damage to aquatic ecology
Poisons	Industrial and agricultural	Trace elements; radioactive waste; insecticides, pesticides and herbicides
Taste	Salts and dissolved matter	Deterioration of water Quality; unaesthetic;
Thermal	Discharge of hot effluents from power plants and industrial establishments	Affects the physical properties of water, reduction in dissolved gases has drastic effects on the aquatic ecology.

Source: Narayanan, 2011

4.3.3 Sound Pollution

Sound has become part and parcel of urban living. Hydraulic horns in Busses and trucks, engine noise of three wheelers, music played on loud Speakers, machines running in factories, loud sound of cement mixture and brick grinders used by builders have tremendously polluted the environment. (Tuhin, 2008)

Table 4.2: Maximum Noise Levels in Different Areas

Areas	**Maximum noise levels**
Residential areas	55dB at 6am-9pm 45dB at 9am-6am
Hospitals. Education institutions, place of worship	40-50dB
Public areas (Markets, Playgrounds, Parks)	60-70dB
Commercial or Industrial areas	70-75dB

Source: Bangladesh noise pollution (Control) Rules, 2006

Maximum sound level that can be tolerated by human is 60dB (WHO). But Sound levels are far beyond acceptable levels; particularly in all major cities in Bangladesh. The average sound level is 80-110dB in Dhaka (DoE, 2017).The frequent exposure to sound at a level of between 70-80 decibels is likely to lead to hearing loss. High level of noise can cause high blood pressure and other cardio vascular disorders. Sound produce anxiety symptoms such as irritability and headaches. Sound at a level of between 38-48 decibels may cause sleeplessness in many people. Around 11.7/ people have lost their hearing due to sound pollution.

4.3.4 Air Pollution

The earth is surrounded by the air that covers the environment up to the height of 1.5 km from the surface of the earth. The most hazardous condition that the urban dwellers are exposed to is air pollution. It contains gases such as nitrogen (78) oxygen (21) carbon dioxide (0.3) argon (0.3).The air pollution results mainly from gaseous emission of Industry, Thermal power stations, Automobiles, Domestic combustion, etc. Air pollution in the Dhaka city is at an alarming level. The air is laden with smoke, dust and suspended particulate matters containing lead unburnt hydrocarbon. Around 1.23 lakh people were killed in Bangladesh in 2017 due to indoor and outdoor air pollution said a new study on global air pollution. Two US based institutes Health Effects Institute (HEI) and Institute for Health Metrics and Evaluation (IHME) on Wednesday released a detailed report on quality of the global air with title, “State of Global Air-2019”. (UNB, April 4).

Air pollution problem has local regional continental and global ramification. Local level pollution affects the local, municipal, town and city level; regional level pollution affects at the troposphere level and continental pollution at the stratosphere level. Global level pollution affects the entire atmosphere. Sources causing pollution at different levels are different. (Lave and Seskin, 2013)

Table 4.3: Level of Air Pollution

Serial number	Level	Sources
1.	Local level pollution	Local agricultural activities, waste, sewage disposal and other utility and service establishments.
2.	Regional level pollution	Power plant and large scale Industries.
3.	Continental level pollution	Acid rain
4.	Global level pollution	Air transport, atmospheric testing of nuclear weapons, depletion of Ozone layer, global warming due to greenhouse effect and reduction of solar flux reaching the earth due to contaminants other transport systems.

Source: Narayanan, 2011

4.3.4.a The Air Quality Index (AQI)

The Air Quality Index (AQI) is an index that is used for reporting daily air quality. It describes us how clean or polluted air of a location is and what associated health effects might be a concern for the people of this location. The AQI focuses on health effects that people of a country may experience within a few hours or days after breathing polluted air. Based on the exposure to all types of pollutants (PM, CO, O3, SO2, and NO2) with the AQI based on the worst exposure concentration for any of these pollutants it is measured. This system was first developed by the United States Environmental Protection Agency (US EPA) and has now been adapted to the standards applied in a number of other countries (DOE, 2018)

Table 4.4: Bangladesh Air Quality Index Values and Observable Health Implication

Air quality index (AQI) Range	Category	Health Implications
0-50	Good	A level that will not impact patients suffering from diseases related.
51-100	Moderate	A level that may have a meager impact on patients in case of chronic exposure.
101-150	Caution	A level that may have harmful impacts on patients and members of sensitive groups specially children and old age people.
151-200	Unhealthy	A level that may have harmful impacts on patients and members of sensitive groups (children, aged or weak people) and also cause the general public unpleasant feelings.
201-300	Very Unhealthy	A level that may have a serious impact on patients and members of sensitive groups in case of acute exposure.
301-500	Extremely Unhealthy	A level that may need to take emergency measures for patients and members of sensitive groups and have harmful impacts on the general public.

Source: USEPA, 2005

4.3.5 Soil Pollution

Any change that is brought about by different agents which results in a negative qualitative change in the physical characteristics of land or the chemical constituents of land or the chemical constituents of the soil may be termed as land degradation. Land pollution is one form of degradation of land (Zinatunnessa, 2001).

Soil pollution deals primarily with top soil and aquifers. Top soils consist of clays sand minerals and organic matters. Clays are sedimentary minerals, made up of layers hydrated alumina and silicon dioxide. Organic matter in soil is a heterogeneous mixture of products resulting from the microbial and chemical transformation of organic materials.(Narayanan, 2011).

Agricultural production is very much dependent on the quality of the top soil as are the natural flora of any region. Soil Pollution occurs due to climatic and geological changes, human activities and agriculture, mining and Industrial operations. It is mainly the consequence of urbanization and Industrialization but modern day agriculture practices are also responsible for it. (Lal, 2015)

4.3.5.a Sources of Soil Pollution

According to Zinatunnessa, 2001, The main sources of soil pollution are:

-Urban solid waste including municipal garbage

-Industrial solid wastes and toxic effluents discharged on land

-Waste generated by hospitals and clinic in urban areas

-Waste from thermal power station or nuclear power generation

-Chemical fertilizers, pesticides and herbicides used in agriculture.

4.4 Environment Impact Assessment

A process by which information about the environmental effects of a project is collected, both by the developer and from other sources, and taken into account by the relevant decision making body before a decision is given on whether the development should go ahead (DoE,1995).It can also be defined more simply as an assessment of the impacts of a planned activity on the environment. I addition to the decision on whether a project should proceed, an EIA will consider aspects such as project alternatives and mitigation measures that should be implemented

If the development is allowed EIA involve individual assessments of aspects of the environment (population, landscape, heritage, air, climate, soil, water, fauna, and flora) likely to be significantly affected by a proposed project.

4.4.1 Environment Impact Assessment Process

The EIA process makes sure that environmental issues are raised when a project or plan is first discussed and that all concerns are addressed as a project gains momentum through to implementation. Recommendations made by the EIA may necessitate the redesign of some project components, require further studies, suggest changes which alter the economic viability of the project or cause a delay in project implementation. To be of most benefit it is essential that an environmental assessment is carried out to determine significant impacts early in the project cycle so that recommendations can be built into the design and cost-benefit analysis without causing major delays or increased design costs. To be effective once implementation has commenced, the EIA should lead to a mechanism whereby adequate monitoring is undertaken to realize environmental management. An important output from the EIA process should be the delineation of enabling mechanisms for such effective management.

The way in which an EIA is carried out is not rigid: it is a process comprising a series of steps. These steps are outlined below and the techniques more commonly used in EIA are described in some detail in the section *Techniques*. The main steps in the EIA process are following:

- Screening
- Scoping
- Prediction and Mitigation
- Management and Monitoring
- Audit

Figure- 4.1 shows a general flow diagram of the EIA process, how it fits in with parallel technical and economic studies and the role of public participation. In some cases, such as small-scale irrigation schemes, the transition from identification through to detailed design may be rapid and some steps in the EIA procedure may be omitted.

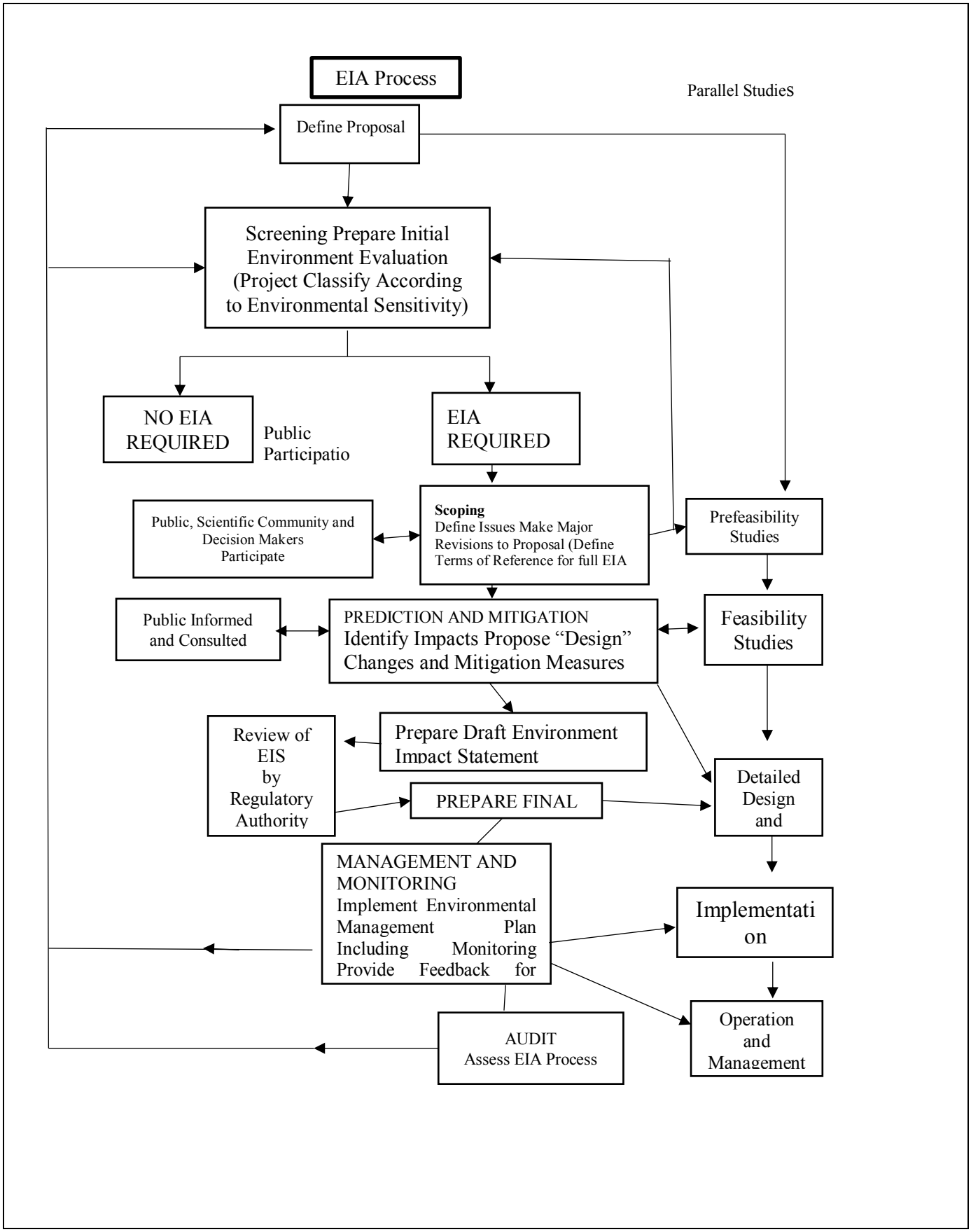
• **Screening** often results in a categorization of the project and from this a decision is made on whether or not a full EIA is to be carried out.

• **Scoping** is the process of determining which are the most critical issues to study and will involve community participation to some degree. It is at this early stage that EIA can most strongly influence the outline proposal.

• Detailed **prediction and mitigation** studies follow scoping and are carried out in parallel with feasibility studies.

• The main output report is called an *Environmental Impact Statement*, and contains a detailed plan for **managing and monitoring** environmental impacts both during and after implementation.

• Finally, an **audit** of the EIA process is carried out sometime after implementation. The audit serves a useful feedback and learning function.



Source: Dougherty et al, 1995

Figure 4.1: Flow Diagram of the EIA Process and Parallel Study

4.4.2 Resources

An EIA team for an irrigation and drainage study is likely to be composed of some or all of the following: a team leader; a hydrologist; an irrigation/drainage engineer; a fisheries biologist/ecologist; an agronomist/pesticide expert; a soil conservation expert; a biological/environmental scientist; an economist, a social scientist and a health scientist (preferably a epidemiologist). The final structure of the team will vary depending on the project. Specialists may also be required for fieldwork, laboratory testing, library research, data processing, and surveys and modeling. The team leader will require significant management skill to co-ordinate the work of a team with diverse skills and knowledge. (Doughterty et al, 1995)

4.4.3 Screening

Screening is the process of deciding on whether an EIA is required. This may be determined by size (eg greater than a predetermined surface area of irrigated land that would be affected, more than a certain percentage or flow to be diverted or more than a certain capital expenditure). Alternatively it may be based on site-specific information. For example, the repair of a recently destroyed diversion structure is unlikely to require an EIA whilst a major new headwork structure may. Guidelines for whether or not an EIA is required will be country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full EIA. All major donors screen projects presented for financing to decide whether an EIA is required. (Ahmed and Sammy, 1985)

4.4.4 Scoping

Scoping occurs early in the project cycle at the same time as outline planning and pre-feasibility studies. Scoping is the process of identifying the key environmental issues and is perhaps the most important step in an EIA. Several groups, particularly decision makers, the local population and the scientific community, have an interest in helping to deliberate the issues which should be considered, and scoping is designed to canvass their views, (Wathern,1988).

4.4.5 Prediction and Mitigation

Once the scoping exercise is complete and the major impacts to be studied have been identified, prediction work can start. This stage forms the central part of an EIA. Several major options are likely to have been proposed either at the scoping stage or before and each option may require separate prediction studies. Realistic and affordable mitigating measures cannot be proposed without first estimating the scope of the impacts, which should be in monetary terms wherever possible. It then becomes important to quantify the impact of the suggested improvements by further prediction work.

Clearly, options need to be discarded as soon as their unsuitability can be proved or alternatives shown to be superior in environmental or economic terms, or both. It is also important to test the "without project" scenario. An important outcome of this stage will be recommendations for mitigating measures. This would be contained in the Environmental Impact Statement. (ERL, 1990)

4.4.6 Management and Monitoring

The part of the EIS covering monitoring and management is often referred to as the Environmental Action Plan or Environmental Management Plan. This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation. The term 'institutional' is used here in its broadest context to encompass relationships:

- Established by law between individuals and government;
- Between individuals and groups involved in economic transactions;
- Developed to articulate legal, financial and administrative links among public agencies;
- Motivated by socio-psychological stimuli among groups and individuals (Craine,1971).

The above list highlights the breadth of options available for environmental management, namely: changes in law; changes in prices; changes in governmental institutions; and, changes in culture which may be influenced by education and information dissemination. All the management proposals need to be clearly defined and costed. One of the more straightforward and effective changes is to set-up a monitoring program with clear definition as to which agencies are responsible for data collection, collation, interpretation and implementation of management measures (ESCAP, 1985)

4.4.7 Auditing

In order to capitalize on the experience and knowledge gained, the last stage of an EIA is to carry out an Environmental Audit sometime after completion of the project or implementation of a programme. It will therefore usually be done by a separate team of specialists to that working on the bulk of the EIA. The audit should include an analysis of the technical, procedural and decision-making aspects of the EIA. Technical aspects include: the adequacy of the baseline studies, the accuracy of predictions and the suitability of mitigation measures. Procedural aspects include: the efficiency of the procedure, the fairness of the public involvement measures and the degree of coordination of roles and responsibilities. Decision-making aspects include: the utility of the process for decision making and the implications for development, (adapted from Sadler in Wathern, 1988).

4.4.8 Public Participation

Projects or programs have significant impacts on the local population. Whilst the aim is to improve the well being of the population, a lack of understanding of the people and their society may result in development that has considerable negative consequences.

There are no clear rules about how to involve the public and it is important that the process remains innovative and flexible. In practice, the views of people affected by the plan are likely to be heard through some form of representation rather than directly. It is therefore important to understand how decisions are made locally and what are the methods of communication,including available government extension services. The range of groups outside the formal structure with relevant information are likely to include: technical and scientific societies; Water User Groups; NGOs; experts on local culture; and religious groups. However, it is important to find out which groups are under-represented and which ones are responsible for access to natural resources, namely: grazing, water, fishing and forest products. The views of racial minorities, women, religious minorities, political minorities and lower cast groups are commonly overlooked, (World Bank, 1991).

The public participation/consultation and information dissemination activities need to be planned and budgeted. The social scientist team member should define how and when activities take place and also the strategy: extensive field work is expensive. It is important to note that public participation activities are often reported as a separate section of the final EIA. Where experience of managing community involvement is limited, training is highly recommended. Further reading on public participation can be obtained from: Ahmed L and G K Sammy (1988) and on Rapid Rural Appraisal from Chambers R (1981). Rapid Rural Appraisal techniques may be an appropriate and cost effective method of assessment.

4.4.9 Managing Uncertainty

An EIA involves prediction and thus uncertainty is an integral part. There are two types of uncertainty associated with environmental impact assessments: that associated with the process and, that associated with predictions. With the former the uncertainty is whether the most important impacts have been identified or whether recommendations will be acted upon or ignored. For the latter the uncertainty is in the accuracy of the findings. The main types of uncertainty and the ways in which they can be minimized are discussed by de Jongh in Wathern (1988).

They can be summarized as follows:

• Uncertainty of prediction: this is important at the data collection stage and the final certainty will only be resolved once implementation commences. Research can reduce the uncertainty;

• Uncertainty of values: this reflects the approach taken in the EIA process. Final certainty will be determined at the time decisions are made. Improved communications and extensive negotiations should reduce this uncertainty;

• Uncertainty of related decision: this affects the decision making element of the EIA process and final certainty will be determined by post evaluation. Improved coordination will reduce uncertainty.

4.4.10 Baseline Studies

Baseline studies using available data and local knowledge will be required for scoping. Once key issues have been identified, the need for further in-depth studies can be clearly identified and any additional data collection initiated. The ICID Check-list will be found useful to define both coarse information required for scoping and further baseline studies required for prediction and monitoring. (OECD, 1986)

4.4.11 The ICID Check-list

A comprehensive and user-friendly checklist is an invaluable aid for several activities of an EIA, particularly scoping and defining baseline studies. "The ICID Environmental Check-List to Identify Environmental Effects of Irrigation, Drainage and Flood Control Projects" (Mock and Bolton, 1993) is recommended for use in any irrigation and drainage EIA. The Check-list has been prepared for non-specialists and enables much time-consuming work to be carried out in advance of expert input. It includes extensive data collection sheets. The collected data can then be used to answer a series of questions to identify major impacts and to identify shortages of data.

4.5 Conclusion

The chapter summarizes the major theoretical concepts that have been addressed in the thesis. The different types of pollution, their current state worldwide and in the national level as well as ways to reduce the level of pollution have been discussed. Water pollution, air pollution, soil pollution, sound pollution and industrial pollution have all been addressed in the thesis. The present state of updated knowledge about the specific topics have been discussed and it is seen that all the sources of pollution are in a dire state. The scales used for measuring such levels of pollution have also been discussed. Finally, the Environmental Impact Assessment (EIA) procedure for attaining the overall environmental impact have been assessed.

CHAPTER FIVE

LANDUSE CHANGE AND ENVIRONMENTAL QUALITY IN SAVAR POURASAVA

Chapter Five

Land use Change and Environmental Quality in Savar Pourasava

5.1 Introduction

Land use referred to as man's activities and the various uses which are carried on land. Land cover is referred to as natural vegetation, water bodies, rock/soil, artificial cover and others resulting due to land transformation. And digital change detection is the process that helps in determining the changes associated with land use and land cover properties with reference to geo-registered multi temporal remote sensing data. The use of remotely sensed data (satellite and aerial) to detect changes in Land use as well as precise and accurate analysis using GIS is widely preferred over other conventional survey techniques because the method is very efficient for assessing the change or degrading trends of a region, from a small city of about 200,000 in 1947. Dhaka has grown into a crowded metropolis of over 4 million people by 1987. During the 1960's and the city's annual rate of population growth was nearly 10 percent, being, one of the highest for any city in the world (Fouzder, 2005).

The acceleration rate of population growth in and around the DMA makes a tremendous pressure on land and on urban infrastructural services.

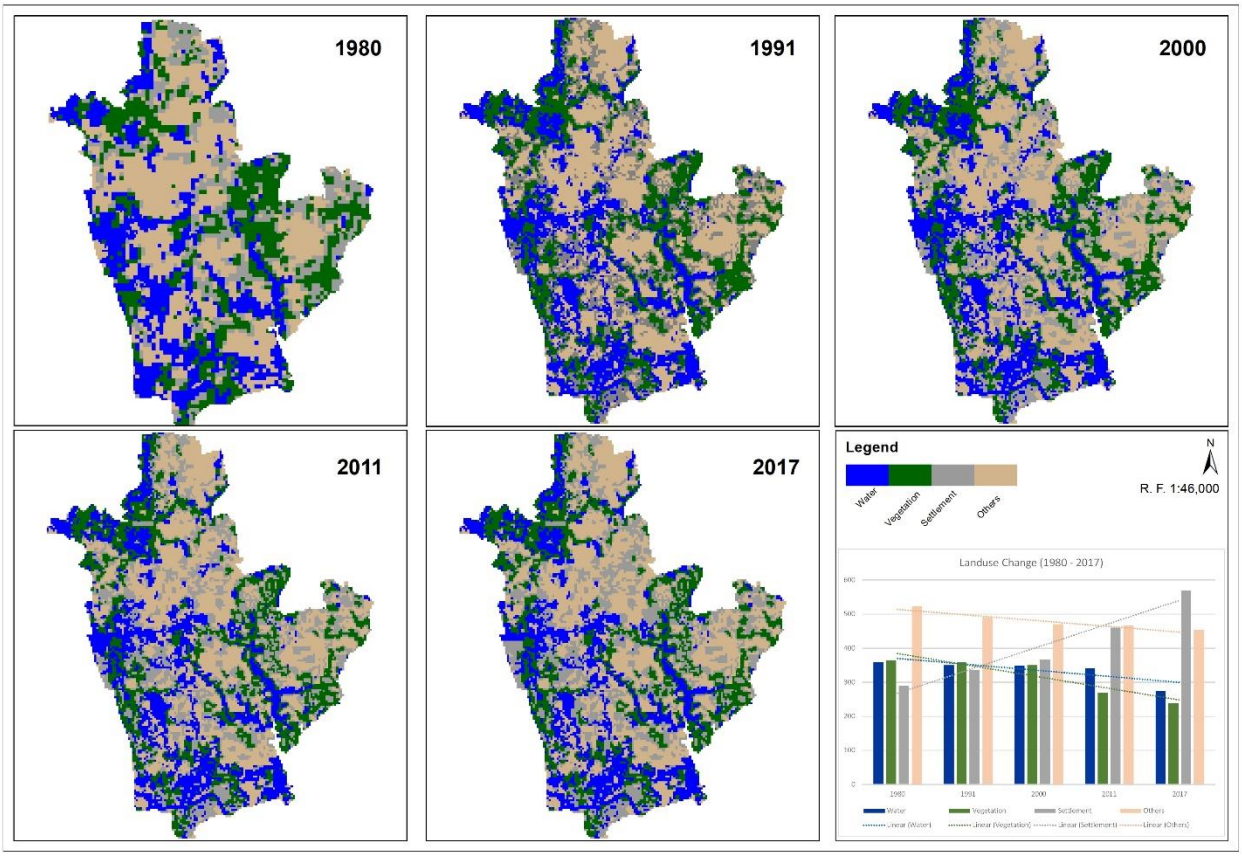
Dhaka city is growing very rapidly towards its west and north-west direction.

The transformation of land use and its potentialities in the northwest and west fringe of the city of Dhaka will be identified. As an agro-based country, this region also not poles apart from any other region, but after construction of "Asian Highway" in 1996, a tremendous change has been transpired here and modified the aspect of this region.

This road provides multi-dimensional advantages and promotes interactional trade and socioeconomic development of this region. Moreover in 1985, Savar was included into the greater Dhaka city and declared as an industrial area by the RAJUK. Since, savar had located close to Dhaka and Asian Highway passes through hit. The area becomes an important place of urbanization. In one hand a number of industries are being established here. Due to the impact of advanced transportation network and communication systems rapid land use changes, reduction of agricultural land, development of local economy, increase of employment opportunity, increase of demand for land can be seen (Elahi et al, 2016)

5.2 Overall changes in Land use in Savar Pourasava from 1980-2017

If we look into the overall land use changes in the Pourasava, there is an overall decrease in the amounts of water and vegetation related land use. While there is an increase in the settlements of the Pourasava.



Source: Field Survey, 2018

Figure 5.1: Land use Change Between 1980 to 2017 in Savar Pourasava

Table 5.1: Land use change in Savar Pourasava between 1980-2017

Types of Land use	Water	Vegetation	Settlement	Others	Total
1980	358.6	364.5	289.4	523.8	1536.3
1980 (%)	23.34	23.73	18.84	34.09	100.00
1991	350.01	358.8	336.78	490.71	1536.3
1991 (%)	22.78	23.35	21.92	31.94	100.00
2000	349.19	350.02	366.74	470.35	1536.3
2000 (%)	22.73	22.78	23.87	30.62	100.00
2011	341.46	269.35	459.81	465.68	1536.3
2011 (%)	22.23	17.53	29.93	30.31	100.00
2017	274.95	238.9	569.28	453.17	1536.3
2017(%)	17.90	15.55	37.06	29.50	100.00
Change 1980-1991 (%)	-8.55	-5.7	47.34	-33.09	
Change 1991-2000 (%)	-0.82	-8.78	29.96	-20.36	
Change 2000-2011 (%)	-7.73	-80.67	93.07	-4.67	
Change 2011-2017 (%)	-66.51	-30.45	109.47	-12.51	
Change 1980-2017 (%)	-23.32	-34.46	96.68	-13.48	

5.3 Changes of The Water Bodies And Environmental Quality

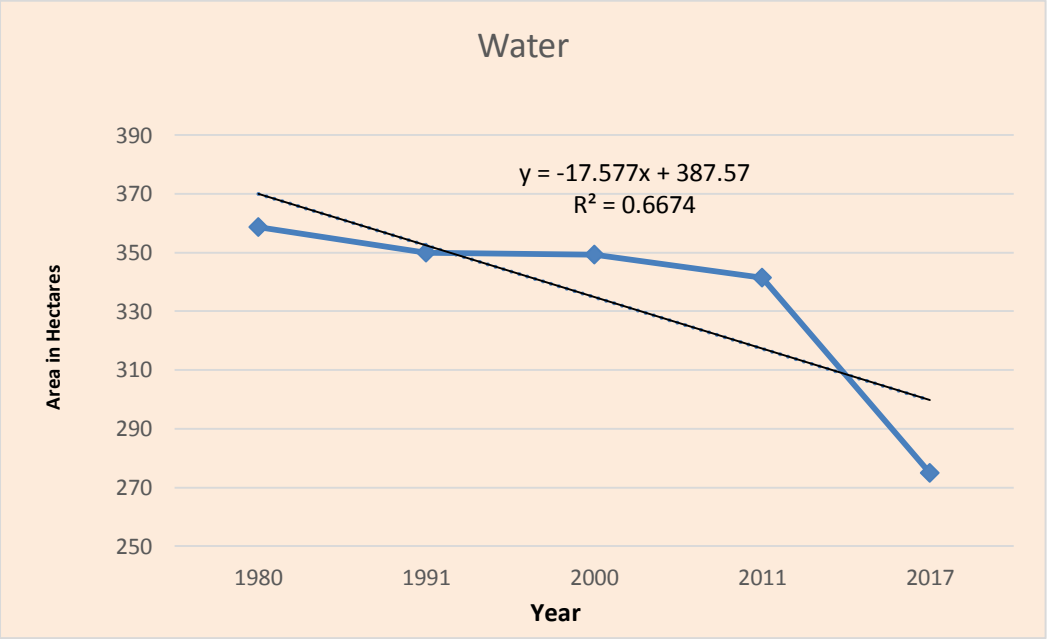
The results show that water bodies in the Savar Pourasava has decreased by 23.32% between 1980 to 2017.

Therefore, the result show that the annual loss of water bodies is about 0.63% yearly (Table) Therefore, considering a total area of 1536 hectares, we see that about 9.67 hectares of water bodies are being lost every year in Savar Pourasava. (Table: 5.1)

We see that there were only slight decreases in the amount of water between 1980 to 2011. But, after 2011, the change in water was drastic with almost 66 hectare decrease in water bodies. (Table: 5.1)

The trend line shows that there is a gradual decreasing trend throughout the years in the water of Savar Pourasava.

The R value of -0.666, means that there is a sharp decreasing relationship trend between water with time.



Source: Satellite Data Analysis

Figure 5.2: Change in the Amount of Water Bodies Between 1980-2017

The water surface in directly related with the environment of the pourasava. The sustainable environment will not be ensured without protecting water surface of the Paurosava.

5.4 Changes of Vegetation and Environmental Quality

The amount of vegetation in the Pourasava has decreased by about 34% in the Pourasava between 1980 and 2017 (Table: 5.1)

The annual loss of vegetation in the Pourasava is about 0.91% per year. (Table: 5.1)

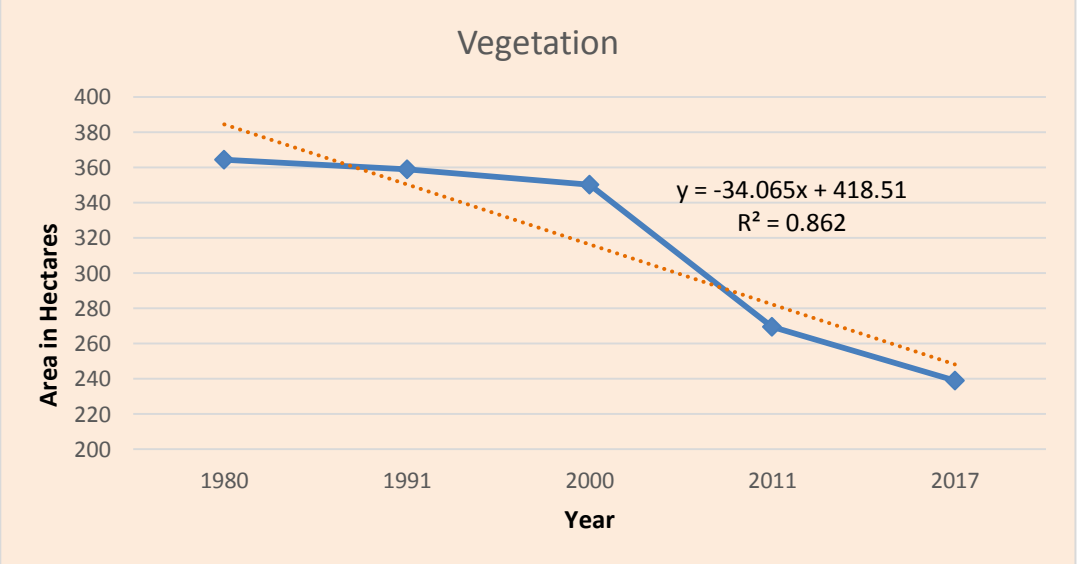
Therefore, considering the total area of 1536 hectares, we can see that there is an annual loss of about 13.98 hectares per year.

The decrease in vegetation was gradual between 1980 and 2000.

After 2000, there was a drastic decrease in the amount of vegetation. Between 2000 and 2011, there was a loss of 80 hectares of vegetation in Savar Pourasava.

The R value of -0.862 shows that there is a sharp decreasing trend between the area of vegetation and time. The forecast shows that there will be 226 hectares vegetation in Savar Pourasava in 2025.

The results show that the green covers are gradually decreasing. Hence, sound environment is decreasing. The environmental quality of any location depends on green coverage. Therefore, green coverage should protect the Savar Pourasava.



Source: Satellite Data Analysis

Figure 5.3: Change in the Amount of Vegetation Between 1980-2017

5.5 Changes of Settlements and Built up Area in Savar Pourasava

The analysis of results show that there is gradual increase in the amount of settlements between 1980 and 2017.

Between 1980 and 2017, there is almost 97% increase in settlements (Table: 5.1)

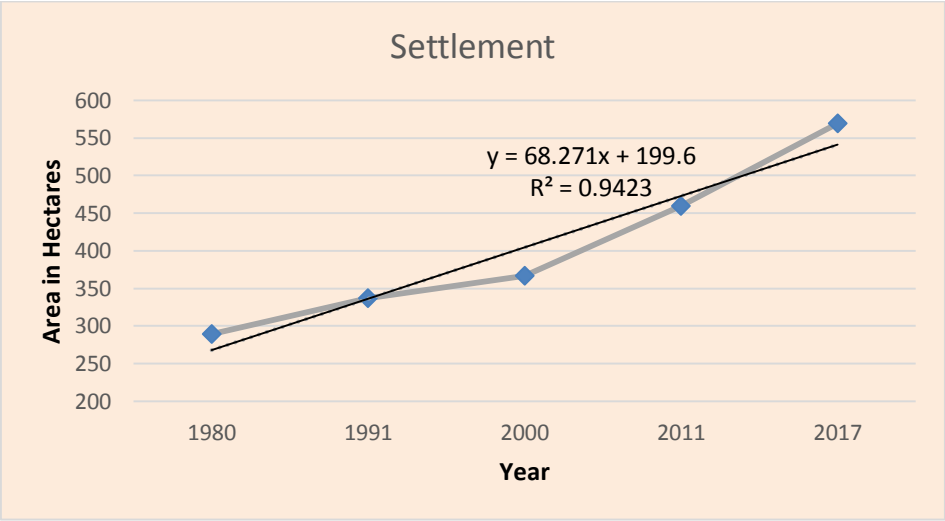
The annual increase in the amount of settlements, is about 2.62% every year. (Table: 5.1)

Therefore, there is an annual increase of about 40.27 hectares per year.

It can be observed that the amount of settlements have gradually increased between 1991 when the Pourasava was declared, but after 2000, the increase was very rapid.

Between 2000 and 2011 there is a 6% decrease in the percentage of vegetation. Between 2011 and 2017 there is a 8% decrease in vegetation cover.

The forecast results shows that there will be about 60 hectares of land area will be covered by settlement. The increasing trend indicated by R value of 0.94 denotes that it's a very strong relationship by urban growth with time. The consequences of urban growth is directly related with the environment of the Pourasava.



Source: Satellite Data Analysis

Figure 5.4: Change in the Amount of Settlement Between 1980 -2017.

5.6. Conclusion

The chapter addresses the overall change in landuse over the period 1981 to 2017.

The study first tries to assess the overall change in landuse in the Pourasava area between 1980 and 2017. It is found that the amount of vegetation and water bodies in the area has decreased by 35% and 23% respectively over this 37 year period.

Whereas, the amount of settlements have increased by a striking 96% between 1980 and 2017.

Therefore, we understand that there has been massive urbanization and industrialization in the area in this period leading to loss of water and vegetation.

CHAPTER SIX

POLLUTION AND QUALITY OF ENVIRONMENT IN SAVAR POURASAVA

Chapter Six

Pollution and Quality of Environment in Savar Pourasava

6.1 Water Pollution and Quality of Savar Pourasava

6.1.1 Introduction

Water pollution is the contamination of water bodies, usually as a result of human activities.

Water bodies include for example lakes, rivers, oceans, aquifers and groundwater.

In Savar Pourasava, there is the presence of some major rivers such as Bangshi river. The water bodies are suffering from increasing levels of pollution as seen from the field investigation.

According to our survey, the following are the types of water pollution that have been identified in the Pourasava:

(a) Industrial Effluent
(b) Leaking Sewerage Lines
(c) Printing Press Chemicals
(d) Oil and Gas spillage
(e) Bathing of Live Stocks
(f) Open Defecation
(g) Poison for Fishing
(h) Household chemicals
(i) Polythene
(j) Dumping of solid waste
(k) Construction materials
(l) Sedimentation
(m) Livestock wastes
(n) Pesticides and Fertilizers
(o) Waste Disposals in Ponds

All the above observed types of pollutions were surveyed and their relative weight was assigned in a 1 to 5 scale where 1 represented lowest level of severity and 5 represented highest severity.

If we look into the individual types of pollution, we can get an idea about their levels of severity.

The various types of water pollution often play individual roles and also combined impacts may also be formed where two or more factors act together in an environment.

Picture 6.1: Water Pollution in Savar Pourasava; (Source: Field Survey, 2018)

(Photo Courtesy: Researcher)

6.1.2 Severity of Types of Water Pollution and Water Quality in Savar Pourasava

Table 6.1- Types of water pollution and level of severity and water quality in savar pourasava.

Types of Water Pollution	1/ Lowest	2/ Low	3/ Moderate	4/ High	5/Very High
Industrial Effluent	3.8	10	40.2	32.2	13.8
Leaking Sewerage Lines	4	8	34.5	44.8	12.3
Printing Press Chemicals	2.7	12.6	33	39.8	11.9
Oil and Gas spillage	3.8	14.6	42.1	29.5	10
Bathing of Live Stocks	5.4	18.4	29.1	39.8	7.3
Open Defecation	5.4	9.2	33.7	33	18.4
Poison for Fishing	5.7	11.1	35.2	35.6	12.3
Household chemicals	1.1	9.6	32.6	37.9	18.8
Polythene	3.4	8.8	34.1	38.3	15.3
Dumping of solid waste	2.7	5.7	40.6	33	18
Construction materials	3.8	10.3	34.9	42.1	8.8
Sedimentation	5	14.2	38.3	32.2	10.3
Livestock wastes	6.9	13	34.5	32.6	13
Pesticides and Fertilizers	8	7.7	31.4	37.9	14.9
Waste Disposals in Ponds	3.4	10.3	28	39.1	19.2

Source: Field Survey, 2018

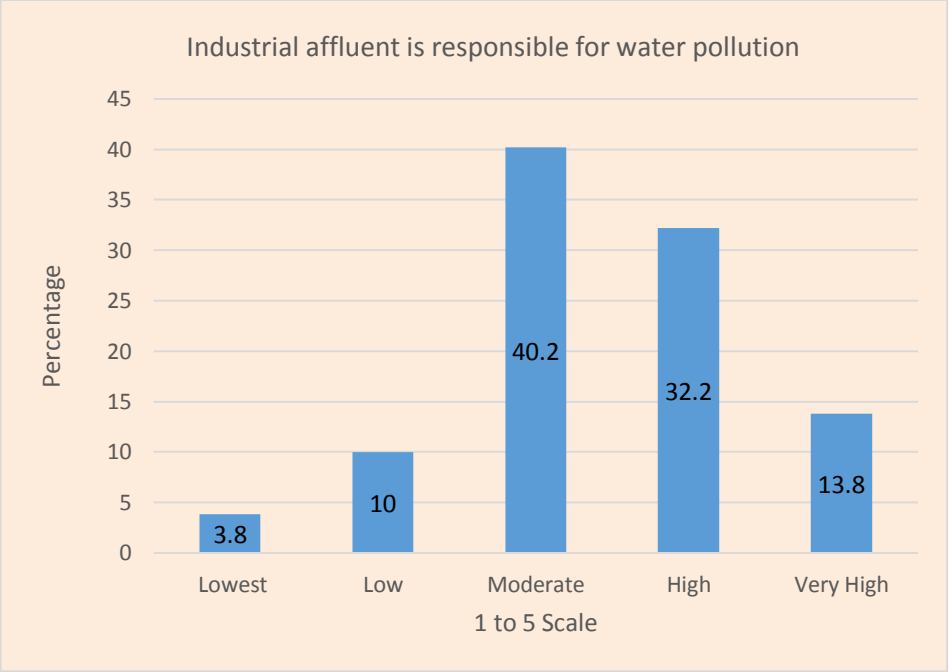
6.1.3 Industrial Effluents and Water Quality in Savar Poursava

In our analysis we have seen that about 45% of the respondents said that there was high or very high.

A significant proportion of the respondents (32%) believe that high levels of water pollution is being caused by industrial effluents.

13.8% of the respondents also believe that highest levels of water pollution is being caused by industrial effluents.

Therefore, as about 45% of the population believes that industrial effluents are having high to very high impact on the level of water population, therefore, the water quality is largely compromised.



Source: Field Survey, 2018

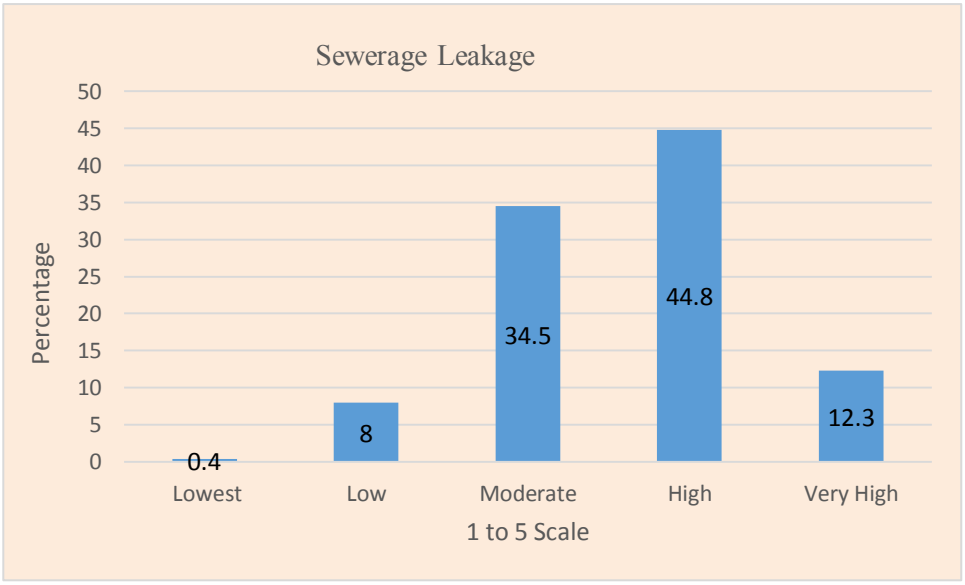
Figure 6.1: Industrial Effluents

6.1.4 Leaking Sewerage Lines and Water Quality in Savar Pourasava

About 57.1% of the respondents believe that leakage of sewerage lines has high or highest impacts on the amount of water pollution in the area.

12.3% of the respondents also believe that highest levels of water pollution is resulting from leaks in sewerage lines.

Therefore, sewerage line leaks maybe attributed as one of the most significant factors causing water pollution. As a significant portion of the respondents (57.1%) believe that leakage of sewerage lines is a major factor, therefore, the overall water quality is compromised.



Source: Field Survey, 2018

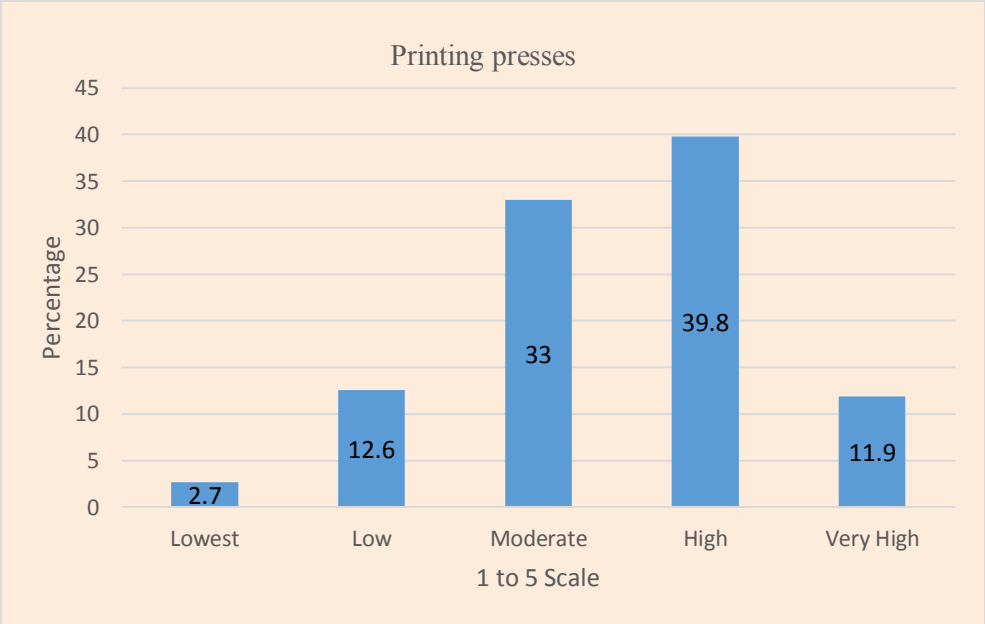
Figure 6.2: Leaking Sewerage Lines

6.1.5 Printing Press Chemicals Material and Water Quality in Savar Pourasava

51.7% of the total respondents believe that printing press chemicals are causing high or highest rates of water pollution.

About 12% of the respondents also believe that highest levels of water pollution is being caused by printing press chemicals.

Therefore, we can address the fact that printing press chemicals being discharged into the rivers are causing major environmental issues. The majority of the population (51.7%) believes that the water quality is reduced due to the industrial waste from printing press.



Source: Field Survey, 2018

Figure 6.3: Printing Press Chemicals

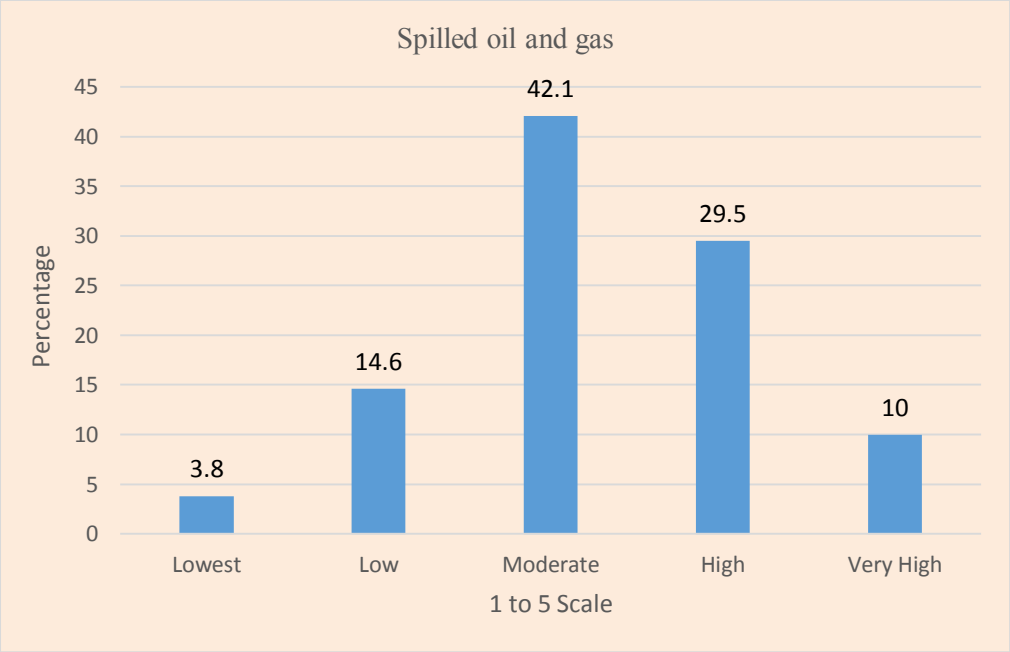
6.1.6 Oil and Gas Spillage and Water Quality of Savar Pourasava

A majority of the respondents believe that oil or gas spillage is causing water pollution in the Pourasava. About 39.5% of the respondents believe that there is high or highest levels of water pollution being caused by oil and gas spillage.

About 30% of the respondents believe that oil spillage causes high water pollution.

Therefore, we can say that the water quality is largely compromised due to the impact of oil and gas spillage.

As a significant portion (39.5%) of the respondents believe that oil and gas leakage is a major problem and therefore the water quality is in threat in the Pourasava.



Source: Field Survey, 2018

Figure 6.4: Oil and Gas Spillage and Water Quality

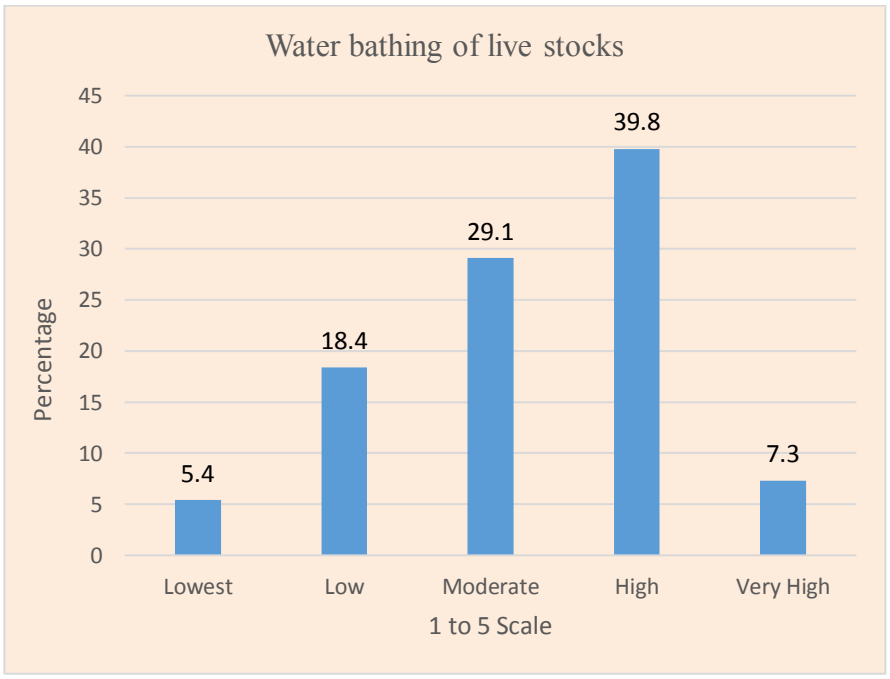
6.1.7 Bathing of Live Stocks and Water Quality of Savar Pourasava

About 47.1% of the respondents have agreed that bathing of live stocks is a major issue that is accelerating water pollution in the Pourasava.

About 40% of the respondents believe that water bathing of live stocks creates high levels of water pollution.

About 7% of the respondents also believe that highest levels of water pollution is being caused by bathing of live stocks in the rivers.

A significant portion of the respondents (47%) believe that live stock bathing in the water is a major problem that threatens water quality.



Source: Field Survey, 2018

Figure 6.5: Water Bathing of Live Stokes Create Water Pollution

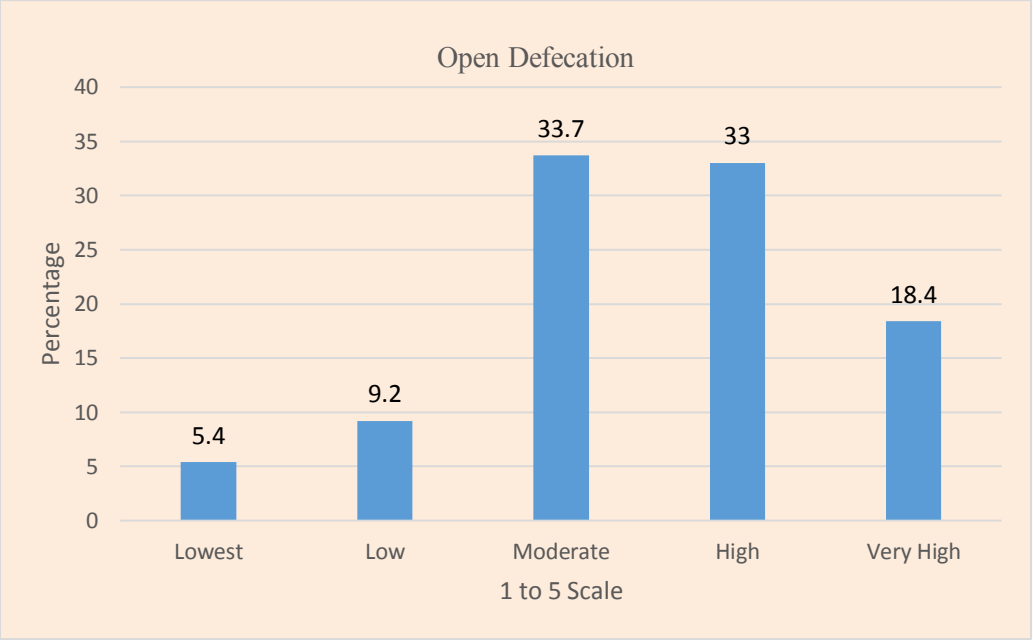
6.1.8 Open Defecation and Water Quality of Savar Pourasava

About 51.4% of the respondents believe that open defecation is causing high or highest levels of water pollution in the area.

About 33% of the respondents believe that high levels of water pollution is caused by open defecation.

About 19% of the respondents also believe that there is highest water pollution from open defecation in the Pourasava. Therefore, we can identify that this is a major area of concern in the Pourasava.

A majority (51.4%) of the respondents believe that the water quality of the Pourasava is compromised due to open defecation in the area.



Source: Field Survey, 2018

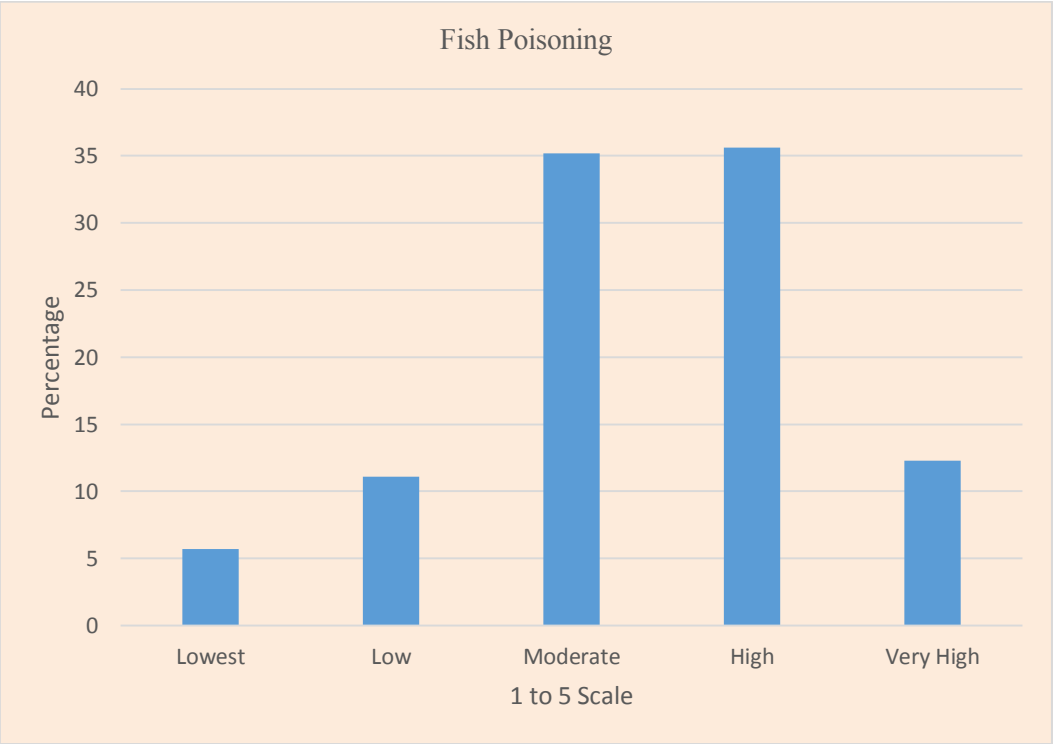
Figure 6.6: Open Defecation

6.1.9 Poison for Fishing and Water Quality of Savar Pourasava

About 48% of the respondents believe that fish poisoning is a major cause of water pollution in the area.

The above table express using poison during catching fish is responsible for water pollution. Such types of pollution went up gradually from 5.7% to 11.1% then it rose quickly 35.2% and 35.6% which is moderate and high level. After that pollution dropped suddenly 12.3%ely which is very high.

As a significant portion (48%) of the respondents believe that fish poisoning is a major threat, therefore, this is possessing a major threat to water quality in the region.

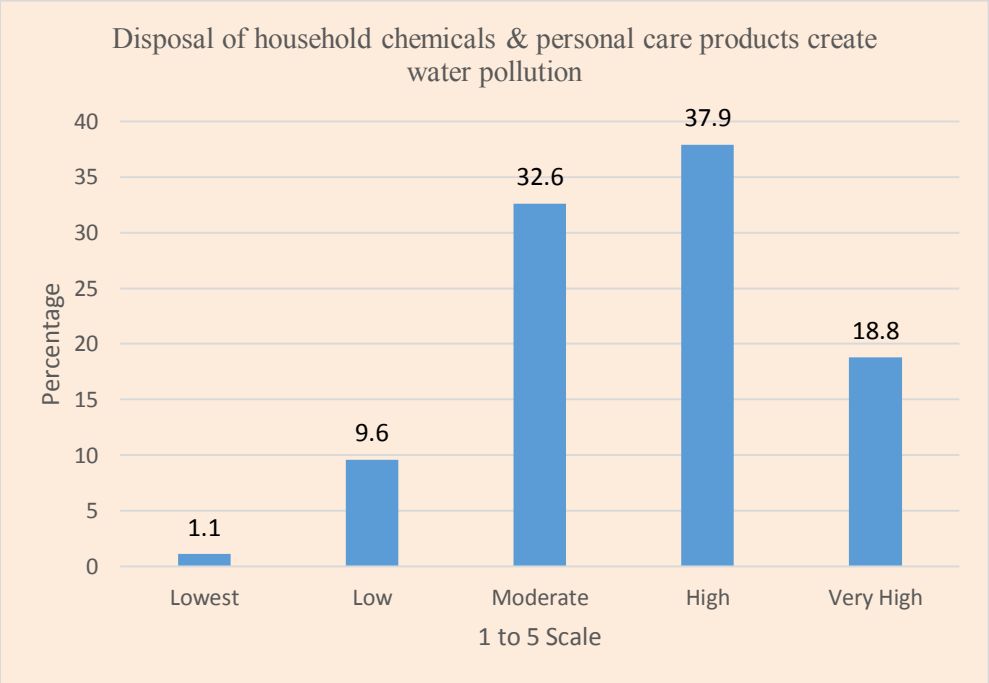


Source: Field Survey, 2018

Figure 6.7: Using Poison During Catching Fish is Responsible for Water Pollution

6.1.10 Household Chemicals and Water Quality of Savar Pourasava

About 57% of the respondents believe that household chemicals and personal products that are being dumped into the rivers are causing high to highest levels of water pollution in the Pourasava.

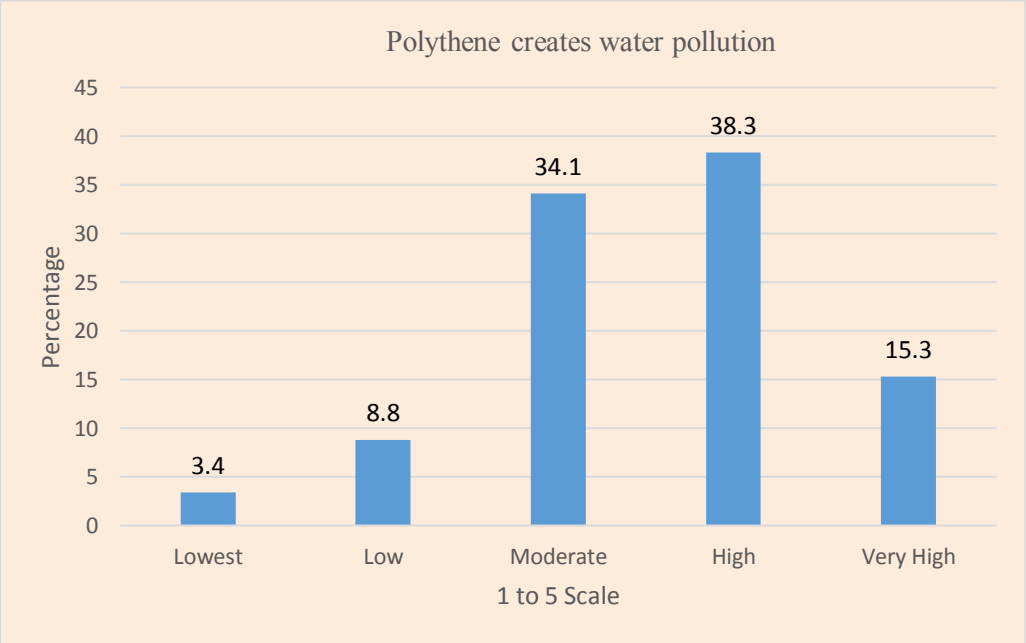


Source: Field Survey, 2018

Figure 6.8: Household Chemicals

6.1.11 Polythene and Water Quality of Savar Pourasava

About 54% of the respondents believe that the use of polythene is a causing high to highest levels of water pollution in the area. Therefore, we can comment that a significant portion of the people believe that the water quality may be compromised due to the excessive use of polythene in the Pourasava.



Source: Field Survey, 2018

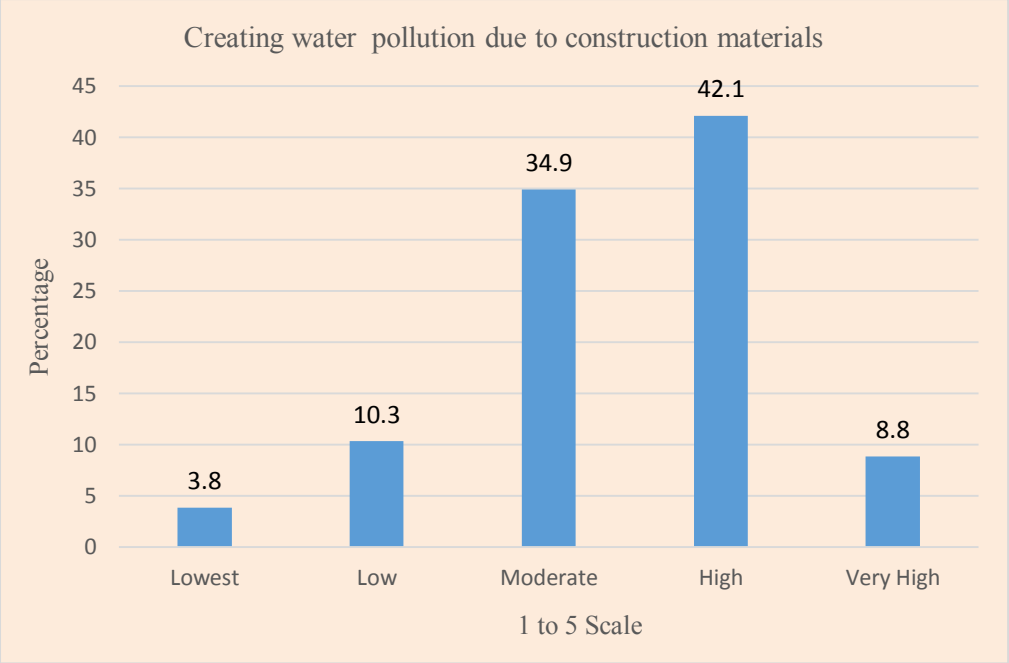
Figure 6.9: Polythene Creates Water Pollution

6.1.12 Dumping of Solid Waste

About 51% of the respondents believe that dumping of solid waste is a major cause of high to highest levels of water pollution in the area. Therefore the water quality is largely threatened by the dumping of solid waste.

6.1.13 Construction Materials and Water Quality

About 50% of the respondents believe that dumping of construction materials is a major source of water pollution in the area. Therefore, we can conclude that a significant portion of the people believe that construction material have a huge impact on the water quality.



Source: Field Survey, 2018

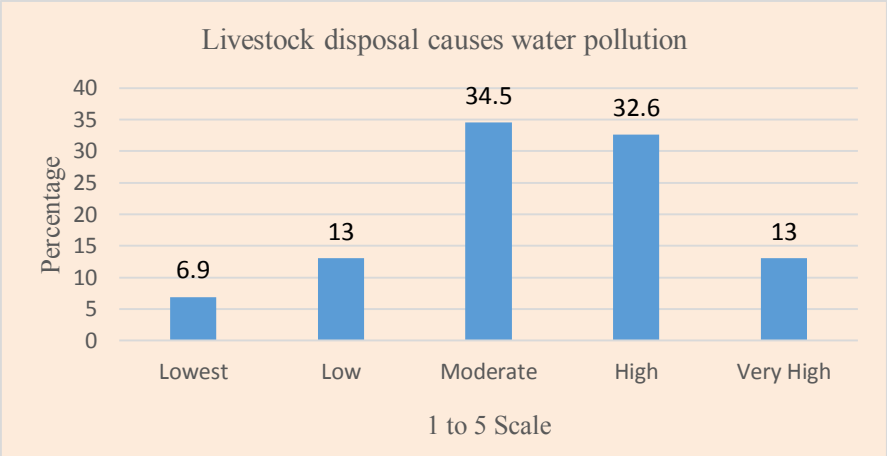
Figure 6.10: Creating Water Pollution Due to Construction Materials

6.1.14 Sedimentation and Water Quality

About 33% of the respondents believe that sedimentation is causing high or highest levels of water pollution in the area. Only moderate levels of impact of sedimentation is seen in case of the impact of sedimentation on water quality.

6.1.15 Livestock Wastes and Water Quality

About 46% of the respondents believe that livestock waste being dumped into the water bodies is causing high to highest levels of water pollution in the area. Therefore, according to a significant portion of the respondents believe that the water quality of the Pourasava is threated die to the dumping of livestock wastes in the rivers.

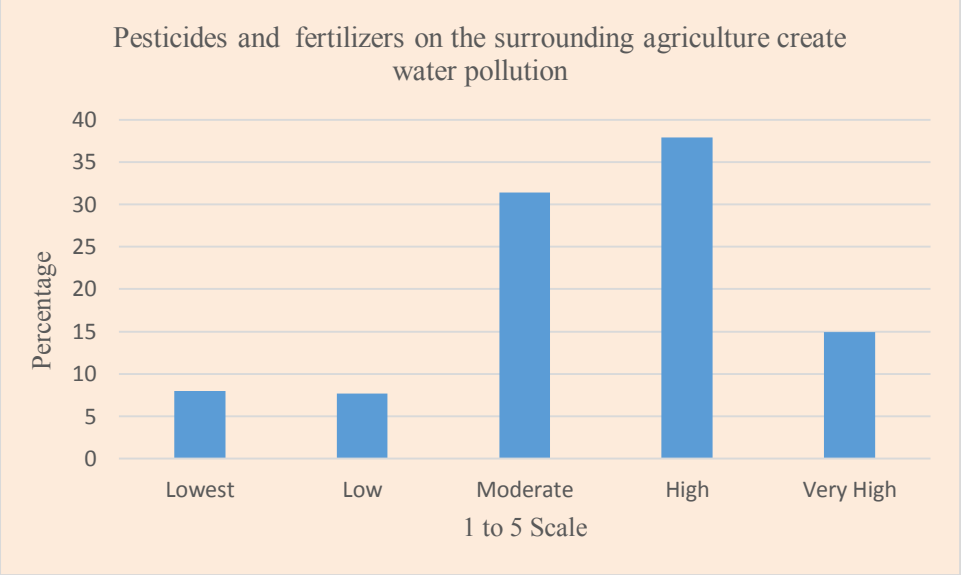


Source: Field Survey, 2018

Figure 6.11: Livestock Wastes for Water Pollution

6.1.16 Pesticides and Fertilizers

About 53% of the respondents believe that pesticides and fertilizers are causing high to highest levels of water pollution in the area. Therefore, a majority of the respondents (53%) believes that the water quality is threatened due to pesticides and fertilizers in the Pourasava.



Source: Field Survey, 2018

Figure 6.12: Pesticides and Fertilizers on the Surrounding Agriculture Create Water Pollution

6.1.17 Waste Disposals in Ponds

About 60% of the respondents believe that waste disposed in the ponds is a major cause of high to highest levels of water pollution in the Pourasava. A significant portion of the respondents (60%) believe that the water quality of Savar Poursava is threatened due to waste disposals in ponds.

6.1.18 Discussions of Results

According to people's perception, the following types of water pollution have been identified to have high to highest impacts on water pollution:

a. Waste disposal in ponds
b. Leakage in sewerage lines
c. Household chemicals

Waste disposal in ponds, leakage in sewerage lines and household chemical disposals have had 60%, 57.1% and 57% of respondents saying that high to highest levels of impacts in terms of water pollution has been incurred.

6.1.19 Waste Disposal in Ponds and Quality of Water in Savar Pourasava

Drainage water management is normally concerned with reducing the amount of drainage water and with managing its disposal.

However, this aim is more complex than it appears. Drainage is practiced to maintain aeration in waterlogged root zone and/or to leach excess soil salinity to sustain agricultural production.

The drainage water generated must then be managed for reuse purposes where it is of suitable quality and finally discharged or disposed of. The discharge of drainage waters in watercourses may have impacts ranging from beneficial to deleterious.

The disposal of drainage water into wetlands, lakes, rivers and coastal waters entails considerations about the quantity and quality allowable and indeed sometimes required to maintain desirable ecological conditions and functions of that given water body.

Photo Courtesy: Researcher

Picture 6.2: Waste disposal in ponds

6.1.20 Leakage in Sewerage Lines

In the absence of modern treatment facilities, a cringe-worthy 80 percent of the capital's sewage goes directly into rivers and water bodies.

The mindless dumping through the city's storm drainage system is wreaking havoc on the water sources and eventually affecting public health.

At its plant in Narayanganj's Pagla, Dhaka Water and Sewerage Authority (Wasa) is able to treat sewage from only 20 percent of the city area, according to official documents.

According to the experts, most people discharge untreated waste water to nearby water bodies or surface drains. Such discharge ultimately ends up in rivers around the city.

The result is obvious: Dhaka's lifeline -- Buriganga, Turag, Sitalakkhya and Balu and wetlands around it have become heavily polluted.

The government also identified untreated sewage as one of the nine major reasons for river pollution. It accounted for around seven per cent of the pollution. Urban planners warned that the government might fall short of achieving sustainable development goals (SDGs) unless it prioritizes the issues.

6.1.21 Household Chemicals

Household chemicals are non-food chemicals that are commonly found and used in and around the average household. They are a type of consumer goods, designed particularly to assist cleaning, pest control and general hygiene purposes.

Food additives generally do not fall under this category, unless they have a use other than for human consumption. Additives in general (e.g. stabilizers and coloring found in washing powder and dishwasher detergents) make the classification of household chemicals more complex, especially in terms of health - some of these chemicals are irritants or potent allergens - and ecological effects.

Together with non-compostable household waste, the chemicals found in private household commodities pose a serious ecological problem.

It is estimated that institutional buildings and commercial premises consume almost 10 billion pounds of cleaning products every year. Even more of such products are used in residential places as a whole. Cleaning chemicals have widespread effects that are detrimental to the environment.

Most of the cleaning agents are non-biodegradable. Therefore, they are washed through the waterways and end up in rivers and lakes. This not only makes the water unsafe for drinking and other uses, but it also kills organisms that live in the water which are essential for maintaining the water ecosystem.

6.1.22 Spatial Dimensions of Severity of Water Pollution

In order to identify the geographic dimensions of the severity of water pollution, the data collected were assigned spatial dimensions and a spatial analysis was conducted on a ward basis.

The overall severity was assessed with respondents in a 1 to 5 scale where 1 represents the lowest level of severity and 5 represents the highest level of severity, the severity values are expressed in the Table below.

6.1.23 Analysis of Results

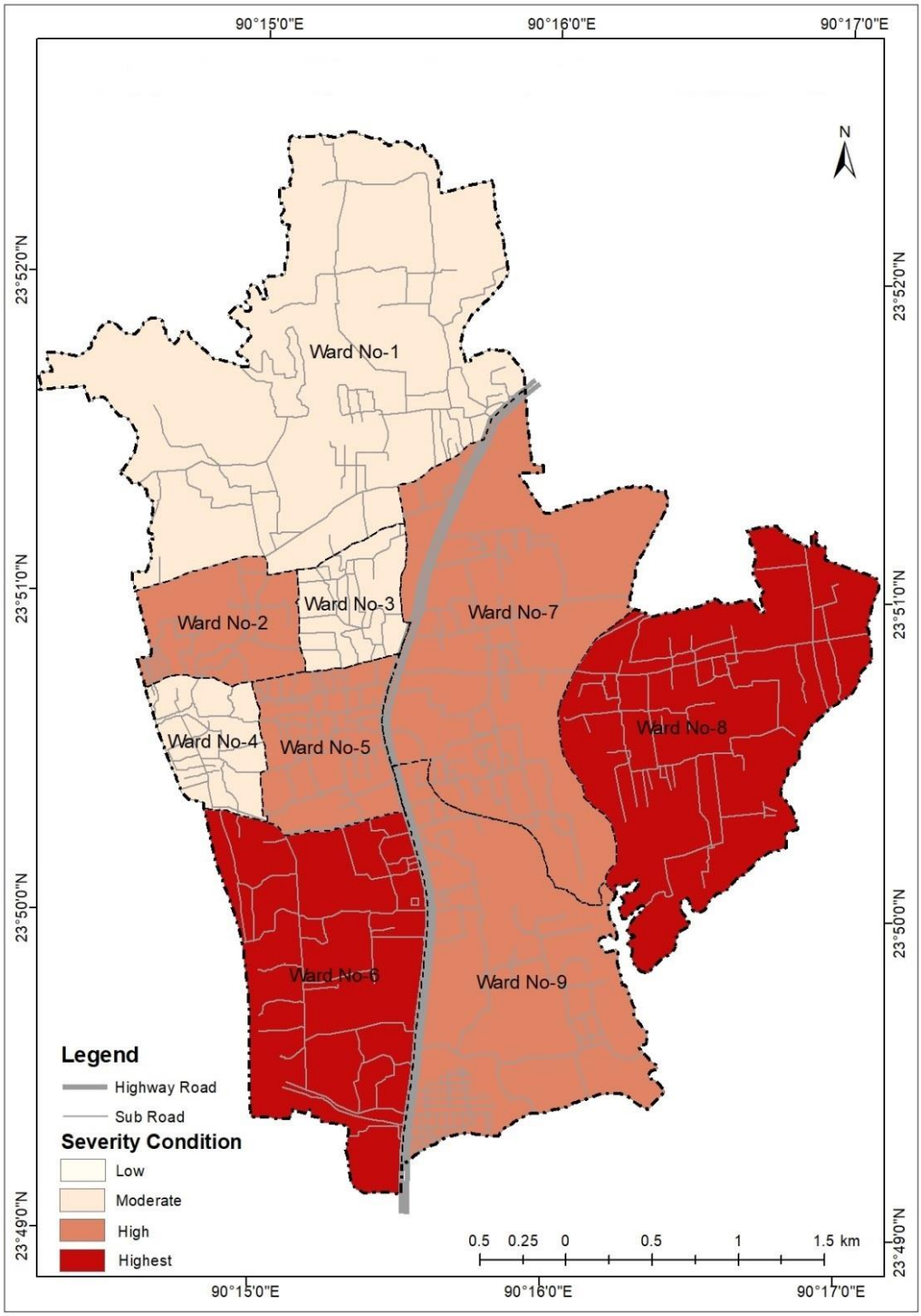
Ward 6 and 8 have the highest levels of water pollution in the Pourasava according to people's perception.

It is seen that air pollution level is highest in Ward 6 where 62 % of the respondents said that there was highest level of severity in terms of water pollution. In ward 1, 3 and 4 the levels of water pollution are lower in comparison.

Table 6.2: Severity scaling with the percentage of respondents ward-wise

Ward	1/ Lowest (%)	2/Low (%)	3/ Moderate (%)	4/ High (%)	5/ Highest (%)
1	0	16.7	36.7	23.3	23.3
2	3.3	13.3	20	50	13.3
3	0	13.3	43.3	40	3.3
4	3.3	10	50	26.7	10
5	3.3	3.3	13.3	73.3	6.7
6	6.9	0	31	0	62.1
7	0	4.2	29.2	62.5	4.2
8	0	13.8	20.7	27.6	37.9
9	0	6.9	31	55.2	6.9

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure- 6.13: Spatial Variation of Using Perceptions Water Pollution in Savar Pourasava

6.1.24 Overall Water Pollution Using Causal Factors

Severity of water pollution was also assessed taking to account the different types of water pollution and the people's perception regarding each type of water pollution.

The results show that the wards that are situated in the southern parts of the Pourasava are the worst affected by water pollution.

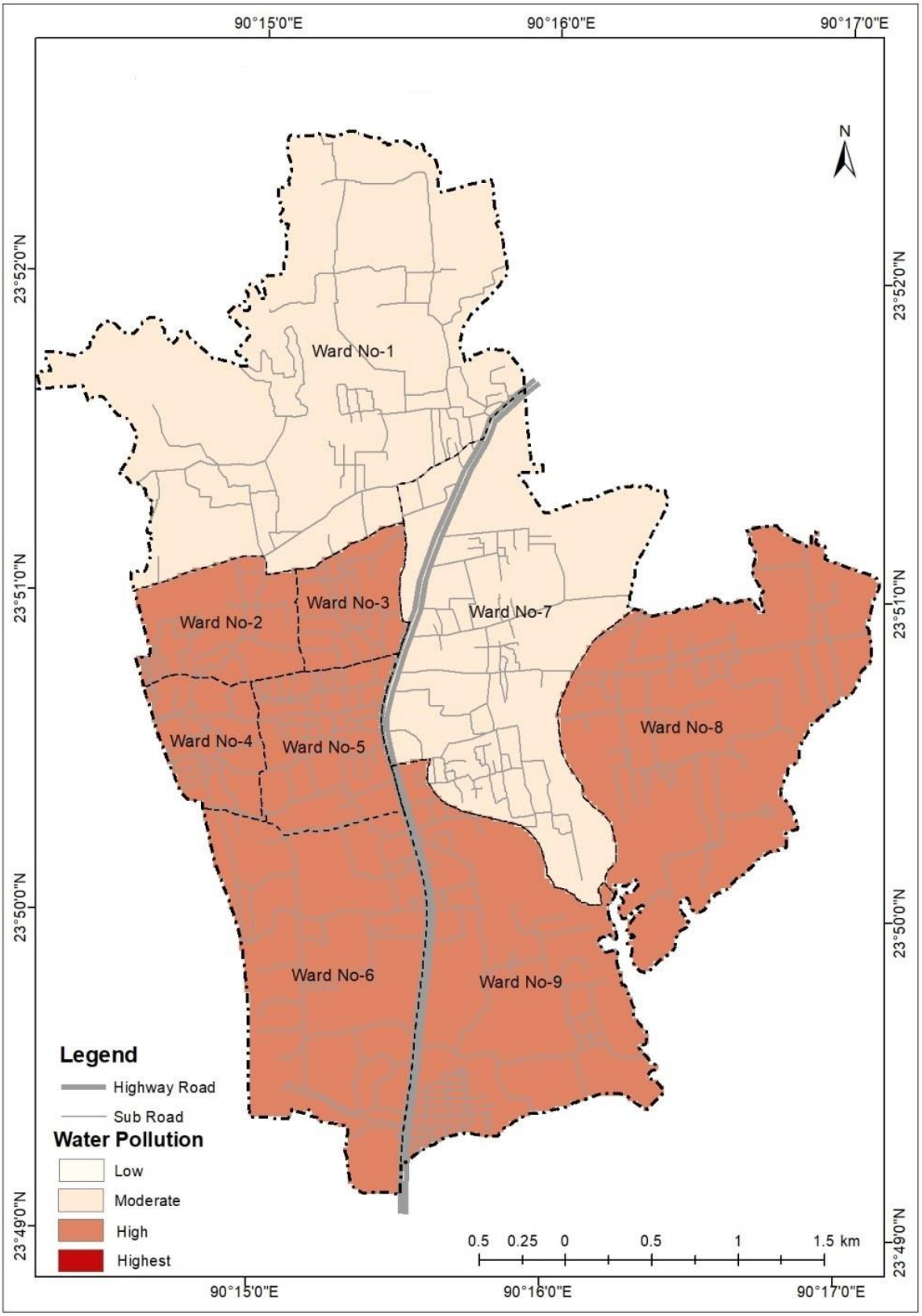
In this analysis, ward numbers 2, 3,4,5,6, 8 and 9 were identified to have high levels of water pollution. Ward numbers 1 and 7 have lower levels of water pollution.

The relative influences have been determined based on the level of severity assigned by each respondents on particular causes for water pollution.

Table 6.3: Causes of water pollution and the relative influence of the causes as used for determining spatial variability

Causes of Water pollution	**Influence (%)**
Industrial effluent is responsible for water pollution	20
Water pollution occurs because of leaking sewer lines	8
Dumping of solid wastes cause water pollution	8
Polythene creates water pollution	6
Printing presses chemical are responsible for water pollution	4
Increasing intervention also causes water pollution	5
Spilled oil and gas create water pollution	5
Water bathing of live stokes create water pollution	3
Passing of urine and stool in water create water pollution	4
Using poison during catching fish is responsible for water pollution	3
Creating water pollution due to construction materials construction	4
Water pollution also occur because of sedimentation	5
Livestock disposal causes water pollution	3
Pesticides and fertilizers on the surrounding agriculture create water pollution	3
Waste discharges into pond causes water pollution	15
Disposal of household chemicals & personal care products create water pollution	4

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.14: Overall Water Pollution Using Causal Factors

6.2 Air Pollution and Quality in Savar Pourasava

6.2.1 Introduction

Air pollution is a mix of particles and gases that can reach harmful concentrations both outside and indoors. Its effects can range from higher disease risks to rising temperatures. Soot, smoke, mold,

pollen, methane, and carbon dioxide are a just few examples of common pollutants.

A new study on global air pollution has reported that at least 123,000 people died in Bangladesh in 2017 due to indoor and outdoor air pollution. Two US-based institutes—the Health Effects Institute (HEI) and Institute for Health Metrics and Evaluation (IHME)—released a detailed report on air quality, "State of Global Air-2019.

As shown in the table above, there are several types of air pollution that can be identified in the Pourasava as seen in the field level observation studies.

Courtesy: Researcher, Source: Field Survey, 2018

Picture 6.3: Air pollution in Savar Pourosava

The types of air pollution that have been identified in the survey are:

(a) Vehicular emissions
(b) Brick Field Emissions
(c) Petrol Engines
(d) Suspended Particles
(e) Fossil Fuels
(f) Exhausts from Industries
(g) Open incineration
(h) Solid Waste disposal sites
(i) Burning painting materials
(j) Chemical Dusts
(k) Smoking Tobacco

Therefore, we notice that there is a wide range of sources of air pollution in the SavarPourasava.

The types of air pollution differ with the different sources of pollution.

If we analyze the different severities of different types of air pollution, we can understand the relative levels of severity of the factors.

The severity was assessed in a 1 to 5 scale where 1 represents the lowest level of severity and 5 represents the highest level of severity.

6.2.2 Air Pollution in Savar Pourasava

Table 6.4: Types of air pollution and level of severity in Savar Poursava

Types of Air Pollution	1/ Lowest	2/ Low	3/ Moderate	4/ High	5/Very High
Vehicular emissions	1.5	10.7	31.4	36	20.3
Brick Field Emissions	7.7	11.9	31	30.3	19.2
Petrol Engines	7.7	13.8	24.9	42.5	11.1
Suspended Particles	1.9	13.4	32.6	30.3	21.8
Fossil Fuels	2.3	9.6	37.9	35.6	14.6
Exhausts from Industries	3.1	9.2	29.9	34.5	13.4
Open incineration	3.8	9.2	26.4	38.3	19.5
Solid Waste disposal sites	4.2	11.5	29.9	38.3	16.1
Burning painting materials	9.6	9.6	33.3	33.3	14.2
Chemical Dusts	5.4	9.6	35.6	35.2	14.2

Source: Field Survey, 2018

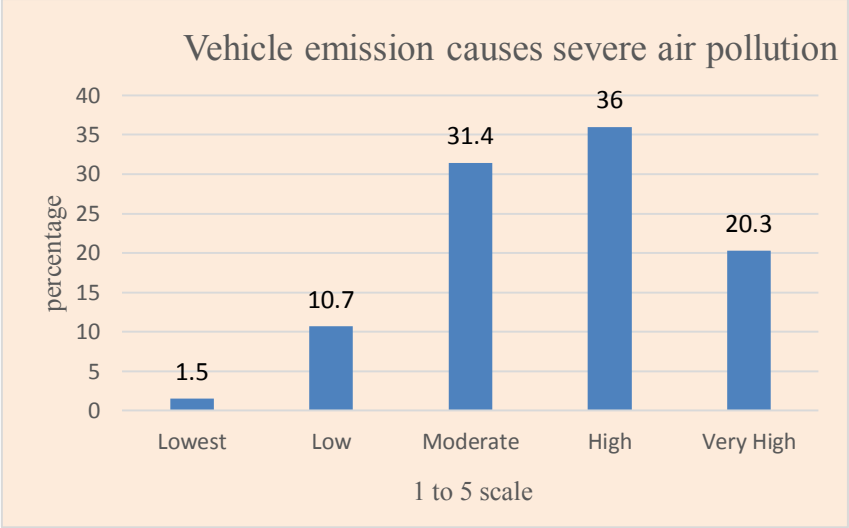
6.2.3 Vehicular Emissions and Air Quality

About 56% of the respondents said that vehicular emissions contribute to a high to highest level to the air pollution.

About 35% of the respondents said that vehicular emissions have high level of impact on the overall air pollution.

Only a small proportion of the respondents believe that vehicular emissions have low levels of severity.

The air quality is therefore threatened by vehicular emissions according to a majority of the respondents.



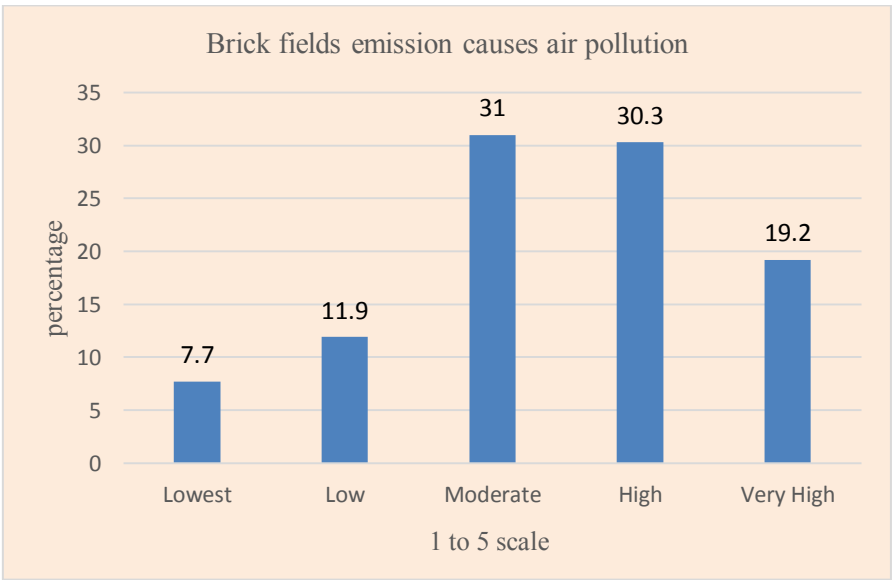
Source: Field Survey, 2018

Figure 6.15: Vehicle Emission Causes Severe Air Pollution

6.2.4 Brick Field Emissions and Air Quality

About 50% of the respondents believe that brick field emissions have high to highest impacts on air pollution level.

The air quality is therefore threatened by brick field emissions according to a majority of the respondents.



Source: Field Survey, 2018

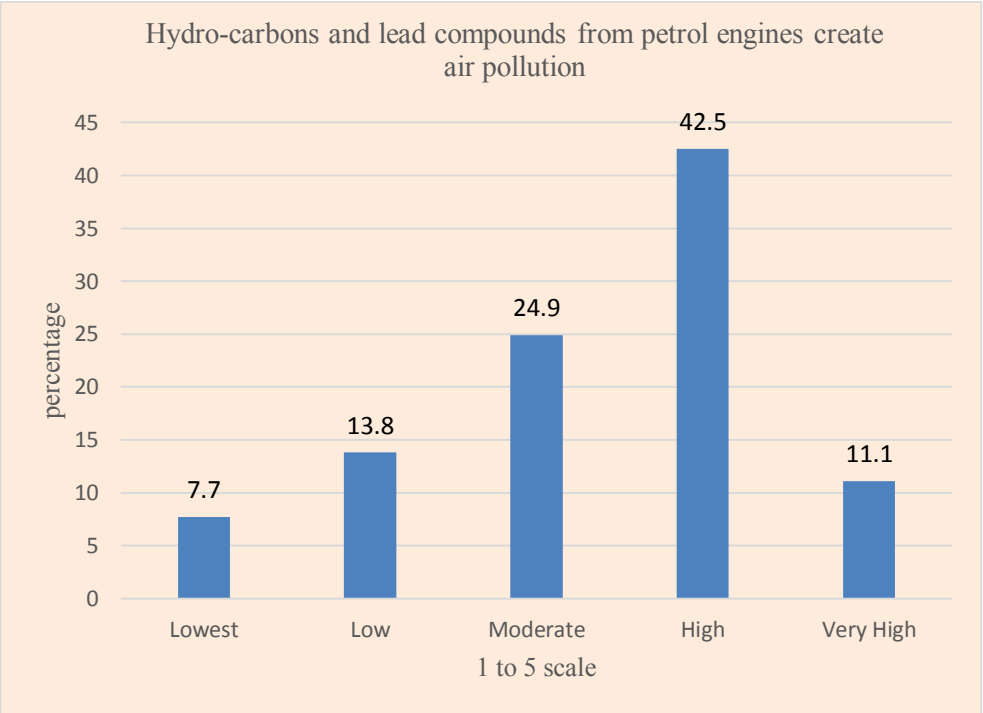
Figure 6.16: Brick Fields Emission Causes Air Pollution

6.2.5 Petrol Engines and Air Quality

About 48% of the respondents believe that hydrocarbon and lead compounds from petrol engine exhaust has high to highest levels of impact on air pollution.

It can be seen that about 12% of the respondents also believe that highest levels of air pollution are being caused by petrol engines.

The air quality is therefore threatened by petrol engines according to a majority of the respondents.



Source: Field Survey, 2018

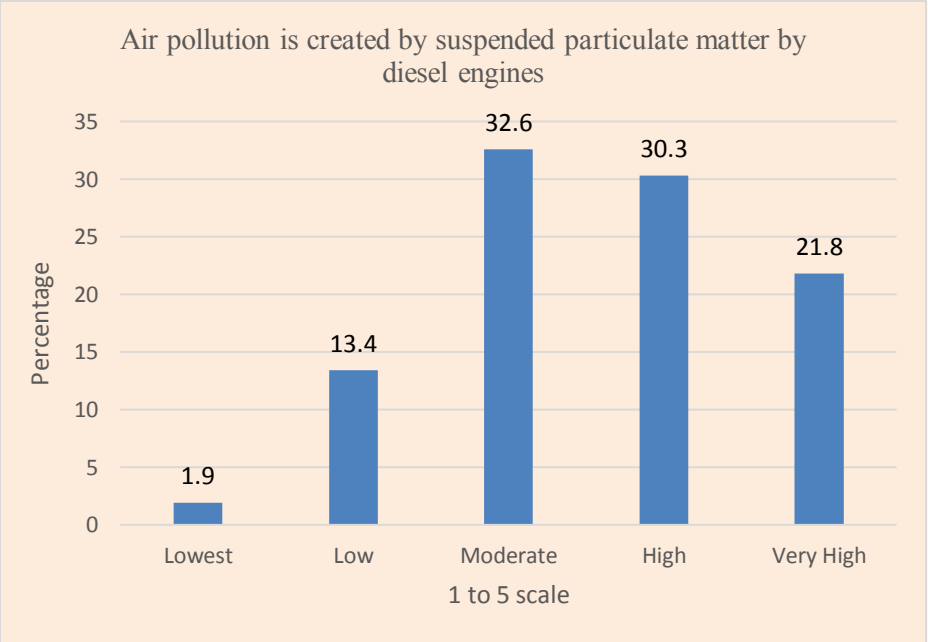
Figure 6.17: Hydro-carbons and Lead Compounds From Petrol Engines Create Air Pollution

6.2.6 Suspended Particles and Air Quality

About 52% of the respondents believe that suspended particles have high or highest impacts on the level of air pollution in the Pourasava.

About 22% of the respondents believe that highest levels of impact is caused due to suspended particles.

The air quality is therefore threatened by suspended particles according to a majority of the respondents.



Source: Field Survey, 2018

Figure 6.18: Air Pollution is Created by Suspended Particulate Matter by Diesel Engines

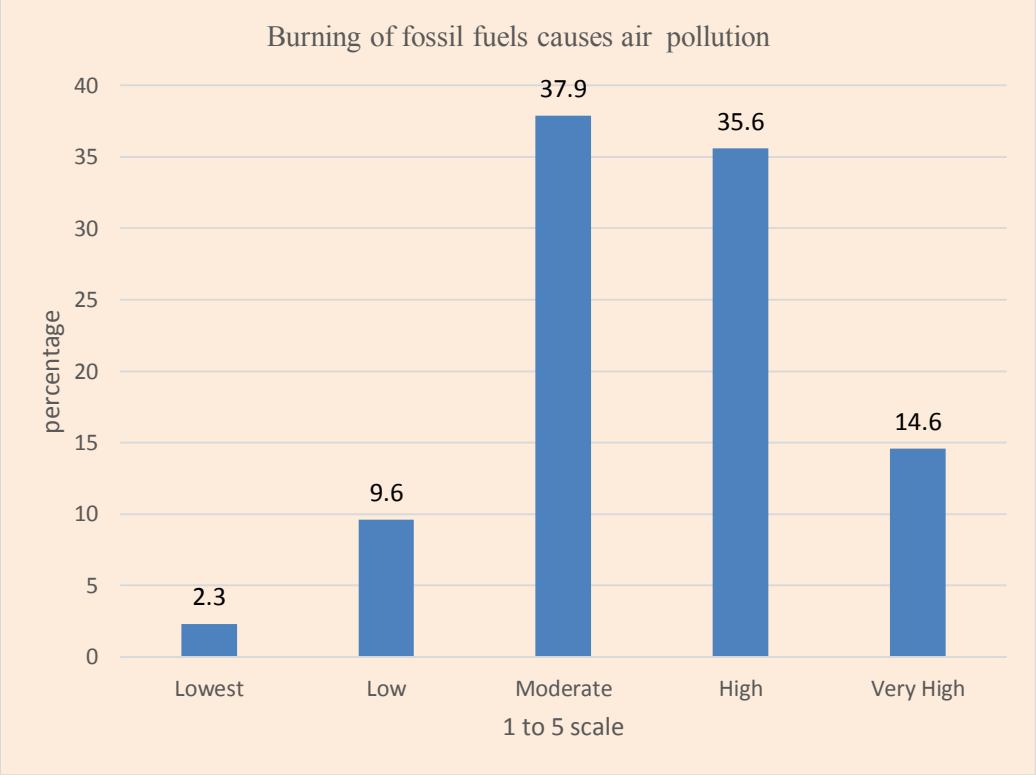
6.2.7 Fossil Fuels and Air Quality

About 50% of the respondents believe that fossil fuels have high to highest levels of impact on air pollution.

About 37% of the respondents have moderate levels of air pollution.

About 11% of the respondents believe that low to lowest levels of severity is caused by fossil fuels.

The air quality is therefore threatened by fossil fuels according to a majority of the respondents.



Source: Field Survey, 2018

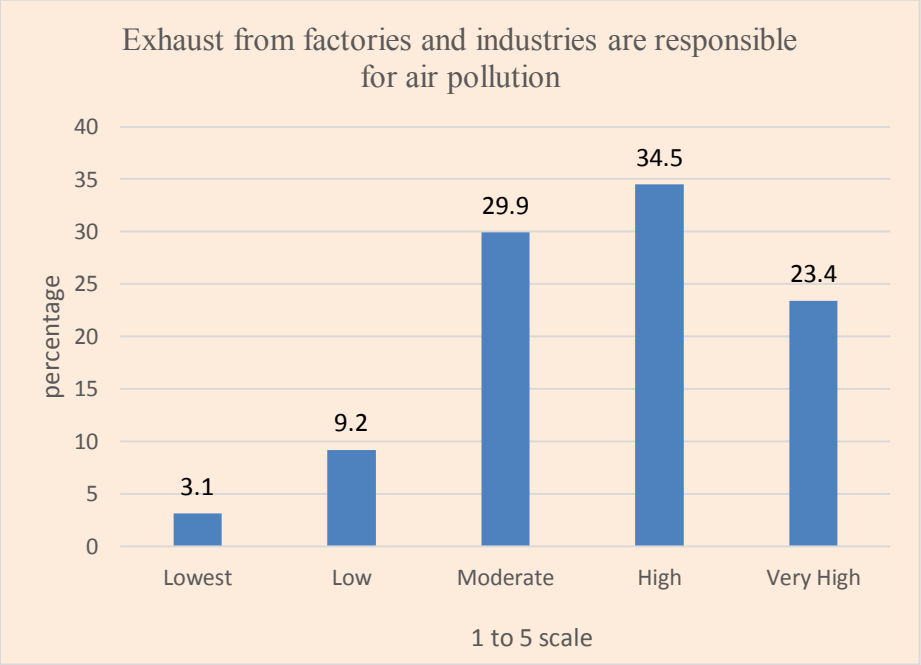
Figure 6.19: Burning of Fossil Fuels Causes Air Pollution

6.2.8 Exhausts from Industries and Air Quality

About 55% of the respondents believe that there is high to highest levels of impact due to exhausts from industries.

About 23% of the respondents believe that there is highest impacts due to exhausts from industries.

The air quality is therefore threatened by exhausts from industries according to a majority of the respondents.



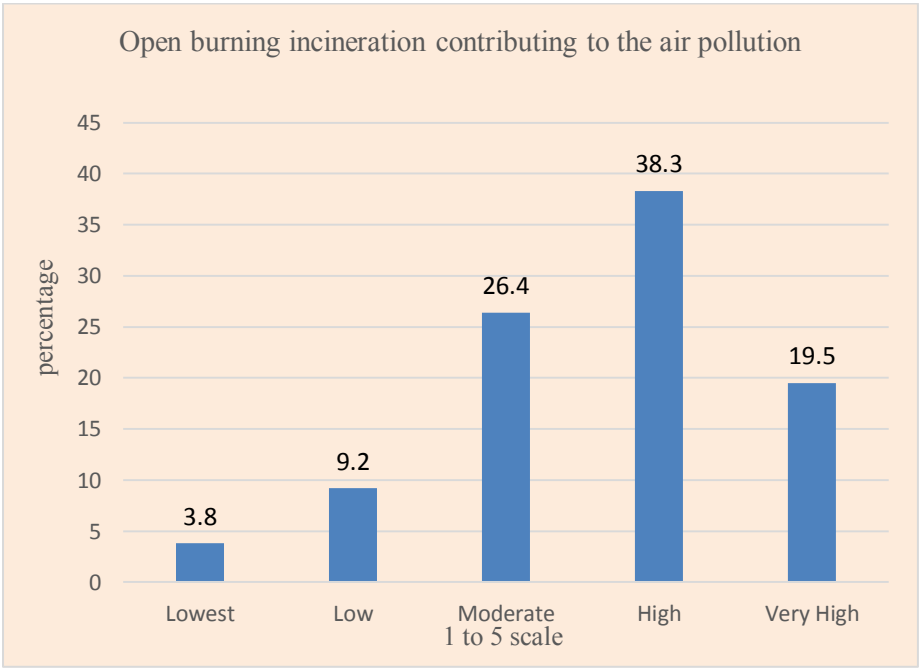
Source: Field Survey, 2018

Figure 6.20: Exhaust from Factories and Industries are Responsible for Air Pollution

6.2.9 Open Incineration and Air Quality

About 60% of the respondents believe that there highest to high levels impact is caused due to open incineration. About 15% of the respondents believe that highest levels of impacts are caused due to open incineration.

The air quality is therefore threatened by open incineration according to a majority of the respondents.



Source: Field Survey, 2018

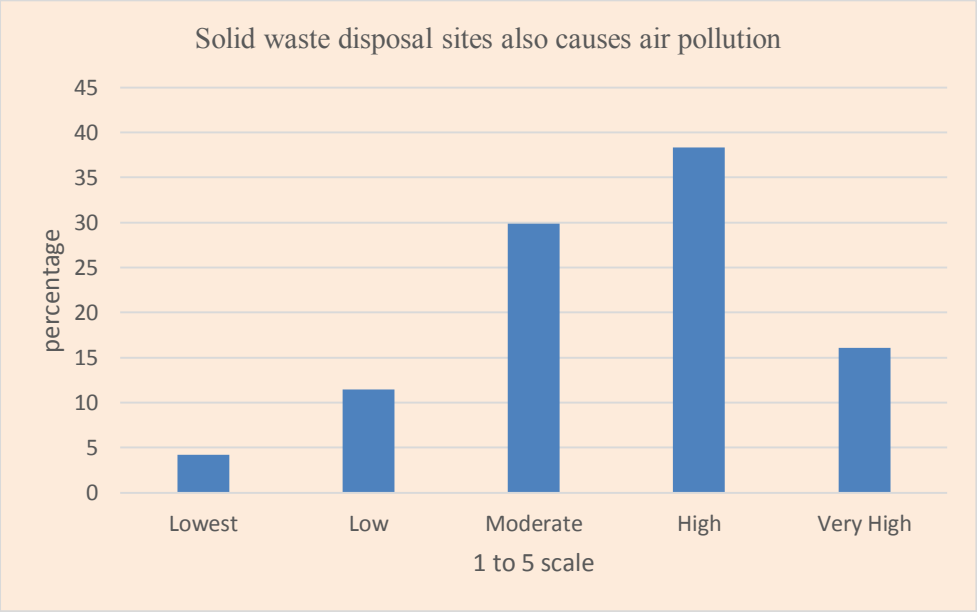
Figure 6.21: Open Burning Incineration Contributing to the Air Pollution

6.2.10 Solid Waste Disposal Sites and Air Quality

About 55% of the respondents believe that solid waste disposal activities are causing high to highest levels of air pollution in the Pourasava.

About 15% of the respondents believe there is only low to lowest level of impacts due to solid waste disposal.

The air quality is therefore threatened by solid waste disposal sites according to a majority of the respondents.



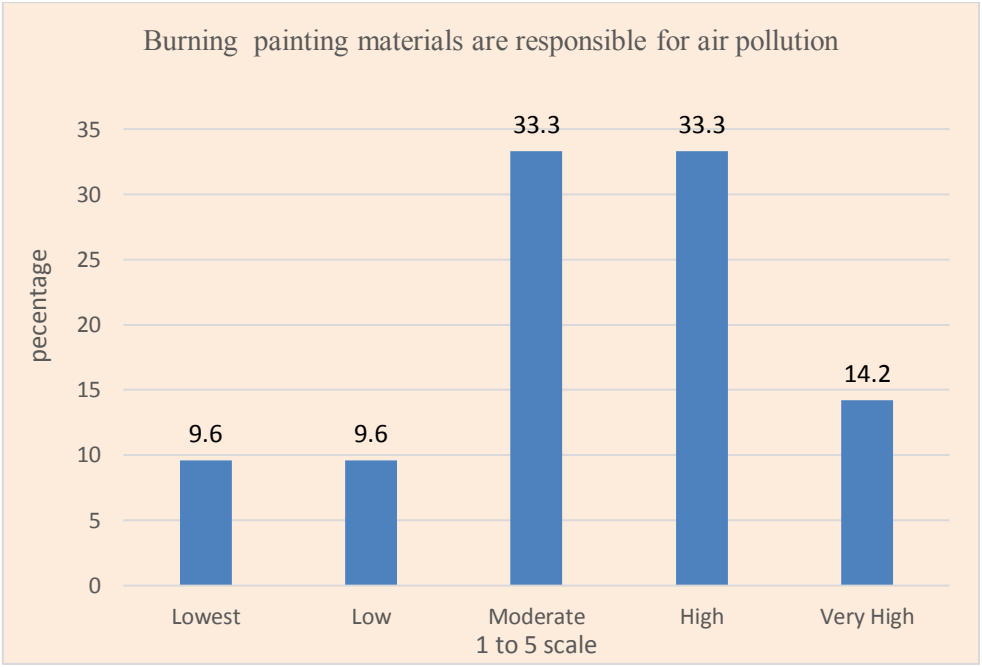
Source: Field Survey, 2018

Figure 6.22: Solid Waste Disposal Sites Also Causes Air Pollution

6.2.11 Burning Painting Materials and Air Quality

About 47% of the respondents believe that burning painting materials are responsible for high to highest levels of air pollution.

About 33% of the respondents think that there is only moderate levels of air pollution due to burning of painting materials.



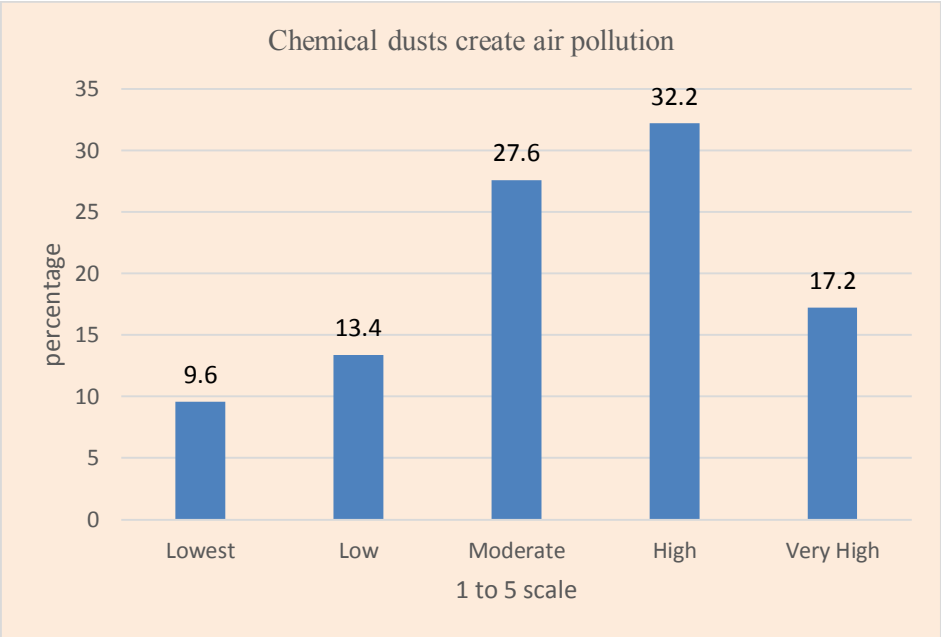
Source: Field Survey, 2018

Figure 6.23: Burning Painting Materials are Responsible for Air Pollution

6.2.12 Chemical Dusts and Air Quality

About 51% of the respondents believe that chemical dust is causing high to highest levels of air pollution. About 17% of the respondents believe that highest levels of air pollution are caused due to chemical dust.

The air quality is therefore threatened by chemical dusts according to a majority of the respondents.



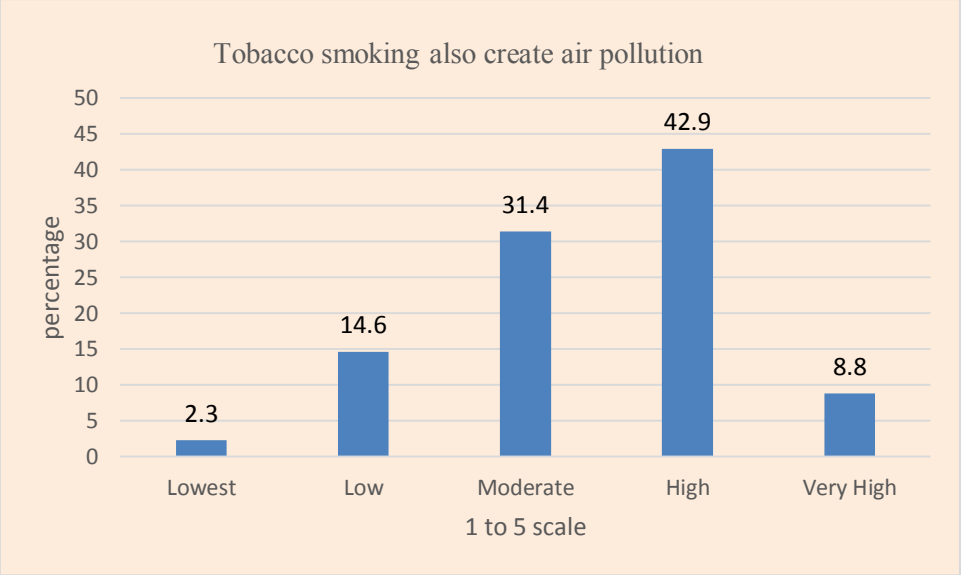
Source: Field Survey, 2018

Figure 6.24: Chemical Dusts Create Air Pollution

6.2.13 Smoking Tobacco and Air Quality

About 45% of the respondents believe that smoking tobacco can have highest to high levels of impact on air pollution level.

The air quality is therefore threatened by smoking tobacco according to a majority of the respondents.



Source: Field Survey, 2018

Figure 6.25: Tobacco Smoking Also Create Air Pollution

6.2.14 Discussions on Results

According to people's perception, if we take the combined high and highest scales into consideration, open incineration and solid waste disposal practices have been identified as key reasons for air pollution with 60% and 55% respondents identifying them to have high or highest impacts.

If we however consider the High scale i.e. scale 4, we see that the impact of petrol engines on air pollution has been identified to have the maximum amount of impact.

Therefore, we can conclude that

(a) Open incineration
(b) Solid waste disposals and
(c) Petrol engine exhausts are identified by people to have maximum impacts in terms of air pollution.

6.2.14.1 Open Incineration

In communities with inadequate waste management systems, waste might be deliberately burned to free up space at dumpsites, to facilitate scavenging of non-combustible materials (such as metals) for profit, or for use as a heat source. In uncontrolled landfills and dump sites, waste may also spontaneously combust as the result of a combination of factors, including the emissions of flammable methane gas from biodegrading waste.

Waste burning is a significant source of dangerous carcinogens like dioxins and furans, and black carbon, a short-lived climate pollutant that contributes to climate change, increased melting in Polar Regions due to the deposition of soot and black carbon on snow and ice, and numerous human health issues.

Open waste burning is a widespread practice spurred, in part, by a lack of systematic waste collection. Its diffuse nature – occurring at major landfills, small or remote dumpsites, and individual households makes it a complex problem to address.

Even those aware of the consequences may continue to burn waste out of habit or because other disposal options are not readily available.

Still, raising awareness about the significant health impacts of waste burning is key to stopping it, as is capacity building for local waste managers to collect waste and prevent build-ups of landfill gas that ignite spontaneously.

Photo Courtesy: The Daily Star

Picture 6.4: Open incineration in Savar Pourasava

6.2.14.2 Solid Waste Disposals

On a mass basis, solid waste disposal contributes much more than the 4.2% of the total air pollution as reported in EPA emission totals. A more accurate estimate is 9.7%.

Air pollutants contributed by solid waste disposal are calculated at 9.9% of the total air pollution health effect (Kupchik and Franc 2012).

Organic solid wastes emits obnoxious odor on their decomposition and make the environment polluted.

Therefore, we can conclude that there is need for proper solid waste management in Savar Pourasava.

6.2.14.3 Petrol Engine Exhausts

The motor vehicle engine emits many types of pollutants including nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide (CO), carbon dioxide (CO_2), particulates, sulphur dioxide (SO_2) and lead.

Emissions are related to use of the engine, mainly the fuel type and the temperature of combustion. If the engine is 100% efficient, then the products of combustion will be CO_2 and water (H_2O). However, at low loads engines are inefficient and therefore the products of incomplete combustion dominate, for example CO and VOCs in petrol engines and carbon monoxide, VOCs and smoke in diesels. As the temperature of combustion increases, the efficiency of conversion to CO_2 and water increases. However, impurities in the fuel such as nitrogen are oxidised to NO_2.

At high temperatures atmospheric nitrogen (N_2) is also oxidised to NO_2, hence at higher loads and speeds, NO_2 production dominates

Therefore, there is need for reduction of the use of petrol engine in Savar Pourasava.

6.2.15 Spatial Variation of Air Pollution in Savar Pourasava

6. 2.15.1 Overall Severity of Air Pollution Using Equal Weighted Overlay Technique

A ward-wise spatial analysis of the severity of air pollution in the Savar Pourasava was conducted.

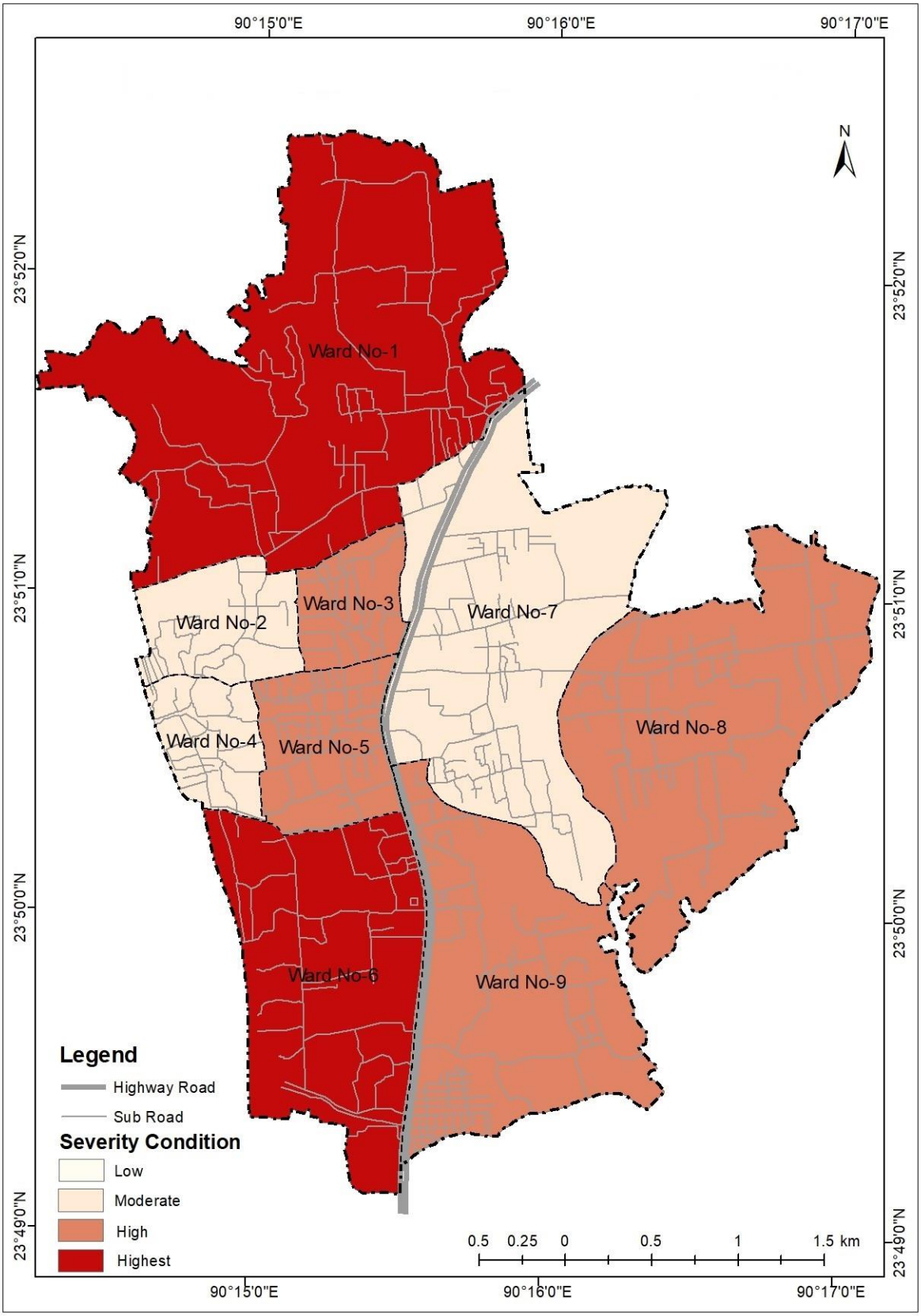
The results shows that, Ward numbers 1 and 6 are identified to have the highest levels of severity according to people's perception.

Ward number 7, 2 and 4 have relatively lower levels of severity of air pollution.

Table 6.5: Severity of air pollution according to people's perception

Ward	1/ Lowest (%)	2/ Low (%)	3/ Moderate (%)	4/ High(%)	5/ Highest(%)
1	6.7	0	30	30	33
2	3.3	3.3	36.7	33.3	23.3
3	0	3.3	43.3	43.3	10
4	0	0	40	50	10
5	0	13.3	40	43.3	3.3
6	0	0	10.4	37.9	51.7
7	4.2	0	62.5	29.2	4.2
8	6.9	13.8	27.6	41.4	10.3
9	0	0	17.2	48.3	34.5

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.26: Air Pollution in Savar Pourasava

6.2.15.2 Overall Severity of Air Pollution in Using Causal Factors

A GIS based analysis was carried out in order to identify the overall severity of air pollution but instead of using equal weights of different, the different causal factors were taken into consideration and a final overlay map was generated.

The causal factors were weighted according to their level of severity in the study area.

All the types of air pollution were considered as sources of overall air pollution.

According to the analysis, ward numbers 1, 2, 4 and 9 were identified as the wards with the highest level of air pollution.

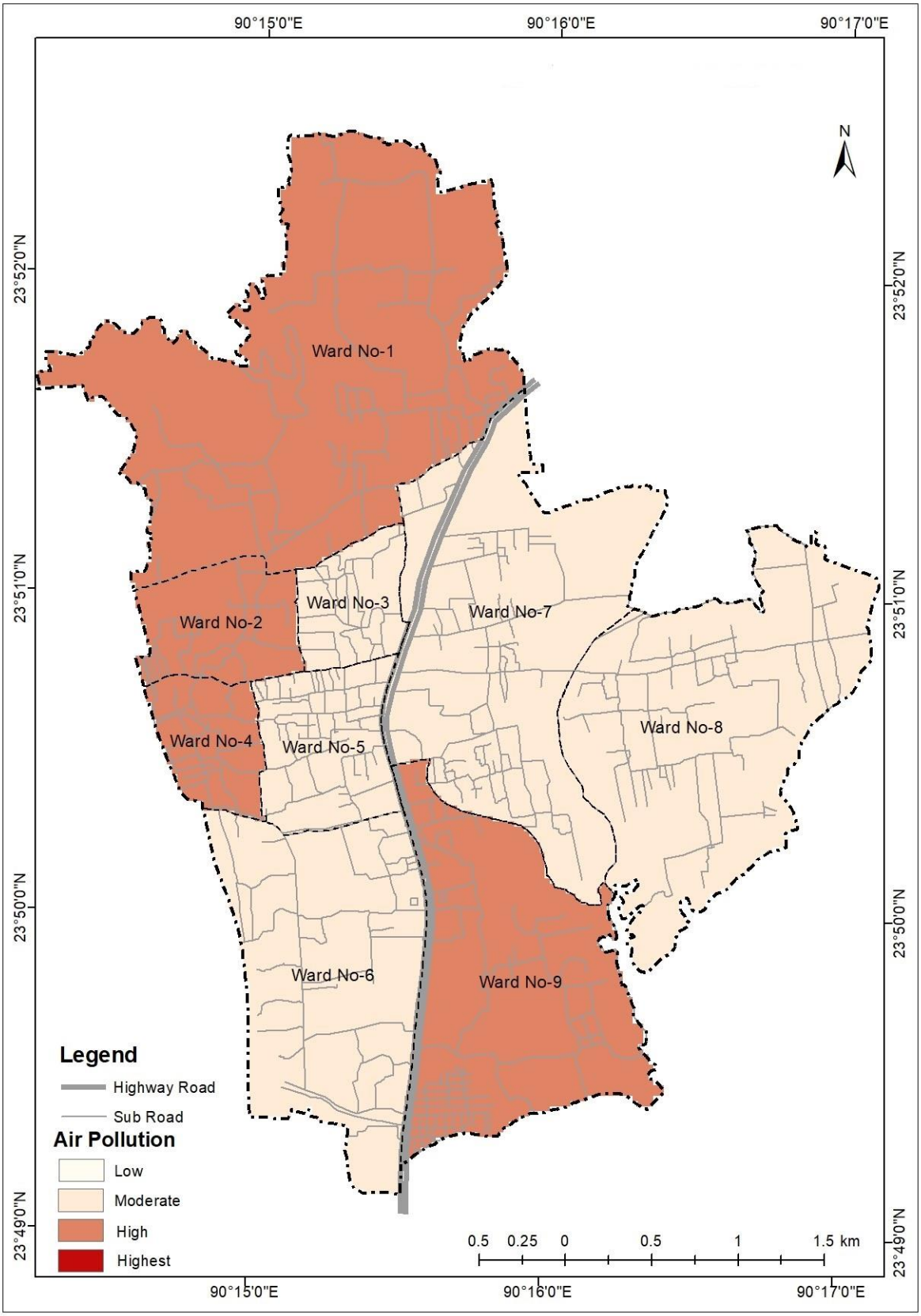
It was noticed that wards in the north and north-eastern part of the Pourasava has more impact of air pollution.

The other wards especially the central wards have reported lower levels of air pollution.

Table 6.6: Causes of air pollution along with the influence used for mapping the spatial variability

Causes of Air Pollution	**Influence (%)**
Vehicle emission causes severe air pollution	7
Increasing level of air pollution	6
Brick fields emission causes air pollution	5
Brick fields dust create air pollution	4
Hydro-carbons and lead compounds from petrol engines create air pollution	5
Air pollution is created by suspended particulate matter by diesel engines	5
Burning of fossil fuels causes air pollution	5
Exhaust from factories and industries are responsible for air pollution	7
Emissions from all types of automobiles and motorcycles have been unabatedly polluting the air	6
Open burning incineration contributing to the air pollution	5
Solid waste disposal sites also causes air pollution	5
Building painting materials are responsible for air pollution	6
Industrial dust causes air pollution	7
Tobacco smoking also create air pollution	5
Air pollution causes by aerosols and CFCs	4
Paper dust causes air pollution	5

Source: Field Survey, 2018



Source: Field Survey, 201

Figure 6.27: Overall Condition of Air Pollution in Savar Paurasava

6.3 Sound Pollution and Quality of Savar Pourasava

6.3.1 Introduction

Sound pollution has become a significant problem in Bangladesh, especially in all the divisional headquarters where sound levels are far beyond the acceptable sound level for the human ear, according to a recent study by the Department of Environment (DoE).

In Dhaka, the average sound level is 80-110dB in prime areas such as Farmgate, Karwan Bazar, Shahbagh, Gabtoli and Mohakhali Bus Terminal, says the study report. This is almost twice the maximum noise level that can be tolerated by humans – 60dB – without suffering a gradual loss of hearing, according to the World Health Organization (WHO).

The country's highest level of noise pollution was recorded in Dhaka's Farmgate area— 130.2 decibels during the daytime and 65.7decibels at night.

According to a survey, sound pollution has reached its highest levels, of 120-130 decibels, at many points across Dhaka city.

Table 6.7: Noise Level in Major Bangladesh cities

Noise levels in major cities in Bangladesh		
City	**Highest**	**Lowest**
Dhaka	132 dB	47 dB
Sylhet	131 dB	50 dB
Khulna	132 dB	42 dB
Barishal	131 dB	54 dB
Rangpur	130 dB	46 dB
Rajshahi	133 dB	56 dB
Mymensingh	131 dB	54 dB
Chattogram	133 dB	47 dB

Source: Department of Environment, 2018

After the initial observation study, we have tried to identify the major types of noise pollution that is present in the Savar Pourasava and then their levels of severity was tested.

Therefore, the types of noise pollutions identified from the study were:

(a) Faulty vehicles
(b) Hydraulic horns
(c) Heavy Factory machinery
(d) Loudspeakers and Amplifiers

The severity was tested based on a 1 to 5 severity scale where, 1 represents the lowest level of impact and 5 represents the highest level of impact.

6.3.2 Types of Noise Pollution and Severity level

Table 6.8: Severity of noise pollution in Savar Paurasava

Types of Sound Pollution	1/ Lowest	2/ Low	3/ Moderate	4/ High	5/Very High
Faulty vehicles	8	13.8	29.1	41.8	14.6
Hydraulic horns	1	10.5	33.3	38.7	16.5
Heavy Factory machinery	1.5	11.9	31	38.7	16.9
Loudspeakers and Amplifiers	7.3	18.8	33.3	26.8	13.8

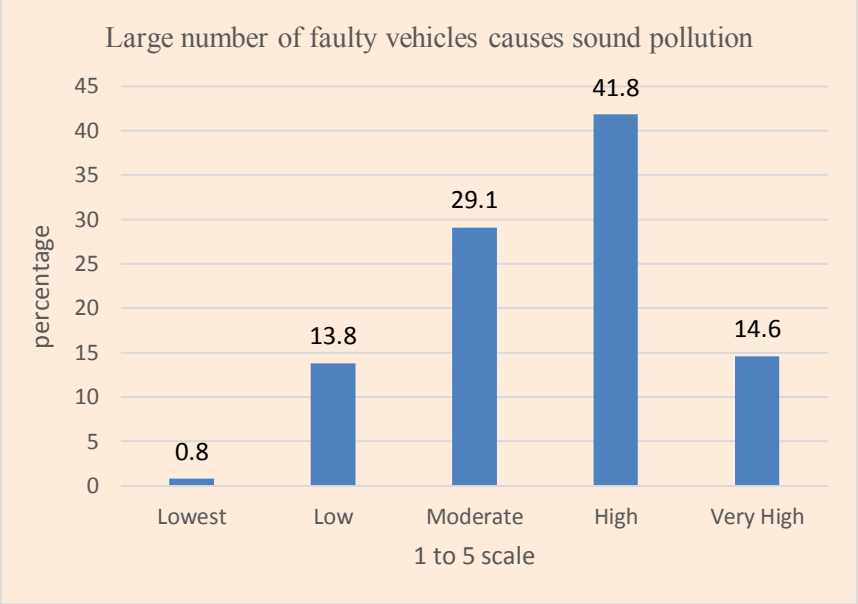
Source: Field Survey, 2018

6.3.3. Faulty Vehicles and Sound Pollution

About 56 % of the respondents said that they perceive faulty vehicles to have high to highest levels of impact on noise pollution.

About 14.6% of the people said that they think that highest impacts on noise pollution are sustained from faulty vehicles.

The noise level in the Pourasava is therefore highly threatened by faulty vehicles according to 56% of the respondents.



Source: Field Survey, 2018

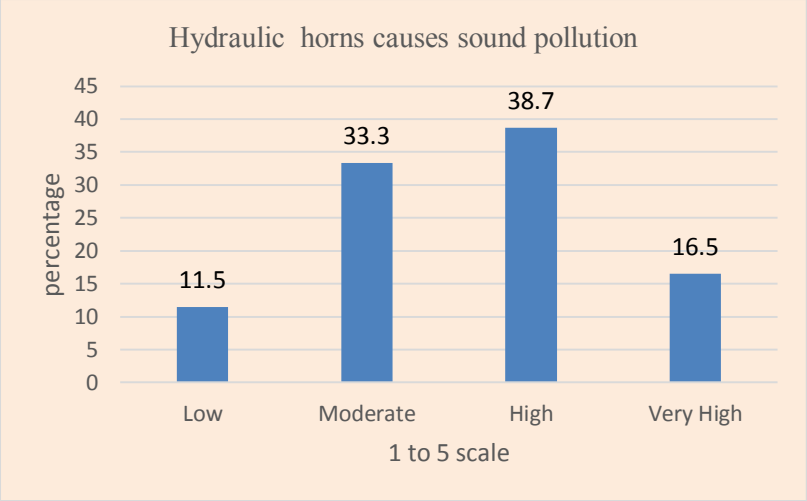
Figure 6.28: Large Number of Faulty Vehicles Causes Sound Pollution

6.3.4 Hydraulic Horns and Sound Pollution

The use of hydraulic horns has been identified to have major impacts on the overall level of noise pollution in Savar Pourasava. A majority (56%) of the respondents believe that hydraulic horns have a high or highest impact on the overall noise level in the Pourasava.

About 16% of the respondents believe that highest levels of impacts are sustained from the use of hydraulic horns.

The noise level in the Pourasava is therefore highly threatened by hydraulic horns according to a majority of the respondents.



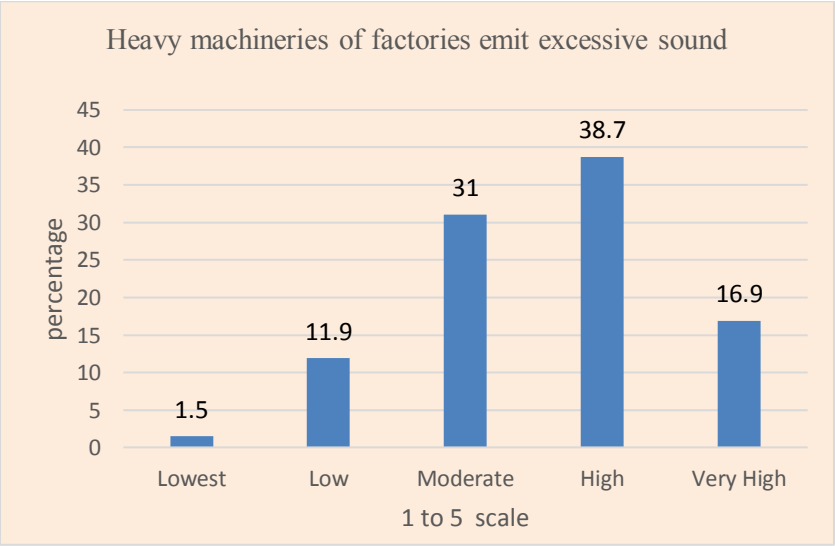
Source: Field Survey, 2018

Figure 6.29: Hydraulic Horns Causes Sound Pollution

6.3.5 Heavy Factory Machinery and Sound Pollution

About 54% of the respondents also believe that noise from heavy machineries have highest to high impacts on the level of noise pollution. About 16% of the respondents also believe that highest levels of noise pollution are sustained from heavy machinery use.

The noise level in the Pourasava is therefore highly threatened by heavy factory machinery.



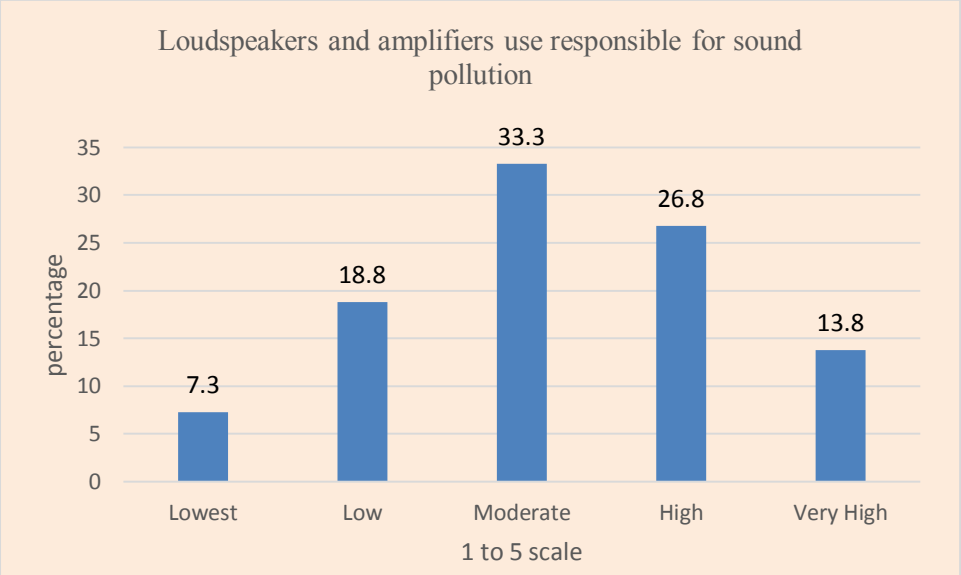
Source: Field Survey, 2018

Figure 6.30: Heavy Machineries of Factories Emit Excessive Sound

6.3.6 Loudspeakers and Amplifiers and Sound Pollution

About 40% of the respondents believe that use of loudspeakers and amplifiers are having high to highest levels of impact on the level of noise solution.

The noise level in the Pourasava is therefore highly threatened by heavy factory machinery.



Source: Field Survey, 2018

Figure 6.31: Loudspeakers and Amplifiers Use Responsible for Sound Pollution

6.3.7 Discussions on Results

According people's perception,

(a) Faulty Vehicles and (b) Hydraulic Horns have been identified to have the maximum contributions to the level of noise pollution in Savar Pourasava.

According to survey, both faulty vehicles and hydraulic horns have been identified by 56% of respondents to have high to highest impacts.

Therefore, we can identify these two types of noise pollution to have the most distressing impacts on the noise pollution level of Savar Pourasava.

6.3.8 Faulty Vehicles

Faulty vehicles inevitably lead to noise levels of noise. There are set standards beyond which a vehicle should not be allowed to operate in the streets.

In Savar Pourasava, there is no such monitoring involved. Often, unfit vehicles are running in the streets and therefore, these cause huge levels of noise pollution.

Besides controlling the honking of vehicles, the fitness of all vehicles including buses, minibuses, trucks and three-wheelers should be checked on a regular basis. Other noise-polluting sources need to be identified and appropriate instructions should be provided to them to control their noise levels.

Courtesy: Researcher

Picture 6.5: Sound pollution near hospitals in Savar Pourasava

6.3.9 Hydraulic Horns

A horn is a sound-making device that can be equipped to motor vehicles, buses, bicycles, trains

It has been observed that most of the trucks and buses plying Savar streets, highways and other towns of Bangladesh use hydraulic horns constantly. The loud noises of these horns cause great disturbance

to the people exposed to those. The drivers of these vehicles do not care about the people and constantly blow their horns while driving the vehicles.

Hydraulic horn is one of the immeasurable medium of traffic noise as well as sound pollution that causes serious problems specially to the children. A High Court Division bench on Sunday directed the government to stop the use of hydraulic horns across the country, aiming to mitigate the sound pollution.

6.3.10 Spatial Variation of Sound Pollution in Savar Pourasava

A ward wise spatial analysis was conducted to identify the severity of sound pollution.

It has been identified that ward 1, 2, 4, 6 and 9 have been identified to have high levels of sound pollution according to people's perception.

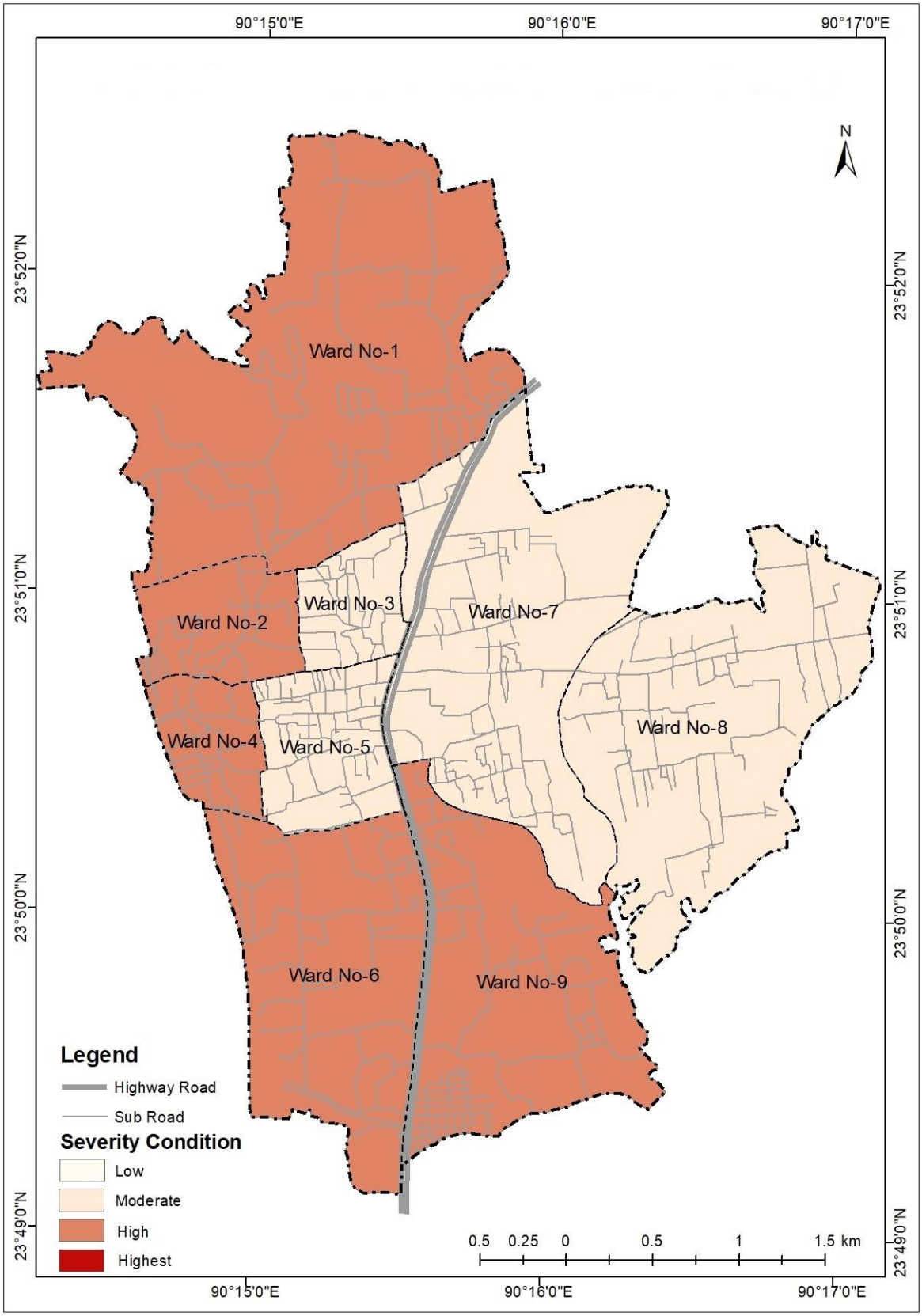
Other wards have moderate levels of sound pollution.

Considering the combined percentage of high and highest levels of sound pollution, ward number 1, 6 and 4 have the maximum levels of sound pollution.

Table 6.9: Severity of noise pollution in Savar Paurasava

Ward	**1/ Lowest (%)**	**2/ Low (%)**	**3/ Moderate (%)**	**4/ High (%)**	**5/ Highest (%)**
1	0	0	40	46.7	13.3
2	0	6.7	30	50	13.3
3	0	26.7	30	20	23.3
4	0	6.7	13.3	63.3	16.7
5	0	13.3	56.7	16.7	13.3
6	0	10.3	24.1	41.4	24.1
7	0	25	50	16.7	8.3
8	13.8	13.8	44.8	20.7	6.9
9	0	6.9	6.9	55.2	31

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.32: Overall Condition of Sound Pollution in Savar Pourasava Using Causal Factors

6.3.10.1 Overall Severity of Sound Pollution Using Causal Factors

In order to further verify the results of severity, a weighted overlay technique taking to consideration the causal factors of noise pollution was conducted.

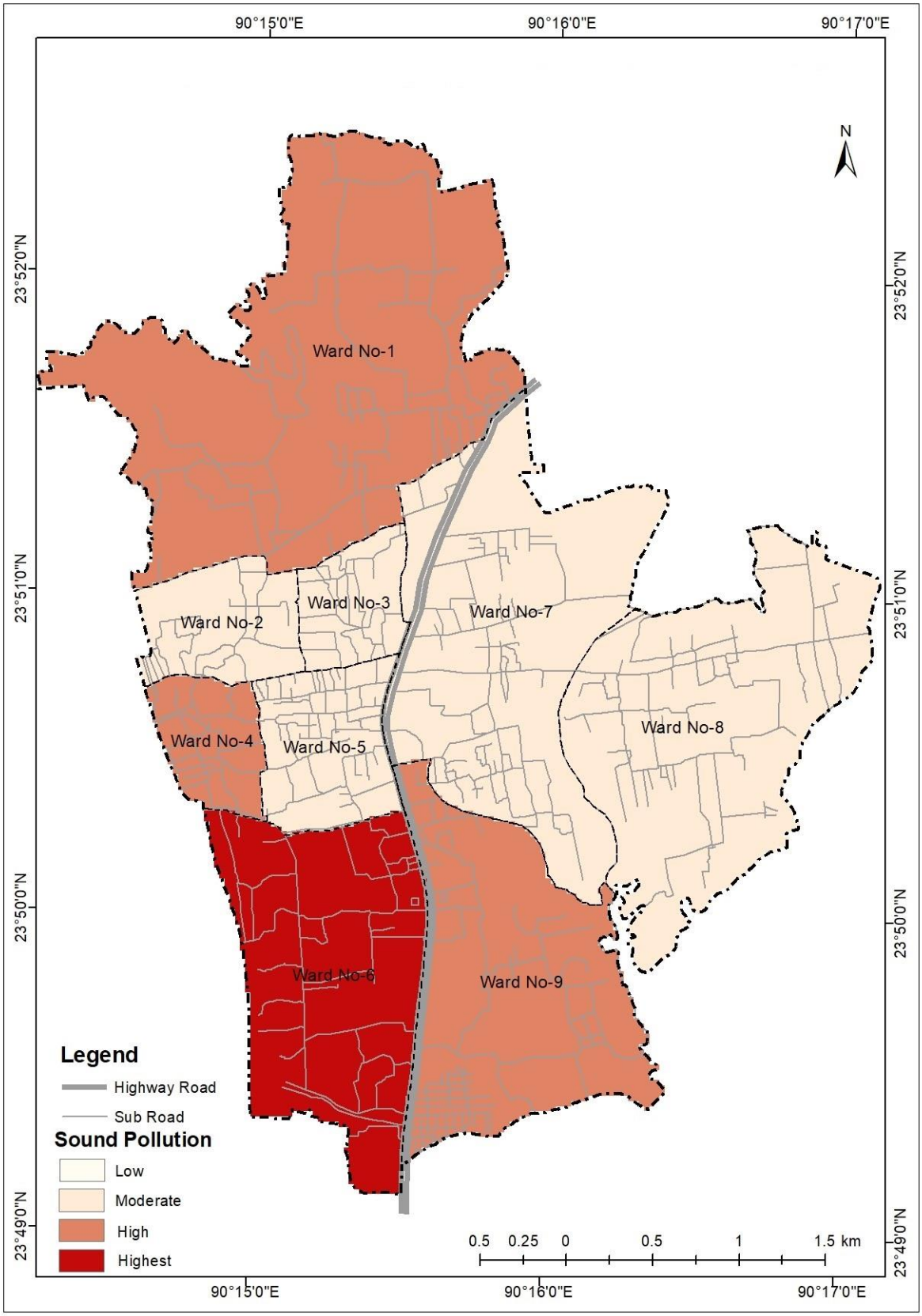
The results show that ward number 6 has the highest level of sound pollution. Ward numbers 1, 4 and 9 have high levels of noise pollution.

The level of sound pollution is relatively lower in the central portions of the Pourasava. The relative influences have been assigned.

Table 6.10: Causes of sound pollution and their relative influence as used to determine the spatial variability

Causes of Sound Pollution	**Influence (%)**
Large number of faulty vehicles causes sound pollution	23
Hydraulic horns causes sound pollution	15
Excessive sound of music creates sound pollution	7
Heavy machineries of factories emit excessive sound	27
Excessive level of sound pollution in Savar Pourasava	19
Loudspeakers and amplifiers use responsible for sound pollution	9

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.33: Overall Condition of Sound Pollution in Savar Pourasava

6.4 Soil Pollution and Environmental Quality of Savar Pourasava

6.4.1 Introduction

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. In Bangladesh, the state of fertility of soil is decreasing.

In Dhaka city, one study has showed that the heavy metal contaminations in some of the areas near land fill sites is alarming.

In Savar Pourasava, rapid industrialization has lead to dumping of various levels of chemical wastes. Soil pollution, also known as soil contamination, is caused by man-made, harmful chemicals penetrating the earth and causing deterioration. There are many health risks associated with soil pollution, through direct contact with the soil or from air contaminants. Whether it's in industrialized countries where soil pollution has regulations, or in developing countries with no such capabilities, the matter of soil pollution is a major problem. Knowing the causes and the potential solutions can help to mitigate some of the risks.

Environmental remediation consists of removing pollution from the soil, groundwater or surface water. Bioremediation (microbes) and phytoremediation (plants) can be used to convert the pollutants into harmless products. These are natural solutions that need to be supported by in-depth actions.

In the course of our field observation study in SavarPourasava, the following types of soil pollution were identified:

(a) Chemical waste
(b) Toxic Vehicular Emissions
(c) Waste in landfill sites
(d) Gasoline and Diesel Leaks

The severity of the above types of soil pollutions were tested using people's perception on a 1 to 5 scale, where 1 represented lowest level of severity and 5 represented the highest level of severity.

Table 6.11: Severity of the types of soil pollution

Types of Soil Pollution	1/ Lowest	2/ Low	3/ Moderate	4/ High	5/Very High
Chemical waste	11.1	18.4	38.7	23	8.8
Toxic Vehicular Emissions	5.7	25.3	31.8	25.7	11.5
Waste in landfill sites	6.5	25.7	26.1	33	8.8
Gasoline and Diesel Leaks	8.8	23	29.1	24.9	14.2

Source : Field Survey, 2018

6.4.2 Severity of Types of Soil Pollution

6.4.2.1 Chemical Waste

About 31% of the respondents believe that high to highest levels of impact shall be incurred due to the exhaustion of chemical waste in the SavarPourasava.

6.4.2.2 Waste in Landfill Sites

About 42% of the respondents believe that waste from landfill sites have a high to highest level of impact on the level of soil pollution in SavarPourasava.

About 9% of the respondents have also reported highest impacts of landfill sites on soil pollution.

6.4.2.3 Gasoline and Diesel Leaks

About 40% of the respondents also believe that gasoline and diesel leaks have high to highest levels of impact on the level of soil pollution.

About 14% of the respondents have also reported highest impacts.

6.4.2.4 Discussions and Results

The survey has identified the severity of various types of soil pollution in the Pourasava and based upon people's perception,

Waste in Landfill sites has been identified to have the most severe impact on soil pollution.

It was seen that about 42% of the respondents found that waste from landfill sites have high impacts on soil pollution in the Pourasava.

6.4.2.5 Waste From Landfill Sites

Landfill has been recognized as the cheapest and more acceptable form for the final disposal of municipal solid waste and as such has been the most used method in the world

The mixture of toxic substances and decaying organic material can impact the soil quality of the areas surrounding a landfill site. This can compound the effects on biodiversity as local vegetation may cease to grow and be permanently altered.

As rain falls on landfill sites, organic and inorganic constituents dissolve, forming highly toxic chemicals leaching into groundwater. Water that rinses through these chemicals collects at the base of the landfill and usually contains high levels of toxic metals, ammonia, toxic organic compounds and

pathogens. This can result in serious contamination of the local groundwater. Even more dangers, this mixture usually creates a high biological oxygen demand, meaning it can quickly de-oxygenate water. If or when these noxious chemicals reach rivers or lakes, it could result in the death of aquatic life

Source: Rahman et al., 2011

Figure 6.34: Waste Disposal Sites in Savar Pourasava

Courtesy: Researcher

Picture 6.6: Land filling activities in Savar Pourasava

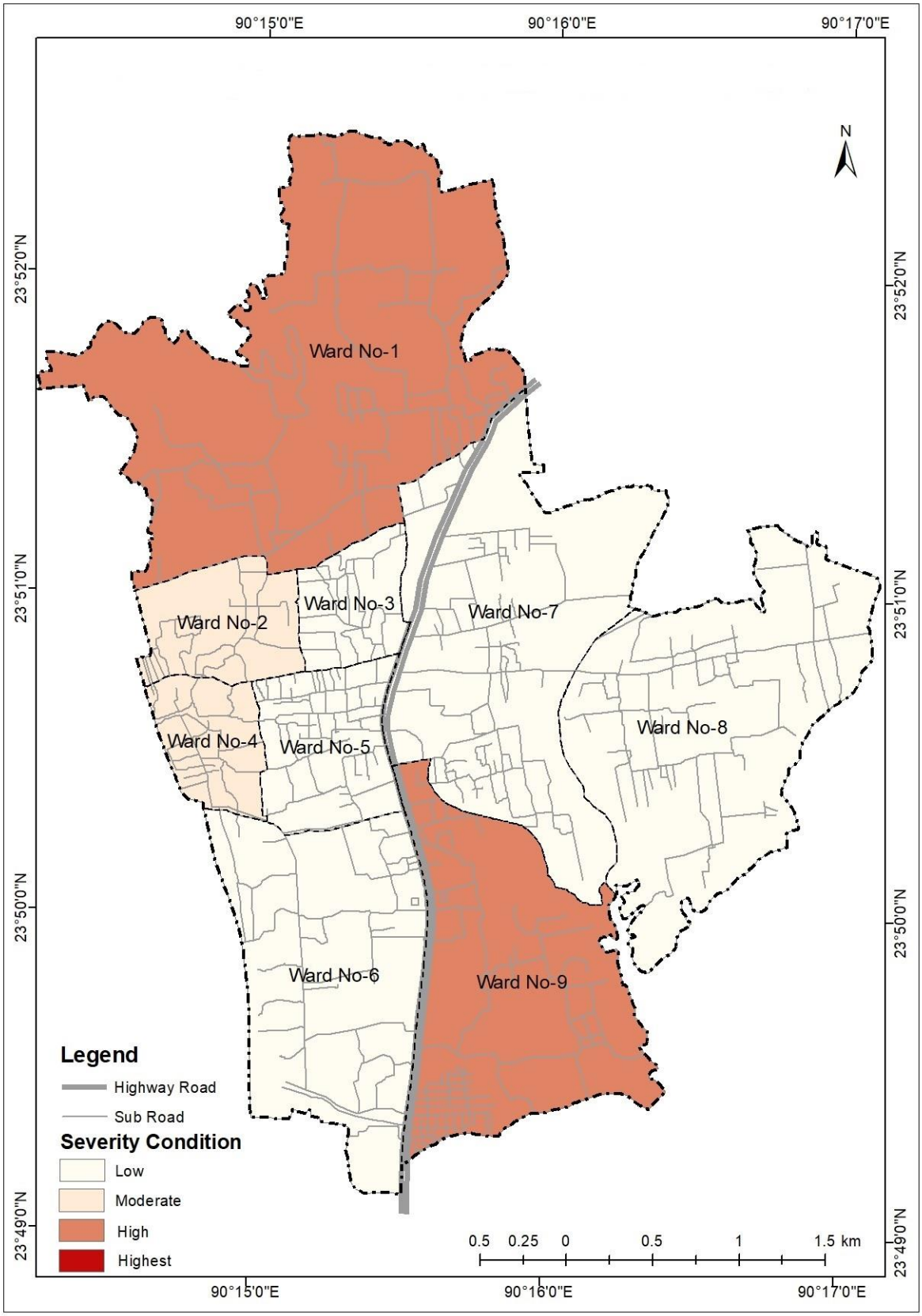
6.4.2.6 Spatial Variation of Soil Pollution and Environmental Quality of Savar Pourasava

According to people's perception, wards 1 and 9 have been identified to have high severity of soil pollution. Ward numbers 6 and 8 have relatively less severity of soil pollution. Moderate levels of severity of soil pollution may be observed in ward number 2 and 4.

Table 6.12: Ward-wise severity of sound pollution in Savar Pourasava

Ward	**1/ Lowest (%)**	**2/ Low (%)**	**3/ Moderate (%)**	**4/ High (%)**	**5/ Highest (%)**
1	3.3	6.7	23.3	40	26.7
2	0	23.3	46.7	26.7	3.3
3	0	46.7	20	30	3.3
4	20	20	40	13.3	6.7
5	3.3	46.7	13.3	23.3	13.3
6	24.1	44.8	6.9	6.9	17.2
7	0	45.8	33.3	16.7	4.2
8	20.7	44.8	27.6	6.9	0
9	0	6.9	20.7	48.3	24.1

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.35: Soil Pollution and Environmental Quality in Savar Pourasava

6.4.2.7 Overall Severity of Soil Pollution using Causal Factors

In order to better assess the results of severity analysis, a weighted overlay using the causal factors of soil pollution was conducted.

In this study, all the particular causes of soil pollution as identified in the study were combined together and overlay map was generated in GIS environment.

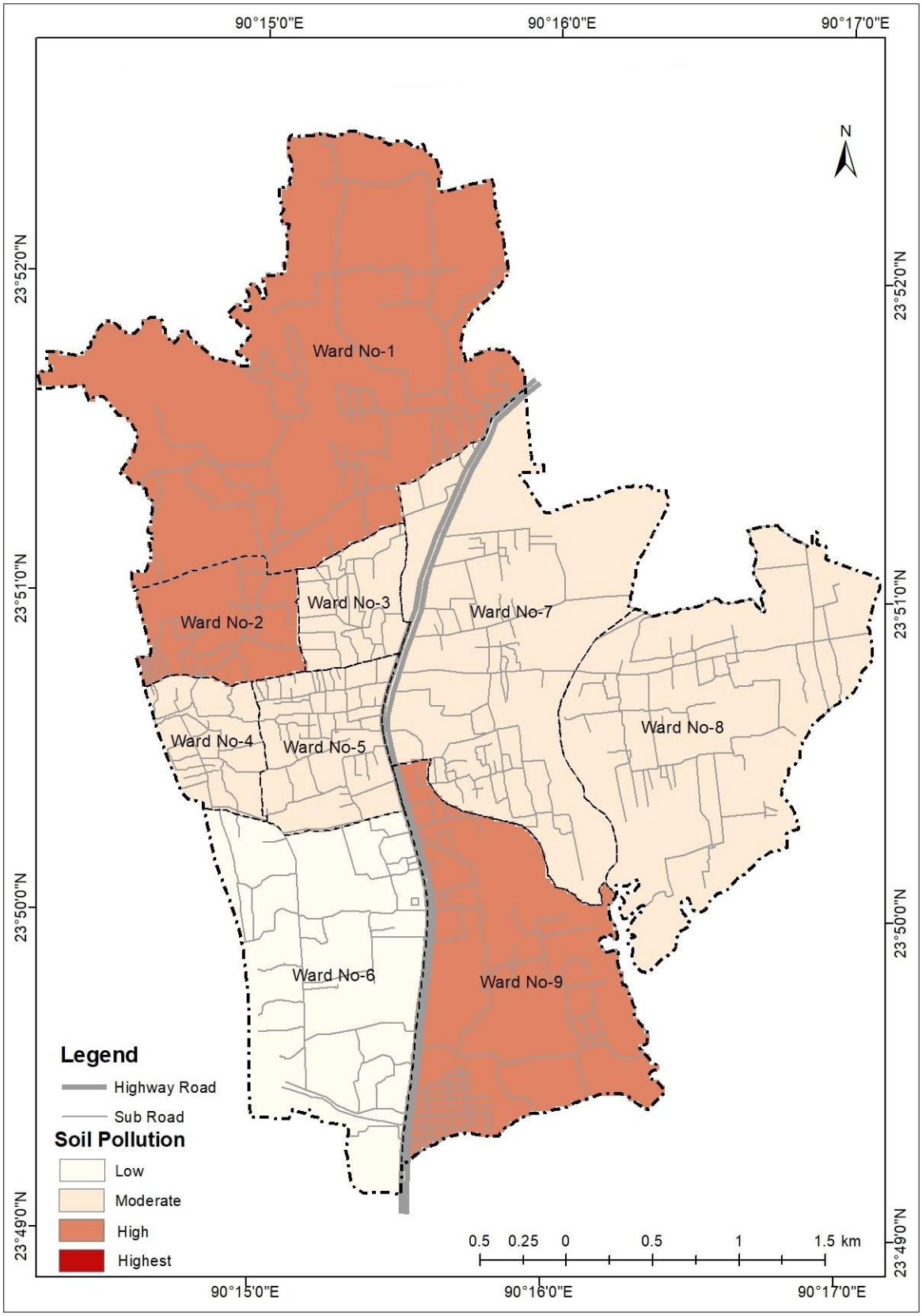
The results show that northern wards of the Pourasava suffer more from soil pollution. Ward numbers 1and 2 which are northern wards have high level of soil pollution according to people's perception.

Ward number 9 is also identified to have high levels of soil pollution.

Table 6.13: Causes of soil pollution and the influence used for mapping spatial variability

Causes of soil pollution	**Influence (%)**
Chemical waste dumping causes soil pollution	40
Releasing toxic vehicle emissions create soil pollution	21
The storage of waste in landfills create soil pollution	25
Leaks and spills of gasoline and diesel causes soil pollution	14

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.36: Overall Condition of Soil and Environmental Quality in Savar Pourasava

6.5 Industrial Pollution of Savar Pourasava

6.5.1 Introduction

Industrial pollution is generally referred to the undesirable outcome when factories (or other industrial plants) emits harmful by-products and waste into the environment such as emissions to air or water bodies (water pollution), deposition on landfills etc. (land pollution) or emission of toxic chemicals into the atmosphere (air pollution).

Industrial pollution is also emitted by industries that convert products to other products—

(i) Automobile bodies from steel,

(ii) Furniture from lumber,

(ii) Paint from solids and solvents, and

(iv) Asphaltic paving from rock and oil.

Industrial sources are stationary, and each facility emits relatively consistent qualities and quantities of pollutants. A paper mill, for example, will be in the same place tomorrow that it is today, emitting the same quantity of the same kinds of pollutants unless a major process change is made.

Control of industrial sources can usually be accomplished by applying known technology. Starting in the 18^{th} century and gaining popularity in the 19^{th} century, the Industrial Revolution brought about drastic changes in the social and economic lives of humans. The benefits of the revolution are felt even today, but so are the adverse effects. The introduction of industrialization brought about industrial pollution.

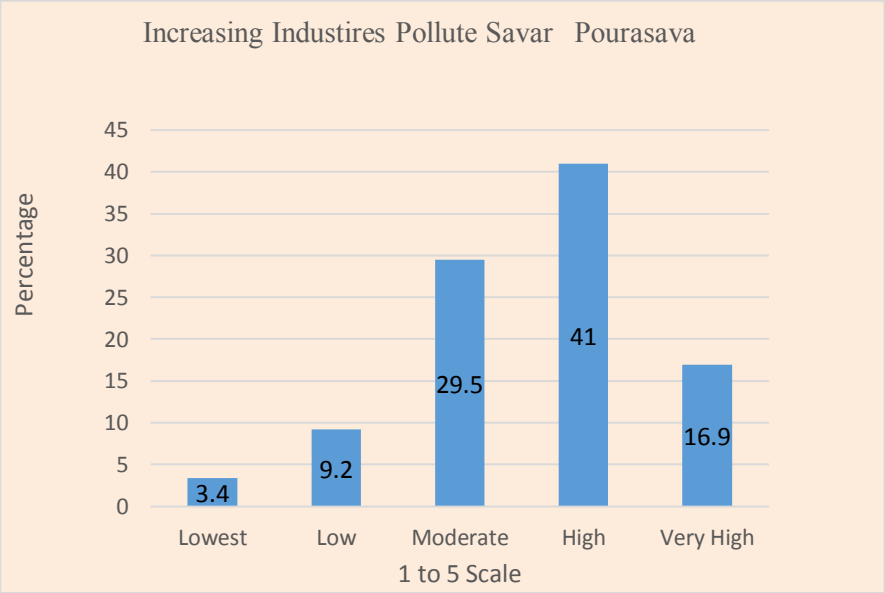
During the revolution, technology, manufacturing, and science all began rapidly increasing, and continue to grow even today. Before the industrial revolution, industries remained small, and their primary pollutant was smoke. The plants had limited time and size, which meant pollution was minor. It was not until companies turned into huge plants and industries that the harmful effects of pollution became known.

6.5.2 Increase of Industrial Pollution and Environmental Quality

Industrial pollution is a major problem in Savar Pourasava. This can be portrayed by the fact that about 58% of the respondents believe that the rate of increase of industrial pollution is high to highest in the recent years.

Only a small proportion of the respondents believe that rate of industrial pollution is low.

Therefore, according to about 58% of the respondents, industrial pollution greatly impacts the overall environmental quality of the area.



Source: Field Survey, 2018

Figure 6.37: Increasing Industries Pollute Savar Pourasava

6.5.3 Severity of the Types of Industrial Pollution

Table 6.14: Severity of industrial pollution

Type of Industrial Pollution	1/ Lowest (%)	2/ Low (%)	3/ Moderate (%)	4/ High (%)	5/ Highest (%)
Detergent chemicals	2.3	13.4	33	46.4	5
Painting chemicals / Dyeing industries	4.6	14.6	33.7	34.9	11.9

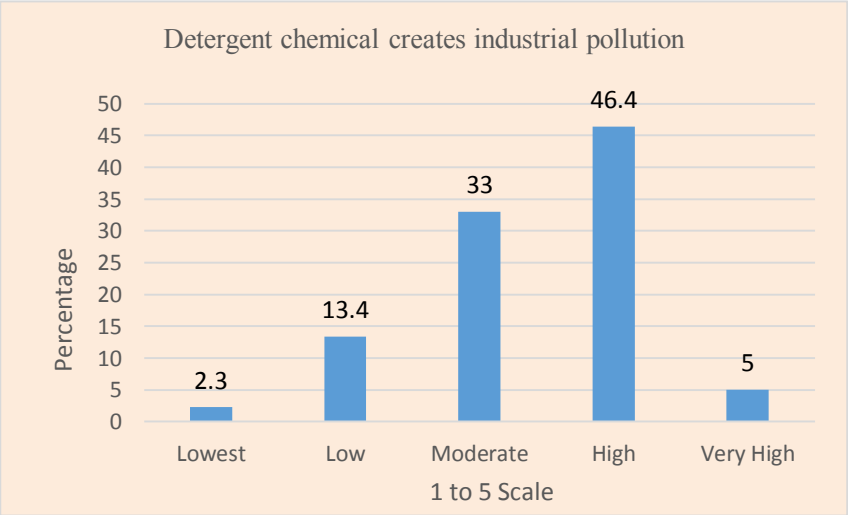
Source: Field Survey, 2018

6.5.4 Detergent Chemicals and Environmental Quality

About 51.4% of the respondents believe that the impact of detergent chemicals on the overall industrial pollution is high to highest.

About 33% of the respondents also believe that there is only moderate levels of impact due to the use of detergents in the industry.

A majority of the respondents believe that industrial pollution caused by detergents causes significant degradation environmental quality.



Source: Field Survey, 2018

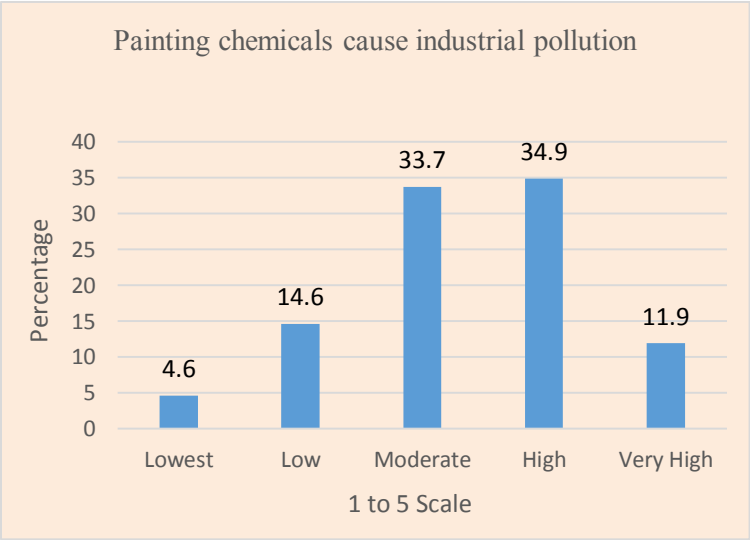
Figure 6.38: Detergent Chemical Creates Industrial Pollution

6.5.5 Painting Chemicals/ Dyeing Industries

About 47% of the respondents believe that painting chemicals or dyeing industries have high to highest levels of impact on the level of industrial pollution.

About 12% of the respondents believe that there is highest level of impact due to dyeing industries.

The overall environmental quality is largely impacted due to industrial pollution caused by painting chemicals.



Source: Field Survey, 2018

Figure 6.39: Painting Chemicals Cause Industrial Pollution

6.5.6 Spatial Variations in Severity of Industrial Pollution Using Causal Factors

A weighted overlay using causal factors was conducted for assessing the level of severity of industrial pollution.

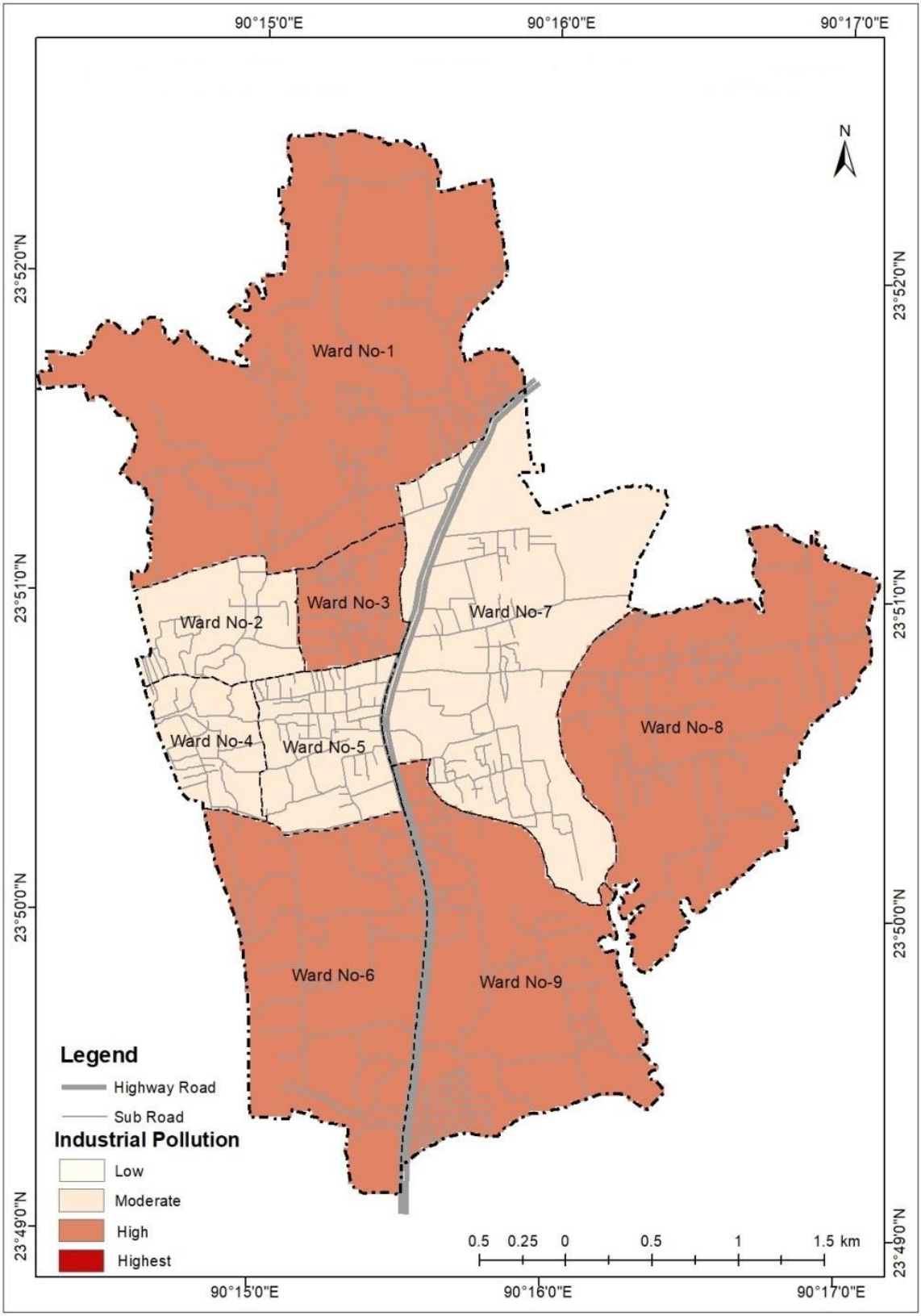
Ward numbers 1, 3, 6, 8 and 9 have been identified to have high levels of industrial pollution.

The influence of the particular causes have been fixed based on the percentage of respondents who have assigned high or highest level of severity.

Table 6.15: Causes of industrial pollution and relative influence used to determine spatial variations

Causes of Industrial Pollution	**Influence (%)**
Increasing Industries pollute Savar Pourasava	38
Detergent chemical creates industrial pollution	18
Painting chemicals cause industrial pollution	13
Industrial pollution accelerates for region development	31

Source: Field Survey, 2018



Source: Field Survey, 2018

Figure 6.40: Overall Condition of Industrial Pollution in Savar Pourasava

6.6 Conclusion

The chapter summarized the different types of pollution along with the severity of each type of pollution and spatial distribution.

The chapter addressed water pollution as one of the major types of pollution in the Savar Pourasava.

After Ward based spatial analysis, It is seen that air pollution level is highest in Ward 6 where 62 % of the respondents said that there was highest level of severity in terms of water pollution.

Waste disposal in ponds, leakage in sewerage lines and household chemical disposals have had 60%, 57.1% and 57% of respondents saying that high to highest levels of impacts in terms of water pollution has been incurred.

The chapter addresses air pollution as a major source of pollution in the area. According to spatial analysis of severity of air pollution it is seen that, Ward numbers 1 and 6 are identified to have the highest levels of severity according to people's perception. Open incineration and solid waste disposal practices have been identified as key reasons for air pollution with 60% and 55% respondents identifying them to have high or highest impacts.

The chapter addressed the overall sound pollution in the area.

Faulty Vehicles and Hydraulic Horns have been identified to have the maximum contributions to the level of noise pollution in Savar Pourasava.

The chapter addresses soil pollution as a major source of pollution in the area. According to spatial analysis of severity of soil pollution it is seen that, Ward numbers 1, 2 and 9 are identified to have the highest levels of severity according to people's perception. Chemical waste dumping and The storage of waste in landfills has been identified as key reasons for air pollution with 40% and 25% respondents identifying them to have high or highest impacts.

According to survey, both faulty vehicles and hydraulic horns have been identified by 56% of respondents to have high to highest impacts. According to the spatial analysis, the results show that ward number 6 has the highest level of sound pollution.

The chapter addressed industrial pollution as a major source of pollution in the Savar Pourasava. Detergents and dyeing chemicals are identified as two of the major sources of industrial pollution.

The spatial variation in severity shows that ward numbers 1, 3, 6, 8 and 9 have been identified to have high levels of industrial pollution.

CHAPTER SEVEN

SEVERITY OF POLLUTION IN SAVAR POURASAVA AND ITS ENVIRONMENTAL QUALITY

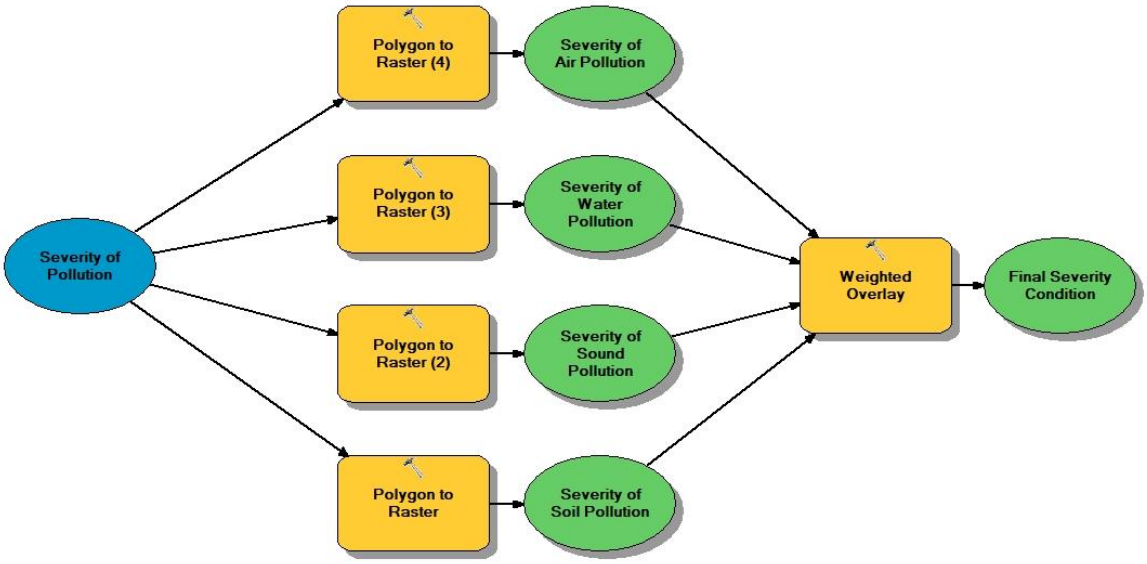
Chapter Seven

Severity of Pollution in Savar Pourasava and its Environmental Quality

7.1 Introduction

In order to identify a combined scenario of the severity of different types of pollution, a spatial analysis was conducted where the ward-wise variations were combined together and overlay analysis was conducted.

Therefore, the severity of air pollution, water pollution, sound pollution and soil pollution were combined. Equal weights were given to all four types of pollution and the final output was generated.

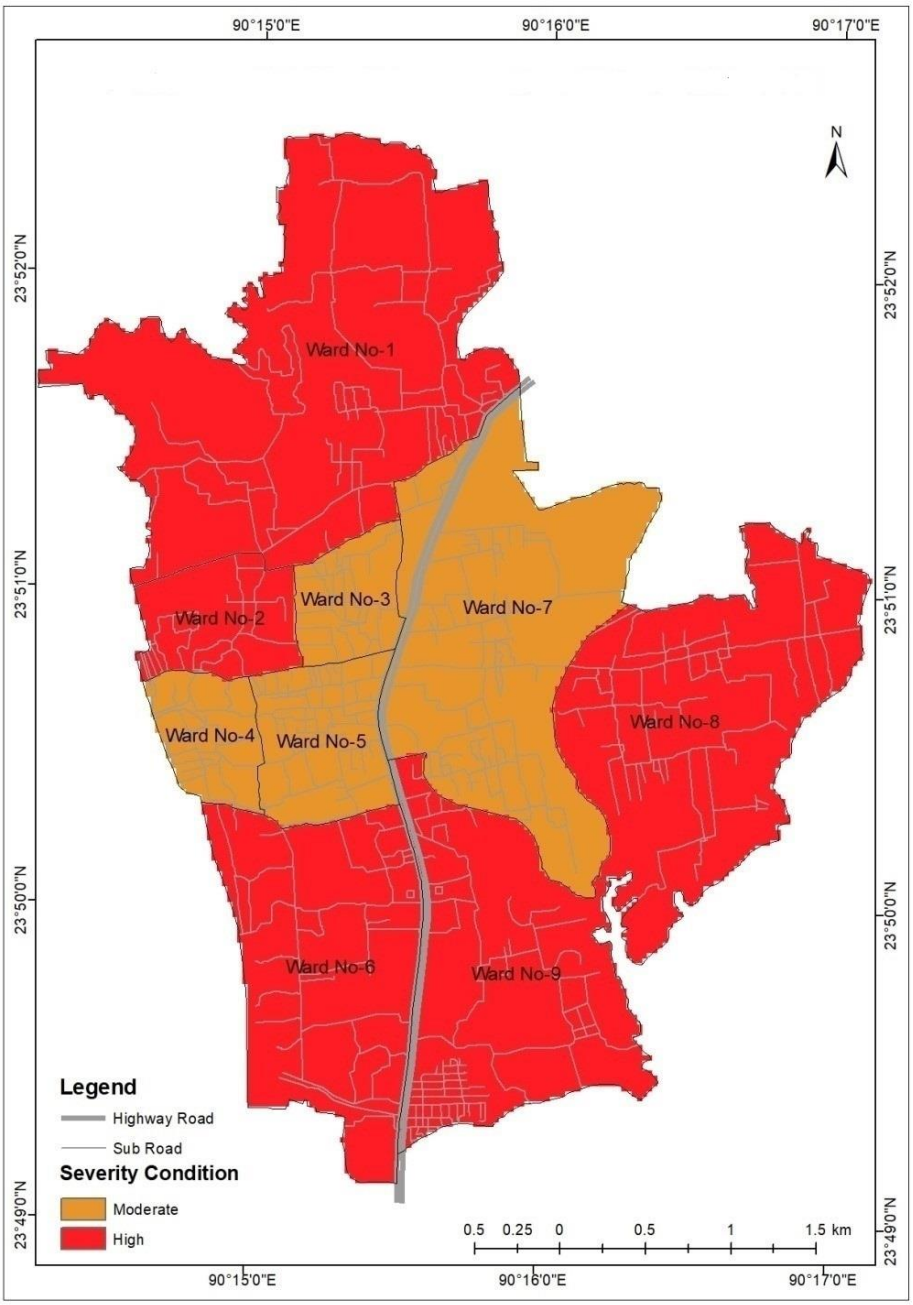


Source: Field Survey, 2018

Figure 7.1: A GIS Model to Analyze Overall Severity of Pollution in Savar Pourasava

7.2 Analyzing Severity of Overall Pollution in Savar Pourasava

It may be seen that ward numbers 1, 2, 6, 9 and 8 have high levels of severity of overall pollution. The other wards, i.e. 3, 7, 4 and 5 have low levels of severity. We notice that according to the analysis, the central wards have lower levels of pollution in comparison to the wards in the peripheral regions.



Source: Field Survey, 2018

Figure 7.2: Overall Severity Condition of Savar Paurasava

7.3 Overall Severity of Pollution Using Causal Factors in Savar Pourasava

A further analysis using causal factors was conducted in order to verify the results.

The overall analysis was conducted using severity values from 4 industrial pollution types, 16 water pollution types, 6 sound pollution types, 18 air pollution types and 4 soil pollution types.

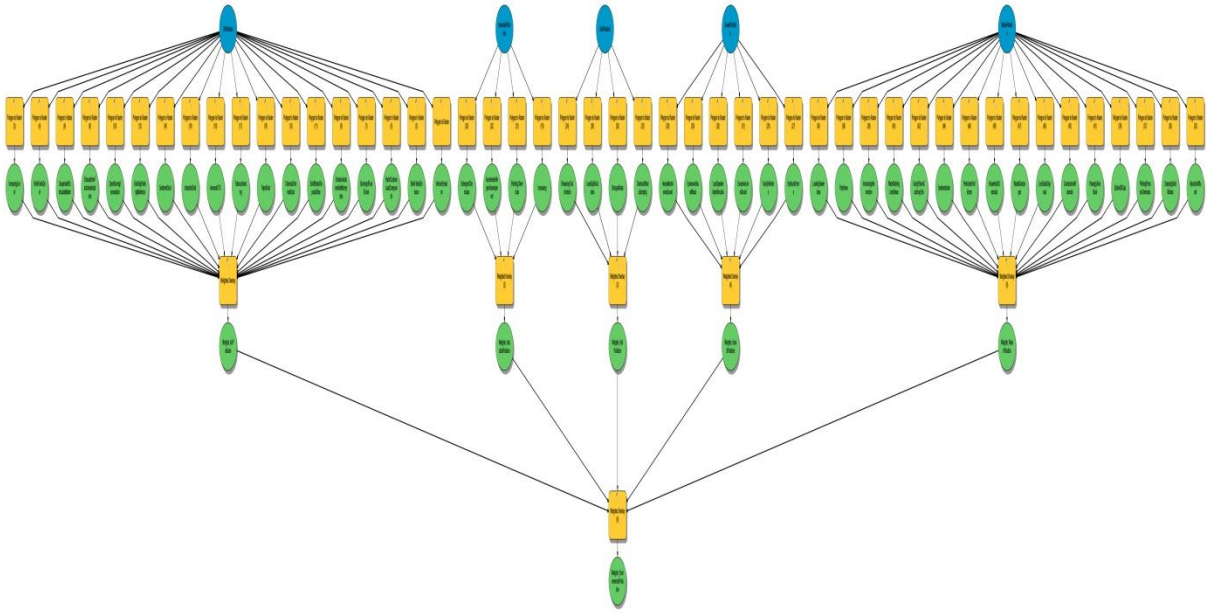
The severity of the causes were first recorded in a 1 to 5 scale where 1 represented the lowest level of pollution and 5 represented the highest level of pollution. The severity values were then added according to ward to the Pourasava shape file.

Then a GIS model was developed combining the overall causal factor's severity and then the weight was assigned.

Table 7.1: Types of pollution and the influence used for determining the spatial variability

Type of pollution	**Influence (%)**
Water Pollution	26
Air Pollution	22
Sound Pollution	20
Soil	9

Source: Field Survey, 2018



Source: Field Survey, 2018

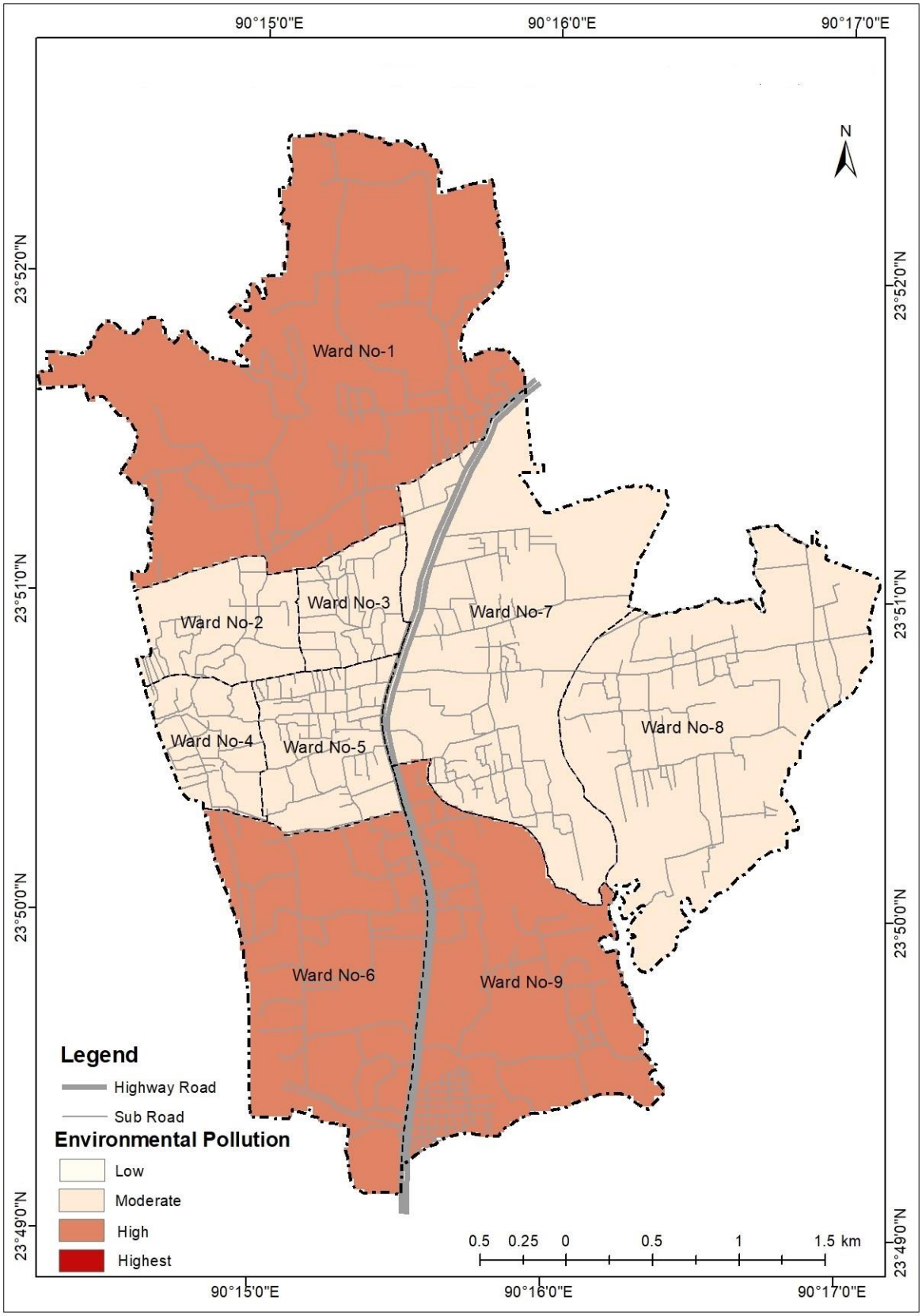
Figure 7.3: Geospatial Model to Analyze Severity of Pollution in Savar Pourasava Using Causal Factors

7.4 Discussions of Results

According to final weighted overlay product, it can be observed that ward numbers 1, 6 and 9 have high levels of severity of pollution.

There are also moderate levels of pollution in the other wards of the Pourasava.

The spatial distribution of the severity shows that the northern and southern peripheral wards have high levels of pollution in comparison to the central regions.



Source: Field Survey, 2018

Figure 7.4: Overall Condition of Environmental Pollution in Savar Pourasava

7.5 Overall Quality of Environment in Savar Pourasava

Environmental quality is a set of properties and characteristics of the environment, either generalized or local, as they impinge on human beings and other organisms.

It is a measure of the condition of an environment relative to the requirements of one or more species, any human need or purpose.

The environment directly affects health status and plays a major role in quality of life, years of healthy life lived, and health disparities. Poor air quality is linked to premature death, cancer, and long-term damage to respiratory and cardiovascular systems. Secondhand smoke containing toxic and cancer-causing chemicals contributes to heart disease and lung cancer in nonsmoking adults. Globally, nearly 25% of all deaths and the total disease burden can be attributed to environmental factors.

Safe air, land, and water are fundamental to a healthy community environment. An environment free of hazards, such as secondhand smoke, carbon monoxide, allergens, lead, and toxic chemicals, helps prevent disease and other health problems. Implementing and enforcing environmental standards and regulations, monitoring pollution levels and human exposures, building environments that support healthy lifestyles, and considering the risks of pollution in decision-making can improve health and quality of life for all.

Poor environmental quality has its greatest impact on people whose health status is already at risk.

There is a close relationship between quality of life and the environment (Diener and Suh, 1997, UNECE, 2009).

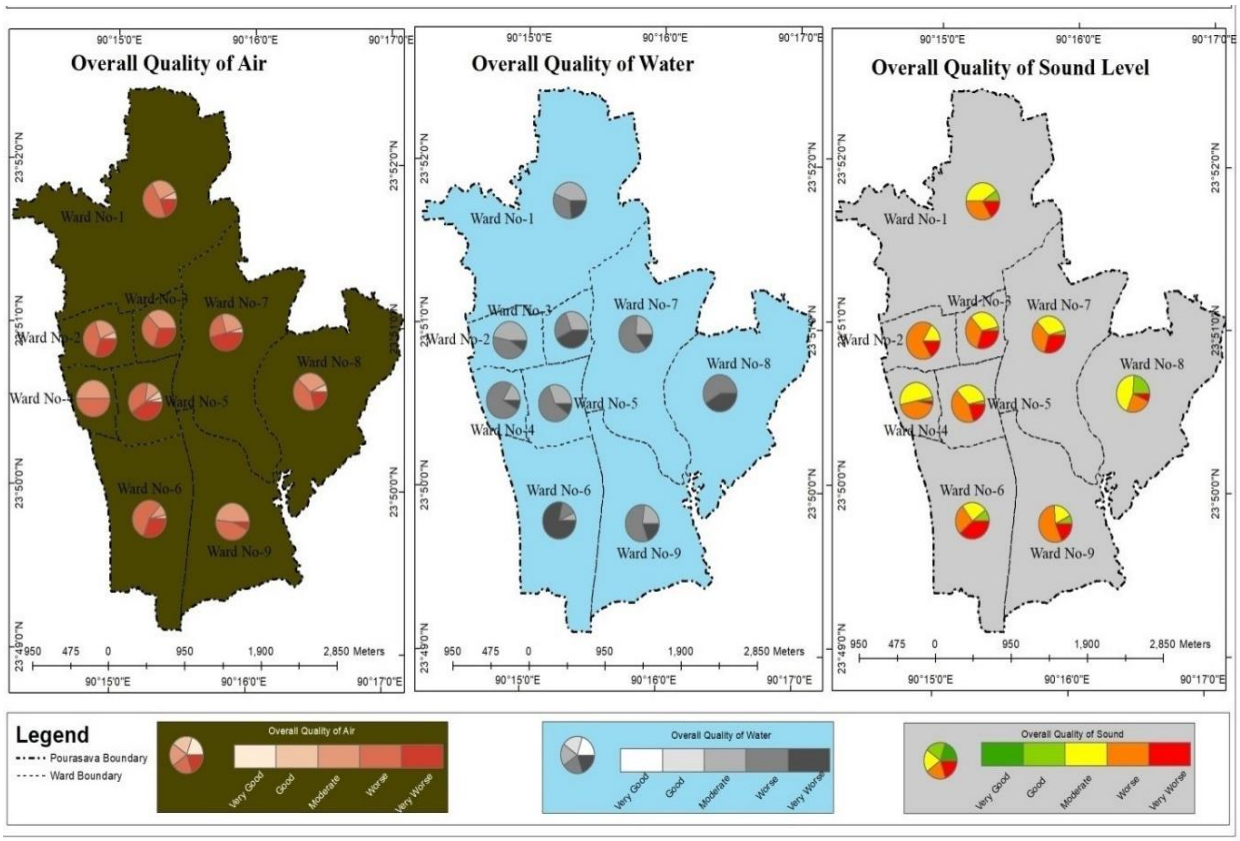
People's lives are strongly affected by the health of their physical environment. The impact of pollutants and hazardous substances on people's health is sizeable. Environmental quality also matters intrinsically because most people value the beauty and health of the place where they live and care about the depletion of its natural resources.

In order to assess the overall quality of the environment, the people’s perception on the quality of air, water and sound was assessed.

Besides, people’s perception about the overall state of the environment and its effect on people was also surveyed.

In our survey, we asked the respondents about the state of the air in recent times in comparison to the past.

A 1 to 5 scale was used to collect the people's perception about air quality, where, 1 represents "very good" quality of air in the present and "very worse" represents a very bad state of air quality in comparison to the past.



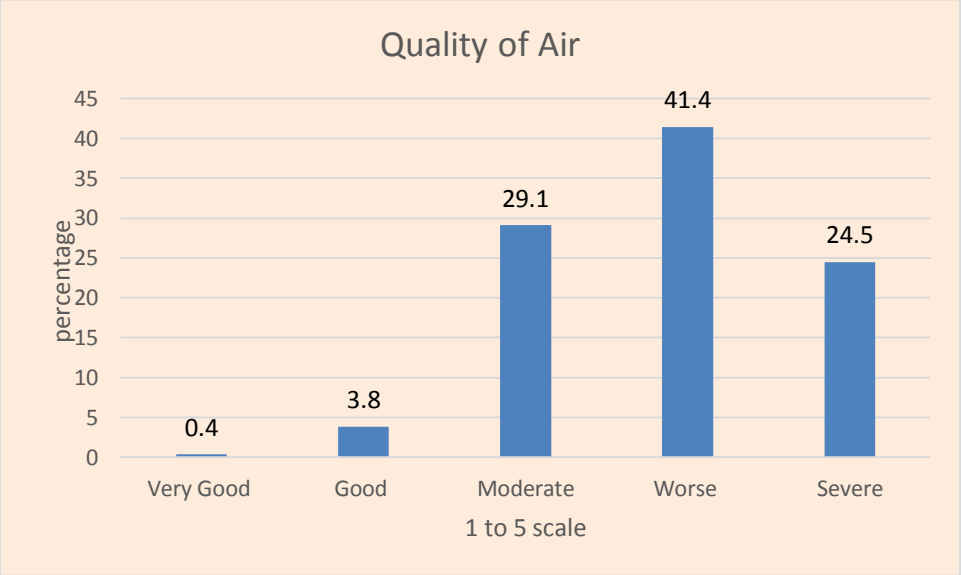
Source: Field Survey, 2018

Figure 7.5: Spatial Variation of the Overall Quality of Environment in Savar Pourosava

7.6 Overall Quality of Air

"Air quality" refers to the condition of the air within our surrounding. Good air quality pertains to the degree which the air is clean, clear and free from pollutants such as smoke, dust and smog among other gaseous impurities in the air. Air quality is determined by assessing a variety of pollution indicators. Good air quality is a requirement for preserving the exquisite balance of life on earth for humans, plants, animals and natural resources. As such, human health, plants, animals and natural resources are threatened when pollution in the air reach high concentrations.

Poor air quality can affect or harm human health and/or the environment. Air quality can be degraded by natural or man-made sources. Natural sources include volcanic eruption, windstorm dust. Man-made source include pollution from moving vehicles, toxic gases from industries, coal powered plants, burning wood or other material in open air, landfills.



Source: Field Survey, 2018

Figure 7.6: Quality of Air

According to people's perception, a striking 66% of the respondents believe that the quality of air has got worse to severe in comparison to the past.

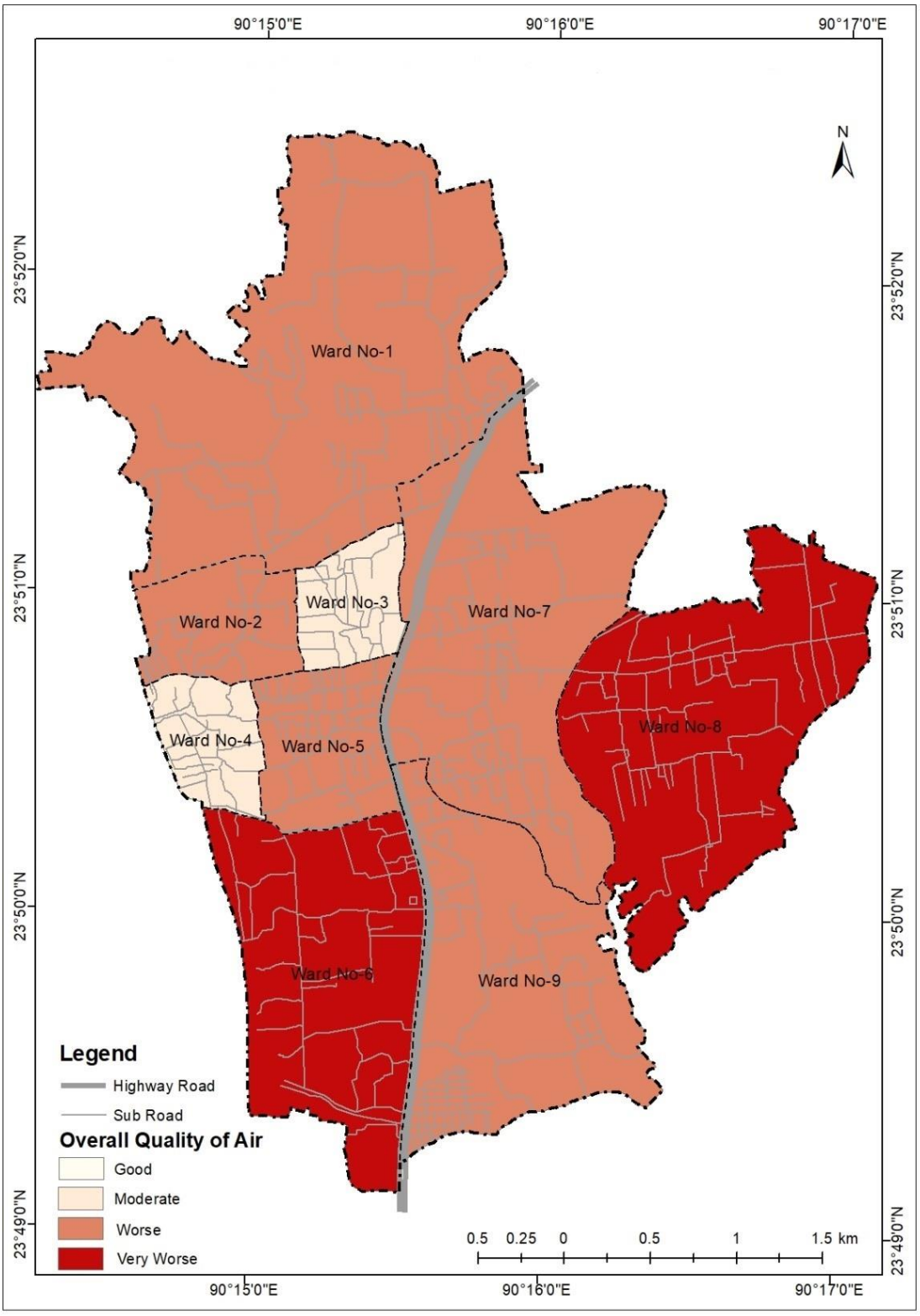
Less than 5% of the respondents think that the state of the air quality is better.

About 28% of the respondents believe that the state of the air quality is moderate.

Therefore, we can conclude that a majority of the respondents (66%) believe that air quality has become worse, which is a very alarming trend for Savar Pourasava.

7.7 Spatial Variation in Overall Quality of Air in Savar Pourasava

Ward numbers 6 and 8 have been identified to have severe levels of air quality according to people's perception. The quality of air is better in ward numbers 3 and 4.



Source: Field Survey, 2018

Figure 7.7: Overall Quality of Air in Savar Pourasava

7.8 Overall Quality of Water in Savar Pourasava

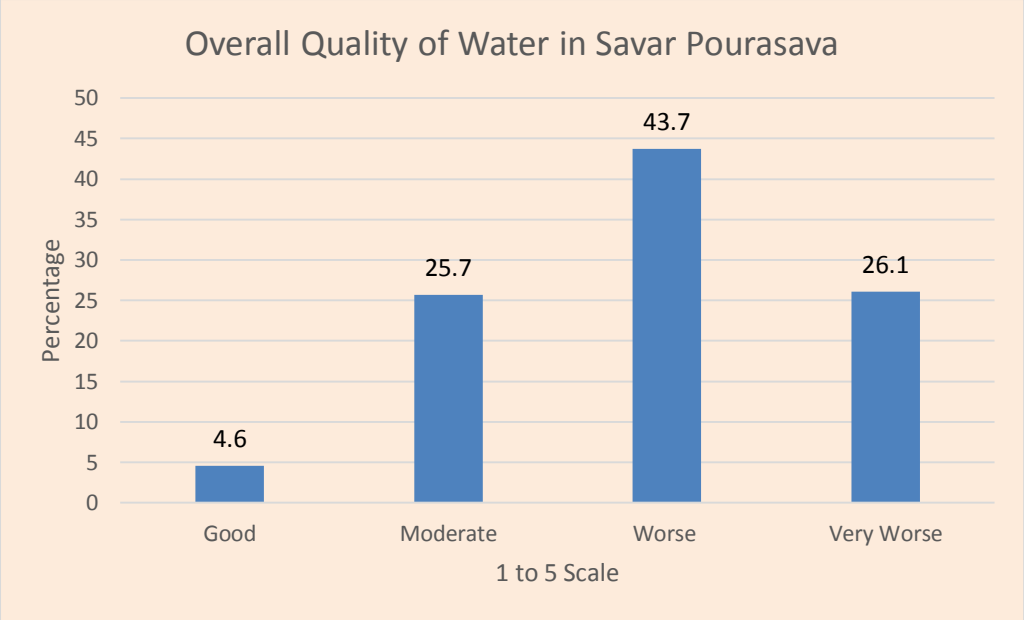
Water quality refers to the chemical, physical, biological, and radiological characteristics of water.[1] It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

Good water quality is important for humans, animals and the environment. Water quality describes the condition of water relative to the requirements of one or more biotic species and to any human need. It makes for a larger variety in flora and fauna. Water quality is measured by several factors. One of those factors is the concentration of dissolved oxygen. Also bacteria levels, the amount of salt or the amount of material suspended in the water determines the water quality.

No one wants to live near polluted, fetid water in ponds or canals. Water quality is affected by a wide range of natural and human influences. The water we drink, the places we swim, and the plants and animals within our environment are increasingly threatened because of pollution. Poor water quality can pose a health risk for people. Poor water quality can also pose a health risk for ecosystems. Water pollution encompasses all human or natural activities that negatively affect the quality of surface water or ground water. Industrial and commercial activities are a major cause of water pollution as are runoff from agricultural areas, urban runoff and discharge of treated and untreated sewage.

In Bangladesh, total environment, as well as economic growth and developments, are all highly influenced by water. In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal waste water, runoff pollution from chemical fertilizers, vehicle emission pollutants, pesticides, etc. (Bhuiyan et al., 2011)

Savar Pourasava has high traffic density and industrial influence. These factors are deteriorating the surface water quality which possesses a potential environmental risk.



Source: Field Survey, 2018

Figure 7.8: Quality of Water

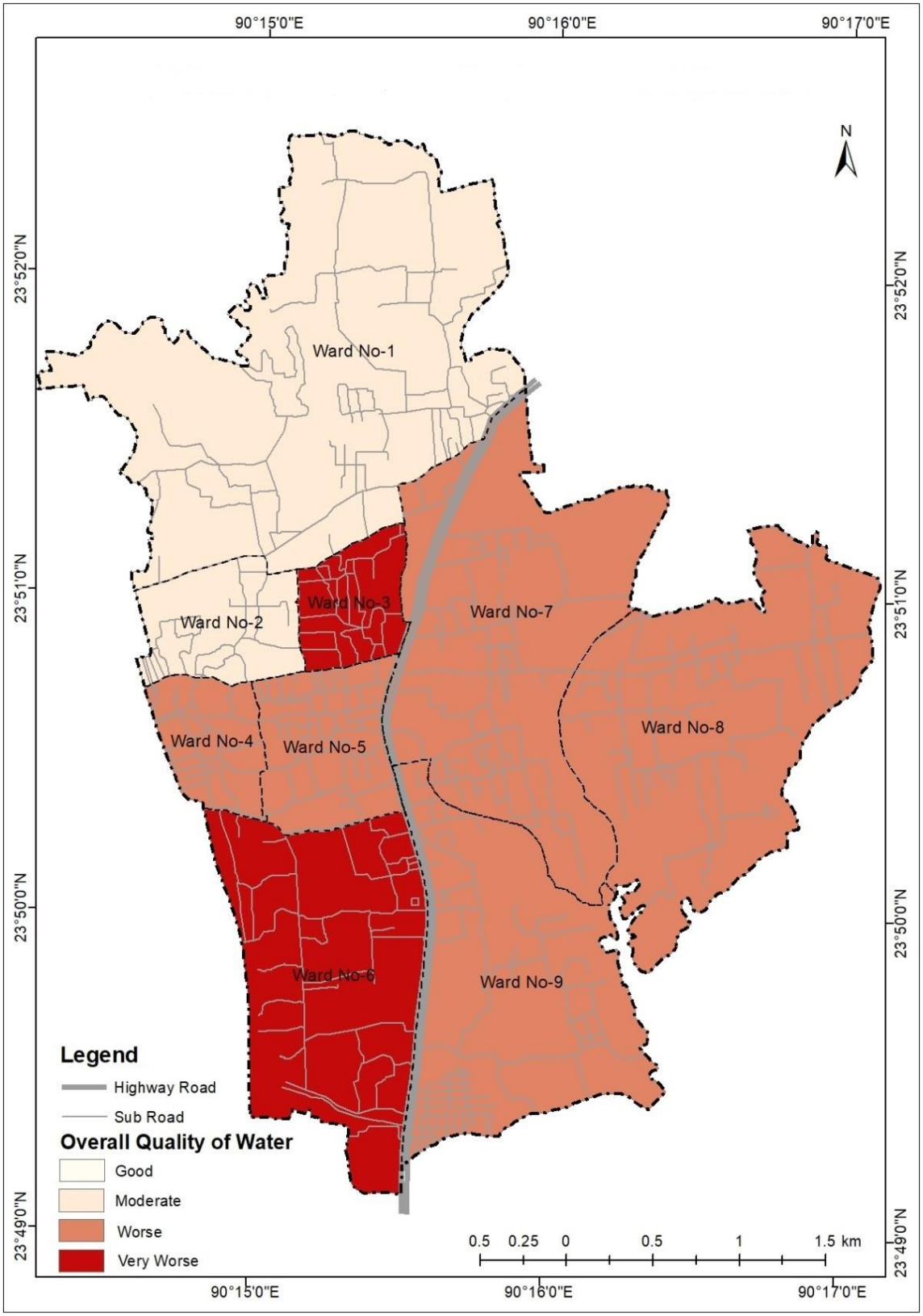
About 70% of the respondents believe that the state of water quality is becoming worse to severe in recent years.

About 26% of the respondents believe that the state of the quality of water is severe in recent times. Only 4% of the respondents believe that the state of the quality of water has gotten better. About 26% of the respondents believe that the state of the quality of water is moderate in the Savar Pourasava.

Therefore, we can conclude that according to the majority of people's perception (70%), the state of the quality of water is worse to severe.

7.9 Spatial Variations in the Quality of Water

According to people's response, ward number 3 and 6 are identified to have severe levels of water quality. Ward numbers 1 and 2 have good level of quality of water.



Source: Field Survey, 2018

Figure 7.9: Overall Quality of water in Savar Pourasava

7.10 Overall Quality of Sound Level in Savar Pourasava

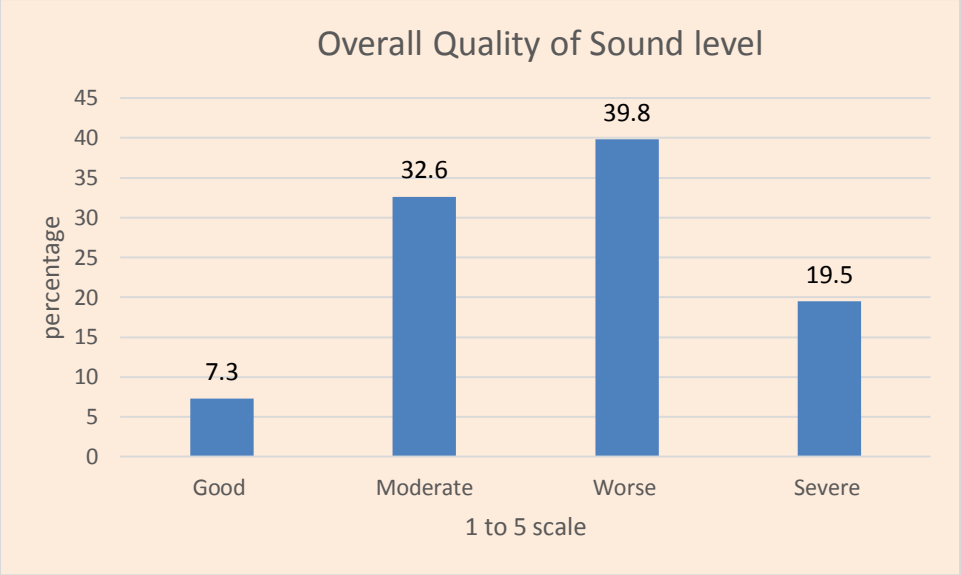
Noise pollution is not only an aggravation, but also a serious health risk. The WHO has established maximum allowable levels of noise, above which people are harmed; it is widely known that in many parts of Dhaka city, those levels are regularly exceeded. Regular exposure to high levels of noise damages hearing.

Noise pollution can also increase stress and blood pressure, cause troubles sleeping and concentrating, and lead to bad tempers and fights.

Noise pollution can also be reduced, through passage and enforcement of laws, and increasing of public awareness about the problem and ways to reduce it.

7.11 Demerits of Noise in Savar Pourasava

(a) It interferes with speech. In the presence of noise we may not able to follow, what the other person is saying.
(b) Noise leads to emotional and behavioral stress. A person may feel disturbed in the presence of loud noise such as produced by heating of drums.
(c) Noise may permanently damage hearing. A sudden loud noise can cause severe damage to the eardrum.
(d) Noise increases the chances of occurrence of diseases such as headache, blood pressure, heart failure, etc.
(e) Noise leads to increased heartbeat, constriction of blood vessels and dilation of pupil.
(f) Noise is a problem especially for patients who need rest.
(g) Noise may cause damage to liver, brain and heart



Source: Field Survey, 2018

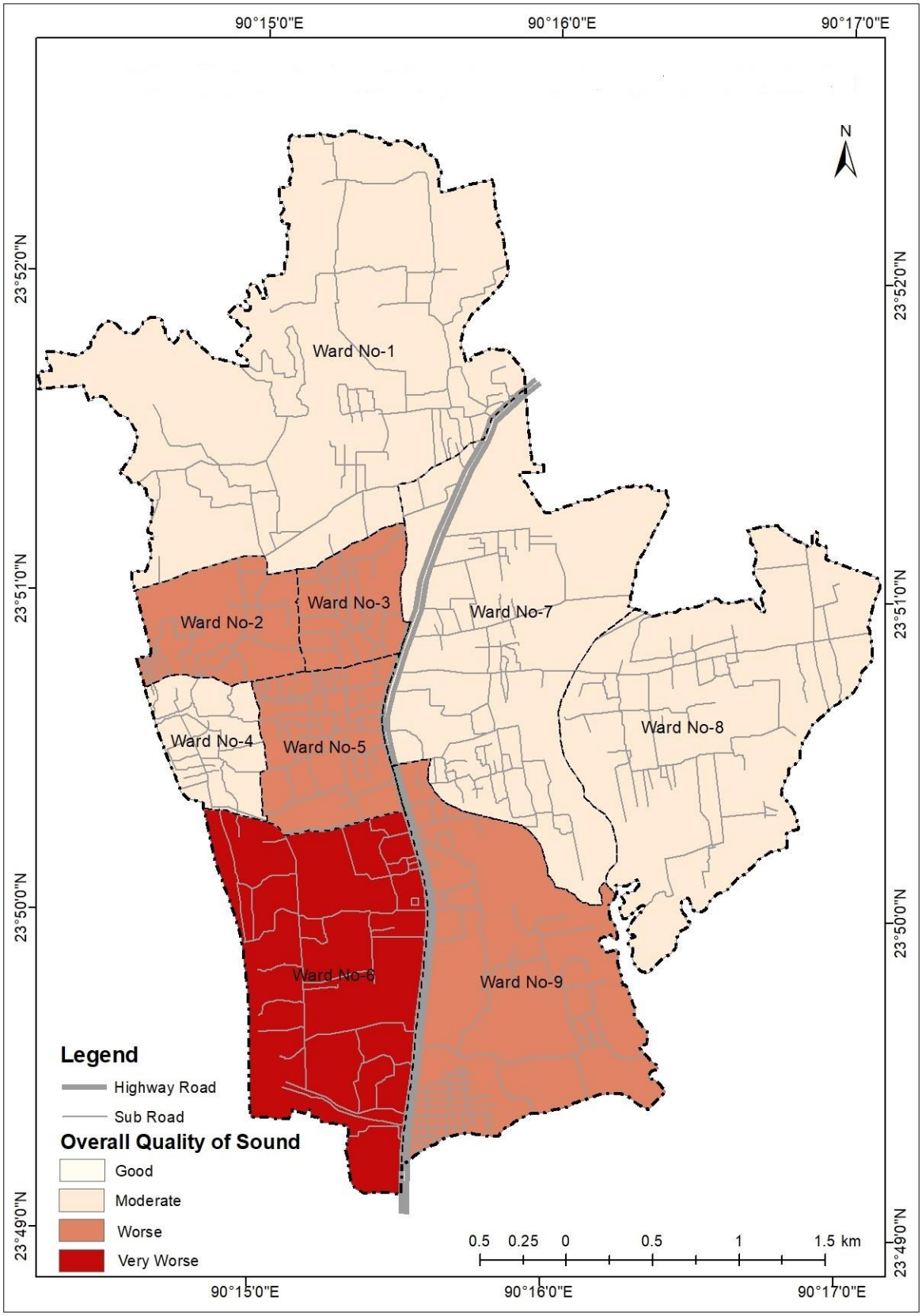
Figure 7.10: Quality of Sound Level

About 60% of the respondents believe that the quality of sound level is getting worse to severe in recent years in SavarPourasava.About 20% of the respondents believe that the state is severe. Only 7% of the respondents believe that the level of sound is tolerable.

Therefore, we can conclude that the majority of the respondents believe the level of sound in the Pourasava is highest in the Pourasava.

7.12 Spatial Variations of the Quality of Sound Level in Savar Pourasava

According to people's perception, ward number 6 has been identified as the ward having severe levels of sound.



Source: Field Survey, 2018

Figure 7.11: Overall Quality of Sound in Savar Pourasava

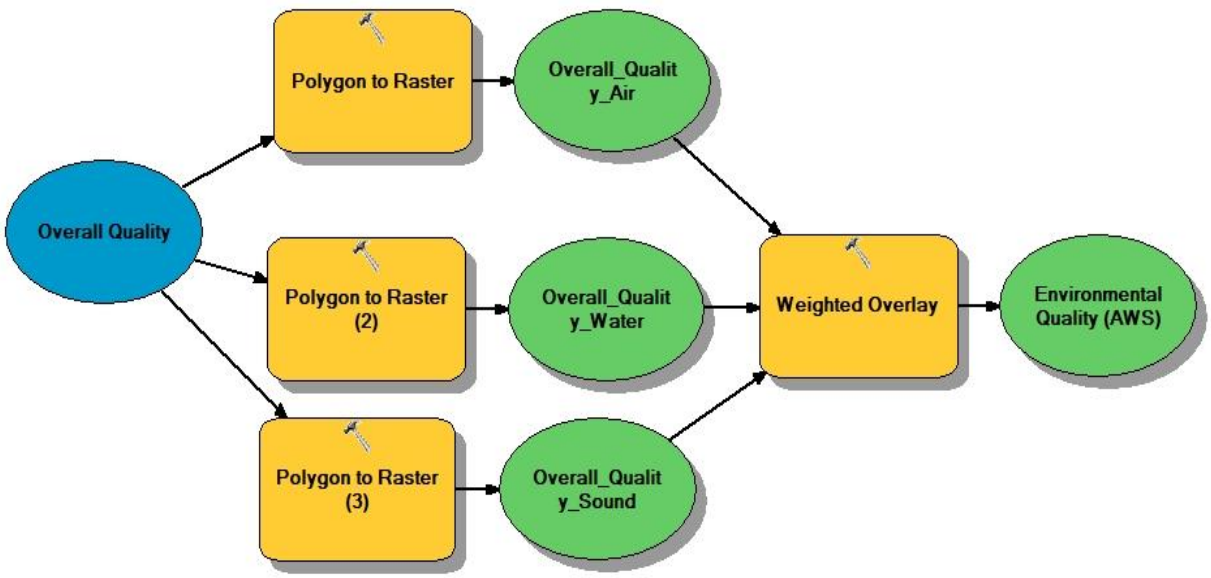
7.13 Overall Quality of Environment in Savar Pourasava

In order to assess the overall quality of the environment, a weighted overlay analysis was conducted. Here, the overall quality of air, water and sound level was used as overlay.

Equal intervals were assigned to each of the parameters and then a overall weighted overlay output of generated.

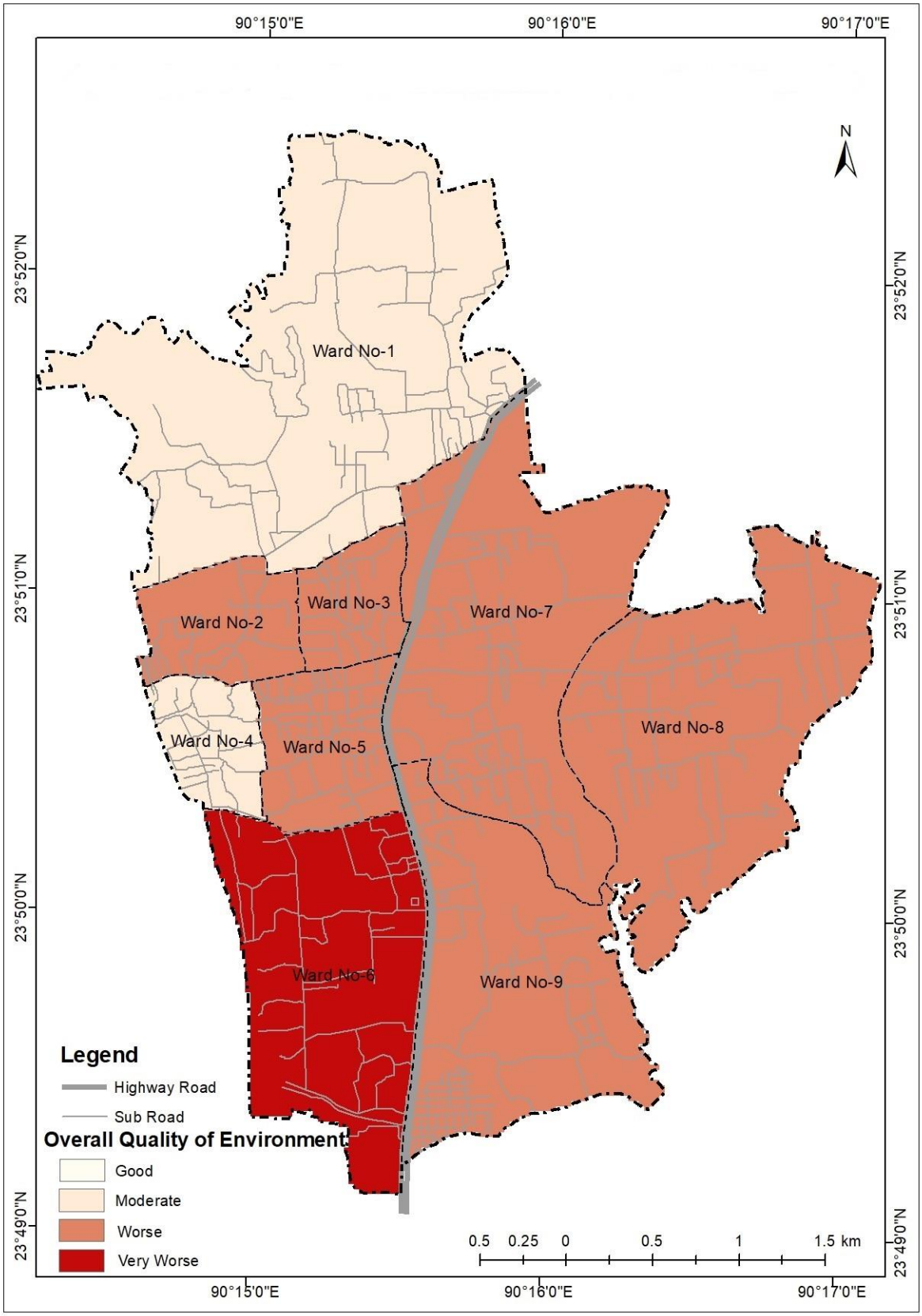
7.14 Discussions

According to the analysis ward number 6 has been identified as the ward with the worst environmental quality. Ward number 1 and 4 are identified to have relatively better environmental quality.



Source: Field Survey, 2018

Figure 7.12: A Geospatial Model to Analysis Overall Environmental Quality in Savar Pourasava



Source: Field Survey, 2018

Figure 7.13: Overall Quality of the Environment in Savar Pourasava

7.15 Conclusion

Severity of pollution of the study area are discussed in various ways and sides on the basis of environmental elements and also discussed the quality of the environment.

CHAPTER EIGHT

SUMMARY AND FINDINGS

Chapter Eight
Summary and Findings

8.1 Summary

Assessment of environmental quality of a particular region is vital to ensure sustainable development of a region. With the advent of sporadic urbanization and industrialization, environmental quality is often compromised. Such as been the case with Savar Pourasava due to its geographical proximity to Dhaka city. Therefore, with the increasing urban sprawl of Dhaka city, its peripheral regions are centers of massive changes in land use and therefore overall environmental condition. This recent phenomenon of change requires thorough scientific investigation. Therefore, this study has aimed to study this change around Dhaka megacity taking Savar Pourasava as an area of interest.

The study employs various methodologies which includes both primary and secondary investigations. There has been use of various tools and techniques including questionnaire survey, Remote-Sensing and GIS techniques, stakeholder consultation etc.

8.2 Land use Changes in Savar Pourasava

The study first tries to assess the overall change in land use in the Pourasava area between 1980 and 2017. It is found that the amount of vegetation and water bodies in the area has decreased by 35% and 23% respectively over this 37 year period.

Whereas, the amount of settlements have increased by a striking 96% between 1980 and 2017.

Therefore, we understand that there has been massive urbanization and industrialization in the area in this period leading to loss of water and vegetation.

Changes in Water: The trend line shows that there is a gradual decreasing trend throughout the years in the water of Savar Pourasava. 9.67 hectares of water bodies are being lost every year in Savar Pourasava

Changes in Vegetation: The amount of vegetation in the Pourasava has decreased by about 34% in the Pourasava between 1980 and 2017. There is a loss of vegetation of about 13.98 hectares per year.

Changes in Builtup area: It can be observed that the amount of settlements have gradually increased between 1991 when the Pourasava was declared, but after 2000, the increase was very rapid. Between 1980 and 2017, there is almost 97% increase in settlements.

8.3 Water pollution

Waste disposal in ponds, leakage in sewerage lines and household chemical disposals have had 60%, 57.1% and 57% of respondents saying that high to highest levels of impacts in terms of water pollution has been incurred.

45% of the population believes that industrial effluents are having high to very high impact on the level of water population, therefore, the water quality is largely compromised.

Sewerage line leaks maybe attributed as one of the most significant factors causing water pollution. As a significant portion of the respondents (57.1%) believe that leakage of sewerage lines is a major factor, therefore, the overall water quality is compromised.

51.7% of the total respondents believe that printing press chemicals are causing high or highest rates of water pollution

Spatial Analysis of Water Pollution: After Ward based spatial analysis, It is seen that air pollution level is highest in Ward 6 where 62 % of the respondents said that there was highest level of severity in terms of water pollution.

Ward 6 and 8 have the highest levels of water pollution in the Pourasava according to people's perception. Ward numbers 1 and 7 have lower levels of water pollution.

8.4 Air pollution

Open incineration and solid waste disposal practices have been identified as key reasons for air pollution with 60% and 55% respondents identifying them to have high or highest impacts.

About 56% of the respondents said that vehicular emissions contribute to a high to highest level to the air pollution. Therefore, vehicular emissions remains a major challenge to the overall air quality.

50% of the respondents believe that brick field emissions have high to highest impacts on air pollution level.

Another important finding from the study shows that suspended particles in air possesses a great risk. About 52% of the respondents believe that suspended particles have high or highest impacts on the level of air pollution in the Pourasava.

55% of the respondents believe that there is high to highest levels of impact due to exhausts from industries. Therefore, there is a need for pollution control from the industries.

A unique factor caused by burning paint materials is identified as a major threat to the overall quality of air. About 47% of the respondents believe that burning painting materials are responsible for high to highest levels of air pollution.

Chemical dust from the industries is also identified as a major source of pollution. About 51% of the respondents believe that chemical dust is causing high to highest levels of air pollution.

Spatial Analysis of Air Pollution: Ward numbers 1 and 6 are identified to have the highest levels of severity according to people's perception. It was noticed that wards in the north and north-eastern part of the Pourasava has more impact of air pollution.

8.5 Sound Pollution

Faulty Vehicles and Hydraulic Horns have been identified to have the maximum contributions to the level of noise pollution in Savar Pourasava. According to survey, both faulty vehicles and hydraulic horns have been identified by 56% of respondents to have high to highest impacts.

About 16% of the respondents believe that highest levels of impacts are sustained from the use of hydraulic horns.

About 54% of the respondents also believe that noise from heavy machineries have highest to high impacts on the level of noise pollution.

Spatial Analysis of Sound Pollution: It has been identified that ward 1, 2, 4, 6 and 9 have been identified to have high levels of sound pollution according to people's perception. According to the spatial analysis, The results show that ward number 6 has the highest level of sound pollution.

The level of sound pollution is relatively lower in the central portions of the Pourasava. The relative influences have been assigned.

8.6 Soil Pollution

Waste in Landfill sites has been identified to have the most severe impact on soil pollution. It was seen that about 42% of the respondents found that waste from landfill sites have high impacts on soil pollution in the Pourasava.

About 31% of the respondents believe that high to highest levels of impact shall be incurred due to the exhaustion of chemical waste in the Savar Pourasava.

About 40% of the respondents also believe that gasoline and diesel leaks have high to highest levels of impact on the level of soil pollution.

Spatial Analysis of Soil Pollution:

According to the spatial analysis, According to people's perception, wards 1 and 9 have been identified to have high severity of soil pollution.

Ward numbers 6 and 8 have relatively less severity of soil pollution.

The results show that northern wards of the Pourasava suffer more from soil pollution. Ward numbers 1and 2 which are northern wards have high level of soil pollution according to people's perception.

8.7 Overall State of Pollution

It may be observed that almost all the major types of pollution have major impacts in the Savar Pourasava. Industrial pollution is a major problem in Savar Pourasava.

This can be portrayed by the fact that about 58% of the respondents believe that the rate of increase of industrial pollution is high to highest in the recent years.

The study has identified the words that require particular attention for different types of pollution and therefore would facilitate spatial planning for tackling pollution in the wards.

According to the weighted overlay using equal weights, It may be seen that ward numbers 1, 2, 6, 9 and 8 have high levels of severity of overall pollution.

According to final weighted overlay using causal factors, it can be observed that ward numbers 1, 6 and 9 have high levels of severity of pollution.

Ward number 9 is also identified to have high levels of soil pollution

Therefore, it may be concluded that ward numbers 1, 6 and 9 requires the maximum level of attention in order to tackle pollution.

8.8 Overall Quality of Environment

Assessing the overall quality of the environment, we have found similar picture, where most people are of the opinion that the state of air, water, sound level are all deteriorating.

Quality of Air: According to people's perception, a striking 66% of the respondents believe that the quality of air has got worse to severe in comparison to the past. Ward numbers 6 and 8 have been identified to have severe levels of air quality according to people's perception.

Quality of Water: About 70% of the respondents believe that the state of water quality is becoming worse to severe in recent years. According to people's response, ward number 3 and 6 are identified to have severe levels of water quality. Ward numbers 1 and 2 have good level of quality of water.

Quality of Sound: About 60% of the respondents believe that the quality of sound level is getting worse to severe in recent years in Savar Pourasava.

8.9 Recommendations

In order to protect the overall state of the environment and to tackle major sources of pollution, there is a need for proper implementation of environmental laws. Some of the relevant laws are The Environment Conservation Act, 1995 and also the Environment Policy, 1992. Also Bangladesh has a series of Environmental Action Plans that needs to focus on Savar Paurasava incorporating a spatial approach to tackling pollution.

Major environmental instruments that may be implemented in the country include: Environmental Pollution Control Ordinance, 1977 and also Bangladesh Environmental Court Act, 2000.

The findings from the report aligns with the overall objectives of environmental laws in Bangladesh. One of the key aims of the Environment Policy in Bangladesh is to identify and regulate activities that pollute and degrade the environment. Therefore, the report has vividly identified the major pollutions in a spatial basis and therefore further steps must be taken accordingly by relevant authorities.

The maintenance of ecological balance and overall development must be prioritized which is a major concern for Savar Paurasva with the rampant industrial growth and encroachment of agriculture land.

Ensuring sustainable development is a major concern in the Environmental Policy of Bangladesh and in this regard Savar Paurasava should be given the highest importance. This is because the development is still ongoing and if major steps are taken immediately, we can expect sustainable development.

From our findings, we have identified the major environmental problems and also their current states as well as their spatial distribution. Based upon these findings, we can suggest the following recommendations for Savar Pourasava:

(a) Ward numbers 1, 6 and 9, which are all situated in the peripheral areas of the Pourasava requires special attention, as the levels of pollution is the higest.

(b) In case of tackling water pollution, waste disposal from industries and also household chemical disposals must be considered with greater importance.

In this case, the implementation of effective Effluent Treatment Plants (ETP) in the industries is key.

(c) There is no effective waste management system in the area, therefore, this needs to develop.

(d) In case of tackling air pollution, solid waste disposal from the industries and households as well must be monitored.

Open incineration activities must also be controlled.

(e) Vehicles must be monitored in order to identify any major faults and their registration must be cancelled if the standards are not maintained.

The use of hydraulic horns must be banned completely according to the High Court's order.

(f) Landfill sites must be located in proper places and also managed well in order to prevent soil pollution.

8.10 Conclusion

Savar Pourasava has unique features in regards to its geographic location and proximity to the megacity Dhaka. It is set to be one of the key strategic locations due to it being a favorable location for industries, particularly garments. With increasing industrialization, urbanization in the pourasava is set to go through a boom. In this regard, the environment of the Pourasava is set to become worse. Therefore, there is need for proper environmental planning. Monitoring and analyzing environmental quality is a major component of achieving the Sustainable Development Goals (SDGs) for Bangladesh. In addition to the global SDG initiatives, the government of Bangladesh is also mandated to work towards conservation of the environment in light of its pledge for reducing National Contribution of carbon emissions.

The first step towards any intervention is a proper study to assess the current state of the environment. The study aims at facilitating this effort to achieve the SDGs by providing vital results for the sustainable development of Savar Pourasava. The results would be vital for stakeholders such as government administrators, local administrators, researchers and the general people. The study employs the use of GIS-RS techniques which should be introduced in all levels of planning from local to national. The results of this study may be used to produce a plan for sustainable development of the Pourasava.

There needs to be concerted efforts by the government and other stakeholders in order to target the specific types of pollution, their main causes and also more emphasis should be given to the specific wards that have been identified in this study. We believe this study shall be very useful for further studies which shall ensure a better quality of environment for the people of Savar Pourasava.

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Appendix

Questionnaire