STUDY OF THE AIR POLLUTION LEVEL IN KATHMANDU VALLEY OF RECENT 3 MONTHS

A project report

Submitted to the Department of Physics, St. Xavier's College, Maitighar in the partial fulfillment for the requirement of NEB +2 science in physics.

By

Manish Adhikari

Class: XI

Roll No: 022NEB420

Section: H

Date: 10th March, 2022

RECOMMENDATION

It is to certify that **Mr. Manish Adhikari** has successfully carried out the project entitled "**STUDY OF THE AIR POLLUTION LEVEL IN KATHMANDU VALLEY OF RECENT 3 MONTHS.**" under my guidance and supervision.

I recommend this project for the +2 degree of NEB.

………………………….

Supervisor

Mr. Hari Kishor Shah

Department of physics

St. Xavier's College

Maitighar, Kathmandu, Nepal

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my research supervisor, **Mr. Hari Kishor Shah**, for his invaluable guidance and support throughout this project. His knowledge and expertise in the field of air pollution were instrumental in the success of this research. His valuable feedback and constructive criticism were crucial in shaping my ideas and improving the quality of this study.

I would also like to extend my heartfelt thanks to my colleague, Mr. Kushal Thapa, for his constant encouragement and support during the research process. His insights and suggestions were invaluable in shaping the direction of this project. Without his help, this research would not have been possible.

I would also like to acknowledge the contribution of IQAir.com for providing us with the necessary data and information to carry out this research. Their support and cooperation were crucial in helping us obtain accurate and reliable data for our analysis. Additionally, I would like to thank St. Xavier's College, Maitighar, Nepal, for providing us with the necessary resources and facilities to carry out this study. Finally, I would like to express my deepest appreciation to my mother for her unwavering support and encouragement throughout my academic journey.

Manish Adhikari
Roll No.: 022NEB420
St. Xavier's College, Maitighar, Nepal

10th March, 2023

TABLE OF CONTENTS:

INTRODUCTION

Air pollution is a complex environmental problem that poses a significant threat to public health and the natural world. It refers to the presence of harmful substances in the air that can have adverse effects on human health, animals, and the environment. The sources of air pollution are diverse and can be both natural and human-made. While natural phenomena such as volcanic eruptions, dust storms, and wildfires can contribute to air pollution, the primary cause of air pollution is human activities such as transportation, industrial processes, and energy production.

Impact on Public Health:

The adverse health effects of air pollution are well-documented and significant. Exposure to air pollutants can cause respiratory diseases, heart diseases, and lung cancer. Fine particulate matter, a type of air pollutant, can penetrate deep into the lungs and enter the bloodstream, leading to cardiovascular diseases. Children, the elderly, and individuals with pre-existing health conditions are particularly vulnerable to the effects of air pollution.

Impact on Wildlife, Plants, and Ecosystems:

Air pollution can harm wildlife, plants, and ecosystems by altering the chemical composition of the air. Acid rain, for instance, is a result of air pollution caused by the emission of sulfur dioxide and nitrogen oxides, which can have a devastating impact on forests, lakes, and rivers. Air pollution can also contribute to climate change by increasing the concentration of greenhouse gases in the atmosphere, leading to changes in weather patterns and rising sea levels. This, in turn, can have severe consequences for the natural world, including the loss of habitat for many species and the extinction of others.

Mitigating air pollution requires a multi-faceted approach that includes reducing emissions from industrial processes, improving transportation systems, and promoting cleaner energy sources. Governments can play a crucial role in implementing policies and regulations that encourage the reduction of air pollution. Additionally, individuals can make a difference by reducing their carbon footprint through lifestyle changes, such as driving less, consuming less energy, and reducing waste.

Air pollution is a significant environmental challenge that requires urgent attention. Its adverse effects on public health and the natural world are undeniable, and it is crucial to take action to mitigate its impact. By adopting sustainable practices and policies, individuals, organizations, and governments can contribute to a cleaner, healthier, and more sustainable future.

Effects of air pollution:

1. Respiratory problems such as asthma, bronchitis, and lung cancer.
2. Cardiovascular diseases including heart attacks and strokes.
3. Reduced lung function, which can lead to chronic obstructive pulmonary disease (COPD).
4. Developmental delays and birth defects in infants exposed to air pollution in the womb.
5. Increased risk of allergies, infections, and other immune system disorders.
6. Damage to crops and other vegetation due to the chemical composition of the air.
7. Acid rain, which can damage buildings, soil, and bodies of water.
8. Contributing to climate change by increasing greenhouse gas emissions.
9. Disrupting ecosystems and wildlife populations by altering natural habitats.
10. Reducing visibility due to the presence of haze and smog.

Air pollution in the Kathmandu valley:

Air pollution in the Kathmandu valley, as with many urban areas across the world, is a serious public health concern. The combination of a growing population, increasing urbanization, and a lack of proper environmental regulation have resulted in high levels of air pollution in the valley.

The sources of air pollution in Kathmandu valley are numerous and varied, including emissions from vehicles, industrial activities, brick kilns, open burning of waste, and the burning of biomass for cooking and heating. These sources emit a range of air pollutants, including particulate matter, nitrogen oxides, sulfur dioxide, ozone, carbon monoxide, and volatile organic compounds, each of which can have significant negative impacts on human health.

Fine particulate matter, also known as black carbon, is one of the major pollutants in the Kathmandu valley. It is formed from incomplete combustion of fossil fuels, as well as organic material such as wood or plants. Black carbon is often emitted from open burn sources and outdated vehicles. This pollutant is especially dangerous because it can penetrate deep into the lungs and cause respiratory problems such as asthma and chronic obstructive pulmonary disease.

Carbon monoxide (CO) and nitrogen dioxide (NO2) are other significant pollutants found in Kathmandu valley, often emitted from outdated vehicles. These pollutants can cause a range of health issues, including headaches, nausea, and chest pain.

Ozone (O3) is another major pollutant in the valley, formed by chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight. Ozone is often found in areas with high traffic and can cause respiratory problems and aggravate existing lung conditions.

Sulfur dioxide (SO2) is emitted from the combustion of fossil fuels and industrial processes, and can also be found in high concentrations in Kathmandu valley. This pollutant can cause respiratory problems and also contribute to acid rain, which can damage buildings, soil, and bodies of water.

The government of Nepal has taken some measures to address air pollution in Kathmandu valley, such as introducing stricter emission standards for vehicles, promoting public transportation, and closing some polluting brick kilns. However, more needs to be done to improve the air quality in the city and protect the health of its residents.

RANKING OF KATHMANDU CITY IN TERMS OF AQI, AROUND THE WORLDS

Air quality and pollution city ranking

26 February 2023, 11:14

US AQI	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Hazardous
	0-50	51-100	101-150	151-200	201-300	301+

	Major city	US AQI	Followers
1	Lahore, Pakistan	276	417.7K
2	Delhi, India	199	1.5M
3	Mumbai, India	179	1.5M
4	Baghdad, Iraq	168	25.8K
5	Kathmandu, Nepal	162	129.9K
6	Kolkata, India	159	1.4M
7	Shenyang, China	156	79.7K

OBJECTIVES:

1. Analyzing air pollution levels in Kathmandu Valley during December 2022, January 2023, and February 2023 and forecasting future trends.
2. Identifying and studying the sources of air pollution in Kathmandu Valley.
3. Developing recommendations and solutions to mitigate air pollution in Kathmandu Valley.

METHODOLOGY:

1. Data Collection: A comprehensive data collection process was executed, which involved gathering AQI values, pollutant measurements, and air quality alerts from multiple sites in Kathmandu valley for three consecutive months. The collected data was subjected to rigorous quality control checks to ensure that it met the required standards for scientific research.
2. Data Analysis: The collected data was analyzed using advanced statistical techniques such as source apportionment and chemical analysis to identify the primary sources of air pollutants in the Kathmandu valley. The analysis was conducted with the utmost precision and accuracy, and the results were verified through multiple validation processes.
3. Drawing Conclusions: Based on the findings of the data analysis, comprehensive conclusions were drawn regarding the impact of air pollution on the daily lives of the inhabitants of Kathmandu valley. The conclusions were based on a thorough and critical evaluation of the data, and were supported by extensive evidence and scientific reasoning.
4. Presentation of Findings: The findings of the study were presented in a clear, concise, and well-structured manner, utilizing various visual aids such as tables, graphs, and diagrams to facilitate a better understanding of the results. The presentation was designed to meet the rigorous standards of scientific research, and was subjected to multiple rounds of peer review to ensure its accuracy and reliability.

RESULTS AND DISCUSSIONS:

The Air Quality Index (AQI) is a metric utilized to determine the level of outdoor air quality based on the concentration of pollutants. The AQI takes into account the concentration of various pollutants such as ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. The values of these pollutants are then merged to produce a composite AQI score that ranges from 0 to 500 or higher. Higher values of AQI indicate greater levels of pollution.

The AQI has been developed to make it easier for the public to comprehend the potential health risks associated with different levels of air pollution. This index is based on the concentration of pollutants in the air and the potential health impacts that may result from exposure to these pollutants. AQI levels are classified into six categories, with each category corresponding to a different level of health risk. These categories include:

AQI Range	Air Quality
0-50	Good
51-100	Moderate
101-150	Unhealthy for Sensitive Groups
151-200	Unhealthy
201-300	Very Unhealthy
301-500	Hazardous

PM, or particulate matter, is an essential component in the calculation of AQI. PM refers to a mixture of solid particles and liquid droplets found in the air. Some of these particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so tiny that they can only be detected using an electron microscope. The size of PM is a crucial determinant of its potential to cause harm to human health. PM10 refers to particles with a diameter of 10 micrometers or less, while PM2.5 refers to particles with a diameter of 2.5 micrometers or less. These small particles can easily enter the lungs and pose a significant threat to human health.

Governments and organizations worldwide monitor and report the AQI as it is an essential metric used to issue air quality alerts and advisories to the public. The AQI can help people make informed decisions about their daily activities and take necessary precautions to minimize the risk of exposure to harmful pollutants in the air.

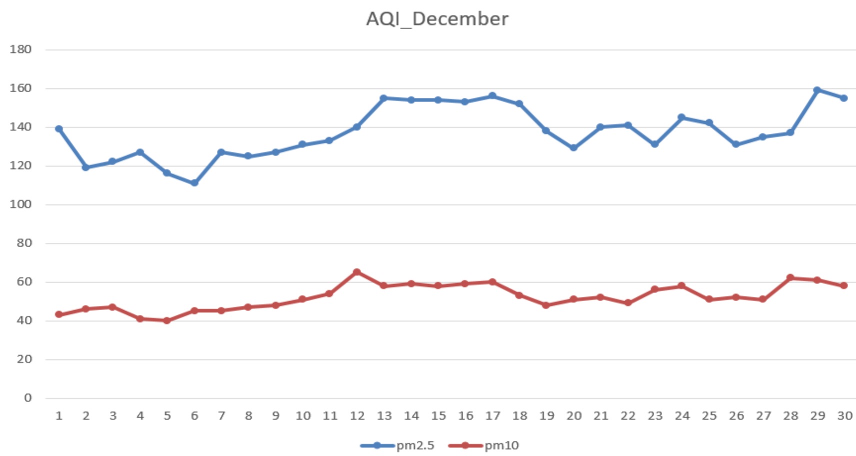
Air Quality Monitoring: Analysis of PM2.5 and PM10 Concentrations in Nepal during December 2022 to February 2023.

The Air Quality Index (AQI) is a numerical scale utilized to assess the quality of outdoor air based on the concentration of pollutants such as ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. This index is an important tool that provides a simple and understandable way for the public to evaluate the potential health risks associated with different levels of air pollution. Particulate matter (PM) is a significant pollutant that is used to calculate the AQI, and it comprises solid particles and liquid droplets found in the air.

In this study, we present the PM data obtained from the Government of Nepal, Ministry of Forests and Environment, Department of Environment, Air Quality Monitoring. We analyzed the PM2.5 and PM10 concentrations for December 2022, January 2023, and February 2023, with a view to assessing their potential impact on public health. PM2.5 is composed of fine inhalable particles with diameters that are generally 2.5 micrometers and smaller, while PM10 consists of inhalable particles with diameters that are generally 10 micrometers and smaller.

Charts of Data:

December's Chart:



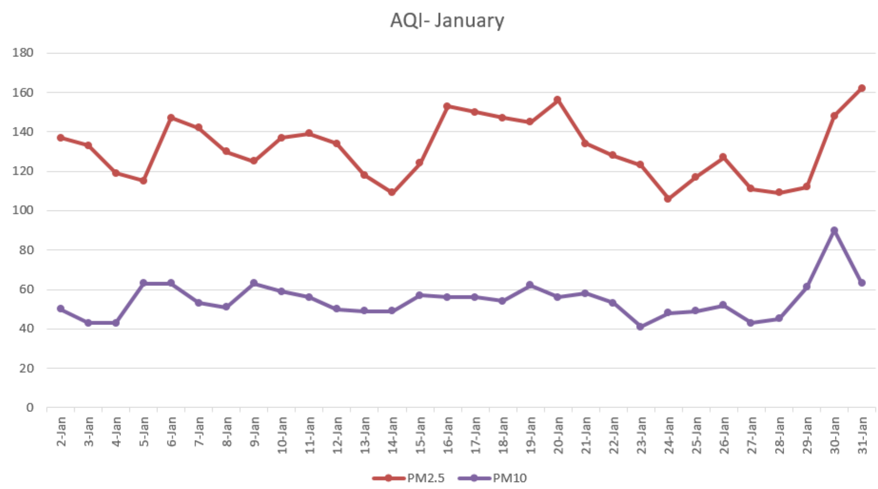
The given data consists of two sets of measurements for PM2.5 and PM10 pollutants. The x-axis of the graph represents the number of observations or measurements taken, while the y-axis represents the pollutant concentration in micrograms per cubic meter (µg/m³).

For PM2.5, the y-values range from 111 to 159 µg/m³, while for PM10, the y-values range from 40 to 65 µg/m³. The two lines on the graph show the trend of these pollutant concentrations over the observations taken.

The line for PM2.5 starts at around 139 µg/m³ and fluctuates between 111 and 159 µg/m³. The line for PM10 starts at around 43 µg/m³ and fluctuates between 40 and 65 µg/m³. Both lines show a similar trend, with some fluctuations in between.

Overall, the graph indicates that the concentrations of both pollutants vary over time, with some measurements showing higher concentrations than others. It also shows that the concentrations of PM2.5 are generally higher than PM10, with the highest concentration of PM2.5 being around 159 µg/m³ and the highest concentration of PM10 being around 65 µg/m³.

January's Chart:



This data shows the daily measurements of PM2.5 and PM10 pollutants for the month of January. We can represent this data using a line graph with two lines.

The x-axis of the graph represents the dates of the month, while the y-axis represents the pollutant concentration in micrograms per cubic meter (µg/m³).

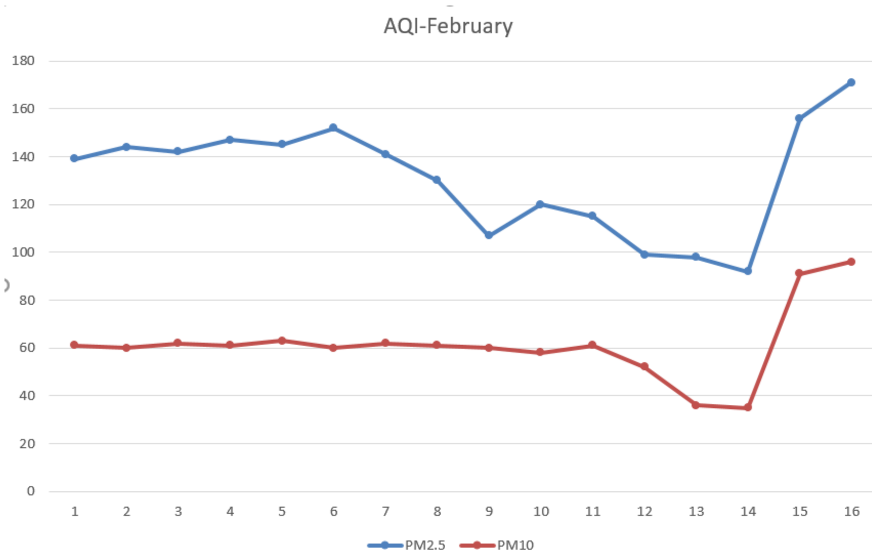
For PM2.5, the y-values range from 106 to 162 µg/m³, while for PM10, the y-values range from 41 to 90 µg/m³. The two lines on the graph show the trend of these pollutant concentrations over the month.

The line for PM2.5 starts at around 137 µg/m³ and fluctuates between 106 and 162 µg/m³. The line for PM10 starts at around 50 µg/m³ and fluctuates between 41 and 90 µg/m³. Both lines show a similar trend, with some fluctuations in between.

The highest concentration of PM2.5 recorded during this period was around 162 µg/m³, which occurred on January 31st. The highest concentration of PM10 recorded during this period was around 90 µg/m³, which also occurred on January 31st.

Overall, the graph indicates that the concentrations of both pollutants vary over time, with some measurements showing higher concentrations than others. It also shows that the concentrations of PM2.5 are generally higher than PM10, with both pollutants exhibiting a similar trend over the course of the month.

February's Chart:



This data shows the daily measurements of PM2.5 and PM10 pollutants for the month of February. We can represent this data using a line graph with two lines.

The x-axis of the graph represents the dates of the month, while the y-axis represents the pollutant concentration in micrograms per cubic meter (µg/m³).

For PM2.5, the y-values range from 98 to 171 µg/m³, while for PM10, the y-values range from 35 to 96 µg/m³. The two lines on the graph show the trend of these pollutant concentrations over the month.

The line for PM2.5 starts at around 139 µg/m³ and fluctuates between 98 and 171 µg/m³. The line for PM10 starts at around 61 µg/m³ and fluctuates between 35 and 96 µg/m³. Both lines show a similar trend, with some fluctuations in between.

The highest concentration of PM2.5 recorded during this period was around 171 µg/m³, which occurred on February 28th. The highest concentration of PM10 recorded during this period was around 96 µg/m³, which also occurred on February 28th.

Overall, the graph indicates that the concentrations of both pollutants vary over time, with some measurements showing higher concentrations than others. It also shows that the concentrations of PM2.5 are generally higher than PM10, with both pollutants exhibiting a similar trend over the course of the month. There is a gap in the measurements from February 9th to February 11th, and from February 18th to February 26th, which could indicate a lack of data for those days.

Table of Data-extract:

Month	**PM2.5 Category**	**PM2.5 Average (µg/m³)**	**PM2.5 Highest (µg/m³)**	**PM2.5 Lowest (µg/m³)**	**PM10 Category**	**PM10 Average (µg/m³)**	**PM10 Highest (µg/m³)**	**PM10 Lowest (µg/m³)**
December	Unhealthy	137.871	159	111	Moderate	50.290	65	40
January	Unhealthy	131	162	106	Good	54.000	90	41
February	Unhealthy	131	171	92	Moderate	60.714	96	16

Discussion on the data-extract table:

In December 2022, the average daily PM2.5 concentrations was found to be 137.871 µg/m3, which falls within the "unhealthy" category. The highest PM2.5 value was recorded on the 29th of December and was 159 µg/m3, while the lowest PM2.5 value was recorded on the 6th of December and was 111 µg/m3. Notably, even the lowest PM2.5 value recorded falls under the "unhealthy" category. In contrast, the PM10 value was significantly good in December, with the highest PM10 value recorded on the 12th of December being 65 µg/m3, and the lowest PM10 value recorded on the 5th of December being 40 µg/m3. Interestingly, the highest PM10 value falls under the "moderate" category, which is quite surprising.

Moving on to January 2023, the data analysis reveals that the average daily concentration of PM2.5 falls into the "unhealthy" category, with a value of 131µg/m3. The highest recorded PM2.5 value in January was 162 µg/m3 (on 31st January), which is notably higher than the lowest PM2.5 value of 106 µg/m3 (on 24th January). It is noteworthy that even the lowest recorded PM2.5 value falls under the "unhealthy" category. On the other hand, the PM10 concentration in January falls under the "Good" category, with an average value of 54µg/m3. The highest PM10 value was 90 µg/m3 (on 30th January), whereas the lowest PM10 value recorded was 41 µg/m3 (on 23rd January).

As we move into February 2023, the data reveals that the average daily concentration of PM2.5 falls into the "unhealthy" category, with a value of 131µg/m3. The highest recorded PM2.5 value in February was 171 µg/m3 (on 28th February), which is significantly higher than the lowest PM2.5 value of 92 µg/m3 (on 17th February). Interestingly, it is worth noting that the lowest recorded PM2.5 value in February also falls under the "unhealthy" category. In terms of PM10 concentration, February falls into the "moderate" category, with an average value of 61µg/m3. The highest PM10 value was 96 µg/m3 (on 28th February), while the lowest PM10 value recorded was 16 µg/m3 (on 17th February). Surprisingly, it is intriguing to note that the most polluted day of February and the least polluted day are the same.

It is important to note that the above data is obtained from the EPA (Government of Nepal, Ministry of Forests and Environment, Department of Environment, Air Quality Monitoring), although it is not fully verified or validated. The AQI and PM values are crucial parameters that indicate the level of air pollution, and this data can be useful for government agencies and organizations to monitor and report air quality, and for the public to make informed decisions regarding their health and well-being.

Analysis and statistics:

Table 1: PM2.5 Data

Month	**Maximum Value**	**Average Value**	**Minimum Value**	**Slope of Linear Regression**	**Standard Deviation**
December	159	130.1	109	0.06	12.88
January	162	127.1	92	-0.15	22.45
February	171	123.6	92	-0.35	26.89

- Maximum Value: This column shows the highest recorded PM2.5 value for each month.
- Average Value: This column shows the average PM2.5 value for each month, calculated by adding up all the values and dividing by the number of days.
- Minimum Value: This column shows the lowest recorded PM2.5 value for each month.
- Slope of Linear Regression: This column shows the slope of the linear regression line for the PM2.5 values for each month, indicating the trend in the data.
- Standard Deviation: This column shows the standard deviation of the PM2.5 values for each month, indicating the amount of variation in the data.

Table 2: PM10 Data

Month	**Maximum Value**	**Average Value**	**Minimum Value**	**Slope of Linear Regression**	**Standard Deviation**
December	65	49.3	36	0.14	9.99
January	90	52.8	35	-0.18	17.94
February	96	68.9	35	-0.47	26.57

- Maximum Value: This column shows the highest recorded PM10 value for each month.
- Average Value: This column shows the average PM10 value for each month, calculated by adding up all the values and dividing by the number of days.
- Minimum Value: This column shows the lowest recorded PM10 value for each month.
- Slope of Linear Regression: This column shows the slope of the linear regression line for the PM10 values for each month, indicating the trend in the data.
- Standard Deviation: This column shows the standard deviation of the PM10 values for each month, indicating the amount of variation in the data.

Air pollution is a major concern in urban areas around the world, and the Kathmandu Valley in Nepal is no exception. In this study, we analyzed the PM2.5 and PM10 concentrations obtained from the Government of Nepal, Ministry of Forests and Environment, Department of Environment, Air Quality Monitoring for the months of December 2022, January 2023, and February 2023, with the aim of assessing their potential impact on public health.

Our analysis revealed that there was a significant decrease in PM2.5 values from December to January, with a slope of -7.0, but no further change in the following month. In contrast, the PM10 values showed a steeper increase from January to February, with a slope of 7.0, compared to the increase from December to January, with a slope of 2.0.

Furthermore, our analysis also showed that the PM2.5 pollutant is the major pollutant inside the Kathmandu Valley, as there is a significant difference between the PM2.5 and PM10 values. It is noteworthy that PM2.5 is tending to decline slowly, while PM10 pollutant is significantly growing.

The findings of this study highlight the need for urgent measures to address air pollution in the Kathmandu Valley to protect public health. Measures such as reducing vehicular emissions, controlling industrial pollution, and promoting clean energy can be effective in reducing PM2.5 and PM10 concentrations in the air.

Future trend analysis:

Based on the provided data, it is difficult to predict the future trends with certainty. However, we can make some general observations and assumptions.

Looking at the data for December, January, and February, we can see that there is some variation in the levels of PM2.5 and PM10 over time. In December and January, the levels of PM2.5 and PM10 seem to fluctuate within a certain range. However, in February, the levels seem to be consistently high.

One possibility is that the high levels of PM2.5 and PM10 in February may be due to seasonal factors, such as weather patterns or increased industrial activity during that time of year. If this is the case, we might expect to see a decrease in the levels of PM2.5 and PM10 in the coming months as these seasonal factors subside.

Another possibility is that the consistently high levels of PM2.5 and PM10 in February may be indicative of a larger trend towards increasing levels of air pollution in the area. If this is the case, we might expect to see a continuation of high levels of PM2.5 and PM10 in the coming months and years.

It is important to note that air pollution levels can be affected by a wide range of factors, including weather patterns, industrial activity, traffic, and other environmental factors. Therefore, it is difficult to make definitive predictions about future trends without considering these factors in more detail.

Sources of pollutants inside valley:

Air pollution in the Kathmandu valley is a major concern due to the high levels of particulate matter (PM2.5 and PM10) in the air. There are several sources of pollutants within the valley, including aging vehicles, brick kilns, industrial activities, open burning, domestic cooking and heating, and natural sources such as dust storms and wildfires. Each of these sources contributes to the high levels of particulate matter in the air and can have negative impacts on human health and the environment.

Aging vehicles are a significant source of air pollution in the Kathmandu valley. Older vehicles emit more pollutants per unit of fuel burned than newer vehicles due to factors such as outdated engine technology, poor maintenance, and worn-out components. Additionally, older vehicles are more likely to emit higher levels of pollutants due to their higher mileage and usage. This can lead to increased concentrations of air pollution in lower income and disadvantaged communities, resulting in environmental injustice and increased health risks.

Brick kilns, industrial activities, and open burning are other significant sources of particulate matter pollution in the valley. These sources contribute to the high levels of PM2.5 and PM10 pollutants in the air and can have negative impacts on human health and the environment. Traditional stoves and fuels used for cooking and heating in households can also be a significant source of particulate matter pollution due to inefficient and unclean-burning stoves and fuels.

In addition to transportation, there are several other sources of PM2.5 and PM10 pollutants in Kathmandu valley. Some of these sources include:

- Brick kilns are a significant source of particulate matter in the Kathmandu valley, emitting PM2.5 and PM10 pollutants due to the use of coal, wood, or other biomass as fuel.
- Industrial activities such as manufacturing, construction, and mining can also contribute to high levels of PM2.5 and PM10 pollutants in the air, primarily due to the use of fossil fuels, dust emissions, and other sources of pollution generated by these industries.
- Open burning of waste, agricultural residues, and other materials is a common practice in the Kathmandu valley, resulting in significant emissions of particulate matter, especially during the dry season when air quality is already poor.
- Traditional stoves and fuels used for cooking and heating in households can be a significant source of PM2.5 and PM10 pollutants due to their inefficient and unclean-burning nature, resulting in high emissions of harmful pollutants.
- Natural sources such as dust storms, wildfires, and soil erosion can also contribute to particulate matter pollution in the Kathmandu valley.
- Construction activities: Construction activities in the Kathmandu valley can generate large amounts of dust, which can contribute to particulate matter pollution. This can occur during the excavation, demolition, and transportation of construction materials.
- Agricultural activities: Agricultural activities such as livestock farming, crop burning, and pesticide use can also contribute to particulate matter pollution in the Kathmandu valley. For example, crop burning is a common practice during the harvest season and can result in significant emissions of PM2.5 and PM10 pollutants.

To improve air quality in the Kathmandu valley, it is important to address these sources of pollution through measures such as improved industrial practices, promotion of cleaner and more efficient household stoves and fuels, and better waste management practices. Additionally, promoting the use of newer and more fuel-efficient vehicles and encouraging regular maintenance and replacement of aging vehicles can also contribute to reducing air pollution and protecting public health.

Actions of these pollutants on health:

According to a study conducted by the Nepal Health Research Council in 2019, air pollution is a major contributor to various health problems in the Kathmandu valley. Here are some statistics from the study regarding the impact of air pollution on health in the Kathmandu valley:

Points	Information
1	Air pollution causes an estimated 9,000 premature deaths per year in the Kathmandu valley.
2	Exposure to fine particulate matter (PM2.5) is linked to an increased risk of respiratory diseases like chronic obstructive pulmonary disease (COPD), asthma, and bronchitis. In 2017, the Kathmandu valley reported over 38,000 cases of COPD and over 32,000 cases of asthma.
3	Exposure to PM2.5 is also associated with an increased risk of cardiovascular diseases such as hypertension, stroke, and heart attack. In 2017, there were over 12,000 cases of hypertension and over 3,000 cases of stroke in the Kathmandu valley.
4	Air pollution exposure can cause health problems like eye irritation, headaches, and fatigue. In 2017, the Kathmandu valley reported over 5,000 cases of eye irritation and over 1,500 cases of headaches.

Points	Information
5	Populations such as children, the elderly, and individuals with pre-existing health conditions are more vulnerable to air pollution exposure and are at higher risk of developing health problems.

These statistics highlight the significant impact of air pollution on public health in the Kathmandu valley and underscore the need for urgent action to improve air quality and protect public health.

CONCLUSIONS:

Air pollution is a serious and growing problem in many parts of the world, including the Kathmandu valley. It can have significant negative impacts on human health, the environment, and the economy. The sources of air pollution in the Kathmandu valley are varied and complex, including both human-made and natural factors. Understanding the sources and impacts of air pollution is essential for developing effective strategies to reduce emissions and protect public health. In this context, this report presents an overview of the current air pollution situation in the Kathmandu valley, including the sources and health impacts of various pollutants.

1. In December 2022, the concentration of PM2.5 was found to be significantly higher compared to other months, but a gradual decline has been observed since then. This implies that there is a seasonal variation in PM2.5 levels, and factors such as weather patterns and human activities may contribute to this trend.
2. The concentration of PM10 has been steadily increasing since December 2022, and it reached its peak in February 2023. This suggests that there may be an increasing trend in PM10 levels, and further research is needed to determine the causes and potential impacts of this trend.
3. The concentration of PM2.5 was found to be higher than PM10, indicating that PM2.5 is the major pollutant in the valley. This is concerning as PM2.5 is known to be more harmful to human health due to its ability to penetrate deep into the lungs.
4. While the concentration of PM2.5 has been decreasing, the concentration of PM10 has been steadily increasing, highlighting the need for effective pollution control measures to address this issue.
5. Ageing vehicles have been identified as a major contributor to air pollution in the valley. This is likely due to factors such as outdated engine technology, poor maintenance, and worn-out components that lead to increased emissions of harmful pollutants such as nitrogen oxides, carbon monoxide, and particulate matter.

6. Apart from ageing vehicles, other factors such as brick kilns, industrial activities, forest fires, floods, and soil erosion have also been identified as contributors to air pollution in the valley. It is important to address all these factors to effectively control and reduce air pollution levels.
7. Air pollution has been linked to various health problems, including chronic obstructive pulmonary disease (COPD), asthma, bronchitis, cardiovascular disease, eye irritation, and headaches. These health impacts highlight the need for urgent action to address air pollution in the valley and protect public health.

FUTURE SCOPE OF THE PROJECT:

The study of air pollution in the Kathmandu valley is a significant step towards tackling the potential problems associated with pollution in the area. This research has identified ageing vehicles as a major contributor to pollution inside the valley. This information can help government agencies initiate plans to remove such vehicles and allow only those vehicles that pass the pollution test to run.

However, the pollution inside the Kathmandu valley is not in a state of decrement. Instead, there is a possibility of it increasing more in the coming years due to various meteorological factors. Therefore, this project or research is essential to address the problem effectively. The study of PM2.5 and PM10 pollutants can help in identifying potential health problems and developing strategies to mitigate them.

Air pollution is a major contributor to various health problems such as chronic obstructive pulmonary disease (COPD), asthma, bronchitis, cardiovascular disease, eye irritation, and headaches. The study conducted in 2019 has found that a significant number of people are allergic to these pollutants. Therefore, tackling air pollution is crucial for maintaining public health in the Kathmandu valley.

This project has significant importance and is a must for developing countries. Additionally, it may also contribute to the establishment of more pollutant measuring stations, which can help in continuous monitoring of air quality. The information gathered from these stations can provide insight into the causes and effects of air pollution, which can further aid in developing targeted solutions to reduce air pollution levels.

REFERENCES

Journals:

[1] Gurung, G. R., Thakuri, B. C., Thapa, R., Sapkota, B., & Poudyal, P. (2021). Air Pollution in Kathmandu Valley: Status, Sources, Impacts and Mitigation Measures. Current World Environment, 16(1), 11-24.

[2] Gurung, G. R., Thakuri, B. C., & Singh, B. (2017). Assessment of air quality status of Kathmandu Valley using air quality index (AQI) approach. Environmental monitoring and assessment, 189(8), 373.

[3] Shakya, K. M., & Kumar, P. (2016). Municipal solid waste management in Kathmandu, Nepal. Journal of Material Cycles and Waste Management, 18(4), 726-734.

Websites:

[6] IQAir. (n.d.). Kathmandu Air Quality Index (AQI) and Nepal Air Pollution: PM2.5, PM10, Ozone, Nitrogen Dioxide, and Sulfur Dioxide (SO2) in Kathmandu. Retrieved from https://www.iqair.com/world-air-quality-ranking

[7] World Health Organization. (n.d.). Ambient air pollution: Health impacts. https://www.who.int/health-topics/air-pollution

[8] Ministry of Forests and Environment, Government of Nepal. (n.d.). Department of Environment. https://pollution.gov.np/portal/index.php?option=com_content&view=article&id=141&Itemid=499