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Analysing the Effects of Acid Rain on Humans with Respect to One Tier Cities

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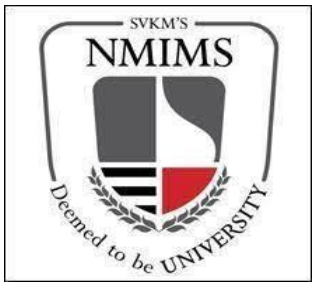


ABSTRACT

Acidification of rainwater has been classified as one of the most important environmental problems of a transboundary character, according to the World Health organization. Acid rain is mostly composed of a mixture of sulphuric and nitric acids, which varies based on the proportional amounts of sulphur dioxide and nitrogen emissions released into the atmosphere. When these acids react with other elements in the environment. Lowering the pH of the soil causes nutritional cations to be mobilized and leached away, as well as increasing the availability of harmful heavy metals. The aim of this study is to find the effect of acid rain on one tier cities. For this we used primary research. For this research, we have used Google forms and created a questionnaire to generate this survey and collect responses to further draw inferences about the topic.

INTRODUCTION

Acid rain is a word that is widely used to refer to any type of acid precipitation that occurs (rain, snow, hail and fog). Worldwide, the effects of acidification have been observed, including detrimental ecological effects such as reduced reproduction of aquatic fish species, dieback and stunted growth in plants, accumulation of toxic aluminum and heavy metals in soil and water bodies, biodiversity loss including corals and shellfish, and degradation of man – made structures such as bridges and buildings (Kumar, Acid Rain-The Major Cause of Pollution: Its Causes, Effects , 2017). It is especially harmful to lakes, streams, and forests as well as the plants and animals that dwell in these habitats, when acid rain falls on them. Rain is one of the most important elements in the lives of humans and animals alike. The water produced by rain is essential for the survival of all species on Earth. Despite the fact that rain is naturally acidic, pollution from houses, companies, power plants, and automobiles is increasing the acidity of the water.

A common belief is that acid rain is caused by the washout of sulphur dioxide, nitrogen dioxide, and other elements prevalent in our environment. However, this is not universally accepted. Primary sources of these oxides are coal – fired power plants, smelters (which emits SO2), and motor vehicle exhausts, among others (producing NOx). These oxides may combine with other chemicals to make corrosive compounds, which are then carried away by rain in either a wet or dry form as acid deposition, depending on the circumstances. However, with the rising usage of tall stacks for power plants and industry, air emissions are being transferred over regional and even global boundaries, resulting in increased global warming (Galloway).

Soil nitrate levels are raised as a result of acid rain, which causes soils to become saturate with nitrogen. Besides removing extra calcium and magnesium from soil, nitrate ions caused by an excessive amount of nitrogen. Aluminum and other nutrients are depleted from trees nutrition as aluminum nitrate or sulphate, which, when absorbed by trees, has negative health implications.

Causes Of Acidification

The principal source of acid rain by sulphur dioxide (SO2), nitrogen oxides (NOx), and ozone, to a lesser extent. These pollutants are produced by human activities such as the combustion of garbage, the use of fossil fuels in thermal power plants, and the use of automobiles. Acid deposition occurs when these ingredients interact with reactants existing in the atmosphere.

Oceans and volcanic eruptions are the primary sources of sulphur pollution, with volcanic eruptions contributing to a lesser amount. The combustion of coal and petroleum, as well as numerous industrial processes, are the primary sources of SO2 emission (Cullis).

Potential hydrogen (pH) is a shorthand version of potential acidity, and it is used to measure the degree of acidity, because water reacts to a minor amount with ambient carbon dioxide (CO2), regular rainwater has an acidic pH as well. The reason for this is that water combines with CO2 to form carbonic acid.

Nitric acid, which id formed by the oxidation of nitrogen in the presence of water during thunderstorms, is also responsible for the acidity of regular rainwater, which is produced by the oxidation of nitrogen in the presence of water.

Acid Rain History

Europe was home to the first recorded observation of acid rain, which occurred in the mid 19th century. Signs of leaf damaged were discovered in a forest that was located downwind of a huge industrial complex. In 1872, an English scientist named Robert Angus Smith coined the term "acid rain" after noticing that acid precipitation was damaging the leaves of trees. The first attempt to decrease acid rain was made with the help of the ecosystem and structures. Studied on atmospheric processes and prospective control programmes were carried out with the assistance of grant funds. According to the National Acid Rain Program's first assessment report on acid rain, published in 1991, approximately 5% of New England's (in United States) lakes were acidic, and issues such as changes in biochemical patterns in soil and fresh water bodies, as well as damage to man – made structures, were observed.

Effects on Surface Water

Acid rain causes aluminum to be released from the soil into lakes and streams, which is hazardous to a wide variety of aquatic creatures. The acidification of granite rocks accelerates the release of aluminum from the rocks. Aluminum causes chronic stress, which causes fish to lose weight or shrink in size, making them ineffective in their attempts to find food and a suitable environment. Apart from that, the majority of the eggs do not hatch, some adult fish may perish, and partially sensitive species such as snails and clams cannot withstand pH levels lower than 5.5 in their natural habitat (Bradford, 2018).

However, in the case of some species, such as the frog, who can tolerate lower pH levels, but whose prey species, such as the mayfly, cannot, a decrease in the prey population will inevitably result in a fall in the frog population as well. The ecosystem is influenced by the interconnections and interdependence that exist in the food chain. The release of harmful heavy metal ions into the environment, such as those of copper, cadmium, nickel, chromium, cobalt, lead and zinc, has been shown to impair the development and growth of aquatic organisms (Bradford, 2018).

Acidic conditions combined with heavy metal toxicity lowered the growth of the fish and increased stress, causing the fish to become less immune and therefore more prone to disease. Acidic conditions also killed the eggs and larval stages, reducing spawning and reproductive success.

Acidification has an impact on shell – forming mollusks, shell fish, coral reefs, sea grass beds, and the juvenile stages of aquatic species, among other things. In the case of shellfish and corals, their calcareous shells or skeletons dissolve when they are exposed to an acidic environment. Acid tolerant organisms such as bacteria and protozoa thrive in environment with low pH. Acid rain is not the only source of acidification; some swamps, bogs, and marshes are inherently acidic due to their low pH levels.

Effects on Forest

When acid precipitation falls on vegetation, it reduces photosynthesis and growth, increasing the plant's susceptibility to draught and disease. This process is known as, "dieback," and it results in browning of leaves and fall off, as well as other effects such as thinning of annual growth rings and reduction in biomass. It also damages the fine root system, affects root mycorrhiza, and decreases the lichens, reducing the plant's susceptibility to draught (Kaur, 1994).

Young seedlings are more sensitive disease and pests than mature plants. The acidity of the soil can be reduced by adding lime, whereas the alkalinity of limestone neutralizes the negative ions present in acid.

A small amount of water soaks into the forest soil during rainstorms, and when the rainfall is acidic, this might result in an increase in the acidic, this might result in an increase in the acidity of the forest soil. Some soil has a natural buffering capacity, which means that the soil is capable of neutralizing the acidity in the surrounding environment. Although these soils are inherently alkaline, the buffering capacity of the soils can be compromised by regular acid deposition.

Soil with a lower buffering capacity is more vulnerable to the various adverse impacts of acid rain than those with a higher buffering capacity. It is possible that acid rain may destroy plants and other procedures at the base of the food chain, resulting in a chain reaction of impacts that will extend all the way up to the top predators. In fact, due of the negative impact acid rain has on plants, it was once referred to as "tree death" by scientists. The addition of crushed limestone or other fertilizer to the soil is frequently required by farmers in order to boost the soil's buffering capacity and reduce acidity.

Effects to manmade structures

Due to the fact that the concentration of nitric acid, sulphuric acid, and sulfuric acid in dew or rain is deposited on automotive coating causes fading of paint, modern vehicle manufactures coat their vehicles

with acid resistant exterior wall paints. Metal structures, such as bronze and alloy buildings, corrode; acid also degrades marble (limestone) structures and other materials (Butler, 2014).

Buildings and constructions are damaged by acid rain because it dissolves the stone or corrodes steel and other metals that are exposed to the elements. In the years before humans were aware of the danger that acid rain posed, they frequently employed metals, limestone, and marble as construction materials that were exposed to rain and fog. In some cases, these materials contain calcium carbonate or calcium – based compounds, both of which are susceptible to dissolution when subjected to acid rain. Sandstone is more resistant to acid rain than limestone, yet it become tarnished by black surface deposits over time.

Health Effects

Aspects that contribute to acid rain's development patients with asthma and emphysema may experience an increase in their risk of death if exposed to SO2, SO3, and NOx. SO2 and SO3 have an adverse effect on asthma and emphysema patient. Particulate deposition of particles smaller than PM 2.5 can even reach the bloodstream through the lungs, causing detrimental effects such as lung cancer (Particulates , 2015). Walking in acid rain, or even swimming in a lake that has been damaged by acid rain, poses no greater risk to humans than walking in normal rain or swimming in non- acidic lakes. When the pollutants that generates acid rain – SO2 and NOx, as well as sulphate and nitrate particles – are present in the air, they can be determinantal to humans.

SO2 and NOx combine in the atmosphere to generate fine sulphate and nitrate particles, which individuals can inhale and cause damage to their lungs. Many scientific investigations have demonstrated a link between these particles and effects on heart function, such as heart attacks that result in mortality in persons at increased risk of heart diseases, and effects on lung function, such as breathing difficulties in people with asthma (Effects of Acid Rain).

LITERATURE REVIEW

(Zhaoji Shi, 2021) Acid rain has been created by anthropogenic-driven acid gas emissions in numerous parts of the world. Despite efforts to quantify the impact of the environment on terrestrial ecosystems, there is a lack of a systematic evaluation of growth-related features across plant aboveground and belowground. The effects of acid rain on plant growth were evaluated in general, and we discovered that regarding the entire as well as belowground plant components behaved differently. Plant development was directly modulated by the acidity of acid rain and the time between acid rains. We also discovered that acid rain pH and other acid rain features had relationships.

(Sonwani, 2020) in his research said that, acid rain is one of the most serious environmental dangers, and it happens when certain acids are present in the atmosphere. The combination of sulphuric and nitric acids in rainwater indicates acidification. Acid rain causes environmental components to degrade when it interacts with them. Acid rain decreases soil fertility, which has a negative influence on forest and agriculture growth. Acidification of water bodies (lakes/ponds) has a negative impact on aquatic vegetation and wildlife. Acid rain has a negative impact on human health, construction, and commodities. Several biotic and abiotic factors ecosystem components have been disrupted as a result of acid rain. As a result, the current analysis focuses on acid rain's causes, effects, and potential solutions.

(Anna Engleryd, 2020) the researcher clarifies exactly the scientific findings that formed the framework for policy development in this work, which is focused on an international symposium held to mark 50 years of successful integration of air pollution research and policy. Important aspects of science–policy linkages, such as the critical loads idea and high biological field investigations, are also discussed. Furthermore, acid rain and air pollution are discussed in the perspective of future social requirements and changes, such as the United Nations' Sustainable Development Goals. We also stress the importance of maintaining and expanding supporting scientific infrastructures.

(Mortimer, 2019) The researcher's project's purpose is to investigate and comment on the impacts of acid deposition on humans, animals, and the ecosystem in which they live. With this project, the researcher wanted to be able to analyze the influence of acid deposition on the world as well as the significance of transitioning to clean, renewable energy sources to others who are either less educated than I am or have a different field of study.

According to Yinjun Zhang, Qian Li, Fengying Zhang, as well as Gaodi Xie, China is dealing with a significant acid issue that is causing economic loss, erosion, as well as material damage, as well as a decrease in material lifespan (Zhang, 2017).

(Maas, 2016) This evaluation review sums up current scientific understanding on transboundary air pollution problems in the UNECE region as well as explains the efficiency of air pollution metrics in attempting to address massive impacts on forests as well as lakes, as well as in protecting human health and preventing other air pollution impacts, such as biodiversity loss or damage to crops, the built environment, as well as culture. The purpose of this assessment is to provide a foundation for contemplating new policy orientations including proposing policy-relevant research problems.

According to Douglas Burns, Julian Aherne, as well as David Gay, acid rain produces acidity of surface waters as well as detrimental consequences on flora, fish, and another biota.
They discovered that acid rain impacts North America and Europe first, before moving on to China and other Asian countries (Burns, 2016).

(Hettiarachchi, 2016) This author describes how to manage water, soil, and garbage as a nexus or how this method can help battle global warming. The book provides the environmental resource point of view of three major dimensions of international change: climate change, urbanization, and population growth, in addition to providing a brief overview of nexus thoughts and it can help us address issues essential to the global community such as food security. The book provides the viewpoints of a variety of opinion makers on how the nexus approach could help to sustainable environmental resource management, taking as its starting place the subject discussions of the Dresden Nexus Conference (DNC 2015) held in March 2015.

Duan investigated acid deposition and its consequences on the ecosystem across Asia. Sulfur deposition has reduced in recent years, while nitrogen deposition has increased throughout Asia and is becoming a big issue in Eastern Asia, according to the researchers. Rapid industrialization as well as unsustainable farming practices are two possible sources of acid rain in Malaysia, according to I. M. Hilmi, K. Susilawati, O. H. Ahmed, and Nik M. Majid **(Hilmi, 2013).**

An examination of literature on the consequences of acid rain reveals severe doubts about the relevance and validity of many of the findings, leaving solid damage estimates lacking. Because there are many natural factors that create as well as consume acidity, as well as numerous other environmental variables that influence ecosystem response, observational trials are required to verify observations in the ground in order to establish end up causing relationships between rain acidity as well as receptor response **(Irving, 2013).**

Anita Singh & Madhookia Agarwal have demonstrated the impact of acid rain on the environment (Singh, 2018). The compressive characteristics of concrete exposed to acid rain were studied by Y. F. Fan, Z. Q. Hu, as well as H. Y. Luan. They looked at the concrete's voids, microcracks, chemical components, elemental distribution, as well as contents (Fan, 2012).

The speed of acid rain studies has accelerated due to international concern about acidic precipitation as a potentially substantial, pervasive pollution problem with severe ecological effects. This increasing activity has been accompanied by an increase in results that directly relate to the clarification of many of the theories offered in the middle of the 1970s. This article concentrates on these major working hypotheses and presents the existing research on the effects of acid precipitation on the terrestrial and aquatic ecosystems, based on the most recent knowledge base **(Lefohn, 2012).**

The atmosphere-related environmental issues diagnostic test (AREPDiT) is a three-tier numerous diagnostic test that was developed as well as validated to detect common misconceptions about global warming (GW), greenhouse effect (GE), ozone layer depletion (OLD), and acid rain (AR). The premise for this research is the establishment of a two-tier diagnostic test technique as suggested by Treagust. A certainty response index is introduced as a third tier to each item to distinguish between a lack of understanding and a mistake. The findings also show that the majority of respondents have a limited awareness of climate-related environmental issues, as well as some misconceptions **(Cigdemoglu, 2012).**

(Rechcigl, 2008) In his research, the literature on acid rain, with a focus on soils as well as soil element leakage. Numerous questions about the consequences of atmospheric acid deposition on soils remain unanswered: 1) Does acid rain speed up the kinetic parameters of corrosion of primary minerals as well as secondary clay minerals in soils, releasing massive volumes of Al,
Fe, as well as Si into the groundwater, rendering it unsuitable for human consumption; 2) Does acid rain accelerate the kinetics of corrosion of primary minerals as well as secondary clay minerals in soils, releasing large quantities of Al, Fe, and Si into the groundwater, rendering it unsuitable for human consumption; and 3) Do the potential benefits of acid deposition offset the consider the negative impacts of acid.

(Dove, 2006) In his research it summarizes and discusses a research of student instructors' knowledge and understanding of the greenhouse effect, ozone depletion, as well as acid rain. It outlines the findings of a small-scale survey intended to learn more about student understanding and misconceptions regarding environmental issues.

Over the last several decades, Fredric C. Menz and Hans M. Seip have explored the progress of science and acid rain preventive actions, as well as the costs and advantages of lowering acid rain in Europe and the United States **(Menz, 2004).**

(Lovenburg, 1988) Ten to fifteen years ago, acid rain was a little-known problem. The problem was only of interest to a tiny group of scientists looking for an explanation for the changes they saw in the environment. Today, acid rain is regarded as a major environmental issue on a global scale. Governments at all levels are working on policies to solve the problem. The public has gotten increasingly engaged as the problem has moved from the scientific to the political realm, and information sources have multiplied.

Acid rain, according to Richard A. Livingston, harms cultural assets, especially exterior marble as well as bronze sculptures **(Livingston, 2016)**. The ecological implications of acid rain in rivers, lake, as well as marshes have been examined by Aadit Gandhi, Parth Patel, and Girish Bagale. They point out that acid rain harms man-made materials as well as components as well. They discovered that human emissions such as waste combustion, fossil fuel combustion in thermal power plants, as well as vehicles are the primary drivers of acid rain **(Gandhi, 2017)**. The impact of simulating acid rain on the root systems of a popular tropical vine was studied **(El-Mallakh, 2014).**

(G. Mark Richardson) According to the literature, acid deposition may cause excessive mercury (Hg) contamination in fish. We calculated the change in related Hg pollution with an elevation in sulphate deposition from 0.25 to 1.25 g sulfur/m2/year using empirical evidence equations. The faster the rate of sulphate accumulation in leakage lakes, the higher the Hg in walleye from these lakes, and subsequent human exposure owing to ingestion of these fish. Increased acidic deposition, on the other hand, was projected to minimize Hg buildup in lake trout as well as northern pike in draining lakes. As a result of the faster rate of acidic deposition, future human exposure to Hg from eating of these species from drainage lakes was projected to be reduced.

(Acid rain information book) In this report, the researcher examines many elements of acid rain, identifies areas of ambiguity, and summarizes existing and future research. The paper is presented in a logical sequence from the sources of pollutants that cause acid rain formation to their atmospheric transit and transformation, and finally to acid rain deposition, its effects, and potential mitigation and regulation alternatives. Following this, a discussion of the ambiguities surrounding our understanding of the acid rain phenomena is presented, as well as a synopsis of existing and prospective study by responsible government agencies as well as other concerned organizations.

(Curren) said the article outlines how acid rain is formed, how acidifying chemicals are emitted in North America, how the problem is growing, and how it affects aquatic and terrestrial ecosystems, human health, including man-made structures. The most vulnerable areas of Canada have been determined.

(Manju Mohan) In her research, the researcher examines the current trend, its anticipated consequences, the causes that contribute to acid rain, as well as possible preventive strategies to reverse the trend. On the basis of the RAINS ASIA model, projections were generated to highlight areas of potential influence on the eco system and strategies to alleviate stress causes.

RESEARCH OBJECTIVE

- To examine the effect of acid rain in one – tier cities.
- To examine how we can solve the problem of acid rain in one tier cities.

RESEARCH PROBLEMS

The main problem of this research is the increasing effect of Acid rain in one – tier cities especially in Delhi, Mumbai, and Bangalore. Due to the increase in acid rain, there are many effects that we have to suffer. Now the question arises that does acid rain actually harms human health? So, this study is to identify the same.

RESEARCH QUESTIONS

- What are the negative impacts of acid rain on environment?
- How does producing energy without using fossil fuels can be a step to stop Acid rain?
- How can acid rain effects on visibility, human health etc?

HYPOTHESIS

H0 – There was no significant impact of acid rain on one – tier cities

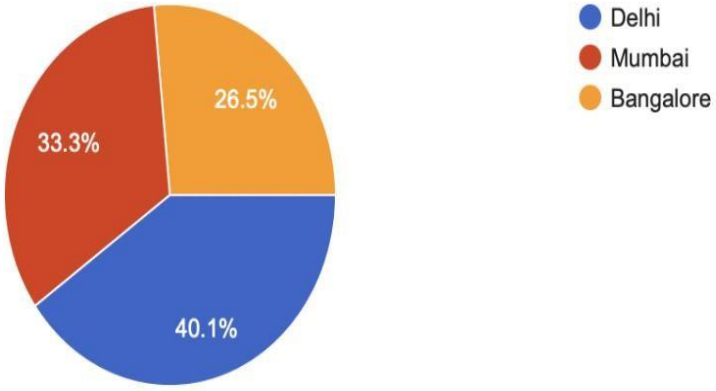
H1 – There is a significant impact of acid rain on one – tier cities

METHODOLOGY

The method used for the collection of this research paper is Primary. For this research, we have used Google forms and created a questionnaire to generate this survey and collect responses to further draw inferences about the topic. The questionnaire was circulated to around 162 people.

Questionnaire was circulated to Students, Adults, and Senior Citizens.

RESULT AND DISCUSSION



From the pie chart we can see that majority of people that is 40.1% are from Delhi, followed by 33.3% are from Mumbai, followed by 26.5% are from Bangalore which is less in number.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
8	161	1289	8.006211	1.831211
8	161	1392	8.645963	1.467624
12	161	2058	12.78261	3.596196
12	161	2043	12.68944	2.55295

ANOVA

ce of Varia	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between C	3164.702	3	1054.901	446.6142	1.9E-156	2.618823
Within Gr	1511.677	640	2.361995			
Total	4676.379	643				

Interpretation- As we can see that, in the above table, mean square value in between the groups to be 1054.901, F value is 446.6142 with degree of freedom as 3. The p value is 1.9E - 156 at 5% level of significance which denotes that there is no significant impact acid rain. Thus, the null hypothesis that is "H0: There is no significant impact of acid rain" gets accepted.

CONCLUSION

Since the nineteenth century, acid rain has been recognized as one of the world's most serious environmental problems. Coal combustion is the most significant source of SO2 production, as well as car emissions, and many fossil-fuel-based power generation sources produce NOx into the atmosphere. As a result of their reactions with 12 atmospheric water vapour, SO2 and NOx form sulfuric and nitric acid, respectively, which precipitate as wet deposition (such as rain, snow, sleet, and fog) and dry deposition (which includes dangerous particles such as PM 2.5). Acid rain has an effect on forest trees, causing yellowing and leaf fall; acidified rivers and lakes have an impact on fish mortality and the extinction of calcareous shell producing species.

RECOMMENDATIONS

Instead, we can use renewable energy sources, like solar and wind power. Renewable energy sources help reduce acid rain because they create much less pollution. There are also other sources of electricity, such as nuclear power, hydropower, and geothermal energy. Of these, nuclear and hydropower are used most widely.

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