

AMITY JOURNAL OF  
**ENERGY &  
ENVIRONMENT STUDIES**

---

January-June 2019, Volume - 5, Number - 1, ISSN : 2454-7778



# AMITY JOURNAL OF ENERGY & ENVIRONMENT STUDIES

Volume 5; Number 1, January - June 2019; ISSN : 2454-7778

Bi-Annual Refereed Journal of Amity Business School

Amity University, Noida, India

- Chief Patron** : **DR ASHOK K CHAUHAN**
- Patron** : **DR ATUL CHAUHAN**
- Desk Advisor & Mentor** : **MR B. P. S. CHAUHAN**
- Editor-in-chief** : **DR SANJEEV BANSAL**
- Editor** : **DR ANITA VENAİK**
- Members, Editorial & Review Board** :
- DR. A. L. AGARWAL**  
Former Chair Professor,  
Department of Environmental Sciences & Engineering,  
Indian School of Mines, Dhanbad, India.
- MR. A.P. MISHRA**  
Managing Director, UP Power Corporation Limited,  
Lucknow
- DR. MEGHRAJ MALLAVARAPU**  
Professor of Environmental Biotechnology,  
Centre for Environmental Risk Assessment and  
Remediation, University of South Australia
- DR. NASER A. ANJUM**  
CESAM-Centre for Environmental and Marine Studies  
and Department of Chemistry, Aveiro University,  
Aveiro, Portugal
- MR. SUNIL WADHWA,**  
Managing Director, Infrastructure Leasing &  
Financial Services Ltd, Gurgaon; Ex Managing  
Director, Tata Power Delhi Distribution Ltd, Delhi.
- Mr. DEEPAK SAPRA**  
Associate Director International Marketing at  
Dr. Reddy's Laboratories Hyderabad
- Mr. K. L. SAPRA**  
Former IES Officer and currently Professor and  
Dean (faculty & Development ),  
Chitkara Educational Trust  
(Chitkara University ).
- DR. UMA S. SINGH**  
Ph. D. (Faculty of Management Studies,  
University of Delhi) Specialization:  
OB, HRM, Business Statistics and  
Research Methodology
- DR. M. A. BHAT**  
Associate Professor, Division of Soil Science,  
Faculty of Horticulture, ( SKUAST-K), Shalimar,  
Kashmir University Srinagar- J&K India

**AMITY JOURNAL OF ENERGY & ENVIRONMENT STUDIES**  
JOURNAL OF AMITY BUSINESS SCHOOL, AMITY UNIVERSITY, NOIDA, INDIA

---

VOLUME 5

No. 1

January-June 2019

---

Plastic Waste in Oceans <i>Simran Chaudhary &amp; Rnusha Sheoran</i>	1
-----	
Gender Discrimination <i>Kalyani &amp; Vaisakha Kurmi</i>	5
-----	
Various Components of AIR Pollution in Delhi <i>Dhruv Gupta</i>	13
-----	
A Study on Child Trafficking <i>Tanya Khosla</i>	24

## From The Desk of the Editor-in-chief...

---

Nature itself destroys its own things. From the Arctic to the Amazon, fires are raging at an unprecedented scale, fueling an enigmatic fear: is the planet glaring at an irreversible meltdown?

The forest fires are a common occurrence in most parts of the world. For instance in India, **Khandava Forest** or **Khandavprastha** was an ancient forest mentioned in the epic Mahabharat. It lay to the west of Yamuna river, in modern-day Delhi territory. Krishna and Arjun cleared this forest to construct the capital city called Indraprastha.

As per the researchers, the forest fires cause significant damage to the forest eco system. The single worst wild fire in U.S. history, in both size and fatalities, is known as the Great Peshtigo Fire which burned 3.8 million acres (5,938 square miles) and killed at least 1,500 people in northern Wisconsin and the Upper Peninsula of Michigan in 1871. Statistical evidences suggest that there is a trend of increasing area burned starting in the early eighties and continuing to increase in the 1990s (IPCC, 2007). Wildl and fire statistics for National Forests in the western United States also show an increase in area burned from the mid-1980s onward compared to the earlier part of the 20th Century.

Wild fires cause a lot of damage to the environment and local ecology. There are several wildfires burning in Arizona. The fire popularly known as the Coldwater Fire began on May 30, 2019 with a lightning strike. The fire is now 6,150 acres in size and is 10 percent contained. The other large fire in Arizona is seen is the Mountain Fire which began on June 07, 2019. The size of this fire is 7,470 acres and is 50 percent contained. The cause of it may be attributed to the farmers, loggers, land grabbers etc. The scorching heat has turned the weather hot and dry. However, the forest fires, though leading to deforestation, are also at the same time clearing the Amazon for agriculture and mining, as per the President Bolsonaro, which has been subject to much criticism by the environmentalists.

The environmentalists are worried that if the Amazon is hit by fires every few years then large parts of it will shift to a degraded shrubby state. Though 80% of the Amazon is still intact, yet climatic change is becoming a great threat. The dry conditions with no precipitation will lead to the spread of the wild fires. Its time to take judicious action through meticulous planning so that the forest fires can be contained, and the planet may be saved.

Enjoy reading all the articles of the present issue. Looking forward for your valued comments.

**Sanjeev Bansal**

# Plastic Waste in Oceans

Simran Chaudhary\*

Rnusha Sheoran\*\*

Plastic pollution is becoming more and more prevalent in world oceans and has gained a lot of attention worldwide after the report published by National Geography. A U.N. draft resolution on Marine litter and Microplastics was signed by close to 200 countries in December 2017 when they realized the urgency of the issue. This draft states that the member states can take initiative but does not contain any legally binding agreement. On the contrary, plastic litter continues to accumulate in world oceans. There is an estimated 5.5 trillion pieces of plastic waste in the oceans of the world and no notable action has been taken. If this continues that volume of waste will be double of what it is right now by 2030. There are various organizations that help reduce plastic in the ocean. But that is still not enough; this problem can only be solved by change in mindset of the individuals and strict government policies. There are many technological implications that can also help manage the plastic waste in the oceans.

**Keywords:** Marine litter, Microplastics, reduce plastic, change in mindset, Technological implications

## INTRODUCTION

“We made plastic. We depend on it. Now we are drowning in it.”

The abundance of plastic garbage created by modern human civilization has infiltrated the deepest trenches of the world's oceans and concentrated in huge areas on its surface. There is an estimated 5.5 trillion pieces of plastic debris in the world's oceans. There are countless sources of this plastic debris, but virtually all of it originates on land through overuse of plastics in our daily lives and improper waste disposal. Once plastic trash enters the ocean, nature's forces and the migration of marine species and birds determine how the plastic material and chemical compounds move and accumulate through the complex marine environment, including the food chain and the Plastisphere. Much of this plastic debris is concentrated at the centers of enormous oceanic current circulation regions, called gyres.

Among the large quantity of information available, it is difficult to differentiate exaggerated alarms from miracle solutions, while taking into account unknown but potential risks of plastic pollution. Scientific evidence shows a complex reality. In order to increase overall scientific

literacy on plastic pollution, the associated risks and the possible solutions, the camp, the new innovation campus located in Aix-en-Provence, France, has created the Plastic and Ocean Platform with the view of bringing together and promoting collaboration between scientists, NGOs and plastic experts. The goal of the Platform, supported by the Intergovernmental Oceanographic Commission of UNESCO, is to facilitate the exchange of information and provide a clear and comprehensible overview of the current scientific knowledge and understanding about plastic pollution and the way to fight it. This information will be shared widely to the media, the general public and the decision makers. As of today, more than 30 international research scientists and 20 NGOs have contributed to the Plastic and Ocean Platform. We are now expanding this network. The first production of the Plastic and Ocean Platform is a state of the art on what is known and what is not known about plastic pollution. Following a collective work with the NGOs, the scientists have produced a scientific summary that gives synthetic answers to the most common questions the public is asking on the reality of plastic pollution and its consequences. The summary focuses on three themes: • Sources, distribution and fate of plastic pollution in the ocean; • Impacts of marine pollution on marine ecosystem and environmental and human health; • Analysis of proposed measures to address plastic pollution in the ocean. It also provides references to the scientific literature on which the information is based. Scientific research continues

---

\*Engineer, Samsung Research and Development

\*\* Talent acquisition specialist Standard chartered global business services

and as new information will become available, new versions of this scientific summary will be made. This evolving common vision should be a basis to build new collaborations and science-based actions.

## LITERATURE REVIEW

Despite the evidence of plastic accumulation in the marine environment and biota, marine debris was considered only an eyesore by the plastics industry of that time, comprising only a small proportion of all litter and causing no harm to the environment (Ferguson, 1974, in Derraik, 2002, p. 842). Waldichuk (1978), then a leading Canadian marine scientist, in his report on global marine pollution stated that 'while this type of pollutant is largely cosmetic in character and affects mainly the amenities, there are other uses of the sea which are also affected' (p. 31), listing the impacts of plastic on boating in the form of propeller entanglement. However, marine debris pollution is now currently acknowledged as a severe environmental hazard and raises a great deal of concern due to its cumulative persistent nature and associated toxicity, and known, as well as its yet unknown, impacts on marine ecosystems and humans (Derraik, 2002; Gregory and Andrady, 2003; Thompson et al., 2004; Sheavly and Register, 2007; Moore, 2008; Barnes et al., 2009; Gregory, 2009; Ryan et al., 2009; Thompson et al., 2009a; Kershaw et al., 2011; Koelmans et al., 2014).

## OBJECTIVES

The proposed framework to study plastic debris in the marine environment addresses three fundamental questions:

1. How much plastic is in the marine environment?
2. What are the impacts of plastics in the marine environment?
3. What is the risk to a particular cohort (organism, species, assemblage, etc.) from a particular type of plastic debris (item, material, size, form, function, etc.)?

The first question amounts to a mass balance exercise, akin to the carbon budgeting carried out since the 1990s to uncover the "missing sink" of anthropogenic carbon dioxide. The mass balance can be evaluated using two approaches: (a) assessing the plastic inputs into and outputs from the marine environment as a whole and (b)

quantifying the standing stock of plastics in major marine reservoirs. Of course, reliance on state variables alone is a gross oversimplification of time-dependent processes, ignoring the flux of plastics between reservoirs as well as their transformation within those reservoirs. In addition, the term plastics refer to a broad collection of synthetic materials that is further diversified by innumerable combinations of chemical additives; thus, their behavior upon entering the marine environment is not easily generalized. However, the simple box model shown in provides a useful starting point to evaluate available information and to highlight major gaps in data or understanding.

The second question seeks to quantify the impacts (negative or positive) that result from an encounter with plastic marine debris. Potential impacts include those that affect marine organisms, habitats, ecosystems, and perhaps even biogeochemical cycling, as well as those that affect human activities, economics, and human health. The most commonly reported interactions between plastic debris and wildlife are entanglement and ingestion, whereas people commonly encounter litter on beaches and large debris as hazards to navigation. Impacts upon encounter with debris are dependent on the particular characteristics of the debris, such as its size, shape, form, and chemical composition. For example, both a large derelict fishing net and a millimeter-sized plastic particle drifting at the sea surface could transport rafting organisms; however, unlike the net, the particle does not pose a hazard to navigation but could be easily ingested. Evidence of impacts might come from observational data (such as surveys of wildlife or habitats), laboratory experiments, or field experiments. Especially for observational data, care must be taken to distinguish evidence of contamination (i.e., the presence of debris) from evidence of impact, or a response to the debris. On the other hand, laboratory and field experiments must ultimately ensure a robust experimental design that reflects environmentally relevant conditions.

To quantitatively assess the consequences of plastic debris and its interactions with constituents of the marine environment, one useful approach is a probabilistic risk assessment framework. The US Environmental Protection Agency (US EPA), for example, commonly uses risk assessments to evaluate the consequences of exposure to

environmental stressors on ecosystems. Risk assessment frameworks can provide a robust scientific basis for recommendations of remediation or mitigation activities. They can also be used to evaluate uncertainties in the analysis, which are useful to inform the design of future research efforts, particularly if a goal is to inform management decisions. Because of the heterogeneous nature of marine plastics, a risk assessment must necessarily target a particular type of debris and/or a cohort that is potentially at risk.

Although not discussed in this review, social science research is also under way to understand behavioral, societal, and economic drivers of marine debris that might be altered as strategies for reduction

## **DATA ANALYSIS**

Plastic pollution can now be found on every beach in the world, from busy tourist beaches to uninhabited, tropical islands nowhere is safe. In 1950, the world's population of 2.5 billion produced 1.5 million tons of plastic; in 2016, a global population of more than 7 billion people produced over 320 million tons of plastic. This is set to double by 2034. Every day approximately 8 million pieces of plastic pollution find their way into our oceans. There may now be around 5.25 trillion macro and microplastic pieces floating in the open ocean. Weighing up to 269,000 tonnes. Plastics consistently make up 60 to 90% of all marine debris studied. 100,000 marine mammals and turtles and 1 million sea birds are killed by marine plastic pollution annually.

### ***Findings***

An estimated 8 million metric tons of plastic trash ends up in our oceans every year. The ocean currents have formed five gigantic, slow moving whirlpools where the plastic collects, called gyres. Most of the plastic debris sinks or remains in the gyres, however a significant percentage of it washes onto our coastlines daily. While it's difficult to know exact figures, a 2012 report from WSPA indicates that between 57,000 and 135,000 whales are entangled by plastic marine debris every year in addition to the inestimable- but likely millions- of birds, turtles, fish and other species affected by plastic marine debris.

Studies show that ingested plastic damages the

internal organs of fish, this raises the question about the safety of our sea food.

### **About The Scope of The Problem**

According to a recent report from the World Economic Forum and PwC, the rapid development of key technologies involving big data and machine learning is opening up new possibilities for measuring and tracking Earth's resources. It also allows for better coordination between researchers to share and analyse key data on pollution.

Using data analysis and data visualization, environmental scientists and organizations can gather, clean and analyse existing data on plastic pollution and use data visualization tools in order to gain better insights and raise awareness about the causes, effects and the scope of the issue.

In addition, scientists could train machine learning models to identify the key variables and make predictions that could be used in building long-term strategies to reduce ocean plastic.

## **RECOMMENDATION**

### ***Reduce plastic dependency***

We use an incredible quantity of single-use plastic items, such as straws, plastic bags, packaging, plastic cups, plates and cutlery. We must put an end to it. An increasing number of countries have now imposed a ban on disposable plastics and plastic bags, or established concrete targets for reducing plastic consumption and waste. This effort must be scaled up, so that global plastic consumption goes down.

### ***Increased producer responsibility***

Over the past 50 years, world plastic production has doubled, and leading plastic manufacturers are planning to increase production by almost a third over the next five years. In 1974, the average per capita plastic consumption was 2kg. Today, this has increased to 43kg! This is taking the world in the wrong direction. Instead, alternatives to non-degradable plastics must be developed, and the industries responsible for the major plastic wastes must be targeted with specific industry agreements and producer liability arrangements, with requirements for handling, collection and reuse of waste and broken plastic equipment.

### ***Increased waste management where the problem is greatest***

The bulk of plastic waste comes from developing countries. Rapid population growth and a swelling middle class means the consumption of plastic is increasing faster than the capacity to handle the plastic waste, and therefore much of the excess ends up in the sea. China and Indonesia are among the countries that produce the most plastic waste. As part of the solution, an international aid programme should be established to develop waste management and recycling infrastructure.

### ***Implementation of the zero vision for ocean plastic***

In December 2017, the UN Environment Assembly adopted a global goal to stop the discharge of plastic to the sea. As a follow-up, an international agreement with firm targets and time frames for implementation should be established, ensuring the mapping of sources of marine waste, increased market responsibility to prevent new propagation and strengthening of waste management globally.

### ***Increased mapping, surveillance and research***

There is still much we do not know about the plastic problem. Researchers estimate that more than 70 percent of the plastic ends up on the sea floor. Over time, it breaks down into tiny particles, but we do not know what happens to this material or how to get rid of it. The efforts to map and monitor, as well as conduct research on the negative effects, must be strengthened. An important initiative in this direction is REV, the world's largest research and expedition vessel, which aims to solve the biggest challenges around the ocean, including a dedicated effort on plastic.

### ***Stop the flow of plastic waste into the sea***

Around 80 percent of the plastic in the ocean is suspected to come from activities and industry on land. This can include everything from car tyres, technical sports equipment and fleece clothing, to cigarette butts and cotton buds. Everyone can and should contribute to the solution. For example, you can participate in clean-up operations, cut

your own plastic consumption and of course always pick up any garbage you find along your way.

### ***Increased funds for clean-up***

To solve the plastic problem, we must ensure that action and clean-up operations are undertaken in areas where the problem is the greatest. Much of the work, however, is hampered due to the lack of financial resources. By establishing a global ocean fund, with waste management and clean-up of marine areas high on the agenda, we will be one step closer towards the goal: a future without plastic and marine pollution in our ocean.

## **REFERENCES**

- Al-Odaini, N. A., Shim, W. J., Han, G. M., Jang, M. & Hong, S. H. (2015) Enrichment of Hexabromocyclododecanes in Coastal Sediments Near Aquaculture Areas and a Wastewater Treatment Plant in a Semi-Enclosed Bay in South Korea. *Science of the Total Environment* 505, 290–298.
- Bakir, A., O'Connor, I. A., Rowland, S. J., Hendriks, A. J. & Thompson, R. C. (2016) Relative Importance of Microplastics as a Pathway for the Transfer of Hydrophobic Organic Chemicals to Marine Life. *Environmental Pollution* 219, 56–65.
- Barnes, D. K. A., Galgani, F., Thompson, R. C. & Barlaz, M. (2009) Accumulation and Fragmentation of Plastic Debris in Global Environments. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364 (1526), 1985–1998.
- Brouwer, R., Galantucci, M., Hadzihska, D., Ioakeimidis, C., Leermakers, A., Ouderdoorn, H., Boteler, B. & Fernandez, P. (2015) Socio-Economic Assessment of the Costs of Marine Litter, D 4.11. Developed under CleanSea project co-funded by the European Union Seventh Framework Programme under grant agreement n° 308370.
- Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T. & Thompson, R. (2011) Accumulation of Microplastic on Shorelines Worldwide: Sources and Sinks. *Environmental Science & Technology* 45, 9175–9179.
- Browne, M. A., Underwood, A. J., Chapman, M. G., Williams, R., Thompson, R. C. & van Franeker, J. A. (2015) Linking Effects of Anthropogenic Debris to Ecological Impacts. *Proceedings of the Royal Society B: Biological Sciences* 282 (1807).
- Cedervall, T., Hansson, L. A., Lard, M., Frohm, B. & Linse, S. (2012) Food Chain Transport of Nanoparticles Affects Behaviour and Fat Metabolism in Fish. *Plos One* 7.
- Cho, D. O. (2005) Challenges to Marine Debris Management in Korea. *Coastal Management* 33, 389–409.
- Cole, M., Lindeque, P., Fileman, E., Halsband, C. & Galloway, T. S. (2015) The Impact of Polystyrene Microplastics on Feeding, Function and Fecundity in the Marine Copepod *Calanushelgolandicus*. *Environmental Science & Technology* 49, 1130–1137



# Gender Discrimination

Kalyani\*

Vaisakha Kurmi\*\*

Discrimination based on gender (or sex) is a common civil rights violation that takes many forms, including sexual harassment, pregnancy discrimination, and unequal pay for women who do the same jobs as men. Unfortunately, most Indian women are all too familiar with all of these inequalities. This section offers in-depth information on unlawful gender and sex discrimination in a number of settings -- including employment and education -- and provides links to key federal laws and Indian Supreme Court decisions related to gender and sex discrimination. Gender discrimination laws also protect the rights of transgender individuals.

- **Gender Discrimination in Education:**

A collection of articles and resources on gender discrimination in education. Learn about federal laws against gender discrimination in schooling, the types of actions that are prohibited, and more.

- **Gender Discrimination in Employment:**

In this section, you'll find a wealth of information on gender discrimination in the workplace, filing an EEOC complaint, identifying sexual harassment, the Equal Pay Act of 1963, and more.

- **Equal Pay Discrimination:**

The Equal Pay Act of 1963 protects men and women who perform the same work from sex-based wage discrimination. This section provides a number of resources on equal pay discrimination.

- **Pregnancy Discrimination in Employment:**

Employers may not discriminate against a female employee based on a pregnancy.

Gender inequality in India refers to health, education, economic and political inequalities between men and women in India. Various international gender inequality indices rank India differently on each of these factors, as well as on a composite basis, and these indices are controversial. Gender inequalities, and their social causes, impact India's sex ratio, women's health over their lifetimes, their educational attainment, and economic conditions. Gender inequality in India is a multifaceted issue that concerns men and women. Some argue that various gender equality indices place men at a disadvantage. However, when India's population is examined as a whole, women are at a disadvantage in several important ways. In India, discriminatory attitudes towards either sex have existed for generations and affect the lives of both sexes. Although the constitution of India grants men and women equal rights, gender disparities remain. Research shows gender discrimination mostly in favor of men in many realms including the workplace. Discrimination affects many aspects in the lives of women from career development and progress to mental health disorders. While Indian laws on rape, dowry and adultery have women's safety at heart, these highly discriminatory practices are still taking place at an alarming rate, affecting the lives of many today.

**Key words:** Gender discrimination, Inequalities, justice

## INTRODUCTION

Gender equality aims to achieve genuine equality between men and women by planting the idea of respecting human rights deeply into society's soil. This century is significant in that equality between men and women has become accepted as a universal value and that the construction of the social framework has taken place to materialize that concept for the first time in human history. Referring to suffrage, for example, which is one of

the most basic indices of male-and-female equality, in the beginning of the century, only New Zealand had given women the right to vote at the national-government level; almost a century later, there are few countries today that do not extend suffrage to women. In line with efforts made by the international community such as those by the United Nations, Japan has been endeavoring to establish laws and systems to realize gender equality in the post-war years, ever since gender equality was enshrined in the Japanese Constitution. As a result, it seems that gender equality has been achieved to a significant extent. Yet, many problems remain unsolved, preventing a gender-equal society from being achieved. As the 21st century is only 4 years away, it is a pressing and

---

\* Student Amity Business School

\*\* Student Amity Business School

important issue to realize a gender-equal society. Although laws and systems may appear impartial to men and women, they sometimes maintain and reinforce discrimination against women and the entrenched norms imposing stereotyped roles for men and women. In some aspects, people's thoughts and actions, as well as customs and traditions, are discriminatory and prejudiced against women and are based on stereotyping regarding men and women's roles. Such a way of thinking in society makes it difficult to achieve genuine gender equality, and not only prevents women from reaching their full potential in various fields but also hinders men from seeking freedom in their lives. Hence, it is necessary to broadly analyze and reform people's thoughts, customs and traditions in society, not merely to consolidate laws and systems, in view of substantial equality between men and women. Such socioeconomic changes raise the need to swiftly achieve a society with gender equality. Gender equality is basically an issue concerning human rights, and we need to make constant efforts to ensure it regardless of the socioeconomic conditions. At the same time, we should strongly recognize that it is absolutely essential for both men and women to participate in all corners of society as equal partners, in order to explore new frontiers for the development of Japanese society amid the rapidly changing socioeconomic environment. The preamble of the Charter of the United Nations enshrines the "faith in fundamental human rights, in the dignity and worth of the human person, in the equal rights of men and women." However, many women throughout the world still suffer from poverty and starvation and are threatened by the violation of their human rights due to civil war and regional conflicts. Looking at the facts in the real world, we must admit that many problems are serious and need to be tackled by the global community. It is impossible to raise women's status without solving problems at an international scale such as poverty, population and environmental issues. But on the other hand, such global-scale problems cannot be solved without pursuing gender equality. The United Nations has been aiming for "equality, development, and peace" since 1975, the International Women's Year. Gender equality is indispensable to achieve harmonious, sustainable socioeconomic and human development. Fusae Ichikawa, the pioneer of the Japanese suffragette movement stated "no equality without peace, no peace without equality", stressing that peace and equality are mutually dependent to achieve either. The significance of her statement

remains unchanged today. Peace, development and equality are closely correlated and are complements of each other, each one being equally indispensable.

## LITERATURE REVIEW

Women's access to academic careers has been historically limited by discrimination and cultural constraints. Comprehensive information about gender inequality within disciplines is needed to understand the problem and target remedial action. India is the fifth largest research producer but has a low international index of gender inequality and so is an important case. This study assesses gender inequalities in Indian journal article publishing in 2017 for 186 research fields. It also seeks overall gender differences in interests across academia by comparing the terms used in 27,710 articles with an Indian male or female first author. The data show that there are at least 1.5 male first authors per female first author in each of 26 broad fields and 2.8 male first authors per female first author overall. Compared to the USA, India has a much lower share of female first authors but smaller variations in gender differences between broad fields. Dentistry, Economics and Maths are all more female in India, but Veterinary is much less female than in the USA. There is a tendency for males to research thing-oriented topics and for females to research helping people and some life science topics. More initiatives to promote gender equality in science are needed to address the overall imbalance, but care should be taken to avoid creating the larger between-field gender differences found in the USA. Keywords: Research publishing; gender inequality; India; Disciplines; Academic fields 1 Introduction Gender inequalities have been a persistent feature of all modern societies. Although employment-related gender discrimination in various forms is legally prohibited, prejudice and violence against females have not been eradicated. Moreover, gendered social expectations can constrain the career choices of both males and females. Within academia, continuing gender imbalances have been found in many countries. India was the fifth largest research producer in 2017. Moreover, the complex web of influences that have led to women being underrepresented in science in India is not well understood 2015. The absence of basic information about gender inequalities is a serious limitation because gender issues in India differ from the better researched case of the USA, due to economic conditions, probably stronger family

influences 2007, greater female safety concerns 2007, and differing cultural expectations 2014.

In the USA, where gender imbalances have been much more investigated than in India, underrepresentation of females in science, technology, engineering and mathematics (STEM) fields has caused concern, and is paralleled by underrepresentation of males in health care, elementary education and the domestic sphere (HEED) fields. Many strategies have been suggested to encourage females into STEM subjects. For example, talking about biases faced by women may encourage girls to choose a scientific career and proactive recruitment and retention strategies at the university and department level may be needed to overcome explicit and hidden biases. Current research suggests that these may not address the root causes, however. The current cause of female STEM underrepresentation in the USA unlikely to be any differences in abilities or direct prejudice but is more likely to be greater male interest in inanimate objects, "things", compared to greater female interest in people. Moreover, certain thing-oriented fields have cultures in the USA that are unattractive to females as a career choice, including computer science and engineering. Gender differences in the extent to which people have personal status or social impact goals for their career also explain some gender differences in academic-related career choices. International variations in gender differences show that gender influences are not universal. These include the female domination of computing in Malaysia. Gender inequality in India is ranked 125th out of 159 countries in the world for gender equality in the United Nations Gender Inequality Index 2015 (UNDP, 2016) and so has a relatively unequal society on a world scale. In contrast, the United States ranks 43rd, Switzerland is ranked first (i.e., the most equal society) and Yemen is last (159th). The index includes health, empowerment and labour market participation components. According to UN statistics, 27% of Indian females aged 15 or over are employed compared to 79% of males. The corresponding figures for the USA are 56% (female) and 68% (male). From the same source (UNDP, 2016), 35% of females and 61% of males have some secondary education (compared to 95% for both genders in the USA). India is also ranked below average for the world (108th out of 144) for gender inequality by the World Economic Forum in 2017 (WEF, 2017). India was particularly

unequal for labour market participation. In contrast, India is above average (15th out of 144) for female political empowerment because of the relatively high proportion of women in parliament. Some factors are known to affect the likelihood of females becoming highly educated in India. Girls from wealthier districts are more likely to be educated, although core siding with in-laws negatively impacts education (Rammohan & Vu, 2018). Girls achieve less at school when they have regular heavy domestic duties at age 12 (Singh & Mukherjee, 2018). Girls from poorer families may be expected to help with housework and childcare, reducing their chance of getting an education (White, Ruther, Kahn, & Dong, 2016). Explicit parental bias towards the education of sons is also an important factor (Singh & Mukherjee, 2018). Girls may sometimes have less desire to be educated (Bhagavatheeswaran, Nair, Stone, Isac, Hiremath, Raghavendra, & Watts, 2016), perhaps because they believe that other factors are more important for their life chances.

Gender in higher education In contrast with lower levels, the Indian tertiary education gender gap has almost disappeared in recent years. According to UNESCO data (UNESCO, 2018b; see also: World Bank, 2018), the proportion of females enrolled in tertiary education within India has increased steadily, achieving parity with males for the first time in 2016. Based on government statistics from 2014-15 (the last available), gender inequality is higher for PhDs (41% female) than for undergraduates (47%) (MHRD, 2016, calculations based on data in p.5). Since it takes time for gender equality at lower levels to progress to higher levels, it seems likely that gender parity in PhDs will be achieved in the next five years. Nevertheless, the existing pool of Indians with PhDs is likely to be predominantly male due to their training having taken place during times of higher gender inequality. Moreover, post-PhD gender issues are an important cause of continuing gender inequalities in academic employment, such as a lack of support around childcare commitments (Godbole & Ramaswamy, 2008). Almost half (49%) of PhDs studied in India in 2016 were in science, technology and engineering, with the social sciences attracting 12% and both management and the Indian language attracting 5% (MHRD, 2016). There is no public information about whether gender differences in PhD program participation vary between fields.

There are substantial differences between India and the USA in the proportion of females studying some subjects. Using UNESCO statistics from 2015, 23% of Information and communication technologies tertiary graduates in the USA were female, compared to 46.3% in India (UNESCO, 2018a; see also: Nair, 2012). Similarly, for Science, Technology, Engineering and Mathematics (STEM), the female proportion in 2015 was 42% for India and 33% for the USA and for engineering, manufacturing and construction the Indian female proportion in 2015 was 31% and the USA female proportion was 20% (UNESCO, 2018). Thus, there seem to be fewer STEM and engineering barriers to females in India than in the USA, or less gender inequality overall in Indian higher education. The root causes include a growing belief in India that computer-related engineering is female-friendly (Varma, 2009), partly because office-based work is relatively safe. Another factor is an increasing parental desire for daughters to have successful careers in the context of plentiful computing jobs in India (Gupta, 2012). Such a career has financial value and many parents believe that it improves marriage prospects. It has been suggested in the past that Indian society is more family focused than is typical for the West, with higher education for women being viewed as a luxury rather than an economic investment because a bride joins the groom's family, but this may no longer be true. Some engineering fields may be regarded internationally as involving an element of dirty, strength-based work, which may be alienating for females, but this does not apply to computing. It is possible that males target engineering and technology careers partly because they offer higher salaries, especially in contrast to the social sciences, arts and humanities.

Gender and research in India Women are underrepresented amongst higher education faculty in India, particularly at senior levels (Morley & Crossouard, 2015). An investigation of four prestigious higher education institutions with a focus on technology in 2000 found explicit sexist attitudes when hiring staff (Gupta & Sharma, 2003). These included beliefs that women would be less effective due to family commitments. A study of two Indian Institutes of Technology in 2004 found that women were disadvantaged by male prejudices against them, through being a highly visible minority and having less opportunity for informal interactions because of decorum considerations. The issue of male

cultures in Indian technology institutes seems to be decreasing in importance. The research design was to download the metadata on all Indian first authored journal articles published in 2017 from Scopus and compare the proportions of male and female first authors in each field. The second stage was to identify words used disproportionately by males or females overall and within individual fields for this article set. Scopus was chosen as the most comprehensive standard bibliometric database. In support of this, an approved list of (nonpredatory) journals approved by the University Grants Commission for use in promotions and the Academic Performance Indicators (API) in India was taken from Scopus. Journal articles were analysed because these are the primary outputs in most academic fields and there is not a reasonably comprehensive useful index for conference papers (computing, computational linguistics, some areas of engineering), books (humanities, some social sciences) or artistic works/ performances. This is a limitation of the analysis. First authors were analysed because these make the largest contribution to a study in most fields (Larivière, Desrochers, Macaluso, Mongeon, Paul-Hus, & Sugimoto, 2016; Yank & Rennie, 1999), even though the first author may tend to be the most senior author in some areas (Kosmulski, 2012). For the word comparisons, terms were analysed in titles, keywords and abstracts since these should summarise the essence of a paper and patterns for these may therefore reveal core gender differences. Alphabetical ordering occurs in some fields and may even impact research quality. Nevertheless, it is not universal in any field and is most prevalent in maths, economics, and high energy physics. Alphabetisation may result in the first author of a paper not being its main contributor

Research question- Field participation in all 26 broad fields, most journal articles from 2017 with a first author from India were male first-authored and there were almost three male first authors per female first author overall. The fields varied from 0.64 (Nursing) to 0.15 (Veterinary) female authors per male author. For narrow fields with at least 50 Indian first authored articles in 2017, the proportion varied from 0.05 (Orthopaedics and Sports Medicine) to 1.23 (Obstetrics and Gynaecology) female authors per male author. Thus, the male dominance of all broad fields has exceptions within narrow fields. The results cannot be fully analysed with the people/things

dimensions because the extent to which researchers perceive each specialism to involve people or things is unknown, as are the key stages at which this information would influence career choices (e.g., childhood ambitions, degree choice, postgraduate decision and topic choice, post education research/industry career decision, mid-career job change decision). For non-academic careers, this has been assessed with large scale questionnaires but this is impractical for the current paper. Thus, simplifying assumptions must be made for initial judgements about the dimensions. Complicating the issue of judging the orientation of a field by its subject, a field may be perceived as people/thing oriented if it underpins a career that is perceived as people/thing oriented, it has people/thing research objects or its daily practices involve people or things. Thus, a library and information science researcher may study books (things) to support a career in publishing books (thing) or working with authors (people) or library visitors (people). S/he may also enjoy studying books (things) for the stories they tell about people or the opportunity to work alone (no people) or collaboratively (people). For the discussion below, academic fields are accepted at face value for their object of study (e.g., nursing = looking after people; engineering = making things) unless other information is available to support a deeper analysis (e.g., librarians support people's need for books). This is necessarily a superficial and weak approach that does not take into account the Indian context but provides a transparent baseline for analysis that can be challenged. To increase transparency, three graduate or postdoctoral librarians not involved with this article, two from Asia but not India, were asked to estimate the degree of people/thing orientation of Scopus broad fields and Arts and Humanities (for completeness) and Social Science narrow fields on a five-point scale. Librarians were chosen because this profession records and classifies subject-based information (books, journals, other information resources). Experienced academic librarians from India would have been ideal for this, but could not be found. Agreement by at least two or the average of their results taken as a baseline for the analysis. As the above paragraph suggests, this is a subjective task. Whilst there was strong agreement overall there was complete agreement on only 20% of the categories and some cases of sharp disagreements, including for Veterinary. People and health care-based fields (Nursing); Psychology; Dentistry; Arts and Humanities;

Health Professions; Social Sciences have above average levels of female first-authors but Medicine is about average and Business, Management and Accounting has people-oriented aspects (e.g., personnel management). Thus, the ordering of the broad fields only partly reflects a people/thing dichotomy because some people-related fields do not have a high ranking. The laboratory-based life sciences broad fields (Immunology and Microbiology; Biochemistry, Genetics and Molecular Biology also have above average female first author shares despite not being people-dominated, whereas Agricultural and Biological Science and Veterinary is last. Thus, less laboratory-based life sciences are more male-dominated. Environmental Science combines life and physical sciences. Underpinning this, three life-sciences-related narrow fields have the highest proportion of female authors for their broad fields: Bioengineering (Chemistry); Cellular and Molecular Neuroscience (Neuroscience and Biomaterials (Materials Science). At the narrow field level, the female domination of Obstetrics and Gynaecology within the Medicine broad field reflects the women's medicine topic, and perhaps female patients' preference for a female doctor. The most female field within Engineering is Architecture, perhaps because its artistic component is perceived as being more feminine or because Architecture is more likely to be office-based and therefore safer. Within Agricultural and Biological Sciences, the most female specialism, Food Science, reflects a traditional female role, whereas the most male specialism, Forestry, might be unappealing from a safety aspect for its countryside component. Within Environmental Science, the most female-oriented specialism is Waste Management and Disposal. The 180 papers on this theme with a female first author from India frequently deal with microbiology issues, making this a partly life sciences topic. Within Mathematics, the most applied specialism, Numerical Analysis, is female-oriented in contrast to the highly abstract most male-oriented Geometry and Topology. This is not due to specific applications since most of these papers were abstract.

## OBJECTIVES OF RESEARCH

Is there?????????

- Equal career opportunities for women and men
- Fair distribution of unpaid and paid work

among women and men, wages and salaries that women and men can live on independently

- Equality of women and men with regard to political representation and participation
  - Enhancement of gender roles and standards for women and men, elimination of restricting standards
  - Same personal freedoms for women and men, protection against all forms of aggression
- Identifying users of public services and their different expectations increases the chances for politicians and administration staff to really address people's concerns. It allows them to reconcile public services and projects with citizens' needs, while raising planning accuracy, quality and success of services.

## MAJOR FINDINGS

There is a growing body of field-experimental evidence on gender discrimination in hiring in the United States. This evidence points to the deep and persistent consequences that gender discrimination has for employment outcomes. It is not the case, however, that all types of women are disadvantaged or that they're disadvantaged to the same extent at the early moments of the hiring process. Rather, the average "gender effect" hides significant complexity, and recent research highlights how gender works with other applicant characteristics and contextual forces to produce disparate outcomes. At the individual level, gender intersects with an applicant's parental status, social class background, and prior employment history to affect the likelihood of receiving a call back for a job. These three key results, which are summarized in Figure 1, are central to our current understanding of gender discrimination in hiring. Although there are of course other important forces at work, especially race and ethnicity, the discussion below focuses on three key forces that reveal how differential perceptions of worker commitment can drive some types of discrimination.

## RECOMMENDATIONS

1. Mainstream gender equality in the design, development, implementation and evaluation of relevant public policies and budgets.
2. Strengthen accountability and oversight mechanisms for gender equality and mainstreaming initiatives across and within

government bodies.

3. Achieve gender balanced representation in decision making positions in public life by encouraging greater participation of women in government at all levels, as well as in parliaments, judiciaries and other public institutions.
4. Take adequate measures to improve the gender equality in public employment.
5. Strengthen international co-operation through continuously sharing knowledge, lessons learned and good practices on gender equality and mainstreaming initiatives in public institutions.

## LIMITATIONS

Many Indian articles are published in journals not indexed by Scopus and therefore excluded from this study. In the arts, humanities and some social sciences, journal articles are not the primary research outputs, with books, performances or other artefacts being more important. Moreover, scholars in some fields in India may have no imperative to produce tangible research outputs, with their teaching and perhaps consultancy activities being sufficient. The study also assumes that the first author of a journal article does the most work, but this may be less true in India than elsewhere, for example, if senior researchers in India (as previously claimed: Menezes, Sharma, Manipady, & Kanchan, 2006) or international collaborators insist on being the first authors for junior researchers' papers. In 86% of fields with at least 50 articles, there were more female first authors (average: 30%) than subsequent authors (average: 24%), but these figures may conceal some unwarranted male first authorships. Finally, the data from 2017 mixes younger researchers from the current more equal education system with older researchers and the gender differences found may naturally reduce each year as newer researchers join and older researchers retire. The results are compared to a previous study of the USA using the same methods (Thelwall, Bailey, Tobin, & Bradshaw, submitted) as well as the Indian context. There are several substantial differences from the USA in the gender composition of broad fields. Whilst in the USA, two broad fields have a female majority (Nursing F/M: 1.93; Veterinary F/M: 1.49), and one has close to gender equality (Health Professions: 0.99) broad fields have a male majority of over 3 to

2 for India. The difference between broad fields in gender composition is narrower for India than for the USA, however. The broad field with the lowest proportion of females is lower in India (0.15 in India for Veterinary compared to 0.22 in the USA for Mathematics) but there are similar numbers of broad fields with proportions below a third (<0.33) in the USA (7, with additionally Physics and Astronomy: 0.24; Energy: 0.26; Economics, Econometrics and Finance: 0.28; Computer Science: 0.30; Engineering: 0.32; Decision Sciences: 0.32) compared to India (8). Thus, whilst Indian research has a substantial overall male bias, broad research field choice is less influenced by gender. This echoes the tertiary education situation in India, as discussed above. For individual broad fields, there are also substantial differences between the USA and India. Most prominently, the least female broad field in India, Veterinary, is the second most female in the USA. Veterinary science may be less attractive to females in India because there may be safety issues for women working at isolated countryside locations with animals. Similarly, Neuroscience has the fifth highest proportion of female-authored papers in the USA (0.82) but is only seventeenth in India (0.33). A word association analysis of the category for the USA and India found Indian research to focus more on healthcare contexts (e.g., the term patient is in 39% of Indian and 23% of US articles) whereas US research focused more on theoretical analyses (e.g., fMRI [functional magnetic resonance imaging] and connectivity are mentioned more). This does not explain the US-India difference, however, since the Indian topics are more female-associated, despite the lower female ranking. In the opposite direction, Dentistry has the fourth highest proportion of female authored research in India (0.57) but is only 19th in the USA (0.33). Similarly, Economics, Econometrics and Finance has the 13th highest proportion of female-authored research in India (0.39) but is only 23rd in the USA (0.28). These two broad fields have higher proportions of female authors in India than the USA, despite the much lower overall proportion of female first authors in India. Word association analyses of the broad fields for the USA and India did not find substantial topic differences between these countries, so the differing rankings seems to reflect internationally differing gender relationships. For example, Dentistry research seems to be similar in India and the USA but it is relatively more attractive to Indian females than to American

females. Mathematics is more female in India (0.22) than in the USA (0.30) and is higher ranked for female ratio (20/26 instead of 26/26) and so this is a substantial difference. Mathematics research in India seems to be less theoretical (prove is in 6% of Indian and 13% of US articles) and more oriented on assessing existing ideas (proposed is in 28% of Indian and 15% of US articles) and so the discipline may differ in practice between the two countries. The social sciences narrow fields very broadly echo the results from the USA. The biggest exception is that Library and Information Sciences is overall female in the USA but strongly male in India. This may be due to the quantitative element, scient metrics, being relatively more popular in India than the USA. For example, the term citation occurs in 4% of US articles and 18% of Indian articles in this category. There are substantial differences with the USA in terms of gendered topics (i.e., topics covered by a higher proportion of female authors than of male authors). Topics that occupy a higher proportion of female than male first authors for the USA but not India include the following, grouped into related themes. Themes evident in the broad field results are omitted. Recall that F:M is the percentage of female-authored articles containing the term divided by the percentage of male-authored articles containing the term.

## CONCLUSION

The results show that research publishing in India is dominated by males in all 26 broad areas of scholarship, at least in terms of first-authored journal articles in Scopus. This may exaggerate the male domination of research publishing in India if there is an element of senior (mainly) male researchers unfairly taking first authorship positions (e.g., Menezes et al., 2006). Research publishing is male-dominated in 183 out of 186 narrow fields, with the exceptions being Histology (F/M: 1.15) (56% for cytology – the study of cells), Reproductive Medicine (F/M: 1.16), and Obstetrics and Gynaecology (F/M: 1.23). Indian research has fewer female researchers (at least in terms of Scopus first authors in 2017) than the USA but smaller differences between fields in the share of female researchers. In terms of fields and topics, the data echoes to some extent the people/things dichotomy previously found for the USA (with patients as an important exception), but not the greater female use of qualitative methods found in the USA. Thus, the gender imbalance in India is

substantially different from that in the USA but with some overlaps. There are also many differences for individual topics that may be due to national context (e.g., type of commercial activity, differing health issues) that change the nature of a field (e.g., more algorithms in Indian mathematics). The substantial female minority overall and in all 26 broad areas of scholarship underlines the importance of initiatives to overcome gender inequalities in research within India (e.g., the Indo-U.S. Fellowship for Women in STEMM), although a more systematic effort is still needed (Ovseiko, Godbole, & Latimer, 2017). The differences with the USA confirm that national policies or cultures can influence the gendering of science. This should encourage initiatives to overcome gender imbalances by showing that they

are not universal and can therefore be combatted. Indian policy-makers and research managers should also guard against the potential for gender imbalances to increase in areas where the USA has a greater discrepancy in case research cultures from the USA influence practice in India.

## REFERENCES

Journal of Informetric.

Journal of the Royal Statistical Society.

International journal of educational development.

Gender inequality amid educational expansion in India: an analysis of gender differences in the attainment of reading and mathematics skills.

Journal of Research in Gender Studies, Gender equality in academia: A critical reflection.

<http://datatopics.worldbank.org/education/country/india>  
Accessed.



# Various Components of AIR Pollution in Delhi

\*Dhruv Gupta

Mitigating the impact of all kinds of pollution on human health worldwide is mandatory to limit the morbidity and mortality arising from exposure to its effect. The various level and type of pollutants vary in different rural and urban areas. I explored the extent of air pollution and its impacts on human health in the megacity of Delhi (India) through a review on this literature. This study aims at describing the extent of air pollution in the city Delhi also the magnitude of health problems due to air pollution and the risk relationship between air pollution and associated health effects also the steps taken to mitigate air pollutions and the possible recommendations for the same aspect.

Air pollution in India has expanded quickly due to population development, increase in the number of vehicles, fuel utilisation, bad transportation frameworks, poor land use pattern, industrialization more of all ineffective environmental guidelines and regulations. Sulphur Dioxide, Nitrogen Dioxide, Particulate Matter are a portion of the poisons which are adding up to environmental contamination. Purpose for this research is to review the analysis of ambient air quality of Delhi, review the steps taken to cut down air pollution and offer recommendations to curb it.

**Keywords:** Sulphur Dioxide, Nitrogen Dioxide, Particulate Matter, Air Quality Index

## INTRODUCTION

Air is a mixture of various gases such as oxygen, argon, nitrogen, carbon dioxide, and small amount of other gases in a fixed proportion. If the composition of air alters, then it is known as air pollution, which can lead to effects on human health, environment, and other living creatures. According to The Air (Prevention and Control of Pollution) Act, 1981, "air pollution is presence of any solid, liquid, or gaseous substance in the atmosphere in such concentration as maybe or tend to be injurious to human beings or other living creatures or plants or property or environment".

Air pollution has now become a serious issue of concern and many countries in the world such as India, Iran, UAE, and China etc. are formulating strategies to deal with it.

There are a number of factors that are responsible for the altered composition of the ambient air which can be mainly categorised as natural causes and anthropogenic (man-made) causes.

### Sources of air pollution

- Natural sources: Natural sources of air environmental pollution includes volcanic activity, dust, the sea-salt, lightening, soil outgassing, forest fires etc.

- Anthropogenic sources: These sources include stationary point sources (e.g. emission from industries), the mobile sources (e.g. vehicular emission, marine vessels, airplanes etc.), open burning waste disposal landfills, etc.

### Air pollutants

The substances which are responsible for causing air pollution (environmental damage) are called as air pollutants. Classification of air pollutants is as follows:

- On the basis of source of origin
  - Natural air pollutants: Natural air pollutants are emitted from natural sources such as dust, volcanic activity, the lightning, sea-salt, forest fires, soil outgassing etc.
  - Anthropogenic air pollutants: These environmental pollutants include the emissions from stationary point sources (e.g. emission from industries), the mobile sources (e.g. vehicular emission, the marine vessels, airplanes etc.), controlled burning, the waste disposal landfill etc.
- On the basis of method of origin
  - Primary air pollutants: These are those pollutants which are emitted directly from any emission source into the atmosphere are termed as primary air pollutants, e.g. sulphur dioxide (SO<sub>2</sub>), the carbon monoxide (CO), lead (Pb), ammonia (NH<sub>3</sub>) etc.

---

\* Associate Consultant, KPMG

Secondary air pollutants: The Secondary pollutants are formed by the reactions between primary air pollutants and normal atmospheric constituents. In some of the cases, these pollutants are formed by utilizing the solar energy, e.g. the ozone, peroxyacetyl nitrate (PAN), smog etc.

- On the basis of chemical composition

Organic air pollutants: A few examples are the hydrocarbons, ketones, the amines, aldehydes and alcohols etc.

Inorganic air pollutants: A few examples are the carbon compounds (CO and carbonates), nitrogen compounds (NOX and NH3), the sulphur compounds (H2S, SO2, SO3, H2SO4), the halogen compounds (HF, HCl etc.), flyash, silica etc.

- On the basis of state of matter

Gaseous air pollutants: Pollutants which are in the form of gas are termed as gaseous air pollutants, e.g. SO2, NOX, O3, CO etc.

Particulate air pollutants: The Particulate air pollutants or particulate matter (PM) can be defined as the liquid matter or the microscopic solid suspended in the earth's atmosphere.

### Criteria Pollutants

Criteria pollutants are the particulate air pollutants, photochemical oxidants and ground level ozone, sulphur oxides, carbon monoxide, lead and nitrogen oxides. These pollutants are responsible for causing serious health hazards, environmental hazards such as acid rain smog and property damage etc. The sources and effects of criteria pollutants are shown in the Table Below.

Criteria Pollutants	Emission Source		Major Effects	
	Natural Sources	Anthropogenic Sources	Health Effects	Environmental Effects
<b>Nitrogen dioxide (NO2)</b>	Forest fires, lightening etc.	Burning of fossil fuels, biomass and high temperature combustion process	Pulmonary disorders, increased susceptibility to respiratory infections	Precursor of ozone formation in troposphere, aerosol formation
<b>Sulfur dioxide (SO2)</b>	Emissions by volcanos	Burning of fossil fuels, metal smelting, petroleum refining etc.	Respiratory problems, heart and lung disorders, visual impairment	Acid rain
<b>Particulate matter (PM)</b>	Windblown dust, pollen spores, photochemically produced particles	Vehicular emissions, industrial combustion processes, commercial and residential combustion, construction industries	Respiratory problems, liver fibrosis, lung/liver cancer, heart stroke, bone problems	Visibility Reduction
<b>Carbon monoxide (CO)</b>	Animal metabolism, forest fires, volcanic activity	Burning of carbonaceous fuels, emission from IC engines	Anoxemia leading to various cardiovascular problems. Infants, pregnant women, and elderly people are at higher risk	-
<b>Ozone (O3)</b>	Present in stratosphere at 10 – 50 km height	Hydrocarbons and NOX upon reacting with sunlight results in O3 formation	Respiratory problems, asthma, bronchitis etc	O3 in upper troposphere causes green house effects, harmful effects on plants as it interferes in photosynthesis and results in death of plant tissues since it assists in the formation of Peroxyacetyl nitrate (PAN)

Criteria Pollutants	Emission Source		Major Effects	
	Natural Sources	Anthropogenic Sources	Health Effects	Environmental Effects
Lead (Pb)	-	Metal processing plants, waste incineration, automobile exhausts, lead-acid batteries, industrial effluents etc.	Serious effects on central nervous system since it is absorbed rapidly in blood stream, anemia, toxic for soft tissues and bones	-

## LITERATURE REVIEW

Activities involving burning things/fuels and mixing substances that can cause chemical reactions releases toxic gases in the process and some activities like mining, transportation, construction etc. produce large amounts of dust which have the potential to cause air pollution.

There are millions of cars on the road today. Virtually all of them are powered by diesel and gasoline engines that burn petroleum to release energy. Petroleum is made up of hydrocarbons (large molecules built from hydrogen and carbon) and, in theory, burning them fully with enough oxygen produces nothing worse than carbon dioxide and water.

In practice, fuels are not the pure hydrocarbons and the engines do not burn them cleanly. As a result, exhausts from the engines contain all kinds of possible pollution, notably particulates (soot of various sizes), carbon monoxide (CO), a poisonous gas, nitrogen oxides (NOx), volatile organic compound (VOCs), and Lead (Pb) indirectly produced ozone. Mixing up of these noxious gases together and energizing it with the sunlight produces sometimes brownish, sometimes bluish fog of pollution called Smog, which can hang over cities for many a day.

Air Pollution renders air unfit for respiration for both humans and animals. This problem has been aggravated by the tremendous increase in the number of mobile sources (motor vehicles) in the urban areas.

During this study I had reviewed several research papers and taken the opinion of several people living both within India (Delhi and outside Delhi) and out of India. It was a very enriching experience as I understood their take and beliefs about pollution. As I reviewed several papers I

came across various thoughts processes and World Health Organisation reports which talks about the changing climate and the dynamic activities of humans which leads to air pollution. Some reports talks about air pollution in general, a few described the causes for the same and a few about the steps taken and recommendations for future on how to curb and decline air pollution.

As per the insight gained from various sources, I have a covered the maximum ground possible. Firstly, this report talks about what is air pollution in general so that even a lay man can have a brief understanding of this unfortunate concept. Then it discusses the sources of air pollution which mentions both Natural and Anthropogenic sources which further leads to pollutants and its criteria.

After this the review moves on to the research study which explains the motive and the reason behind the study and the tools used to shine more light on this alarming rate of air pollution. One can have an idea about this unfortunate pollution by the air quality monitor and air quality index of Delhi, which leads us to assessment of the air quality in Delhi.

After performing all the above tasks and gaining respective insights from various people and various research papers Steps taken to curb air pollution were taken into consideration.

The phenomenon of air pollution is a critical environmental factor that has caused a great havoc in the present world we live in. Controlling of air pollution has become a massive challenge of rising significance. Most researches have been focusing on the negative effects of air pollution on living things. Considering the fact that this issue needs immediate damage control and rectification a few recommendations have been suggested to provide a healthy life to the coming generations

## RESEARCH OBJECTIVE

Delhi, with an area of 1483 km(Square), is geographically located in North of India within the latitude 28°24'17" and 28°53'00"N, and longitude 77°45'30" and 77°21'30"E. Delhi is jointly administered by the Central Government and State Government. As of 2011, Delhi inhabitants approximately 16.3 million people, thus becoming the second most populous city and second most populous urban agglomeration in the country. Delhi is also the third largest urban area in the world. However, due to rapid development, Delhi is also facing serious challenges in terms of air pollution with respect to several other factors leading to severe air pollution in the state. The objective of this study is to understand, analyse and recommend solutions for decreasing air pollution in Delhi.

## RESEARCH METHODOLOGY

### *Air quality monitoring in Delhi*

Air quality monitoring in the state is carried out through a number of air quality monitoring stations situated across the city, Delhi. The monitoring is undertaken by various organizations viz. Delhi Pollution Control Committee (DPCC), Central Pollution Control Board (CPCB), and System of Air Quality and Weather Forecasting and Research (SAFAR) of Indian Institute of Tropical Meteorology (IITM), Pune.

As per the NAMP of CPCB, manual air pollution monitoring is carried out at Sarojini Nagar, Shahzada Bagh, Nizamuddin, Janakpuri

ChandniChowk, Mayapuri Industrial Area, Pitampura, Shahadra, ,Siri Fort, and at ITO as traffic intersection station across the Delhi. Apart from the manual air monitoring stations, continuous ambient air quality monitoring (CAAQM) stations of CPCB are also located at 11 locations viz. Anand Vihar, Civil Lines, ITO, Mandir Marg, Punjabi Bagh, R.K. Puram, DCE, Dilshad Garden, Dwarka, IGI Airport, and Shadipur across the city (as shown in the table below)

DPCC has air quality monitoring stations at 6 locations viz. Civil lines, Punjabi Bagh, AnandVihar ISBT, IGI Airport, MandirMarg, and R.K. Puram. In addition to CPCB and DPCC, there are 8 more monitoring stations of SAFAR at various locations in Delhito monitor the ambient air quality on real time basis.

### *Air quality trends in Delhi*

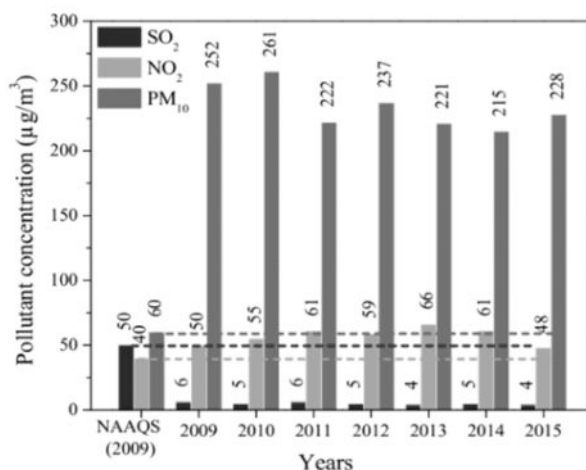
Air quality for the three major pollutants (SO<sub>2</sub>, NO<sub>2</sub>, and PM) is determined to understand the trend of pollution in Delhi during recent years. On the basis of annual concentration (average) of pollutants, air quality trend has been seen for the years 2009 - 2015 along with the comparison with existing NAAQS (national ambient air quality standard), 2009. It can be seen in the figure below that among the three pollutants viz. SO<sub>2</sub>, NO<sub>2</sub>, and PM<sub>10</sub>, the concentration of the pollutant NO<sub>2</sub> and PM<sub>10</sub> are far exceeding the prescribed standard limits. The concentration of the component SO<sub>2</sub> is within the standard limits. However, as far as pollutant NO<sub>2</sub> is concerned,

**Air quality monitoring stations of various organizations in Delhi**  
(Source: CPCB)



continuous rise in the concentration was observed in past 7 years. Moreover, the problem of particulate matter PM10 is more critical. Since 2009, approximately 250 - 335% rise has been observed in the PM10 concentration compared to the standards. Although the concentration has been slightly lowered down since 2011, but it is still far above the safety limits.

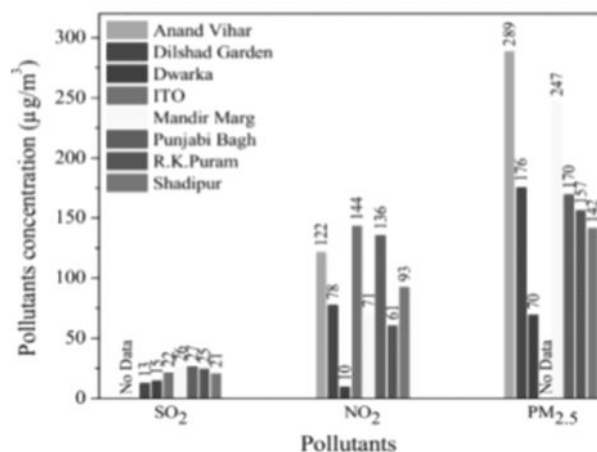
**Air quality trends in Delhi (2009 – 2015) based on manual air quality monitoring stations (Source: CPCB)**



Apart from the annual average data, the continuous air monitoring data of Delhi is also recorded by the CPCB at 11 locations, as stated above. Out of 11, the data of the 8 operating monitoring stations for the period of December 1 – 10, 2015 is shown in the figure below. This graph reflects the average values of the NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>2.5</sub> concentration for the period of 10 days. Since the standards for ambient air quality is only suitable for the data based on the time weighted average of annual and 24 hours/8 hours/1 hour, the comparison of the data of the 10 days average with the standards is not feasible. However, it is evident from the graph that concentration of PM<sub>2.5</sub> and NO<sub>2</sub> is very high. Among all the

locations, PM<sub>2.5</sub> and NO<sub>2</sub> concentration is least in the area Dwarka. The concentration of particulate matter (PM<sub>2.5</sub>) at all the other locations needs to be curbed down immediately as the values recorded are alarmingly high. Moreover, the concentration of SO<sub>2</sub> is acceptable at all the locations across the territory (Delhi).

**Air quality trends in Delhi (Dec. 1 – 10, 2015) based on the data of continuous air quality monitoring station (Source: CPCB)**



### Air quality index (AQI) in Delhi

Air quality index (AQI) is the tool to monitor the air quality in major urban cities across the country on a realtime basis and to enhance the public awareness. The AQI developed is based on the human exposure and the health effects and may not be strictly applicable to ecologically sensitive areas. Various pollutants which are considered for AQI determination are NO<sub>2</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, O<sub>3</sub>, CO, SO<sub>2</sub>, NH<sub>3</sub>, and Pb. The data obtained from the online air quality monitoring stations is most suitable for the AQI determination as information on AQI can be generated in real time basis.

For the ease of understanding, colour bands are used to represent various AQI bands below.

AQI	Associated health impacts
Good (0 – 50)	Minimal impact
Satisfactory (51 – 100)	Minor breathing discomfort to sensitive people
Moderately polluted (101-200)	Breathing discomfort to people with lungs, asthma, and heart diseases
Poor (201 – 300)	Breathing discomfort to most people on prolonged exposure
Very poor (301 – 400)	Respiratory illness on prolonged exposure
Severe (401 – 500)	Affects healthy people, and seriously impacts those with existing diseases

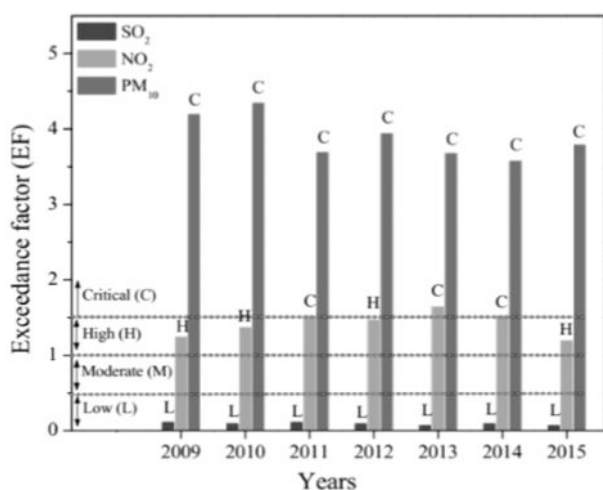
## Air quality assessment in Delhi

For the ease of understanding the pollution content level, air quality can be categorised into four broad categories on the basis of exceedance factor (EF), viz. the ratio of annual mean concentration of a pollutant and its respective standards. Accordingly, the air pollution can be categorized into four types as:

- Critical pollution (C) :  $EF \geq 1.5$ ;
- High pollution (H) :  $1.0 \leq EF < 1.5$ ;
- Moderate pollution (M) :  $0.5 \leq EF < 1.0$ ; and
- Low pollution (L) :  $EF < 0.5$

Based on the data of PM<sub>10</sub>, SO<sub>2</sub> and NO<sub>2</sub> the exceedance factors are calculated which are shown in the figure below. It is evident from the figure below that pollution level is low for SO<sub>2</sub>. The pollution level is high in case of NO<sub>2</sub> along with critical in few of the years. Moreover, the pollution level crosses critical level for PM<sub>10</sub> in all the years. This indicates that immediate attention and action is needed to curb the particulate matter.

**Pollution level based on exceedance factor (EF) of SO<sub>2</sub>, NO<sub>2</sub>, and PM<sub>10</sub> in Delhi**



## Source apportionment study in Delhi

The review and the study shows that the concentration of pollutants is continuously on the rise, especially in the case of particulate matter, where pollution level is very critical. Therefore, source apportionment study for the particulate matter has been undertaken for assessing the contribution of various pollution sources for the PM<sub>2.5</sub> and PM<sub>10</sub>. In case of the state Delhi, the survey has been conducted by IIT Kanpur in coordination with Government of NCT of Delhi during winter and summer seasons at six

characteristic locations - Okhla (industrial), Vasantkunj (residential-cum-commercial), Dwarka (residential), Rohini (residential and industrial), Dilshad garden (industrial), and Pusa road (residential-cum-commercial), for assessing the contribution of various pollution sources for the PM<sub>10</sub> and PM<sub>2.5</sub>. The idea of sampling in the winter and the summer months is influenced by the fact that winter conditions provide the low dispersion and high concentrations of pollutants while during the summer months the meteorology gets improved leading to better dispersion conditions for pollutants.

Based on the study, following information can be summarized:

- PM<sub>2.5</sub>: For the PM<sub>2.5</sub>, secondary particles, biomass burning, vehicular emissions, soil and road dust, and solid waste burning are largely responsible in the winter months. Moreover, coal and flyash, soil and road dust, the secondary particles are the major factors responsible for PM<sub>2.5</sub> during the summer months along with the other sources. The Industrial pollution contributes to <1 - 2% at all the locations. Large amount of the flyash and dust during the summer months may be due to high wind speed and the high temperature leading to extremely dry conditions which make the dust airborne.
- PM<sub>10</sub>: At all the locations, the major sources for PM<sub>10</sub> during winter months are biomass burning, soil and road dust, vehicular emission, secondary particles etc. in different proportions. Secondary particles originate from precursor gases such as, NO<sub>2</sub> and SO<sub>2</sub>. Vehicles and the power plants are largely responsible for the NO<sub>2</sub> emission, while SO<sub>2</sub> emission is mainly attributed by the large power plants and the refineries situated in the upwind direction of Delhi. The construction materials are also responsible for PM<sub>10</sub>. During the summer months, soil and road dust, coal and flyash, the secondary particles, solid waste burning, and vehicular emissions are largely responsible for PM<sub>10</sub>, along with minor contribution from the construction activities. The role of industrial pollution in the overall concentration of PM<sub>10</sub> is < 1% at all the respective locations.

## LIMITATION

Based on the above observations, it can be observed that the air of Delhi is polluted especially

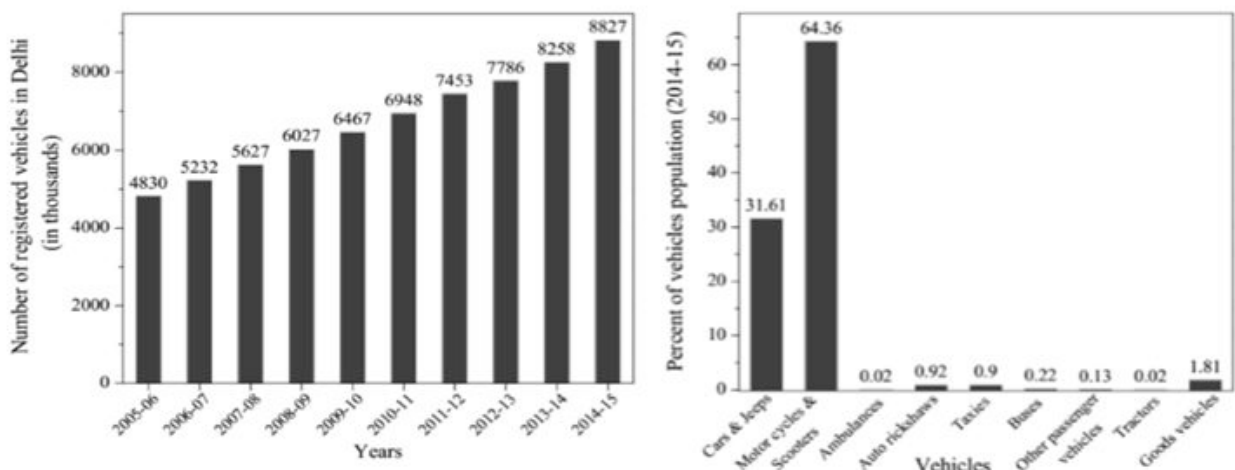
in terms of particulates. Vehicular pollution alone contributes about a major proportion of the total air pollution load in Delhi as estimated using emission factor and the activity-based approach recommended by the IPCC. However, this study finds that it is not only the vehicular pollution, rather, domestic pollution, the industrial emission, the road dust, and garbage burning also have a large share in the state's total pollution load. The construction of infrastructure including the large residential complexes potentially contributes to the territories air pollution load. This study also finds that the concentration of the SO<sub>2</sub> is well under control. This is due to phasing out of diesel driven buses, the reduction of sulphur content in diesel by about 90%, and the implication of Bharat Stage IV norms in vehicles of the state Delhi. The major cause of rising NO<sub>2</sub> concentration in the state Delhi is increased traffic load. In atmosphere, the combination of nitric oxide (NO), ozone (O<sub>3</sub>), and the hydrocarbons leads to the formation of NO<sub>2</sub>. Thus to minimize the NO<sub>2</sub> pollution, all the three components involved in its formation needs to be targeted. To substantiate the findings, trend of increasing vehicular usage is shown in figure below. Since the year 2005–2006 to 2014–2015, 82.75% increase can be noted in the number of registered vehicles in the state. Moreover, the excessive usage of motor cycles and cars are the pertinent causes for rising vehicular pollution load in the state. This corroborates the cause of increasing the NO<sub>2</sub> as well as particulate matter concentration. Particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) emanates especially from the vehicular exhausts, particularly diesel vehicles, construction activities, and industrial activities such as combustion processes, road dust etc.

Tremendous growth of the industrial sector is also responsible for the growing pollution. As per the report of Economic Survey of Delhi 2014-2015, there are a total of 8.93 lakhs industrial establishments operating in Delhi according to the 6th Economic Census 2013, which is 18.35% more than the number of establishments according to the 5th Economic Census 2005. In many of the industries, the installed air pollution control devices are found in the idle conditions which lead to the emission of the pollutants directly into the atmosphere without any filtration. Further, the construction of the short chimneys also restricts the polluting gases to escape into the upper layers of the present atmosphere. Traffic congestion on the roads, although underestimated, is also another very important factor as far as the air pollution is concerned. As it is evident from the above figure, cars and motorcycles are responsible for a major share of Delhi's vehicular load, their congestion on the roads creates nuisance. Moreover, 4-wheelers (automobile) also need a lot of space for parking. This further reduces the space on the roads leading to high frequency of traffic jams. To reduce the pollution at the traffic intersection points, time clocks have been installed at most of the points in Delhi. But it has been observed that hardly any vehicle owner switches off the engine during this period. Therefore, fuel is continuously burned at a fixed place which further adds up to in the atmospheric pollution load.

### *Meteorological issues (Limitations)*

Apart from the industrial emissions and vehicular emissions, the local climatic and seasonal factors also affect the air quality of the city. Delhi, being a land-locked territory, is unable to dilute its

**Traffic load in Delhi**  
(Source: Economic Survey of Delhi 2000s)



emission using the moderating effects of sea, the opportunity which is availed by other metropolitan cities, such as Chennai, Kolkata and Mumbai. Surrounded by the regions of the varied climate, Delhi also represents a great variability in the seasonal patterns. At its south, there are central hot plains. At its west, there is the Great Indian desert (Thar desert) of Rajasthan while in the north and east direction there are the cool hilly regions. Thus, Delhi is located in the subtropical belt with the extremely scorching summers, the moderate rainfall, and chilling winters. The winters are extremely important in the city as it is dominated by the cold, dry air, and ground based inversion with the low wind conditions, which are responsible for the increasing concentration of the pollutants. High concentration of pollutants is trapped close to the earth's surface because a layer of warm air acts as a lid on top of this layer. Moreover, the dense smog formation during winter months has also been witnessed in the city, the reason of which is the vehicular pollution as well as the prevailing meteorological conditions in the months of December and January.

Similarly, the wind pattern also affects the weather conditions. According to a study, during the autumn and the winter months, approximately 500 million tons of crop residues are burnt in IndoGangetic plains. The image in figure below shows the biomass burning in the state of Punjab. The wind blows from the India's north and the north-west to the east direction during winters as depicted from the wind-rose diagram of Delhi

(Figure below). This ultimately results in the combination of pollution and fog, leading to heavy smog formation in the city especially during winters.

In summers, although there is no inversion phenomenon as such, still the air quality gets deteriorated because of the increased concentration of the PM10, which is due to dust. However, it becomes toxic due to the coating of polluted emissions from the various sources. Nevertheless, during rainy season the pollution level goes down due to dust suspension. Therefore, air pollution in Delhi is a transboundary and a climate induced phenomenon.

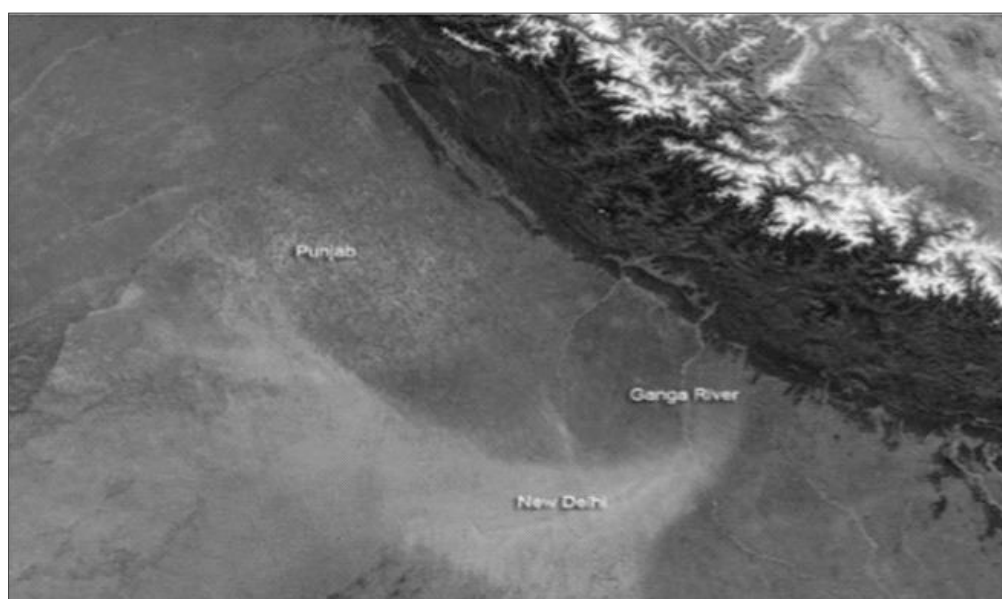
## FINDINGS

### MEASURES ADOPTED TO IMPROVE THE AIR QUALITY OF DELHI

#### *Odd-Even scheme*

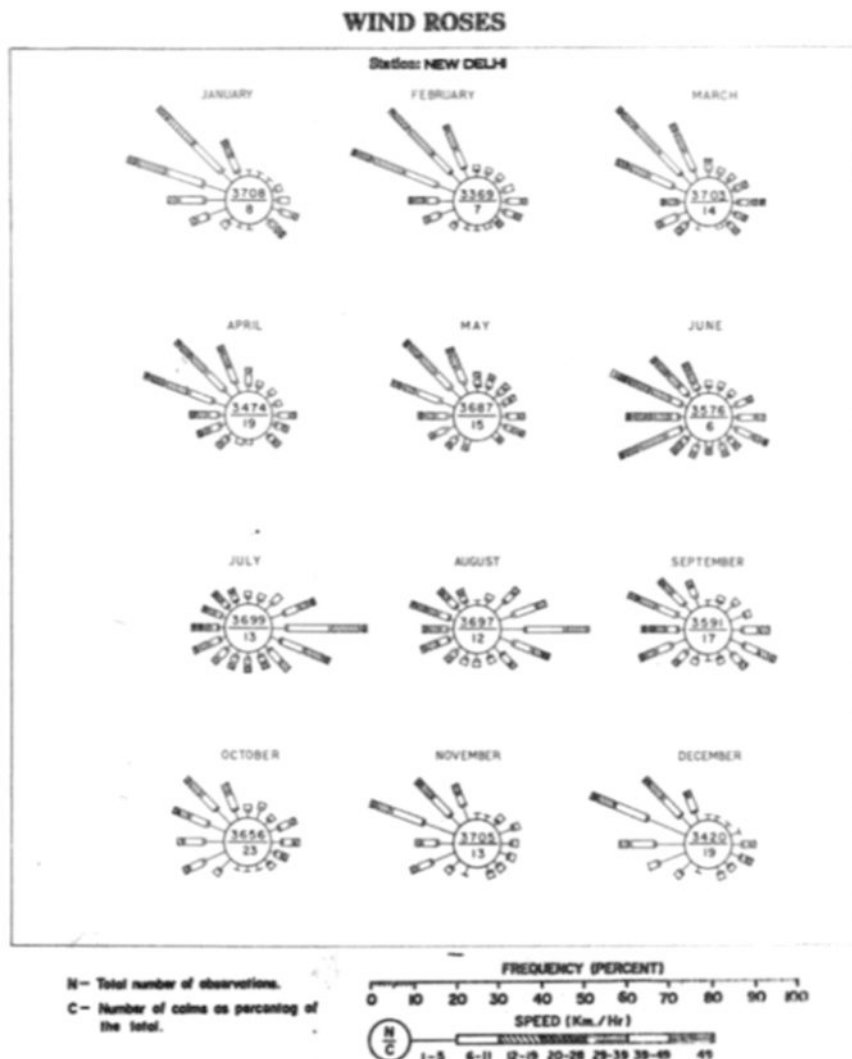
An initiative by Government of NCT of Delhi to curb the air pollution by applying 'Odd-even scheme' on the 4-wheelers plying on the roads (exempting a few) from Jan. 1st - 15th and Apr. 15th - 30th, 2016, which is yet to come again from 4 November 2019 to 15 November 2019. The scheme is proposed to run the vehicles as per their registration numbers on alternate days. The vehicles having registration number ending with an odd digit are allowed to run on the odd dates and vice-versa. The ultimate aim of the scheme is to reduce the number of vehicles from the roads of Delhi.

**Biomass burning in Punjab (red dots show the fires and plume)  
(Source: NASA)**





**Effect of meteorological conditions on the air quality of Delhi Wind-rose diagram of Delhi**  
(Source: Indian Metrological Department, Ministry of Earth Sciences)



To assess the effect of this scheme on the air quality of the city, an analysis was done using the data collected by the CPCB from 8 operational CAAQMS (4 of CPCB and 4 of DPCC) and the 7 manual stations of the CPCB. The pollutants studied include the PM10, PM2.5, SO2, benzene, O3, NO2, and CO. The study reveals that during the odd-even period, there was a marked increase in the pollutants concentration as compared to 'pre - odd even period', for e.g. there can be seen 13 - 39% rise in the PM10 concentration, 52 - 70% rise in the PM2.5, and 37 - 80% rise in the NO2 concentration. Other pollutants were also found to be increasing. No definite reason could be determined for this, however, unclear trend and the wide fluctuations of air pollutants can be attributed to the meteorological factors and the emissions from pollution sources other than transportation. Moreover, the odd-even scheme effect might also be diluted due to coverage of the very few vehicles under this scheme.

**Court directions**

A number of directions under the Section 18(1)(b) of the Air (Prevention and Control of Pollution) Act, 1981 regarding prevention, the control or abatement of air pollution and the improvement of ambient air quality in Delhi and National Capital Region (NCR) were issued to Uttar Pradesh Pollution Control Board, Haryana Pollution Control Board, Delhi Pollution Control Committee, and the Jhalana Institutional Area, Jaipur, Rajasthan on Dec. 29th, 2015. The directions included various significant issues such as the control of vehicular emission, the tcontrol of road dust and other fugitive emission, the control of air pollution from biomass burning, the control of industrial air pollution, control of air pollution from construction and the demolition activities, etc.

- A control room has been set up in the CPCB to facilitate the review of levels of air pollution

and monitoring ambient air quality in the Delhi and National Capital Region (NCR).

- Prohibition on the entry of overloaded and the non-destined trucks in Delhi and imposition of 'Green Tax'. 12.1.5. The Delhi Government has launched a car-free day campaign 'Ab Bus Karein' since 22nd October 2015 to be observed on the 22nd day of every month.

### ***Air Quality Index (AQI)***

To reduce the health impacts of the pollutants, the dissemination of the information related to air quality is also equally important, so that the preventive measures can actually be adopted. In the view of this, CPCB and the Ministry of Environment, Forest, and Climate Change (MoEF& CC) initiated the project on the national Air Quality Index (AQI) to strengthen air quality information dissemination system for larger public awareness and their participation on air quality management. The index was launched by Hon'ble Prime Minister in April 2015 starting with fourteen cities. At present, AQI is determined at twenty three locations across the country, including Delhi, Faridabad, and Gurgaon.

For the on-line continuous (24x7) air pollution monitoring, out of the 2800 major industries, 920 industries have already installed the devices and others are in process of installation.

### ***Other initiatives***

- Stringent provision for ash content in the coal for thermal power plants.
- Stringent industrial emission standards formulated and notified for public or stakeholders'
- Construction of the Eastern and the Western Expressways for by-passing non-destined traffic to Delhi.
- The Regular co-ordination meetings to discuss air pollution control in the NCR adopting airshed approach.
- The Revision of rules for handling and the management of municipal waste.
- The Revision of rules pertaining to construction and the demolition waste.
- Ban on burning of leaves/ biomass in the city.
- Introduction of Fuel quality standards (Bharat Stage - I, II, III, and IV).

- Introduction of the Pollution under control (PUC) certificate with three month validity
- The introduction of compressed natural gas (CNG) for commercial vehicles phased out from 1998.
- Introduction of Metro rail transit system for rapid mass transport.
- The construction of fly-over and sub-ways for smooth flow of the traffic.
- Time clocks installations at the red lights.
- Route diversion of the inter-state buses.
- Benzene (a carcinogen) in gasoline reduced from 5% (April 1996) to 1% (November 2000).
- Sulphur content in diesel reduced from 0.5% (April 1996) to 0.05% (April 2000).
- Restrictions imposed on operation of goods vehicles during day time from August 1999.
- Introduction of car lifecycle of Petrol(15 years) and Diesel(10 years) cars in the city.
- Catalytic converter in passenger cars introduced from April 1995.

## **RECOMMENDATIONS**

### **RECOMMENDATIONS / SUGGESTIONS TO IMPROVE THE AIR QUALITY OF DELHI**

Even after taking several initiatives, the pollution in Delhi is still rising to a great extent. To tackle the problems and to reduce health risks generated due to air pollution, steps are to be taken immediately.

Therefore, following issues need to be judiciously addressed at the earliest possible.

- For the development of the country, establishment of new industrial units cannot be downgraded, an effective control measures of pollution, and a proper installation of air pollution control devices and smooth functioning must be ensured before the establishment of any industry. After the establishment of the industry, proper functioning of the installed controlling units must be ensured.
- Restrictions can be imposed over the number of vehicles owned by an or a individual / family.

- Provision of parking space in the commercial establishment or shopping
- Mall or parks or residential apartments should be mandatory.
- Emission from construction industries or activities can be minimized by adopting best practices such as creating ridges to prevent dust, compaction of disturbed soil, use of water sprays for dust suppression, prevention of dumping of earth materials along road side etc.
- The improvement in traffic signal co-ordination for continuous traffic flow to reduce traffic jam thereby resulting in minimization of idling time.
- Corporate firms or government offices may draw up an action plan to have the bus or cab services for their employees with reasonable rates.
- Strict rules should be imposed for the proper dumping and the disposal of solid waste, since unregulated burning results in pile-up of smoke and the particulate matter in concentrated form at one place. The regular functioning of all the installed solid waste treatment facilities must also be ensured after regular intervals
- Vegetation cover should be increased along the highways, the road dividers, and busy traffic intersection points.
- There should be a strict checking of the PUC certificates.
- There should be more allotted space for pedestrians and the two-wheeler vehicles on the roads.
- Up-gradation of the public transport is necessary by improving service quality, the

enhancing of number of buses, and the better road management

- The Research and the development for the battery-run buses or cars etc. needs to be promoted.
- The mass awareness should be increased through the electronic and the print media for all age groups towards sustaining the environment and to reduce pollution. The public should also be motivated for the use of public transport.

## REFERENCES

National air quality index, CPCB – CUP Series (CUPS/82/2014 – 15).

Economic survey of Delhi (2004), Planning Department, Government of National Capital Territory of Delhi, 6th level, New Delhi (India).

Economic survey of Delhi report 2014 – 15.

Anfossi D., Brusasca G., and Tinarelli G. (1990), Simulation of atmospheric diffusion in low windspeed meandering conditions by a Monte Carlo dispersion model, *II NuovoCimento C*, 13(6), 995 – 1006.

<https://pdfs.semanticscholar.org/58b6/fdff4b7eedcbd4543a25920c3d78d2053045.pdf>

<https://pdfs.semanticscholar.org/58b6/fdff4b7eedcbd4543a25920c3d78d2053045.pdf>

[http://www.indyatour.com/india/environment/indian\\_pollution.php](http://www.indyatour.com/india/environment/indian_pollution.php)

<https://www.youtube.com/watch?v=e6rglsLy1Ys>

<https://aqicn.org/city/delhi/>

<https://www.ndtv.com/topic/delhi-air-pollution>

<https://timesofindia.indiatimes.com/topic/delhi-air-pollution>

Central Pollution Control Board

The Air (Prevention and Control of Pollution) Act, 1981

One India Air Quality Index

Press India Bureau , Ministry of Environment and Climate Change

# A Study on Child Trafficking

Tanya Khosla\*

According to the law person who have not completed eighteen years of age comes under the category of child. When any injustice or exploitation caused to such children it is termed as child trafficking. It is defined as act of cruelty where illegal transportation of child, act of buying and selling for some commercial use and for the purpose of exploitation which is performed within or outside the country. There are many ways through which the children's have reached in the traffickers but generally these child's are promised for an daily wage to support their family and in some cases the parents themselves insist their children due to poverty considering them as an asset to the family rather than providing them education but in reality they are bought into forced slavery or transported to various regions for begging, labour and sexual exploitation. It is difficult to find out traffickers involved in such activities since there is lack of proper enforcement of such laws over the issue which is otherwise called as an silent crime unless and until there is traces of such activities found no one will be aware of illegal prevailing of such crimes. The cause of child trafficking is generally due to poverty, unrecovered bond or debt of their parents or ancestors indulging children into forced and bonded labour.

Children can be trafficked with the intention of adopting them. Over the past few decades the rate of child trafficking has become more and in the previous two years children have been abducted, kidnapped and harboured. The general crimes against children are child and bonded labour, sexual exploitation, child servitude, involuntary domestic servitude, child soldiers etc.

**Keywords:** Transportation, buying, unrecoverable, poverty, abduction, intention, slavery.

## INTRODUCTION

Child trafficking is generally defined as the act of harbouring, transferring and receiving of the child who is below 18 years of age who are abducted and taken from homes without their consent and sold for money in the illegal market.

The nature of the crime is that it is difficult to track there is existence of such child trafficking since there is no proper enforcement of laws. The reasons for child exploitation maybe due to poverty, lack of proper safety to children in remote areas as well as in urban cities. Generally children are trafficked for begging, poverty or debt to be paid by their parents, relatives or guardians. In some cases the children are drugged and they are prone to sexual exploitation voluntarily. Such traffickers are difficult to trace they are also called as silent crime makers this is the largest crime in the world. Types of child labour such as involuntary domestic servitude, forced child labour, illegal activities, child soldiers, child exploitation for commercial sex, child prostitution. The rate of child trafficking is higher in Nepal.

(Enakshi Ganguly Thukral 2009)

The role of private institutions are lacking and adoptive agencies that may be the reason for child trafficking (Mayeda Jamal 2005). The slave as a trade is increasing due to extreme poverty, illiteracy, inability to access to resources are the causes of increased crime of child trafficking (Salivia Scarpa 2006). Because of which the traffickers faces physical and mental stress and unable to adapt to the environmental setting (RCY Chung 2007). The crust of this problem is due to clandestine and secret evidence and reports remain untracked and no proper records (Biswajit Ghosh 2009). From the past decades the problem of child trafficking has gain more importance and addressed as social problem (Jonathan Todres 2010). Health and safety standards are more that may (Yvonne Rafferty 2013) be the reason for child trafficking and there is large volume of victims of such traffickers.

There must be interference of the government and intergovernmental organization and committee must be formed and strict enactments to be made to protect children and pass stringent laws to decrease the rate of this crime (Mike Dottridge 2004). The offenders involved in such trafficking can involve in illicit trafficking, that includes aggravated form such as sexual exploitation, slavery, slavery for commercial sex. The exploration of standardisation of judiciary may

---

\* Software Analysis Engineering Trainees Samsung Research & Development

represent a way out to response to ecology. The protection of such children and the enactment of laws have been done at international level (R Fong, JB Cardeso 2010).

The best way to prevent child trafficking is the parents should not employ their children to work rather than educating them (Sylvian E.Dessy, Stephen Pallage 2006).and inculcating proper knowledge about the current society and teaching safety precautions India is viewed as the central hub of child trafficking. The Immoral Traffic Prevention Act In 1956 was brought into force to prevent exploitation of women and children from the offence of child trafficking (A Bajpai 2017). Government of India has enacted laws in the United Nations Convention Centre to punish the offenders who perform such harmful activities against women especially children. There are many reasons for such happening of child trafficking and means through which children are exploited that leads to them to exploitation. The aim of the study is to analyze the types of child trafficking.

## LITERATURE REVIEW

The author explores that the children who belongs to various parts of the country who are been affected with the unequal regularity and says that the children are forced and get them married and involve them in household at an early age (Enakshi Ganguly Thukral 2009). The author says that there is consequent increase in the crime rate of India. The lack of security and child protection agencies are the main reason for such crimes (Mayeda Jamal 2005).

The author analysed that the trafficking stands third at the list of largest crime rate and the system of slavery of children is new that is due to most of the people below the line of poverty.(Silvia Scarpa 2005). There is existence of international laws and discusses about the mental stress faced by the affected people which can be difficult to adapt to the environment (RCY Chung 2007).The child trafficking can be linked with various difficulties faced by young children's and the reason for crime is due to lack of political will in state (Biswajit Ghosh 2009). The children's incapability to take decisions and lack of mental maturity can be a key to such crimes (Neil Howard Sam 2015).In the past few years there is increased importance given to such crimes which is been happening to children though there is various welfare measures formulated for children (Jonathan Todres 2010) The author describes the definition of child trafficking where infringement of a child by the offenders so there is no freedom provided and

cruelty is expressed (Yvonne Rafferty 2013).The act of trafficking has violated the pattern of human rights of children and the process of kidnapers is targeted to children without guardian and stray children ( Mike Dottridge 2004).The ethical and cultural values are also lost its freedom and represent an ideological aptitude towards the society and talks about enslavement( DM Smolin 2012).The author says that the affected children must be considered and the people must be given some finance to help to recover and other incentives from the government ( R Fong, JB Cardeso 2010).

The author suggests measures to protect such child trafficking such as inculcating the importance of issues and teach safety measures at initially proper education must be provided (Sylvian E.Dessy, Stephen Pallage 2006). It is considered as the centre of such offenders the Immoral Prevention Act 1956 which gives protection against the women and children (Johnson 2003). Human trafficking which stays at the profitable industry in the world which is prevailing in developed and undeveloped countries(web article).There is more demand in the illegal market for organs so such traffickers make use of it kidnap various children plunder their organs and they sell for higher price at illegal black market the intermediaries involved here also gains more profit (Philip Perry 2014). The author suggests that every child must have minimum education in order avoid such crimes there is prevalence until there is chance for it (Tomar O.Muhammad 2010).The author describes that the main purpose of targeting children is employing them in forced labour and for commercial sex (QJiang, Jesus J Sanchez 2013).The author describes the process through which the children's are prey to such crimes that involves planning as initial (S Baker 2012). The author explains about types of forced labour and reasons ( Jason H 2009).Child soldering which is the most rarest and the worst practices where triggering the children to involve into violence which is most rarest form of exploitation found in the world(Ilse Deryln, Mediac Eric Brokerat 2004).

## OBJECTIVES OF RESEARCH

1. To analyze in detail the types of child trafficking in which the children are exploited.
2. To analyze the laws which protect the child in from child trafficking.

## FINDINGS

Trafficking of children is one of the gravest offensive crimes worldwide. Child trafficking is

rapidly expanding in several forms of exploitation. It is the children of the poor and marginalized communities who are often trafficked to be forced into labour. Parents of these children are either betrayed or lured due to their poor socio-economic conditions thus forcing them to 'send' or 'sell' their children for better livelihood options. The lack of awareness is a situation that traffickers exploit especially when it comes to uneducated poor living in slums and other backward regions in the country. Traffickers promise daily wages to parents of young children and transport them to big cities where they are often treated as commodities. Families in dire financial conditions are often approached by traffickers with an offer to buy their children and with no other escape from their pitiful conditions, parents comply.

The result of the study is that there are child trafficking still prevailing in India and the main cause is that due to proper awareness and knowledge about such crime happening around them and illiteracy which may be the cause which creates an opportunity to such traffickers and poverty which provides an opportunity to traffickers.

### SUGGESTIONS

The main reason of child trafficking is illiteracy that has surrounded the major parts of India. Following are the points that should be followed in order to reduce the rate of child trafficking in India.

- Foster the spread of education
- Spread awareness among parents and communities
- Strict laws in place to prevent child trafficking
- Encouraging business to not use child labour
- Support an NGO like Save the Children in the

fight against trafficking

- Fighting child trafficking and child labour
- Child safety

### CONCLUSION

Through a joint effort of civil society and government in Child Education, Health & Nutrition, Child Protection, Humanitarian Response, lakhs of children have found hope. Relationships with Government, national and international bodies make child rights NGOs like Save the Children a driving force in resolving such issues. Child trafficking is a major social menace and the best way to deal with it is through following the "prevention is better than cure" approach. The Immoral Traffic interference Act was initial amended in 1956; the act was created to stop trafficking and sexual exploitation of ladies and children however will the Act offer clear definition of "trafficking" In 2003, Asian nation implemented the international organization Convention against multinational gangland, which incorporates 3 protocols, specifically the Protocol to stop, Suppress, and penalize Trafficking in Persons, particularly girls and kids.

### REFERENCES

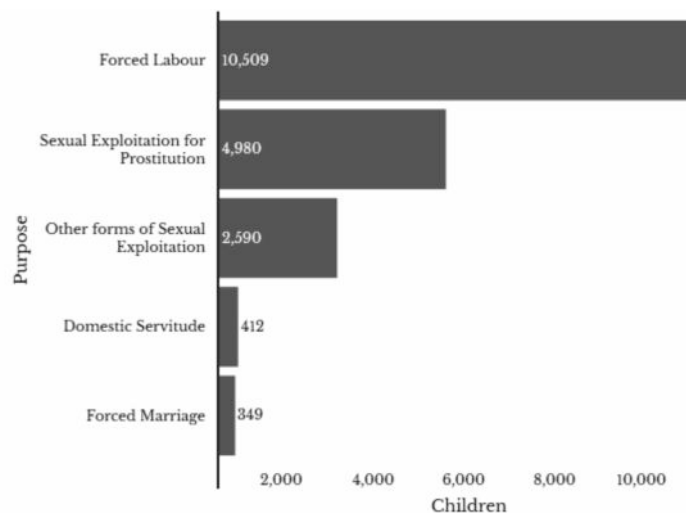
<https://www.savethechildren.in/resource-centre/articles/how-can-child-trafficking-be-prevented-in-india>

<https://www.theguardian.com/global-development/2015/apr/28/child-trafficking-india-domestic-labour-chhattisgarh>

<https://www.cry.org/issues-views/child-trafficking>

<https://www.indiaspend.com/3-in-5-indian-adolescents-vulnerable-to-abduction-sexual-slavery/>

**Top Five Purposes of Human Trafficking, 2016**



## Manuscript Preparation Guidelines

*Amity Journal of Energy and Environmental Studies* prefers manuscripts submitted in electronic form in Microsoft Word. The advantage of electronic manuscripts is that they can be edited and prepared for publication without having to retype anything. Please keep in mind, however, that a design for your manuscript will be created by our design staff, and the final edited files will be converted to a typesetting program from which the page proofs will be created. So please keep it simple – if you spend a lot of time using your software to format your manuscript and customize the way it looks, we, in turn, must spend time paring your manuscript back to its basic elements to ensure that the whole process goes smoothly.

Please use the following guidelines to ensure that the electronic manuscript and printouts you submit to us will be ready to edit without further ado. Contact your editor if you have any questions!

## FORMATTING

---

Your manuscript should be **double-spaced throughout**. The printouts you provide should be **single-sided** with every page numbered. No two pages of your manuscript should have the same number. Either number the pages according to section (e.g., “Author last name, chap. 1, p. 57”; “Author last name, tables, p. 12”) or consecutively throughout the manuscript (e.g., “Author last name, p. 1”). Use the same typeface (or font) throughout the entire manuscript. For information about special characters, please see below.

### *Sections and Headings*

Do not assign “styles” to achieve different formats for subheads, block quotes, paragraph indents, etc. The default, or “normal,” style should be the only style in your manuscript. (If your program assigns a special style to automatic notes, however, that’s okay.) If a chapter has more than one level of subheads, differentiate them by typing (using angle brackets) <A>, <B>, or <C> at the beginning of each subhead, as appropriate. It is also acceptable to differentiate subheads visually (with centering, bolding, underlining, etc.), but please be consistent in the way you use such formatting.

### *Spacing and Indentation*

- Do not use the space bar to achieve tabs or indents or to align text.
- Do not use the space bar or the tab key to start a new line, format block quotations, or create hanging indents for your bibliography.
- Format prose extracts (block quotations) and verse extracts with your word processor’s feature for indenting paragraphs (0.5 inch). Insert a hard return only at the end of a paragraph or a line of verse.
- Do not insert an additional hard return to create extra space between paragraphs. Where you want a space break in the Journal, type “<space>” on a line by itself.
- Do not use the automatic hyphenation feature. There should be no “optional” hyphens in your manuscript.
- Do not “justify” text to the right margin.

### *Special Characters*

Use the same font throughout the entire manuscript. Produce any special characters using your word-processing program’s built-in “special characters” set. If you need a character that’s not available, you can use descriptive shorthand enclosed in angle brackets. For example, <bhook> aci might indicate that the typesetter should render the Hausa word aci. Do not “make” a character by combining more than one character, or by using graphics or codes. **If you use a special font to create characters, please alert your acquiring editor and send a test file early in the process so that we can see whether the font is compatible with our system.** When you submit your manuscript, include a list of special characters and, if applicable, include their angle-bracketed shorthand descriptions.

### *Hidden Text, Comments, and Field Codes*

Make sure that there are no comments, annotations, field codes, or hidden text whatsoever in the final version of the manuscript that you submit to us. In addition, make sure that all “tracked changes” or other revision marks have been accepted as final (i.e., there should be no revision marks, hidden or otherwise, in the final manuscript).

## BOXES/SIDEBARS, TABLES, AND FIGURES

---

### Separating Boxes/Sidebars, Tables, and Figures from the Text

Each text box/sidebar, table, or figure of any kind (including photographs, maps, charts, and graphs) must be submitted in files separate from those of the main text.

### Numbering

Text boxes/sidebars, tables, and figures should be numbered separately.

### Indicating Placement

To indicate ideal placement in the text, please place a bracketed, sequentially numbered “callout” on a separate line in the manuscript between paragraphs that indicates placement: [Figure 1.1 about here]. Do not embed figures in the text files. The typesetter will attempt to follow your callouts, while adhering to the specifications of the Journal design we provide.

### Preparing a List of Captions

Include a separate, sequentially numbered list of captions that matches the callouts in the manuscript with the proper caption and credit line (or source), if any, for each illustration.

## DOCUMENTATION GUIDELINES

---

- Reference information needs to be in APA Format
- Please note that full citations in notes are not necessary as long as complete bibliographic information is provided in your bibliography or reference list. Shortened versions of citations in notes are recommended, in fact: e.g., Melville, Moby Dick. Manuscripts that do not have a bibliography or reference list must give full citations the first time a work is cited in the notes (preferably the first time in each chapter); thereafter, short citations should be used. If you are using an Author/Date reference style instead of notes and a bibliography, the year of publication must immediately follow the author’s name in each entry of your reference list.
- Do not manually create hanging indents for your bibliography or reference list by using hard returns and tabs in the middle of an entry. Instead, either use the hanging indent feature in your word-processing program or format each entry like a normal paragraph with a first line indent.

## ABSTRACTS AND KEYWORDS FOR ONLINE DISCOVERABILITY

---

*In order to enable the text of your journal to be fully searchable alongside other online content – a crucial feature in ensuring its discoverability – we need you to create an abstract and to identify keywords for the full text of your journal as well as abstracts and keywords for each chapter. By creating these, you will ensure that the contents of your journal are represented as you think best and most appropriate. This information may well be the primary means by which students, academics, and researchers are led to your content in its digital forms.*

### **Abstracts**

The abstract should provide a clear idea of the main arguments and conclusions of your chapter, while chapter abstracts should give an overview of the content of each chapter, including the introduction and conclusion. The abstract may be no more than 250 words, where possible, you should adopt an impersonal voice rather than using personal pronouns: “This paper discusses...” rather than: “In this chapter, I discuss...”

Abstracts cannot be more than one paragraph in length and cannot contain the following:

- lists of any kind;
- tables;
- footnotes or endnotes;
- graphics; or
- boxed material.



Only the following special formatting is allowed:

- italics;
- bold;
- small caps; or
- superscript/subscript.

### ***Keywords***

Please suggest 5–10 keywords for the paper. The keywords will enable the full text of the journal to be searchable online. Keywords are equivalent to terms in an index in a printed work and distinguish the most important ideas, names, and concepts in the journal.

- Each keyword should be kept short, one word where possible (though two- and three-word specialist terms are also acceptable where necessary);
- A keyword should not be too generalized;
- A keyword cannot contain punctuation of any sort (i.e., no commas, periods, colons, semi-colons, etc.);
- Keywords should not be too generalized;
- Each keyword should appear in the accompanying abstract;
- A keyword can be drawn from the book or chapter title, as long as it also appears in the text of the related abstract;
- A keyword must be all lower case except for proper nouns; and
- No special formatting (e.g., italics, bold, superscript text, etc.).

# AMITY JOURNAL OF ENERGY & ENVIRONMENT STUDIES

July 2018

## Subscription Form

I wish to subscribe my subscription to Amity Journal of Energy & Environment Studies for Rs. 500/- (Annual Subscription Fee).

A draft/cheque bearing no..... dated.....

For Rs. 500/- drawn in favour of Amity University Uttar Pradesh, Noida is enclosed.

Name : .....

Address : .....

: .....

: .....

City : ..... Pin:.....

Country : .....

Email Address : .....

Signature : .....

**STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS OF  
THE JOURNAL AMITY JOURNAL OF ENERGY & ENVIRONMENT STUDIES**

**Form - IV  
(Rule 8)**

- |    |                                |   |   |
|----|--------------------------------|---|---|
| 1. | Place of Publication           | : | Noida   |
| 2. | Periodicity of its Publication | : | Bi-annual   |
| 3. | Printer's Name                 | : | Venus Pressworks LLP  |
|    | Whether citizen of India       | : | Yes   |
|    | Address                        | : | D-84/3, Okhla Industrial Area,<br>Phase-I, New Delhi-110020                                     |
| 4. | Publisher's Name               | : | Amity Business School   |
|    | Whether citizen of India       | : | Yes   |
|    | Address                        | : | Amity Business School<br>Amity University, Uttar Pradesh,<br>Sector-125, NOIDA -201 313 (INDIA) |
| 5. | Editor-in-chief's Name         | : | Dr Sanjeev Bansal   |
|    | Whether citizen of India       | : | Yes   |
|    | Address                        | : | Amity Business School<br>Amity University, Uttar Pradesh,<br>Sector-125, NOIDA -201 313 (INDIA) |

I Sanjeev Bansal, hereby declare that the particulars given above are true to the best of my knowledge.

(Sd/-)  
Sanjeev Bansal  
(Signature of the Editor-in-chief)



# AMITY BUSINESS SCHOOL

Amity Business School, Amity University, Uttar Pradesh,  
Sector-125, Noida - 201 313, INDIA  
Phone: 91-120-4392333; Fax: 91-120-2432784