



Faculty of Design

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Air Quality in Delhi

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AIR POLLUTION DELHI, INDIA

The wicked problem we chose to address is the air pollution in Delhi, India's capital territory located in the north of the country. Air pollution is one of the most hazardous issues that the developing nation is facing.

The air pollution in Delhi is caused and exacerbated by multiple factors in the social, technological, economic, ecological, and political (STEEP) aspects of the region. Our group investigated this topic because we were curious about how the problem gradually developed to the scale it is today. Furthermore, air quality control is a problem faced by many developing countries with similar experiences. Therefore, analyzing the problem through the lens of Delhi also helped us gain insight into a global health crisis. Additionally, we utilized strategic solutions and design thinking to locate possible points of interventions that may help alleviate the problem.

We broke our map down into 5 overarching factors - Agriculture, Industry, Urban life, Ecology, Political. Through various interventions, we created a map of this wicked problem and how to affect change in the different categories within this system. As the map moves inwards, so does the scale of analysis. The various factors of STEEP are marked with different colored arrows, as well as noted with inputs and outputs of different intervention actions described.

THREE HORIZONS

Increase by 2050:

- The number of electric vehicles and charging stations in Delhi, before the implementation of the electric vehicle policy.
- Growing number of electric vehicles and charging stations in Delhi, as a result of government subsidy and low import tax.
- More than 25% of all transportation vehicles becomes electric or hybrid to reduce emissions of PM2.5 + PM10.

Decrease by 2050:

- High concentration of pollutants and dust in the atmosphere, resulting in heart and lung problems.
- Regulated emission of harmful particles. Controlled level of PM2.5 + PM10.
- Healthy level of PM2.5 + PM10.

Transition by 2050:

- Standard taxation on rice and grain to curb stubble burning. Low subsidy for farmers to grow fruit and vegetables.
- High tax on rice and grain. High subsidy for farmers to grow fruit and vegetables.
- Both taxation and subsidy return to standard levels, when other infrastructures and policies are developed and in effect.

INTERVENTION POINTS

Regulation, subsidy, and taxation on Indian farms

- Individual:** Starting higher taxation on grain and rice, encouraging farmers to grow more fruit and vegetables, which do not leave significant emissions behind. Introduce technicians and advisors from the Ministry of Environment, Forest and Climate Change to help to support and monitor progress on neighborhood level.
- State:** Introduce national regulation and standards on stubble burning, including the implementation to burn, limit on the amount of stubble burnt, and the week when burning can happen. Additionally, the country may invest in other environmentally friendly ways of feeding the farmers and killing microbes.
- Nation:** Advancements to farming methods can be made by introducing farming machinery such as the United States. This can be achieved by decreasing import tax on foreign electric vehicles and rapidly growing the Indian electric vehicle industry with government support.

KEY

Now (Blue dot)

Transition (Red dot)

Future (Orange dot)

Social (Green arrow)

Technological (Yellow arrow)

Ecological (Light green arrow)

Economic (Orange arrow)

Political (Blue arrow)

Individual (Purple dot)

State (Light blue dot)

Nation (Pink dot)

POTENTIAL CONSEQUENCES

- Restrictions and regulations being placed on farming is a somewhat abrupt move that may result in discontentment among the farmers.
- Reduction in diesel and petrol vehicles on the roads, as a result of existing electric alternatives, may lead to transfer of jobs from traditional vehicle industry to electric vehicle industry, which is a slow process that may cause unemployment in the short term.
- With those construction regulations, it might be difficult to enforce them and workers might not maintain proper safety protocols when advisors are not around. There also might be some difficulties with measuring the amount of PM2.5 and PM10 particles emitted by specific regions.

Consequences above address each of the intervention points respectively

POLITICAL

"100% electrification"

Newly introduced policy regarding availability of electricity in every Indian household. This led to an increase in demand of electricity, which means a rise in fuel cost consumption, especially domestically produced coal.

"Treatment after pollution"

Indian government prioritizes public infrastructure and economic growth over environmental policies, making environmental damage a secondary concern.

Impeded local funding

Introduction of goods and services taxes had taken away the powers of local state governments. Funding issues and had made them highly dependent on the union government for funds.

Corruption & Malfeasance

The state government and grass-root village government are influenced by the landlords, whereas the ruling party of the central government is sponsored by monopolistic capitalists. These stakeholders make it hard for an environmental policy to be properly implemented and enforced.

Regionalism vs Centralism

The central government has put huge effort in making the power previously owned by the state government, such as reaching out to the grass root level neighborhoods using internet apps. Such practices result in resistance from the state government.

Low forest cover rate

Delhi has forest cover percentage of only 13.8%, which is still facing a decrease.

Lack of "clean" energy

There is not only a lack of renewable energy, but also a lack of relatively "clean" traditional fossil fuel like low-sulfur coal.

Lack of hydro and wind energy

Since Delhi is located on a plain, it does not have sufficient water potential and wind speed to power a hydro power station or wind farm.

Lack of crude oil resource

India has an estimated crude oil reserve of only 324-49 million tonnes, and has to import 80% of its oil needs, which means the country has to rely heavily on coal burning power stations.

Lack of high quality coal

Although India produce millions of tons of coal per year, it is of low calorific value and high ash content. It also contain more toxic element.

Encourage the use of more electric vehicles and public transit

- Individual:** Creating personal goals to reduce the amount of three wheeled and personal vehicles, favoring towards public transport and greener alternatives. There should be a lower tax on domestic and imported vehicles to stimulate demand from the people.
- State:** On a regional level, the city government should also take action to reduce the number of vehicles on the road. The Beijing government was renowned for its program in improving the city air quality. One of the policies that Beijing introduced was setting an annual quota on new vehicles being registered within the city. Delhi needs benefit from setting a similar quota.
- Nation:** Introducing and subsidizing electric vehicles, bus, three and four wheeled, in the Delhi transportation system. This can be achieved by decreasing import tax on foreign electric vehicles and rapidly growing the Indian electric vehicle industry with government support.

Impose regulations on construction sites that produce dust & pollutant

- Individual:** Send advisors and technicians to large construction sites to ensure the tarpaulin is used to prevent dust from escaping the site. Also, the advisors should ensure that workers are wearing proper protective equipment for their respiratory system.
- State:** The city government could set regulations on the amount of PM2.5 & PM10 particles being emitted to the air in districts since each district may have various levels of emission.
- Nation:** Set national standards and reward & punishment system to enforce regulations and ensure that are in place. Use media platforms to raise awareness of the harm of construction & coal dust to increase pressure.

AGRICULTURE

Farming Emissions

The use of underdeveloped machinery contributes to the use of harmful fuels and the production of dangerous gases.

Stubble burning

Usually occurs at the end of harvest season, in which farmers burn the left-over crop stubble.

Manufacturing

As one of the most economically developed regions in India, Delhi is also a hub for manufacturing and production of goods and services.

Construction

Economic growth in Delhi leads to the rapid growth of housing and infrastructure.

Brick kilns

The process of producing bricks is an essential material for the construction, which is also a major source of air pollution.

Vehicle emissions

Lack of regulation on the number of cars on the road, high concentration of cars, and the use of old cars contribute to the air pollution in Delhi.

Burning fossil fuels

Burning fossil fuels is a category of problems through local different classes from individuals to households to industrial facilities.

Transportation

All industry is sustained by an efficient transportation system. In Delhi, it is primarily sustained by road.

Education

Lack of educational awareness about the local environment amongst lower class citizens, including public educational facilities in Delhi.

Practices

Historical customs and traditional practices of citizens of Delhi have contributed towards the bad air quality because of lack of consideration for the environment.

Mindset

Careless attitude of high portion of citizens towards the environment due to lack of easy access to information.

Large population density

Delhi originally faced exponential population growth due to migration from Punjab in mid 1900s due to the Partition.

Increased work opportunities

Increasing population led to more work opportunities, leading to increased migration in Delhi.

Increased dry days

Due to the ongoing deforestation and climate change, the dry season is prolonged and the rain season is shortened.

Monsoonal climate

Rainy season from June to September, Dry season from October to May. High variation in temperatures and precipitation between dry season and rainy season.

Dry Season

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Rain Season

South-eastern wind during rain season helps bring air pollution toward North. The precipitation during rainy season also helps remove the pollutants in the air.

Reduced fertility in agriculture land

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Lack of organic composting

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Lack of effective policies

There have been a quality policies and regulations on the farms, but none of them have proved to be effective due to lack of proper enforcement.

Lack of investment

Rural urban divide is most of the farming done in the rural part of the country.

Exploitive and unfair laws

Need for firmly structured policies that focus on the level of sustainability and productivity.

Labour cost

The extremely high availability of manual labour makes it cheaper and more accessible.

Low productivity

Most farming activities are carried out in manual labour, lowering the productivity and efficiency.

Manual Farming

As the industry grows, there is a need towards some more modern farming approaches that are machine-expensive.

"Make in India"

Government used Covid-19 as an excuse to ease the environmental assessment rules, in order to restore the economy and industries.

Agricultural reforms

In order to motivate the farmers to engage in a more productive way of farming, the government decided to "liberalize" the farmers from a state-regulated food market system, where a stable food price and subsidies are guaranteed. However, the lack of subsidies, given any environmental policy from being properly implemented in the village.

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ECOLOGY

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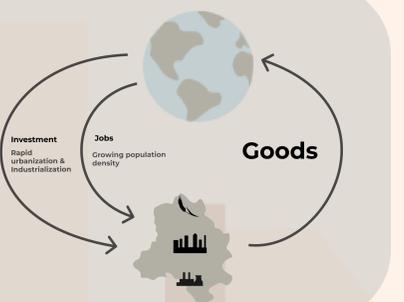
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THE IMPACT OF GLOBALIZATION

Delhi's connection to a more globalized economy created economic growth and prosperity. However, globalization also played a crucial role in worsening Delhi's air. Firstly, Delhi's involvement in the global economy allowed foreign direct investment and off-shore investment to flow into the region, which encouraged the building of infrastructures to support these business activities. This resulted in a higher demand for buildings, roads, and energy, all of which leads to higher emission of pollutants. Secondly, off-shore manufacturing is also a growing trend in Delhi and India overall: more developed countries are taking advantage of India's low labour cost to produce goods, which also contributes to the air quality crisis. Ultimately, this section acknowledges that Delhi's air pollution is not just caused by regional factors, instead stakeholders from around the globe are responsible for exacerbating the wicked problem.



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The state government and grass-root village government are influenced by the landlords, whereas the ruling party of the central government is sponsored by monopolistic capitalists. These stakeholders make it hard for an environmental policy to be properly implemented and enforced.

Regionalism vs Centralism

The central government has put huge effort in making the power previously owned by the state government, such as reaching out to the grass root level neighborhoods using internet apps. Such practices result in resistance from the state government.

Low forest cover rate

Delhi has forest cover percentage of only 13.8%, which is still facing a decrease.

Lack of "clean" energy

There is not only a lack of renewable energy, but also a lack of relatively "clean" traditional fossil fuel like low-sulfur coal.

Lack of hydro and wind energy

Since Delhi is located on a plain, it does not have sufficient water potential and wind speed to power a hydro power station or wind farm.

Lack of crude oil resource

India has an estimated crude oil reserve of only 324-49 million tonnes, and has to import 80% of its oil needs, which means the country has to rely heavily on coal burning power stations.

Lack of high quality coal

Although India produce millions of tons of coal per year, it is of low calorific value and high ash content. It also contain more toxic element.

FEEDBACK LOOPS

Increased food supply leads to **Increased food demand**, which leads to **Increased job opportunities**, which leads to **Increased food supply**.

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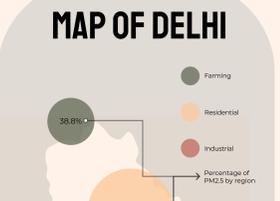
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LEVERAGE POINTS

- Parameters (Yellow circle)
- Feedback (Orange circle)
- Design (Red circle)
- Positive Loops (Light orange circle)