

AN ECONOMIC CASE FOR CLEARING THE SMOG

(An economic case of Delhi's smog situation and how it is being caused through stubble burning.)

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ABSTRACT

Northern India's annual pollution season is here. What used to earlier be described as a foggy winter season, the air in the months of November to February is now a toxic blanket of pollutants made worse by the changing atmospheric conditions.

INTRODUCTION

A study by IQAir and Greenpeace showed that seven out of the 10 most polluted cities in the world are in northern India. There are multiple reasons for the deterioration in air quality, with crop burning being a major cause.² Atmospheric conditions in the months of October and November, with the retreating monsoon, also play a role in this, with winds moving in a southeasterly direction, thereby taking smoke from crop stubble fires from Punjab and Haryana and into Delhi NCR and eastwards into Uttar Pradesh.

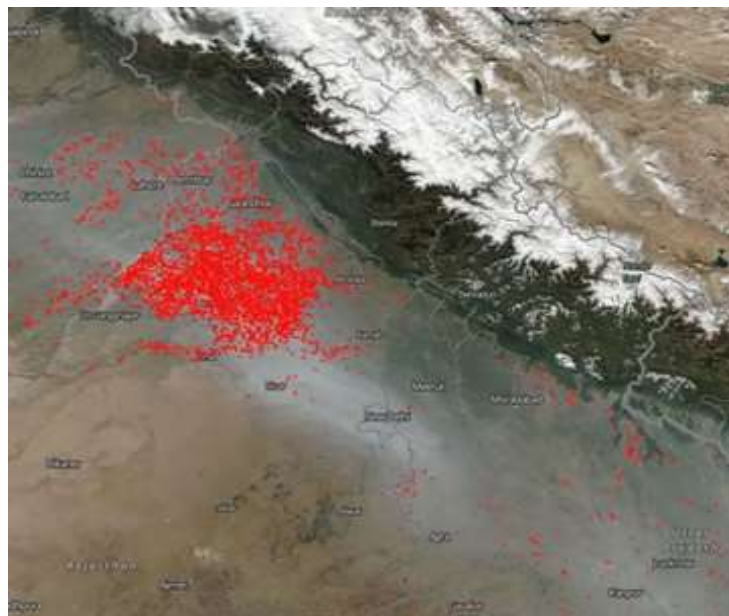


Fig. 1: Satellite Image of crop fires
Source: NASA Worldview (worldview.earthdata.nasa.gov)

ISSUE ANALYSIS

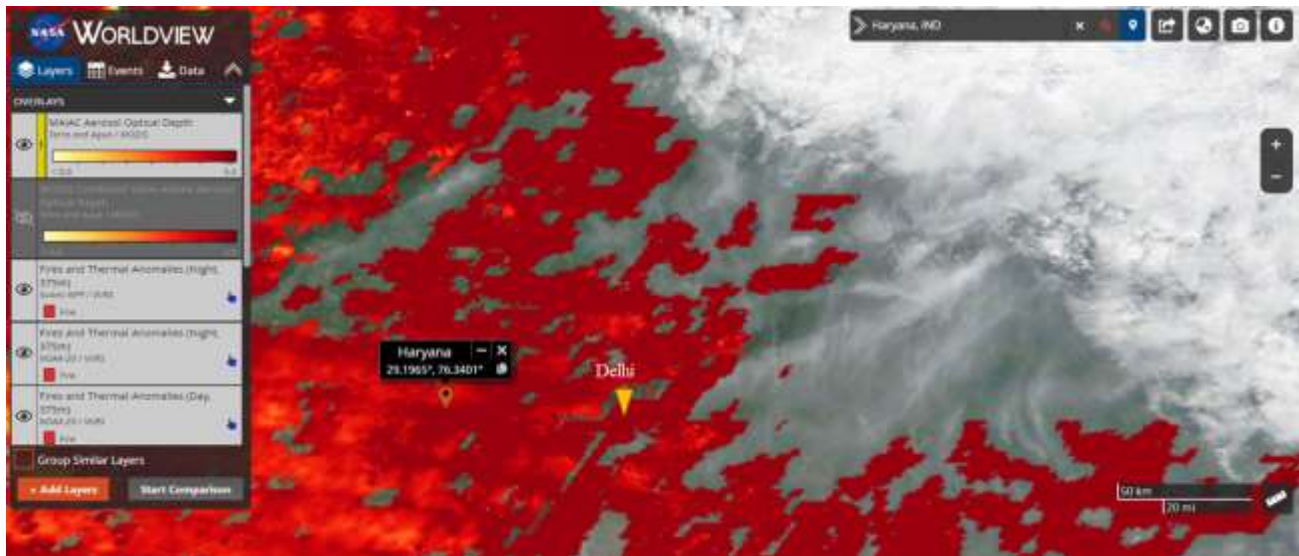


Fig. 2: Aerosol Optical Depth

Source: NASA Worldview, EOSDIS Worldview (nasa.gov)

It is also evident from the image below that the Aerosol Optical Depth (AOD) is intensively high in Haryana, Punjab and even in Delhi. The values range between 4.8 and 5.0. Multi-angle. Implementation of Atmospheric Correction is the only function that provides highly accurate one-kilometer aerosol properties resolving finite scale of urban pollution/smoke from fires.

There is another annual phenomenon that takes place during the same time – various decisions taken by the central and State governments, such as commissioning of ‘smog towers’ or banning of firecrackers. These are well known to have an insignificant impact on the overall pollution in these States yet the same exercises are repeated every year. To understand the factual issues behind increasing pollution in north India in the winter months, we need to delve into some legislative and policy aspects.

The nature of the problem is so extreme that it compelled the Supreme Court to describe the situation as “worse than the Emergency.” This deterioration in air quality has significantly increased after 2009, with the enactment of the Punjab Preservation of Subsoil Water Act. This Act effectively barred any sowing or transplanting of paddy between May 10-15 and June 10-15, reason being that sowing paddy in the peak summer depleted groundwater. In fact, it was found that to grow 1 kg of rice, 4500 litres of water was needed when sown in April-May, while this quantity of water required for 1 kg of rice reduced to just 1500 litres when sown in June. Once the Act was implemented, there was a decrease in groundwater depletion. While the Act may have put a stop to the rapid depletion of groundwater, the lesser time left for farmers for harvest and changing.

crop meant that instead of the crop stubble disintegrating into the soil, it is now being burned. This burning of crop stubble also gives farmers the added advantage of the ash increasing the fertility of the soil. Therefore, there is a clear economic incentive to burn the crop stubble and farmers are not willing to bear the costs of alternative means of disposal. Also, farmers do not feel the need to adopt better means as they are not the ones being fully affected by it, while the consequences of their actions are borne by the people of Delhi and further downwind.

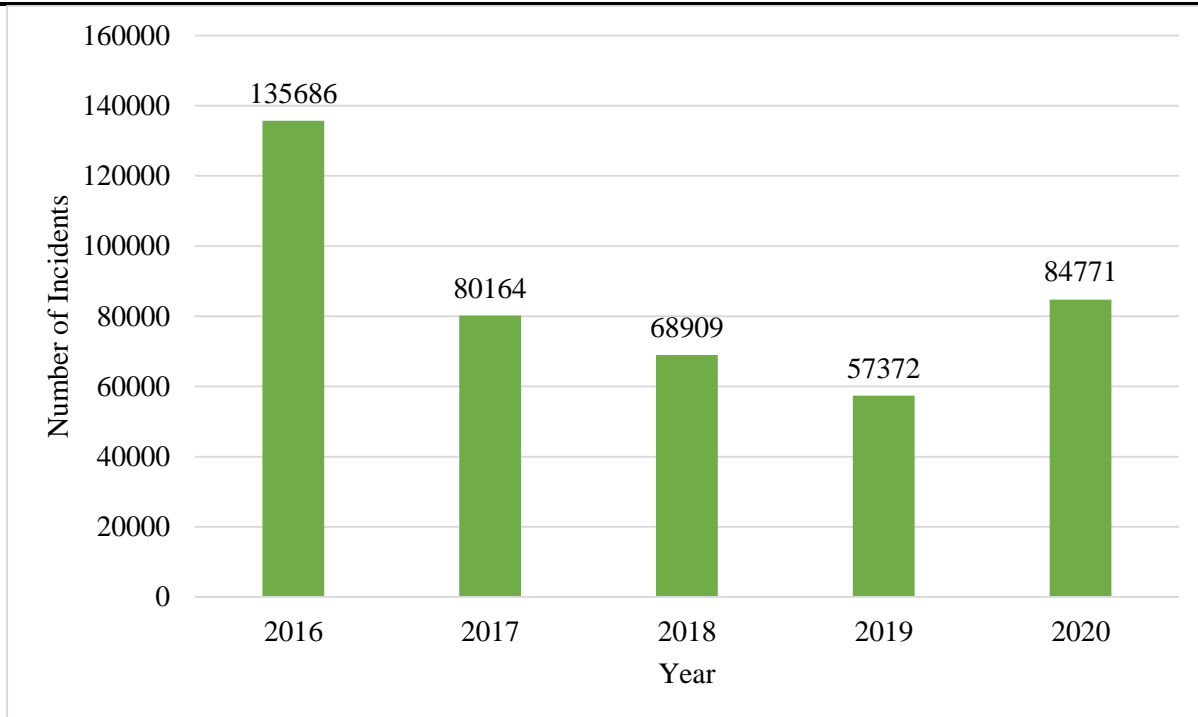


Fig. 3: Incidents of Stubble Burning from 2016-2020

Source: Indian Agricultural Research Institute

Negative Externality in This Case

In economics terms, an externality is a cause or a benefit imposed upon a third party by the production or consumption of a good. There are two types of externalities: positive and negative. A positive externality arises when an action by an individual or a group produces benefits to others without any contribution from the individual or group. A negative externality occurs when their actions produce harmful effects on others. The term externality is used to describe the difference between the costs of production incurred by a company and those that are passed on to society. The problem of air pollution in northern India can therefore be understood as an externality arising out of the actions of the farmers to dispose of their crop stubble. Since they do not have any incentive to dispose of the stubble in a non-polluting manner, and market forces themselves cannot remove externalities, there is a need for intervention. This is where the work of Ronald Coase is highly relevant. In 1960, he had theorised that if property rights are well defined, even with negative externalities, two parties can bargain to an efficient outcome. However, this is a perfect scenario, and property rights are indeed not well defined in our case in point. Further, Coase theorem makes a key assumption that there are negligible transaction costs in the bargaining process itself. This assumption is used to argue that market forces may be sufficient in resulting in an efficient outcome even in the presence of negative externalities, however, the presence of high transactional costs in an imperfect real-world situation make this highly unlikely. This is the reason some economists argue that externalities require government intervention, and markets alone cannot solve them.

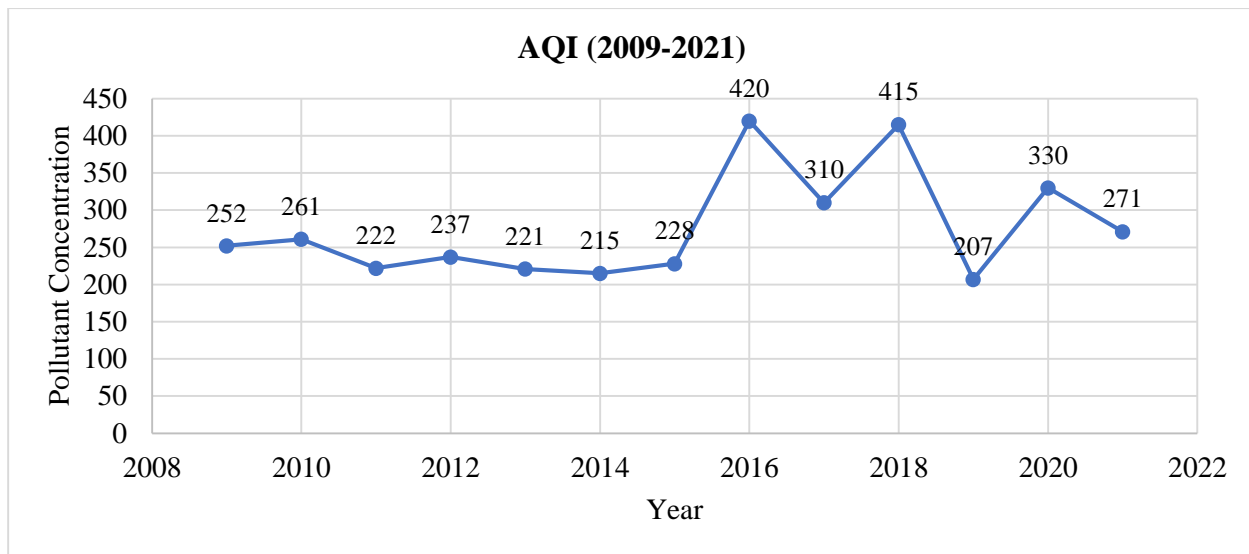


Fig. 4: Air Quality Index from 2019-2021
 Source: Central Pollution Control Board

With respect to Delhi’s air quality, the two parties are the residents of Delhi NCR on the one hand and the farmers of Punjab and Haryana on the other. In an ideal situation, the residents of Delhi NCR should have been able to bargain with the farmers of Punjab and Haryana in a way that the farmers are compensated for choosing alternative methods to dispose of crop stubble. However, with the sheer number of people involved, the costs of such a bargain on such a scale would make the transaction costs unreasonably high. Furthermore, the parties are not well defined either. There are three-four state governments being direct stakeholders, and the Union government. Agriculture being a State Subject, it has been difficult for the Union government to dictate terms to States and the States have no incentive to put an end to the cheap and simple method of disposal of stubble. This present situation can be depicted in a graphical format (below). The supply curves are based on choices firms make while looking at their marginal costs demand is based on the benefits individuals perceive while maximizing utility. If no externalities existed the supply curves would coordinate social costs and benefits but externalities do exist because markets no longer consider all social costs but only some of them. When a market produces too much of the product if firms are required to pay the social externality, they create less pollution but produce fewer goods and charge a higher price.

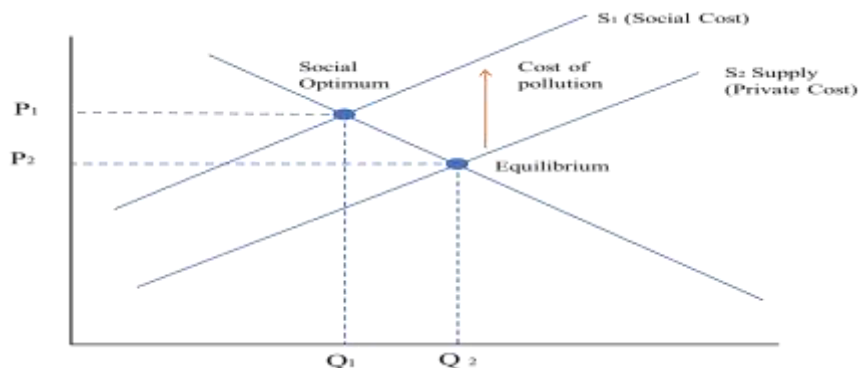


Fig 5: Negative Externality
 Source: by author

Because the government have no proper control over or influence over emitters' production (stubble burning) decisions, pollution victims bear the whole cost of pollution. The market equilibrium is found in this scenario when supply matches demand at the equilibrium quantity (Q_2) and the equilibrium price (P_2). However, in the presence of an externality, the cost of cultivating crops for the population is greater than the private costs to producers. S' is the social cost, which includes the private cost as well as the cost to the externality victims who are harmed by pollution. The private expenses of stubble burning farmers as well as the costs to those impacted by the emissions are included in this social cost.

The competitive supply S_2 (private marginal cost) will move upward to S_1 (social cost of pollution) if all the stubble burning farmers are made to pay the full social costs (S_1) of harvesting, which include the external costs of emissions. Rice will have a greater market price (P_1), but fewer will be sold (Q_1). The combination (Q_1, P_1) is a societal best since it represents the desired quantity of paddy harvested from a societal perspective.

Decreases in pollution are accompanied by reductions in the supply of the product that contributes to emissions at the social optimum, as seen in this graph. The marginal cost for the enterprise that optimises profits is S_2 , the supply curve. For a competitive company, price Equals marginal cost at its best.

S_1 = the marginal social cost of harvesting the crop + the marginal external cost of pollutants.

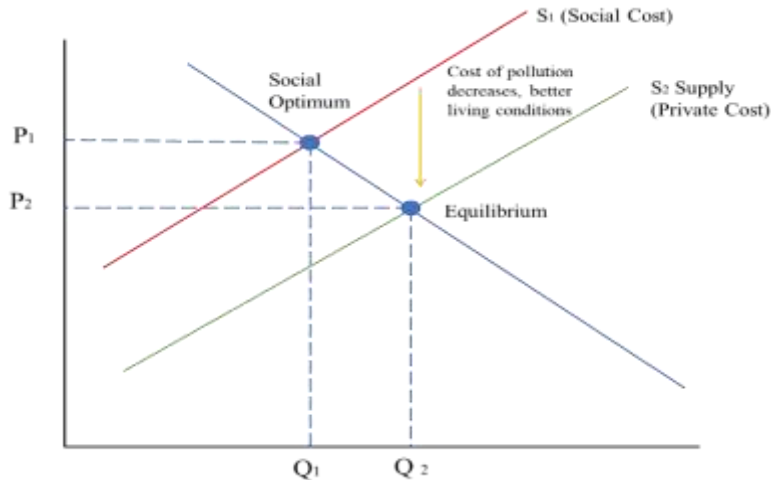


Fig 6: Externality Cost
Source: by author

According to Ronald Harry Coase (Coase theorem), the three important conditions are

1. Effective competitive market,
2. Zero transaction cost, and
3. Free & Symmetrical information.

Case 1, When the Market value of harvesters (incidents of stubble burning)/producers is greater than the Market value of damage done to the environment.

{Harvesters/producers should pay to the residing population with respect to the profits}

Case 2, When the Market value of harvesters (incidents of stubble burning)/producers is lesser than the Market value of the damage done to the environment.

{residing population in Delhi should pay to the harvesters to stop the stubble burning}

In the existing negative externality, both the parties cannot bargain each other because it is Unrealistic/unapproachable.

GOVERNMENT INTERVENTION

Since air quality is a public good, central coordination is even more important. Broadly, the application of incentive-based regulation can be a potential cost-effective way to control air pollution.

The graph indicates the situation if hypothetical projects/initiatives to reduce the externality are successfully implemented. Various other solutions to enable the government to intervene, both technological innovations and legislative/policy changes that could enable minimizing the negative externality of air pollution are in various stages of design and implementation. The Indian Agriculture Research Institute (IARI) has come up with a bio enzyme that can decompose the rice stubble as an alternative to farmers burning it. IARI has tied up an AgriTech startup called nurture farm to distribute the bio enzyme to farmers in these states for free.

In order to identify the source of pollution, the Delhi government has identified 13 hotspots — areas where pollution levels are higher than in other areas. Delhi will use a solution developed by the Indian Agricultural Research Institute, Pusa, to spray crop residue, which can decompose and be converted into manure. Members of Parliament, on a panel tasked with investigating the worsening air quality in Delhi and the National Capital Region (NCR), have demanded that polluting industries be punished harshly. They also stated that more measures are needed to alleviate traffic congestion in larger states.

In a motive to tackle air pollution in Delhi, the Government of India enforced “The Commission for Air Quality Management in the National Capital Region and Adjoining Areas Act, 2021”. This act aims to address the areas of coordination, research & development, problem identification that are related to the Air Quality Index. This law provides for a powerful permanent commission of over 20 members for better air quality management through enforcing strict measures, identification, research, and resolution of problems surrounding the air quality index. If the concerned head of the commission (including heads of the committee and subcommittee) is unable to execute the functions in a timely manner, then the heads/subheads of the commission will be directed to be an offence punishable with a jail term of up to five years or intended to pay fine up to Rs. 10,000,000 (one crore rupees) or with both imprisonment penalty. This commission can take mitigative measures, orders suo moto and can entertain complaints under any other laws. For example, The Air (Prevention and Control of Pollution) Act, 1981 and the Environment (Protection) Act, 1986. The commission can cancel the permission of manufacturing units that are causing or increasing the air pollution in the National Capital Region and adjoining areas.

Other solutions that could help in minimising the negative externality are policy changes, such as the shifting from water-intensive paddy cultivation to wheat and corn in Punjab and Haryana, and crop diversification to help maintain fertility of the soil. A recent innovation has been Solar Power as Remunerative Crop (SPaRC) model in Gujarat, which incentivises farmers to use groundwater efficiently.

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