

Trade off between stubble management and ecosystem services

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Right to clean air is a part of right to life which is a fundamental right enshrined in the constitution of India. Clean air is the most important element of a healthy life. Pollution is a public bad that emanates from a side effect of economic activities, providing us with good things and services. Production and consumption activities generate pollution and waste, and atmospheric environment can absorb pollution/waste up to a limit. According to Green Peace report of the year 2017, severe air pollution is not a problem restricted to Delhi-NCR (National Capital Region). It is a national problem that is killing 1.2 million Indians every year and costing the economy an estimated 3% of GDP. If the country's development is important, fighting air pollution has to be a priority.

Key words: Air pollution, Ecosystem services

AGRICULTURE is one of the important production activities, and biomass residue burning generates a significant amount of air pollution. During November and December of every year, the rice straw (Parali) burning catches attention of media and government due to worsening of air quality index. The institutions of the country geared to multiply their efforts by various means to control parali burning in the north western India. Since this triggers a medical emergency in which people are advised to stay indoors and use masks outdoors. As per government reports, the incidences of paddy stubble fire in Punjab and Haryana has fallen around 18% in 2018-19 compared to previous year. But during last more than five decades (1960-2016), yearly increments in dry matter burnt of rice in India was around 0.4 crore tonnes.

The compelling forces for farmers to resort to rice parali burning is narrow window (10-15 days) between harvesting of *kharif* paddy and sowing of next wheat crop. In Indo-Gangetic plains, growing of rice in *kharif* season delays the wheat sowing

beyond the optimum window of mid-November. The duration of wheat crop is around six months. When the wheat crop sowing is delayed, there are chances of exposure to high temperature stress in March end particularly during the grain development stage. Literature establishes the fact that heat stress could be a major reason limiting wheat yield in India. Sowing of wheat in the last week of November would reduce yield by about 30 kg ha⁻¹ day⁻¹. Therefore, for better production, timely sowing of wheat is critical to avoid yield losses. Another reason for pressing time duration is attributed to 'The Punjab preservation of subsoil water Act, 2009'. This Act prohibits paddy transplanting before 10 June (sometimes 20 June) to avoid evaporation losses due to high temperature. Another reason for paddy straw burning is introduction of combined harvester to overcome shortage of labour, high wages during harvesting season, timely, quick, easy and cheap of harvesting than manual labour. More than 75% of paddy in NW India is being harvested by using combine harvesters which

results in the retention of paddy stalk of 6–9 cm on the fields which comes around 5-6 tonnes straw/ha. The collection and management of such scattered and loose paddy stalk is very labour intensive and costly affair for farmers. In this situation, burning is a 'time and resource free activity' that carries zero cost for the farmer to get rid of paddy straw. Moreover, the available options for paddy straw management entails like selling to industries for paper, brick kilns, packaging, thermal power, biofuel etc. But all these options proved technically infeasible and financially unviable. The cost of collection and transportation are higher compared to the price realized by farmers besides inconsistent demand of paddy straw. This breeds a sense of insecurity among the farmers about the effectiveness and viability of such straw management options. Other *in situ* parali management options such as soil incorporation and composting are less attractive due to highly labour intensive and time consuming, and non-availability of required machineries. All this induced farmers to prefer *in situ* burning.

The parali burnt by farmers emitted poisonous gases (CO_2 , CO , CH_4 , N_2O , NO_x , SO_2) and particulate matter (PM 2.5 and PM 10) besides other compounds and matters in the atmosphere. Atmospheric environment can absorb this pollution in a particular geographic region up to an extent given its assimilative capacity. When pollution exceeds the assimilative capacity of atmospheric environment, then it starts losing its immunity power and becomes sick. However, due to technological advancements in the agricultural sector, waste concentration has gone beyond the assimilative capacity of the environmental limit, thereby distorting the balance. To strike a balance between public bad and public good, we have to accept a certain amount of pollution at the cost of a good life?

During winter, when wind mass starts blowing in Delhi and NCR from north west and sometimes from west, it may pick up the pollutants from Punjab, Haryana and part of Rajasthan especially from large sources (e.g. crop residue burning) and tall emitting sources contribute to air quality in winter. For all other available options, farmer individually has to bear the cost although the benefits of 'not burning' will be enjoyed by community as a whole including the neighboring states. Therefore, to contain straw burning farmers have to bear the cost of additional investment for specialized machineries, and have to sacrifice additional time and efforts for sustainable management of crop residue. This entails the need of devising a mechanism of providing a financial assistance to share the additional investment and efforts to be borne by the farmers, by the society to adopt sustainable measures of paddy straw management.

The ecosystem of rice wheat cropping system provides a wide variety of goods and services for the benefits of humankind. Ecosystem services are generally categorized as: (i) provisioning services (direct or indirect food for humans, fresh water, wood, fibre, and fuel); (ii) regulating services (regulation of gas and water,

climate, floods, erosion, biological processes such as pollination and diseases); (iii) cultural services (aesthetic, spiritual, educational, and recreational); and (iv) supporting services (nutrient cycling, production, habitat, biodiversity). To ensure continuous flow of ecosystem services would not only be possible by conservation methods, but also by in-built system of pain (penal) please (incentive) system. As per polluter pay principle, penalize the recalcitrant polluter of ecosystem and incentivize individuals or communities for undertaking actions that enhance ecosystem services. In rice-wheat system, sustainable paddy straw management practices/technologies for containing burning need to be incentivized.

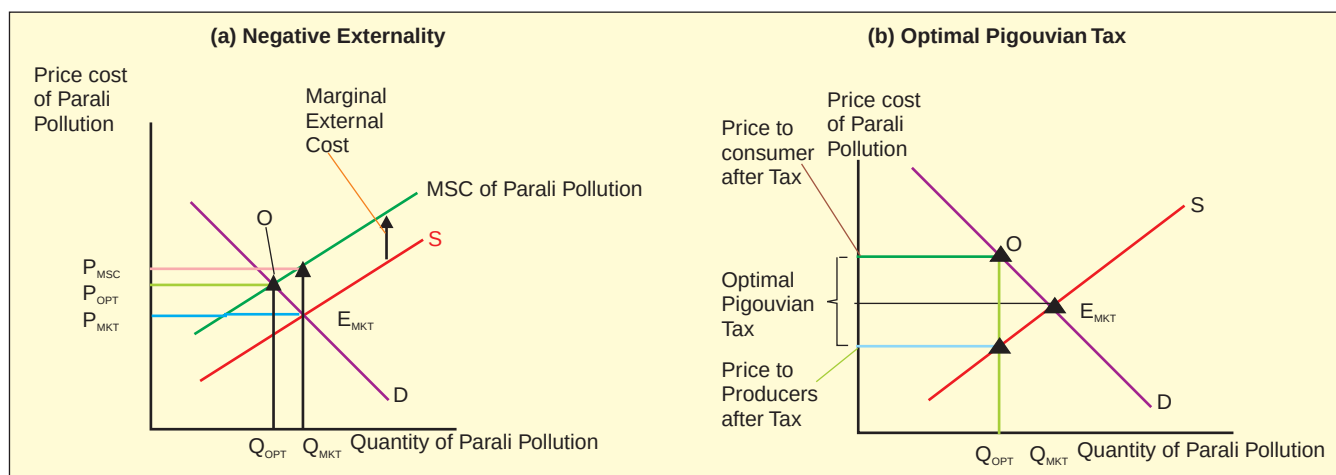
Loss in provisioning services pertains to the negative impact of parali burning on income of the farmer either through increase in cost of production or decline in yields besides other adverse impacts like missing employment opportunities, inconsistent supply of parali for industries, loss of fodder, and additional cost incurred by the farmers for inputs like fertilizer and irrigation. Loss of regulating services entails emission of noxious gases, smog, particulate matters and other compounds etc. Loss of supporting services has an adverse impact on the supporting services rendered by soils. This includes loss of nutrients and organic carbon, micro-flora and fauna, disturbance in soil biodiversity, soil prone to erosion. Parali burning may influence pollinator population dynamics besides earthworm population and damage soil structure. Loss of recreational ecosystem services may adversely impact on the well-being of people in terms of health hazard, increasing incidence of road accidents, discomfort due to delay or cancellation of trains and flights due to poor visibility, reduction in the tourism activities, particularly during October and November, cost of precautionary measures taken by people, suffering to birds and burning of road side trees etc. can be treated as the losses of recreational services. The problem of parali burning

generates cost to society and negligible cost to farmers. This necessitates for establishing balance between benefits of farmers and cost to society of parali burning. An attempt is made to analyze the problems through the lens of Pigouvian Theory.

This theory provides a framework that lets us think about how much pollution a society should have? Here, assumption is that the amount of pollution emitted by a polluter is observable and controllable. 'How much' decisions always involve comparing the marginal social benefit of pollution with the marginal cost of that additional unit of pollution. The marginal social benefit of pollution could be interpreted like avoiding pollution requires using scarce resources that could have been used to produce other goods and services. For example, to reduce the toxic gases the parali burning emit, the bio-energy businesses must either buy parali from the farmer fields or install in-situ parali management system to stop burning in the open field.

The marginal social cost of pollution for instance, an additional cost imposed on society as a whole by an additional unit of pollution. For example formation of aerosols, smog in air due to temperature inversions during October to December led to deterioration of air quality index creates public health emergency. Here consideration is the marginal social cost of a unit of pollution is equal to the highest willingness to pay among all members of society to avoid that unit of pollution.

Parali burning generates external costs, so the marginal social cost curve of burning parali, MSC, corresponds to the supply curve, S, shifted upward by the marginal external cost. Figure (a) shows that without government action, the market produces the amount Q_{MKT} . It is greater than the socially optimal quantity of parali burning, Q_{OPT} , the quantity at which MSC crosses the demand curve, D. At Q_{MKT} , the market price, P_{MKT} , is less than P_{MSC} , the true marginal cost to society of parali burning. Figure (b) shows how an optimal Pigouvian tax on parali burning production, equal to its



marginal external cost, moves the production to Q_{OPT} , resulting in lower output (pollution) and a higher price to polluters (farmers). In the absence of government intervention, market equilibrium will be at point E_{MKT} , yielding the amount of pollution produced and consumed Q_{MKT} and the market price P_{MKT} . At that point, the marginal benefit to society of another unit of pollution emission (measured by the market price) is equal to the marginal cost incurred by polluters for producing that unit. Correspondingly, without government action, the price to public health/consumers of pollution is too low: at the output level Q_{MKT} , the unregulated market price P_{MKT} is lower than P_{MSC} , the true marginal cost to society of a unit of pollution.

The environmental costs of pollution could be an external cost—an uncompensated cost that an individual polluter or a village imposes on others. There could also be external benefits, benefits that farmers or a village confer on others without receiving compensation. External costs and benefits are jointly known as externalities, with external costs called negative externalities and external benefits called positive externalities. These externalities can lead to farmers that are not optimal for society as a whole. Ultimately, we have to reduce the quantity at such a level where the marginal social cost and the marginal social benefit of an additional unit of parali burning are the same, is the outcome efficient.

When transaction cost (cost of making a deal) are sufficiently low, the externalities need not lead to inefficiency because individuals have

an incentive to make mutually beneficial deals—deals that lead them to take externalities into account when making decisions (internalization of the externality). Then the outcome is efficient even without government intervention. This is apt situation when government looks at policies to deal with pollution. At present the main policy tools in formal market are environmental standards, rules that protect the environment by specifying actions by producers and consumers. Society can achieve a cleaner environment at lower cost using economic methods using two approaches viz. taxes and tradable permits. These methods will move the market to the efficient quantity by compelling producers to internalize the externality caused by parali burning in their decisions. In informal market, the group actions (formation of village committee, Panchayat roles) at grassroots level for controlling parali burning and awarding and incentivizing village Panchayat for 'parali burning free village'.

Solution to manage straw burning

In parali burning situation, the gains from not burning fields accrue to everybody in north India, while the cost is only borne by the farmer owning the fields. On the other hand, if the farmer indulges in paddy stubble burning, private gains from reduced costs perhaps outweigh the costs of increased pollution. This mismatch between private costs and social benefits is termed externality in economics. The widely accepted way is Pigouvian Tax, which penalizes the

producer of such negative externalities (pollution from stubble burning) by imposing additional cost. What the courts and governments are demanding from farmers by them not resorting to stubble burning to prepare their fields from the next crop that they internalize this Tax themselves. Are the farmers being unjust in not doing this? But what if they can not afford cost associated with shifting to more eco-friendly ways to clear their fields? Due to lack of farmer income statistics, we are unable to ascertain whether Punjab and Haryana farmers can afford to do without stubble burning or not. Supreme Court in November, 2019 directed the Punjab and Haryana governments to pay Rs 100 per quintal to farmers to compensate for the cost of clearing their fields without resorting to stubble burning. This order does not internalize the externalities. It is unlikely that Punjab and Haryana consume their entire crop. Therefore, it is bit unfair to expect Punjab and Haryana governments to bear the entire fiscal burden of compensation to be paid to farmers. Textbook economics tells us that producers who are not efficient have no business being in business. So if the paddy farmers can not afford to pay for eco-friendly methods to clear fields or make enough returns from farming while ensuring that the consumer does not have to pay too much, they should just quit farming. By forcing the farmers in North West region to bear the cost of larger public good (clean air), India is literally biting the hand which feeds it. This is not sustainable. So what is to be done?

Today, the biggest challenge is not production, but viability. There is need to overcome the technology constraints. There is need to promote the use of appropriate farm machineries enhancing incorporation of straw in soil. The farmers need to be incentivized not only in term of subsidy but also making machinery available through custom hiring centers as and when needed. There is need to find alternatives technological options to use of paddy straw as a fuel in biomass-based power plants and other industries in most efficient and effective ways. The government machinery needs to run extensive awareness programmes to educate the farmers about the ill-effects, innovative policy for parali management to meet the requirements of all the farmers. Given

the fact that problem of straw burning is spreading over a large area involving millions of individual farmers, under such condition the command-and-control approach (banning) will not be effective. Moreover, market-based instruments, which provide more flexibility and financial assistance and incentive-based approach, are more frequently being used for resolving complex environmental problems, and are comparatively more effective than other measures. To meet the high cost for investment in machinery and technology requirement for sustainable paddy straw management and spread of problem over large area, there is a need to share the cost by society as whole rather than putting the entire burden on the farmers. This can be done by

providing financial assistance via direct benefit transfers to farmers on the condition of not burning; however, a strong verification and monitoring mechanism is needed to be put in place for ensuring its effective implementation. Non-burning of straw will also increase the availability of paddy straw at the cheaper rate on the one hand, and the incentivization for not burning on the other hand may also spur the innovation process for finding local solutions for sustainable crop residue management for keeping clean and safe environment while sustaining soil health.

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Food Safety

Consumers around the world have a right to expect that the foods they purchase and consume are safe and of high quality. Good, safe food is the foundation of a nutritious diet. In addition to safeguarding the well-being of consumers, food safety is also crucial to enable agricultural producers to gain access to markets. This in turn contributes to economic development and poverty alleviation.

Food safety is the absence, or safe, acceptable levels, of hazards in food that may harm the health of consumers. Food borne hazards can be microbiological, chemical or physical in nature and are often invisible to the plain eye; bacteria, viruses or pesticide residues are some examples.

Food safety has a critical role in assuring that food stays safe at every stage of the food chain from production to harvest, processing, storage, distribution, all the way to preparation and consumption.

Keeping food safe is a complex process that starts on the farm and ends with the consumer. FAO is the only international organization overseeing all aspects of the food chain, thereby providing a unique, 360° vision on food safety. A longstanding partnership with the World Health Organization (WHO) enhances this perspective. Through complementary mandates, FAO and WHO cover a range of issues to support global food safety and protect consumers' health. WHO typically oversees and maintains strong relationships with the public health sector, and FAO generally addresses food safety issues along the food production chain.

FAO's Role

FAO assists Member Countries in food safety considerations by:

- Strengthening national food regulatory control systems through:
- assisting national authorities to formulate evidence-based, enabling and coherent policies.
- helping governments review and update food legislation.
- developing institutional and individual capacities to perform risk-based food inspections, sampling and analysis, risk-communication and food safety management.
- Working with local food producers to develop measures to prevent or minimize food and feed safety risks
- Hosting the joint FAO/WHO Codex Alimentarius Commission, the global food safety and quality standard-setting body
- Providing independent, broad-based scientific advice to Member Countries and to Codex through expert bodies on Food Additives (JECFA), Microbiological Risk Assessment (JEMRA), and Pesticide Residues (JMPR)
- Contributing to food chain intelligence and foresight on food regulatory issues
- Providing guidance to countries on emerging issues such as antimicrobial resistance, whole genome sequencing and nanotechnology
- Facilitating access to information through relevant platforms, databases and tools to support food safety assessment and management
- Promoting food safety emergency preparedness through the FAO Emergency Prevention System for Food Safety (EMPRES Food Safety) and rapidly sharing information during food safety emergencies through the International Food Safety Authorities Network (INFOSAN).

Courtesy: <http://www.fao.org>