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From Burden To Benefit: Evaluating The Financial, Social, And Health Impacts Of Stubble Burning

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Abstract

Stubble burning creates serious economic challenges, health risks and social burdens for rural communities. This article explores how crop residue burning lowers farm profits, damages soil, and harms public health. It also highlights alternative management practices that can turn this agricultural waste into useful resources, paving the way for more sustainable and beneficial solutions.

Key Words: Stubble Burning, Farmers, Crop Residue, Health, Soil.

Introduction

India is agricultural nation. Millions of farmers still rely on it for their livelihood. After green revolution wheat and paddy is the main crop specifically in Punjab and Haryana. Wheat and Rice is blame for stubble burning (Sain 2020).The major share of residue is due to wheat and rice i.e. 43% and 21%. However the practice of stubble burning poses significant economical, environment and health challenges. Farmers burn their stubble because farmers get only few days between harvesting rice and sowing wheat. Removing residue by machines take more time so burning becomes the fastest option. However, it has many possible uses like animal fodder, compost and organic manure, Mulching in fields, bio char production.Garg et al.2008 observed that in Punjab rice and wheat stubble contribute 36% and 41 % respectively to the total stubble. However, over the past 4-5 years these figures have shifted to 11% for Rice and 36% for wheat .Now a day's air pollution is serious concern specifically in north India. There are several reasons for it and stubble burning is one of them. Stubble burning is significant threats to the environment and human health .The combustion of crop residues releases a cocktail of pollutants, including carbon monoxide ,particulate matter and volatile organic compounds into the atmosphere .The intense heat from burning raises the soil temperature and destroys essential nutrients (nitrogen, phosphorous and potassium) and beneficial microorganisms in the top layer soil ,making the soil less productive in the long term .it disrupts the local ecosystem ,potentially leading to an increase in harmful pests and

contribute emissions of greenhouses gases CO2 and CH4**.**The purpose of this study is to examine the financial and social impacts of stubble burning on farming households ,with a focus on healthcare costs, productivity losses, and the potential economic advantages of adopting residue management alternatives.

Review of Literature

Sharma et al. (2019) examined that the nitrogen oxide and Sulphur oxide also effect on the agriculture productivity. These oxides effect on growth of leaves, soil, grains, inhibit photosynthesis and ozone layer also effect on plants results to decrease the yield of crops.

Mandal et al. (2004) examined that the loss of nutrients from soil like nitrogen 79%, phosphorus 26%, potassium 22%, Sulphur 5-59%

Gupta et al. (2004) observed that the increase of temperature of soil up to 38-42° C results to kill the microbes at 3 cm depth. The burning also reduces the 28-72% nitrogen from soil and growth of microbe population. They reduce the 50% population of bacteria from soil. The long term burning results to reduce the nitrogen as well as organic matter from soil up to 0-15 cm.

Ghosh et al. (2019) revealed that the burning effects on human health. It was reported that effect on lungs and particulate matter enter through trachea into kidneys and also causes the chronic diseases like stroke, fever, lung cancer, tuberculosis, coughing, breathing problems etc.

Singh et al. (2008) revealed that the more than 60% population of Punjab lives in rice growing region. According to study, the data of civil hospital Zira in Punjab recorded the 10 % patient increased during burning period within 25 days

Discussion Analysis

Financial Burden On Stubble Burning Communities

Stubble burning creates a significant financial burden on farming households. The immediate impact is the loss of soil nutrients such as nitrogen, carbon and organic matter, which forces farmers to spend more on fertilizers in the following seasons. Continuous burning also reduces soil moisture and hardens the upper layer of the field, leading to lower crop

productivity. As fields decline, farmers face a direct loss of income specially small and marginal farmers who depend entirely on seasonal crops.

In addition, the smoke generated during burning contributes to widespread respiratory and eye – related diseases. Families spend more money on doctor visits, medicines and health checkups during the burning season, increasing out of pocket expenses. These hidden healthcare costs add to the already rising agricultural expenditure. Labor productivity also decrease due to poor visibility and health problems ,creating an indirect economic loss for communities that rely on daily wage work during agricultural seasons.

Social Burden On Rural Communities

Beyond the economic impact stubble burning creates a deep social burden. Thick smoke affects children, elderly people and women more severely, leading to school absenteeism and reduced participation in community activities. The burning season disrupts normal social life, visibility on roads declines, increasing the risk of accidents and limiting mobility for work school or public gatherings.

Farmers also experience social stigma as they are often blamed for rising pollution levels even though many structural factors such as lack of machinery, labor shortage and strict sowing timelines-force them into burning .This blame contributes to psychological stress, frustration and a feeling of isolation among farming families .Overall stubble burning affects not only the physical environment but also the social environment, weakening community wellbeing and harmony.

Direct Healthcare Costs And Productivity Loss

The burning of crop residue releases particulate matter and toxic gases that directly harm human health. Many community members suffer from breathing difficulties asthma, coughing ,eye irritation and skin allergies. As a result household spend more on treatments emergency visits and long term medications increasing financial strain. At the same time smoke reduces outdoor working capacity. Furthermore the negative health effects of stubble burning increase medical expenses for rural households and reduce their overall productivity. These impacts are more severe in villages where smoke exposure is high making the burden even more significant (Cusworth et al.,2023). Agricultural laborers, construction workers, transport workers, and elderly household members often reduce their working hour .Reduced

visibility and poor air quality slow down farm operations like sowing and irrigation, leading to productivity losses that affect the entire rural economy.

Benefits Of Residue Management Alternatives

Economic Benefits

Residue management naturally increases soil productivity, Organic matter and moisture retention .This reduces farmer's dependence on costly chemical fertilizers and repeated irrigation. Over the time the cost of cultivation decreases which improving the farmer's net income without any additional investment. Instead of burning farmers can sell straw to biomass power plants, mushrooms growers, dairy farms and packaging units. This creates a direct income source from material that was earlier seen as waste. Such market linkages convert residue into a commodity strengthening the rural economy and reducing financial stress on farming households. Crop residue can be converted into biomass energy providing farmers with an additional source of income .Instead of burning stubble, farmers can supply it to biomass plants, which use the material to produce electricity or fuel. This approach reduces residue waste and supports cleaner energy production. Punjab has established several biomass power plants that generate electricity using paddy straw, thereby reducing the negative environmental impact caused by crop residue. (Kaur, 2020). Residue management requires collection, baling, transportation and storage. These activities generate seasonal employment for rural youth. The circulation of money within the village creates small scale economic activity such as local transport services machine rentals and labor opportunities. This reduces migration and supports community level economic stability.

Social Benefits

When burning stop, smoke and dust decreases .villagers that practices eco - friendly residue management are appreciated by local authorities. Training camps demonstrations and awareness drives expose farmers to scientific knowledge. This shifts the community from traditional burning practices toward informed decision- making, thereby strengthening the agricultural knowledge base.

Health Benefits

Adopting sustainable residue management practices instead of stubble burning can significantly reduce the health burden on rural communities. When farmers avoid open field

burning, the emissions of fine particulate matter (PM 2.5) and toxic gases decreases sharply leading to cleaner village air and fewer respiratory problems among children, women and elderly populations. Reducing smoke exposure therefore lowers the incidence of these health problems that typically intensify during burning seasons (WHO, 2018; IQAir & Greenpeace, 2021; Indian Council of Medical Reasearch, 2017) .Reduced smoke exposure directly lowercases of asthma, chronic cough, eye irritation and cardiovascular complications that often rise during burning seasons.

Government Responses Toward The Burden To Benefits Transition

In 2018, the government of India launched a major support programme to reduce stubble burning. Under this scheme ,farmers were offered up to 80% financial assistance for purchasing crop residue management machines such as Happy seeders, super SMS,and mulchers.These subsidies were especially directed towards the states most affected by stubble burning, including Punjab,Haryana,and uttarpardesh,so that farmers could manage residue in the files without resorting to burning.

Conclusion

Stubble burning, long viewed as a necessary but harmful method in agriculture, brings substantial burdens through environmental pollution, declining soil health, increased farming costs, and serious health risks to rural communities.However,with changing perspective and the growing adoption of sustainable technologies and practices, these burdens can be transformed into benefits. Crop residues that were once considered waste can become valuable resources for compost, energy generation, and livestock feed, offering both economic and ecological gains. By shifting focus from destructive burning to innovative management, farmers and policy makers can create opportunities for increased rural income ,improved public health and community wellbeing.Acheiving this transition relies on coordinated efforts, education and investment in agricultural challenges into pathways for progress.

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