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An Empirical Study on Farmers' Risk Perception of Crop Residue Burning

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Abstract— *Crop residues play an integral role in sustaining traditional rural industries, including rice mills, brick kilns, and potteries, where they serve as an essential feedstock. Unfortunately, due to the lack of proper management, eco-friendly disposal methods, and safe handling practices, a substantial quantity of surplus crop residue, was openly burned in agricultural fields. The present study aims to analyze the risk perception of farmers towards crop residue burning. To collect the data, the questionnaires were distributed to a random sample of 250 respondents, out of these, 200 responses met the criteria for validity and were subsequently subjected to comprehensive analysis through various statistical techniques utilizing software tools such as MS Excel and SPSS. It was observed that there is the risk of health-related issues, increased medical expenses, reduction in assets or production, the potential for social disputes or conflicts, and environmental concerns due to crop residue burning. It was suggested that the associated issues require a multifaceted approach involving public awareness, policy changes, community engagement, research, support for alternatives, and collaborative efforts to find sustainable solutions.*

Keywords— *Crop residue: crop residue management: empirical study: farmers: risk perception.*

I. INTRODUCTION

India, as a preeminent agricultural nation, engages in year-round crop cultivation, resulting in a substantial generation of crop residues annually (Guttigunda & Jawahar, 2014). According to the 2020 Agricultural Statistics at a Glance report issued by the Indian Government, the country achieved a remarkable crop production of approximately 701.71 million metric tons (MT) in the 2019-2020 agricultural season, covering an expansive 173.25 million hectares of sown land. Notably, this prodigious agricultural output led to the generation of an estimated 517.82 million MT of crop residues primarily from the cultivation of major crops in India during the same period. These major crops include rice (34.57%), wheat (29.83%), sugarcane (14.23%), coarse cereals (12.26%), oilseeds (3.02%), and pulses (4.71%). In addition to serving as resources for household applications such as cooking and heating, as well as animal fodder, crop residues play an integral role in sustaining traditional rural industries, including rice mills, brick kilns, and potteries, where they serve as an essential feedstock (Garg & Siddique, 2019). It is worth that any excess residues not used for these purposes are categorized as surplus residues. Unfortunately, due to the lack of proper management, eco-friendly disposal methods, and safe handling practices, a substantial quantity of surplus crop residue, amounting to approximately 124.12 million MT, was openly burned in agricultural fields during the 2019-2020 period (Kaur & Sharma, 2020). The primary contributors to in-situ crop residue burning were paddy straw (43.78%), wheat (26.78%), coarse cereals (11.25%), and sugarcane (10.96%). It is of particular concern that the states of Haryana and Punjab accounted for roughly 48% of the nationwide incidence of in-situ crop residue burning (Anand et al., 2022).

II. LITERATURE REVIEW

(Patel & Panwar, 2023) regarded crop residue as a composition predominantly consisting of carbon and oxygen, with relatively small proportions of hydrogen, nitrogen, and minerals. Upon the combustion of crop residues, a notable volume of noxious gases is emitted into the atmosphere, leading to adverse environmental consequences. (Sisodiya et al., 2023) suggested that implementing extended-term crop residue management enhances productivity, augments soil organic content enriches nutrient levels, and bolsters microbial populations. The most optimal approach involves the integration of residues into the field, while the practice of burning should be abstained from (N. Kumar et al., 2023). The factors affecting crop residue management are residue particle size, age of residue, leaf toughness, and desiccation (K. Kumar & Goh, 1999). (Lopes et al., 2020) observed that farmers who believe that crop residue burning has a detrimental impact on soil quality are significantly less inclined to engage in this practice. However, the acknowledgment of the negative environmental consequences of residue burning does not appear to reduce the likelihood of choosing to burn crop residues. (Tchienkou-Tchiengang et al., 2023) held the view that endorsing management policies aimed at increasing the proportion of immature pests eliminated towards the conclusion of cropping seasons could prove beneficial in regulating the dynamics of MSB. (Ravindra et al., 2019; Sarkar et al., 2020) suggested an inclusive model for managing crop residues with the aim of reducing the harmful consequences of agricultural waste incineration on both human health and the environment.

2.1 Objective

The present study aims to analyze the risk perception of farmers towards crop residue burning.

III. RESEARCH METHODOLOGY

This research is empirical in nature and relies on primary data complemented by secondary data obtained from diverse reputable sources, including newspapers, periodicals, magazines, journals, and official websites. The selection of the sample was methodically undertaken from the broader

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population using a purposive and convenience sampling approach. A meticulously designed questionnaire was administered to collect data from the study's participants, who were farmers residing in Rohtak city, Haryana. The questionnaires were distributed to a random sample of 250 respondents, resulting in the receipt of 220 responses. Of these, 200 responses met the criteria for validity and were subsequently subjected to comprehensive analysis through various statistical techniques utilizing software tools such as MS Excel and SPSS. The data analysis encompassed the application of methods including tabulations, frequency distributions, percentage calculations, and similar analytical procedures.

IV. FINDINGS AND DISCUSSION

TABLE 1. Demographic profile of the respondents

Category	Sub-category	Frequency	Percentage (%)
Gender	Male	150	75
	Female	50	25
	Total	*200*	*100*
Age (in years)	Below 30	40	20
	31 to 45	60	30
	45 to 60	70	35
	Above 60	30	15
	Total	*200*	*100*
Marital status	Married	170	85
	Unmarried	30	15
	Total	*200*	*100*
Educational qualification	Uneducated	30	15
	10^{th} pass	80	40
	Graduate	70	35
	Others	20	10
	Total	*200*	*100*
Annual earnings (in INR)	Upto 100,000	50	25
	100,000 to 500,000	140	70
	Above 500,000	10	5
	Total	*200*	*100*

Table 1 offers a comprehensive demographic overview of the 200 respondents involved in the study. The breakdown by gender reveals that 75% of the participants are male, making up a total of 150 individuals, while the remaining 25% are female, constituting a group of 50 individuals. In terms of age distribution, 20% of the respondents are below 30 years old, with 40 individuals fitting into this category. A significant portion, 30%, falls within the age range of 31 to 45 years, totalling 60 individuals. An additional 35% belong to the 45 to 60 years age bracket, accounting for 70 individuals, and finally, 15% are above 60 years of age, which comprises 30 individuals. On the marital status front, 85% of the respondents are married, representing 170 individuals, whereas the remaining 15% are unmarried, amounting to 30 individuals. In terms of educational qualifications, the distribution shows that 15% have an uneducated background (30 individuals), 40% are 10th grade pass (80 individuals), 35% are graduates (70 individuals), and 10% have other educational qualifications (20 individuals). Finally, annual earnings reveal that 25% of respondents earn up to 100,000 INR (50 individuals), 70% fall in the bracket of 100,000 to 500,000 INR (140 individuals), and 5% earn more than 500,000 INR annually (10 individuals). This comprehensive demographic profile provides valuable insights into the composition of the respondent sample across various key demographic categories.

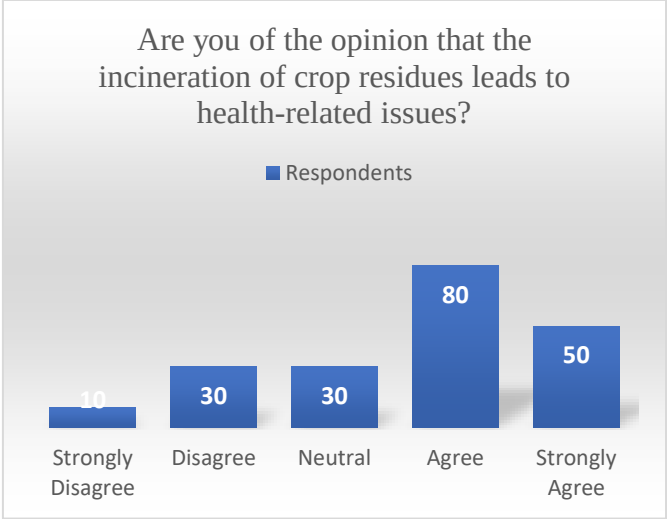

Figure 1. Are you of the opinion that the incineration of crop residues leads to health-related issues?

Figure1 presents the respondents' opinions regarding the potential health-related issues associated with the incineration of crop residues. The responses are categorized into five levels of agreement. Notably, 10 respondents (5%) strongly disagree with the notion that crop residue incineration leads to health-related problems, while 30 respondents (15%) simply disagree. An equal number, 30 individuals (15%), express a neutral stance on this matter. In contrast, a significant majority of 80 respondents (40%) agree that crop residue incineration is linked to health-related issues, with 50 individuals (25%) strongly agreeing with this viewpoint. This data signifies a range of opinions, with a notable portion of the respondents showing concern over the potential health implications of crop residue incineration, while others hold a contrary perspective.

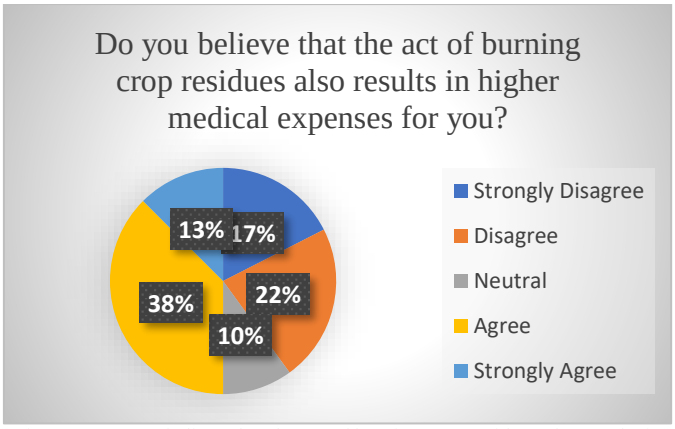

Figure 2. Do you believe that the act of burning crop residues also results in higher medical expenses for you?

Figure 2 presents the respondents' opinions on whether the act of burning crop residues leads to increased medical expenses for them. These opinions are categorized into five levels of agreement. A significant proportion of the

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respondents, specifically 35 individuals (17.5%), strongly disagree with the idea that burning crop residues results in higher medical expenses. An additional 45 respondents (22.5%) express a disagreeing perspective. In contrast, 20 respondents (10%) hold a neutral stance on this matter. On the other side of the spectrum, a substantial majority of 75 respondents (37.5%) agree that burning crop residues is associated with elevated medical costs, and 25 individuals (12.5%) strongly agree with this viewpoint. This data reveals a diversity of opinions among the respondents, with a noteworthy portion acknowledging a potential link between crop residue burning and increased medical expenditures, while others maintain a different perspective.

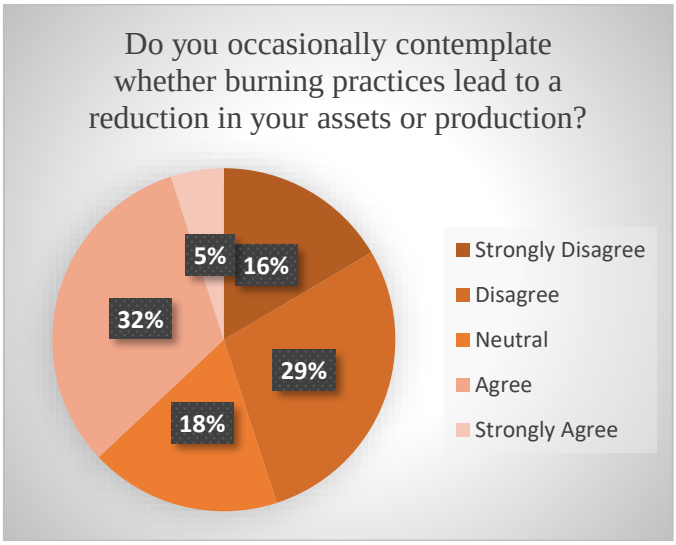

Figure 3. Do you occasionally contemplate whether burning practices lead to a reduction in your assets or production?

Figure 3 represents respondents' perspectives regarding the contemplation of whether burning practices have an impact on the reduction of their assets or production. These viewpoints are categorized into five levels of agreement. A substantial proportion of the respondents, specifically 33 individuals (16.5%), strongly disagree with the notion that burning practices lead to a reduction in their assets or production. An additional 57 respondents (28.5%) express a disagreeing perspective on this matter. A notable number of 36 respondents (18%) maintain a neutral stance, suggesting that they are undecided or do not lean toward a specific viewpoint. Conversely, 64 respondents (32%) agree that burning practices have a potential impact on the reduction of their assets or production, and 10 individuals (5%) strongly agree with this perspective. The data demonstrates a range of opinions among the respondents, highlighting a significant portion who consider the potential consequences of burning practices on their assets or production, while others hold differing views.

Figure 4 presents the viewpoints of respondents regarding whether the incineration of crop residues contributes to social disputes or conflicts. These perspectives are categorized into five levels of agreement. Among the respondents, 13 individuals (6.5%) strongly disagree with the notion that crop residue incineration leads to social disputes or conflicts. An additional 37 respondents (18.5%) express disagreement on this matter. A group of 25 respondents (12.5%) maintains a neutral stance, indicating their uncertainty or lack of a strong opinion. In contrast, a substantial majority, with 84 respondents (42%), agrees that the incineration of crop residues gives rise to social disputes or conflicts. Furthermore, 41 individuals (20.5%) strongly agree with this perspective. The data reflects a spectrum of viewpoints within the respondent group, highlighting a notable portion that sees a connection between crop residue incineration and social disputes, while others hold differing opinions.

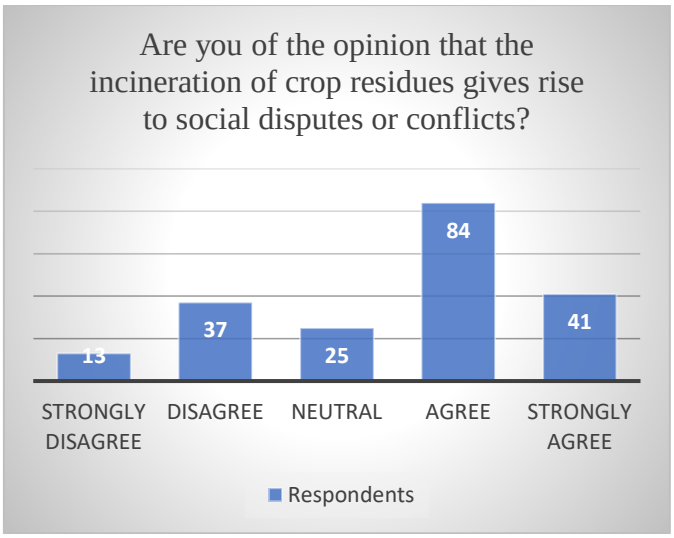

Figure 4. Are you of the opinion that the incineration of crop residues gives rise to social disputes or conflicts?

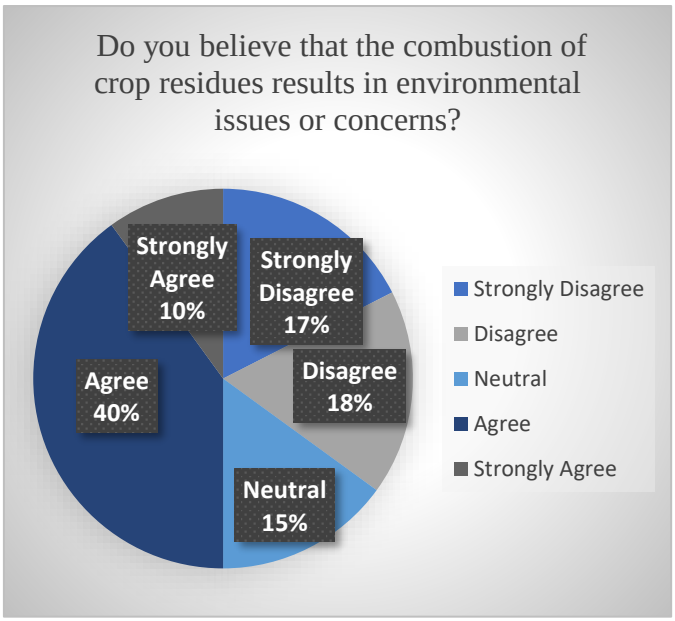

Figure 5. Do you believe that the combustion of crop residues results in environmental issues or concerns?

Figure 5 encapsulates the perspectives of respondents regarding the potential environmental repercussions associated with the combustion of crop residues. Respondents' viewpoints are categorized into five levels of agreement. Among the

participants, 35 individuals (17.5%) strongly disagree with the notion that burning crop residues leads to environmental issues or concerns. An equivalent number of respondents, 35 (17.5%), express disagreement on this matter, reflecting a divided stance within this group. Meanwhile, 30 respondents (15%) maintain a neutral perspective, suggesting a degree of uncertainty or a balanced viewpoint. In contrast, a notable majority of 80 respondents (40%) agree that the combustion of crop residues results in environmental issues, signifying a widespread concern. Moreover, 20 individuals (10%) strongly agree with this viewpoint, further emphasizing the substantial awareness and apprehension regarding the environmental implications of crop residue combustion. This data reveals the diversity of opinions within the respondent group, with a significant proportion expressing concern about the environmental effects of this practice.

V. Conclusion and Suggestion

In conclusion, the data presented portrays the varied perspectives of the respondents on several crucial aspects related to the incineration of crop residues. These aspects encompass health-related issues, increased medical expenses, reduction in assets or production, the potential for social disputes or conflicts, and environmental concerns. The findings reveal a range of opinions within the respondent group, emphasizing a diversity of viewpoints. While a considerable portion express concerns about the health and environmental implications of crop residue incineration and its potential financial consequences, others maintain dissenting stances, suggesting a complex landscape of perceptions. This multifaceted array of viewpoints underscores the importance of considering diverse perspectives when addressing agricultural and environmental practices and highlights the need for further research and dialogue in this domain to develop sustainable and equitable solutions.

On the basis of the diverse perspectives of the respondents regarding crop residue incineration, several suggestions can be made:

TABLE 2: Key suggestions based on the findings

Insights	Suggestion
Public Awareness and Education	There is a need to enhance public awareness and education regarding the potential health-related issues and environmental concerns associated with crop residue incineration. Information campaigns, workshops, and educational programs could help inform the public about the risks involved.
Policy Interventions	Policymakers should consider the concerns raised by a significant portion of the respondents, especially those related to increased medical expenses and environmental repercussions. This data suggests a need for policies that encourage sustainable agricultural practices and provide incentives for alternative methods of crop residue disposal.
Community Engagement	Engaging with local communities, particularly those involved in agriculture, is vital. Their experiences and concerns regarding crop residue management should be considered when designing policies and practices.
Research and Innovation	Further research is needed to better understand the specific health and environmental impacts of crop residue incineration. This could involve scientific studies to quantify these effects and innovation in sustainable agricultural practices.
Support for Alternatives	Support should be provided to farmers to adopt alternative methods for crop residue disposal, such as mulching, composting, or using residues for energy production. Financial incentives or subsidies may encourage the adoption of these alternatives.
Dialogue and Collaboration	Stakeholders, including farmers, environmental experts, healthcare professionals, and policymakers, should engage in open dialogue and collaboration to find sustainable and equitable solutions. This collaborative approach can lead to comprehensive strategies for addressing the concerns raised in the data.

In brief, the study highlights a range of perspectives on crop residue incineration, and addressing the associated issues will require a multifaceted approach involving public awareness, policy changes, community engagement, research, support for alternatives, and collaborative efforts to find sustainable solutions.

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