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Crop Residue Burning in Haryana: Issues & Suggestive Policy Measures

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ABSTRACT

Crop Residue Burning is a persistent problem not only in India but across various parts of the globe. As a result, the issue has raised alarming concerns to the environmentalists and other stakeholders at large. Given this, the present study aims to understand the dynamics of CRB in Jind district (Haryana). The study uses both primary and secondary data for this purpose. Schedule method was used for data collection. A random sample of 50 farmers was taken for the survey. Data was collected from the farmers in Jind district, Haryana through personal visits. Findings of the study suggest 'inadequacy of government initiatives' as the prime reason for crop residue burning in Jind. Overall, the study provides suggestive management and policy measures for both farmers and the government.

KEYWORDS: Crop Residue Burning, Air Pollution, Haryana, India

INTRODUCTION

Crop Residue Burning (CRB) issue has gained a lot of political and environmental attention in recent years. In India, it has assumed a gigantic proportion within the past few years. Especially the pollution in the capital city, Delhi from the north-western states of Haryana and Punjab near Diwali festival has caught much attention from all the stakeholders. Recently, it has become an annual occurrence that converts major sections of Northern India into a gas compartment, thus threatening the wellbeing of the citizens. Over some time, the central and state governments have promised to tackle the problem of stubble burning. However, the current situation completely contradicts the supposed contributions made by the government so far. Keeping in mind the gravity of the problem associated with CRB, the present study aims to get a comprehensive view of the CRB problem in Jind district (Haryana). Moreover, it takes into account the farmer's point of view as well as procedural hurdles which prevent him from adopting the alternative techniques of handling crop residue.

The paper is organized as follows: Section 2 provides a review of theoretical literature on the subject. Section 3 comprises of the objectives of the study. Section 4 describes the research

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methodology adopted. Section 5 includes data analysis and findings. Conclusion and recommendations are presented in Section 6.

LITERATURE REVIEW

Various research studies have been conducted by researchers to examine different issues related to crop residue burning. In this context, the latest CEEW Council Report (2019) monitored the air quality across four districts of Punjab. It analyzed the data to understand the trends of paddy residue burning in the state. The findings of the report established the deterioration in air quality due to crop residue burning. Sarkar(2018) examined the impact of residue burning over eastern parts of the Indo-Gangetic basin and also over the parts of central and southern India. The results of the study established crop residue burning residue as one of the contributors to the declining ambient air quality during the post-monsoon and wintertime. A study by Batra (2017) examined the status of crop residue burning in Northwest India and its consequences on health in general and on child health in particular. Findings suggest that the phenomenon of stubble burning is quite high in Punjab with comparison to other north-west Indian states resulting in increased incidences of acute respiratory problems among children. The study also indicated that crop residue burning resulted in the emission of greenhouse and various harmful gases. Such emission of toxic gases is many times higher than the standard level of gases as recommended by the Central Pollution Control Board (CPCB). A study by Sidhu (2015) has shown that the concentration of the particulate matter and gases cross the permissible limit when monitoring is done during crop residue burning. Another study by Singh (2015) also confirmed the increase in the magnitude of particulate matter due to crop residue burning in a critically polluted area of Punjab. Gupta (2019) also reported the worsening of air quality due to crop residue burning in Ludhiyana and Sangrur.

Some of the research studies have also investigated the reasons behind stubble burning. A recent CEEW Council Report (2019) highlighted the challenges faced by farmers in adopting alternative methods of stubble management and the economic viability of happy seeder, an alternative suggested by the government. Lack of proper education to farmers about the implications of crop residue burning was also quoted as a reason for the limited success of legal bindings to control it. The study by Grover (2015) explored the reasons behind stubble burning and the farmer's level of awareness. The study reported that the need for farmers to prepare their land for the next crop was the main reason for stubble burning. Other reasons found in the study were the high cost of labour for residue removal and low market rates of residue. The study also indicated a lower level of awareness among farmers regarding crop residue burning and its impacts. A study by Agarwala (2018) investigated the determinants of crop residue burning. The findings established the effect of factors such as- labour shortage, legislation change, mechanization, political factors on crop residue burning. A recent study by Bhuvaneshwari *et al*., (2019) addressed the underlying technology as well as policy issues that have prevented India from achieving a long-lasting solution and also potential solutions of crop residue burning that have been overlooked. The study also discussed some of the policy considerations and functionalities based on the analyses and current practices.

Though there are abundant research studies which have enumerated the extent of Crop Residue Burning problem and have identified factors influencing it, however, most of these studies present a fragmented view of the CRB problem. Thus, there is a shortage of studies which have discussed the CRB problem in a holistic manner, which suggests that there is a research gap. Therefore, there is a need to uncover the issues faced by farmers at various stages of cultivation. Keeping this in mind, the present study has been undertaken to fill this research gap.

RESEARCH OBJECTIVES

In particular, the study intends to achieve the following objectives which have been extracted by careful examination of existing literature, extensive discussion and observation:

- To understand the dynamics of CRB in Jind district (Haryana)- it is the genesis and contributing influences.
- To study the farmer's point of view on the subject, it is causative factors and probable solutions.
- To examine the adequacy of existing alternatives suggested by the government and the challenges to their implementation.
- To present a comprehensive view of the CRB issue and suggest policy implications for the same.

RESEARCH METHODOLOGY

The present study is based on primary as well as secondary data. The review of existing literature on the subject helped in framing the research objectives. The research is exploratory as the secondary data along with brainstorming; experts' advice and observation were used to draft a questionnaire. The questionnaire was developed in the Hindi language as per the requirement of the respondents. Schedule method was used for data collection. A random sample of 50 farmers was taken for the survey. Data was collected from the farmers in Jind district, Haryana through personal visits. Total 36 filled questionnaires were used for the analysis. The data was collected on well-established five-point Likert scale. Some scales were also modified for measuring attributes like awareness. Cronbach's alpha checked the reliability of the scale, and a very high overall reliability (0.82) was observed. The items were further checked to detect the effect of deletion of scale items on the value of Cronbach alpha. No significant change was observed, and hence none of the item was deleted. The data was further tested for outliers, and one extreme outlier was found in the data.

No legitimate outlier was found in the data. The single extreme outlier response was removed, and the data were tested for normality. It was found that data was following a normal distribution as KMO and Shapiro-Wilk tests showed a non-significant p-value (Refer to Table 1). Hence the null hypothesis that the data follows a normal distribution was not rejected. This enhanced the researcher's confidence to apply parametric statistical tests as required.

The validity of the data was tested through bivariate correlation, and it was observed that the variables have moderate convergent validity as the items measuring a particular variable depicted a positive correlation amongst them. The suitable descriptive and inferential statistical tools like ANOVA, Correlation and Multiple Regression Analysis were used for examining data and achieving the objectives mentioned above.

DATA ANALYSIS AND FINDINGS

Comparison of Frequency of CRB between different groups categorized based on farmer's age

The mean values were calculated for the frequency of CRB in case of groups categorized based on farmer's age (Refer to Table 2). The null hypothesis, in this case, is that there is no significant difference in the frequency of CRB between different age groups.

To test the significant difference amongst the frequency of burning as per the demographic variable – farmer's age, ANOVA one-way technique was applied. ANOVA results indicate that null hypothesis was not rejected and the difference of frequency of burning stubble concerning age was not significant (Refer to Table 3) Thus it can be inferred that age of the farmer has no significant impact on stubble burning.

Comparison of Frequency of CRB between different groups categorized based on farmer's education

The mean values were calculated for the frequency of CRB in case of groups categorized based on farmer's education (Refer to Table 4). The null hypothesis, in this case, is that there is no significant difference in the frequency of CRB between different education groups. ANOVA results in this case, indicate that null hypothesis was not rejected and the difference of frequency of burning stubble concerning education was not significant (Refer to Table 5), implying that the education of the farmer had no significant impact on stubble burning.

Level of awareness about alternative utility options for Crop Residue

Results indicate that farmers had a higher level of awareness for animal fodder (with highest Mean value -4.63) as an alternative utility option for Crop Residue, out of five significant utilities of Crop Residue. The awareness for other alternatives was found comparatively far lower.

Comparison on level of awareness about alternative utility options for Crop Residue between different groups categorized based on farmer's age

The mean values were calculated for the level of awareness about alternative utility options for Crop Residue in case of groups categorized based on farmer's age (Refer to Table 6). The null hypothesis, in this case, is that there is no significant difference in the level of awareness between different age groups.

In order to test the significant difference amongst the groups on the level of awareness about alternative utility options for Crop Residue as per the demographic variable – farmer's age, ANOVA one-way technique was applied. ANOVA results suggest that the null hypothesis was not rejected and the difference of frequency of burning stubble with regard to age was not significant (Refer to Table 7). This showed that age does not significantly affect the awareness of different utilities of stubble.

Comparison on level of awareness about alternative utility options for Crop Residue between different groups categorized based on farmer's education.

The mean values were calculated for the level of awareness about alternative utility options for Crop Residue in case of groups categorized based on farmer's education (Refer to Table-1.8). The null hypothesis, in this case, is that there is no significant difference in the level of awareness between different education groups.

In order to test the significant difference amongst the groups on the level of awareness about alternative utility options for Crop Residue as per the demographic variable – farmer's education, ANOVA was applied. ANOVA results suggest that the null hypothesis was not rejected and the difference of frequency of burning stubble with respect to education was not significant (Refer to Table 9). This showed that education to does not significantly affect the awareness of different utilities of stubble.

Level of awareness level about the ill effects of CRB on health and environment-related issues

The results indicate a high level of awareness amongst farmers about the ill effects of CRB on both- health and environment-related issues.

Examining the relationship between the frequency of CRB and the causative factors/dependent variables

Correlation Analysis and Multiple Regression Analysis

To explore the relationship between the dependent variables and the frequency of CRB, correlation analysis was carried out. The correlation results (Refer Table 10) depicted the

negative correlation between stubble burning frequency and knowledge of other utilities of stubble. Though the correlation was very weak, it supported the argument that the increasing knowledge of alternative usage of stubble leads to a reduction in the frequency of CRB. Similarly, the correlation also indicated that if alternatives for CRB are not efficient, the frequency of stubble burning will rise. Further, it has been found that the reducing expenses on other alternatives had a positive correlation with CRB, i.e. as the cost of other alternatives will rise, the frequency of CRB will decline. The correlation between the frequency of CRB and difficulty level of using alternatives is also positive. This implies that as the level of ease of exercising alternatives increases the frequency of CRB decreases. The variable Cooperation and support from government'' was found to be negatively correlated to the frequency of CRB. Further, the lack of awareness of environmental and health issues raises the chances for CRB. Hence, the correlations amongst the variables and CRB frequency were found in tune with assumptions and the recommendations.

Further, in order to determine the relative importance of dependent variables/causative factors on the frequency of CRB, Multiple Regression Analysis was carried out. Result table indicates that that collectively all variables cause 33.6% variation in the frequency of CRB (Refer Table-11). However, the model under study is non-significant as the p-value of the analysis of variance is above 0.05(Refer to Table 12). Nevertheless, the variable –the inadequacy of government initiatives towards crop residue management is a significant contributor to the regression model (Refer to Table 13). Thus, the inference can be drawn from both the tests that there is a need for government support to handle the CRB problem.

Farmer's Media Preference for Agriculture Related Information

Result findings show that the internet is the most used medium for farmers to explore agriculture-related information. Nearly 37% of farmers were found to engage themselves with agriculture-related programs through the internet with TV following the league with 33% viewership. Not even a single farmer answered in favour of radio for hearing any agricultural program.

Recommendations

Based on the data analysis and findings on the subject, some of the recommendations to tackle the issue of crop residue burning have been formulated and discussed below:

- Education and age have no significant impact on farmers' frequency of burning stubble; hence there is no need for government to customize the agriculture-related programmes in accordance with age or education.
- Awareness regarding the alternative options to CRB was poor across all the education and age categories of farmers. Barring the usage of stubble for animal fodder, other alternatives utilities must be advertised, and the related information must be disseminated at a large scale by the Government.
- Farmers have a high level of awareness about health-related as well as environment-related issues caused by CRB. One to one interaction with the farmers revealed that they themselves feel the need to stop the residue burning as it affects their physical wellbeing and deteriorates the soil quality (leading to a loss in productivity). Hence the content of government awareness programmes should be focused on providing knowledge about what complementary/alternative courses of action should be taken to manage the crop residue rather than burning it.

- There is a lack of government support and initiative to tackle the issue. Since this factor came out as a significant contributor to the frequency of burning crop residue, there exists a need for practical and viable support from the authorities.
- The individual interview sessions with the farmers also revealed that a few years back, they took an effort to extract the crop residue and kept it for the government agencies for pick up. Nevertheless, they were discouraged due to the failure of government machinery to collect and carry the crop residue. It led to several losses not only in terms of cost and labour involved in extraction but also led to the wastage/blockage of that portion of the fields where crop residue was placed in a hope to be carried by the government. Some of them also quoted the instances that after investing money on extraction and waiting long enough, they had to burn the stubble ultimately. This shows a lacuna on the part of the government to provide practical support to the farmers. This again highlights the farmer's inclination to collaborate with the government to curb this menace.
- The interviews of the farmers further revealed that the support from the government is expected in terms of funds for extraction of the crop residue, support in terms of pickup of the residue and training on the methods to manage it without burning.
- Though it was found that the internet is the highest used medium for exploring agricultural-related programmes, still the percentage of people engaged in agricultural programs is less than 50%. These low viewership statistics point to the failure of these programmes in providing the relevant information or lack of trust of farmers on these sources. Government-sponsored programmes can be built to address both these issues. The government must provide content based on research and practicality. The government should disseminate information regarding agricultural practices through the internet and TV and should keep the contribution (in terms of expenses) of radio to a minimal.
- It is further recommended for the farmers that they should opt for those varieties of paddy, which leads to less crop residue in the fields after harvesting.
- It is highly recommended that the farmers should show more patience, be more receptive to alternative options and act in accordance with the measures suggested by the government to manage crop residue.

Conclusion and Implications of the Study

In particular, the present study has been able to identify 'the inadequacy of government initiatives' as the prime reason responsible for crop residue burning in Jind (Haryana). The study has implications for both farmers and the government. The two expected outcomes from the government in the form of support are the training of farmers and financial support. Further, government interventions such as expanding the infrastructural support in terms of labour availability, storage and transportation of crop residue should be put into practice.

There is a strong need to look into the problem from a fresh perspective by solving the issues involved at every stage since its origin. This study strongly recommends the need to look into the feasibility of alternatives as to their suitability in that demographic area, the efficiency of alternatives to consume the quantum of crop residue generated and their user-friendliness as to the implementation. It also advocates that the question of farmer's awareness and knowledge about the alternatives to manage the crop residue need to be put on the backseat rather government needs to discover feasible alternatives to manage crop residue through research and development. This initiative should be followed by mass propaganda by government and agriculture support institutions to educate the farmers about them. Overall, the study advocates a robust public policy to ensure the implementation at the grassroots level.

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Table 1: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Overall	.129	34	.153	.952	35	.135

a. Lilliefors Significance Correction

Table 2: Mean values of frequency of CRB between different age groups

Age	Mean	N	Std. Deviation
21 years to 40 years	4.50	8	.535
41 years to 60 years	4.56	16	.629
61 years and above	4.91	11	.302
Total	4.66	35	.539

Table 3: ANOVA with respect to age and frequency of CRB

			Sum of Squares	df	Mean Square	F	Sig.
How many times you have burnt the stubble * Age	Between Groups	(Combined)	1.039	2	.520	1.879	.169
	Within Groups		8.847	32	.276		
	Total		9.886	34			

Table 4: Mean values of frequency of CRB between different education groups

Education	Mean	N	Std. Deviation
Uneducated	4.64	11	.505
Below 10th	4.40	5	.894
10th pass	4.58	12	.515
12th pass	5.00	3	.000
Graduate	5.00	4	.000
Total	4.66	35	.539

Table 5: ANOVA with respect to education and frequency of CRB

			Sum of Squares	df	Mean Square	F	Sig.
How many times you have burnt the stubble * Education	Between Groups	(Combined)	1.224	4	.306	1.059	.394
	Within Groups		8.662	30	.289		
	Total		9.886	34			

Table 6: Mean values of Farmers awareness regarding alternatives to CRB with respect to Age

Age		Mulching	Roof Thatching	Mushroom Farming	Animal Fodder	Biogas	Other Industries
21 years to 40 years	Mean	1.75	2.75	2.00	4.63	1.13	1.13
	N	8	8	8	8	8	8
	Std. Deviation	1.389	1.909	1.069	.518	.354	.354
41 years to 60 years	Mean	1.94	1.44	1.44	4.19	1.38	1.25
	N	16	16	16	16	16	16
	Std. Deviation	1.569	.629	.814	1.167	.806	.683
61 years and above	Mean	2.27	2.45	1.82	4.55	1.82	1.36
	N	11	11	11	11	11	11
	Std. Deviation	1.489	1.635	1.401	.522	1.401	.924
Total	Mean	2.00	2.06	1.69	4.40	1.46	1.26
	N	35	35	35	35	35	35
	Std. Deviation	1.475	1.434	1.078	.881	.980	.701

Table 7: ANOVA with respect to Age and Farmers awareness regarding alternatives to CRB

			Sum of Squares	df	Mean Square	F	Sig.
Mulching * Age	Between Groups	(Combined)	1.381	2	.690	.304	.740
	Within Groups		72.619	32	2.269		
	Total		74.000	34			
Roof Thatching * Age	Between Groups	(Combined)	11.721	2	5.860	3.224	.053
	Within Groups		58.165	32	1.818		
	Total		69.886	34			
Mushroom Farming * Age	Between Groups	(Combined)	1.969	2	.984	.838	.442
	Within Groups		37.574	32	1.174		
	Total		39.543	34			
Animal Fodder * Age	Between Groups	(Combined)	1.360	2	.680	.869	.429
	Within Groups		25.040	32	.782		
	Total		26.400	34			
Biogas * Age	Between Groups	(Combined)	2.424	2	1.212	1.282	.291

	Within Groups		30.261	32	.946		
	Total		32.686	34			
Other Industries * Age	Between Groups	(Combined)	.265	2	.133	.258	.774
	Within Groups		16.420	32	.513		
	Total		16.686	34			

Table 8: Mean values of Farmers awareness regarding alternatives to CRB with respect to Education

Education		Mulching	Roof Thatching	Mushroom Farming	Animal Fodder	Biogas	Other Industries
Uneducated	Mean	1.82	1.64	1.73	4.27	1.36	1.09
	N	11	11	11	11	11	11
	Std. Deviation	1.168	1.027	1.191	1.191	.924	.302
Below 10th	Mean	1.60	1.80	1.40	4.40	1.40	1.40
	N	5	5	5	5	5	5
	Std. Deviation	1.342	1.789	.548	1.342	.894	.894
10th pass	Mean	2.08	2.08	1.58	4.58	1.42	1.42
	N	12	12	12	12	12	12
	Std. Deviation	1.782	1.443	.900	.515	.793	.996
12th pass	Mean	2.00	2.67	1.67	4.00	1.33	1.33
	N	3	3	3	3	3	3
	Std. Deviation	1.000	.577	1.155	.000	.577	.577
Graduate	Mean	2.75	3.00	2.25	4.50	2.00	1.00
	N	4	4	4	4	4	4
	Std. Deviation	2.062	2.309	1.893	.577	2.000	.000
Total	Mean	2.00	2.06	1.69	4.40	1.46	1.26
	N	35	35	35	35	35	35
	Std. Deviation	1.475	1.434	1.078	.881	.980	.701

Table 9: ANOVA with respect to Education and Farmers awareness regarding alternatives to CRB

			Sum of Squares	df	Mean Square	F	Sig.
Mulching * Education	Between Groups	(Combined)	3.497	4	.874	.372	.827
	Within Groups		70.503	30	2.350		
	Total		74.000	34			
Roof Thatching * Education	Between Groups	(Combined)	6.957	4	1.739	.829	.517
	Within Groups		62.929	30	2.098		

	Total		69.886	34			
Mushroom Farming * Education	Between Groups	(Combined)	1.828	4	.457	.363	.833
	Within Groups		37.715	30	1.257		
	Total		39.543	34			
Animal Fodder * Education	Between Groups	(Combined)	1.102	4	.275	.327	.858
	Within Groups		25.298	30	.843		
	Total		26.400	34			
Biogas * Education	Between Groups	(Combined)	1.357	4	.339	.325	.859
	Within Groups		31.329	30	1.044		
	Total		32.686	34			
Other Industries * Education	Between Groups	(Combined)	.993	4	.248	.475	.754
	Within Groups		15.692	30	.523		
	Total		16.686	34			

Table 10: Correlations between frequency of CRB (independent variable) and dependent variables

	Frequency of Burning of stubble
Awareness regarding alternative options to CRB	- .216
Lack of time	- .109
Availability of low cost alternatives (cost)	- .147
Ease of exercising alternatives (Convenience)	- .306
Cooperation from government	- .375
Lack of Awareness regarding Ill effects of CRB on health	.318
Lack of Awareness regarding Ill effects of CRB on environment	.231

Table 11: Regression analysis-Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.580[a]	.336	.170	.487

a. Predictors: (Constant), Total_DF, Total_DC, Total_D, Total_C, Total_DB, Total_DD, Total_DE

Table 12: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3.364	7	.481	2.027	.087[b]
	Residual	6.636	28	.237		
	Total	10.000	35			

a. Dependent Variable: QB1

b. Predictors: (Constant), Total_DF, Total_DC, Total_D, Total_C, Total_DB, Total_DD, Total_DE

(C-Awareness regarding alternative options to CRB; D-Reasons for CRB; DB-Cost; DC-Convenience; DD- Lack of Government Support; DE- Awareness regarding Ill effects of CRB on health; DF- Awareness regarding Ill effects of CRB on environment)

Table 13: Regression results-Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.683	1.319		4.307	.000
	Total_C	-.129	.136	-.157	-.950	.350
	Total_D	-.140	.166	-.143	-.848	.404
	Total_DB	.192	.197	.176	.975	.338
	Total_DC	-.095	.104	-.151	-.913	.369
	Total_DD	-.493	.203	-.416	-2.426	.022
	Total_DE	.029	.164	.032	.179	.860
	Total_DF	.269	.169	.263	1.592	.123

a. Dependent Variable: QB1