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Readiness of Farmers to Adopt Crop Residue Management Alternatives: A study from Haryana State

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ABSTRACT
The research was carried out to assess the readiness of farmers toward crop residual management. For this study, Karnal, Kurukshetra, and Fatehabad districts were selected purposely according to the report of Haryana Space Applications Center. The total number of the respondent understudy was 180. Data regarding socio-economic status, assets availability, source of information, and readiness of farmers were collected with the help of a structured interview schedule because some driving factors may affect the readiness of the farmer. A positive and significant relationship was found at a 0.01% level of Significant between the readiness of the respondents and operational land holding, annual income, farm assets, and source of information and with education at a 0.05% level of significance. So, making farmers aware of available management alternatives using the different extension and educational programs and by providing financial and technical backup it may reduce the rate of residue burning and increase the rate of adoption of management practices.

KEYWORDS
Correlation, Haryana, Readiness, Residue management

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INTRODUCTION

Open burning of agricultural crop residue is a major environmental concern across the world, particularly in nations like India, where rice-wheat farming dominates (Singh *et al*, 2017). Every year, India creates around 500-550 million tonnes of crop residues as a result of its agricultural dominance (Anonymous, 2012). The increasing need for food has resulted in a significant increase in the intensity of agro-based activities, notably in the Indo-Gangetic plain. Agriculture has been heavily commercialized and agricultural processes have been mechanized in the region. Traditional agricultural methods are gradually being phased out as contemporary farming methods are introduced. Crop residues have traditionally been used for a variety of purposes, including animal feed, fodder, fuel, roof thatching, packing, and composting. However, as farming becomes more commercialized and specialized, the use of machines to harvest the produce is becoming more common. The automation of crop harvesting results in longer stalks in the fields, causing issues for the following crops. a considerable volume of agricultural residue must be disposed of in the short time between harvesting one crop and planting the next. So as a consequence, farmers are increasingly burning stalks in their fields, as it is a less expensive and more practical option to dispose of crop residue fast (Subbaiah *et al*, 2020). Burning is not a new activity; grasslands have been burnt for many centuries. Burning is a cost-effective and labor-saving way of removing unwanted crop residues before tillage or seedbed preparation. Crop wastes are subjected to open burning as a result of high labour wages and farmers' need to get their agricultural products collected and marketed as quickly as feasible. Apart from that, the short time between harvesting the Kharif (rice) crop and growing the Rabi (wheat) crop, labour scarcity, and poor industrial demand for agricultural waste are all major causes of CRB (Anuradha *et al*, 2021). During the rice harvesting season (October–November) crop residue burning is one of the most important causes of pollution in the IGP and beyond. The combustion of biomass emits a variety of pollutants into the atmosphere, contributing to the degradation of air quality. It also emits greenhouse gases such as carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4), as well as tiny particles known as black carbon, which have a long-term impact on the climate. Punjab and Haryana alone produce 48 percent of India's 13915 Gg (Giga gram=10 billion gram) rice straw excess, which is vulnerable to being burned in open fields (Gadde *et al*, 2009).

Aside from environmental concerns, crop residue burning has a long-term impact on agricultural production since it deteriorates soil health, depletes minerals and organic carbon content, and kills important microorganisms. As a result, there is a need to battle residue burning to limit its negative effects. Currently, the state and federal governments are implementing a variety of punitive and compensatory measures to reduce agricultural residue burning. Raza *et al* (2019)

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said Farmers are the real implementers and critical stakeholders, and gaining a better understanding of their intents to embrace sustainable residue management methods could aid policymakers in developing successful policies that boost agricultural productivity while reducing environmental damage. Roy and Kaur (2015) conducted a study in West Bengal, observed that there are many alternatives are available for paddy straw management but these are not adopted by the farmers. Farmers are also aware that burning operations are detected, prohibited, and punished (Anuradha *et al*, 2021), however, the majority of farmers continue to do it. Therefore, it's critical to comprehend the primary elements that influence farmers' readiness to implement or not implement accessible residue management techniques. As a result, the present study is undertaken to learn more about farmers' readiness to adopt crop residue management alternatives and the factors that influence their willingness to do so.

MATERIALS AND METHODS

This study was undertaken in Haryana state during 2019-2020 to assess the readiness and factor effecting to adopt residue management practices of farmers. Haryana is often called the "Food Mine" of the country. About 80% of the population of the state is agriculture-dependent, directly or indirectly. Haryana is self-sufficient in producing food grains and is also a significant contributor of food grains in meeting other states' needs. The average state productivity is about 3.1 tonnes/ha. Haryana contributes 13.3% toward national production of nearly 4 tonnes/ha. With this tremendous amount of food grain, it also generates 27.83 MT crop residues (NPMCR, 2017). Therefore, Haryana state is considered as one of the major crop residue burning states of North India and it contributes to the adverse air quality of national capital Delhi during the peak period of residue burning (Oct- Nov). Hence, Haryana state was selected purposely for this study. During the past five years, the Haryana Space Applications Center reported high paddy stubble burning in Karnal, Kurukshetra, Fatehabad, Kaithal, and Sirsa districts. The top three districts, Karnal, Kurukshetra, and Fatehabad, were purposefully chosen for this study based on this observation report.

Further, stratified random sampling was applied, two blocks were selected from each district, i.e. Nissing and Indri from Karnal, Sahabad, and Thanesar from Kurukshetra and Fatehabad, and Ratiya from Fatehabad Districts and each block, three villages were selected randomly. In the last strata, respondents were selected randomly from the purposively selected list of preset criteria, which were farmers who had at least one acre of landholding and cultivating rice and wheat crops from the last five years. Thus, 180 farmers have constituted the sample for the study.

The descriptive research design was applied in the present study. It was used for fact-finding with adequate interpretation. For the study, a face-to-face interview method by using an interview schedule was adopted. The schedule was first prepared in English and then translated to Hindi (native language) and then back to English to verify the consistency and content. For socio-economic variables like age, education, annual income, and operational land holding, direct questioning was made. Structured interview schedules were used for measuring another independent variable such as farm assets availability and source of information. The responses were collected on a dichotomous point yes for 1 and 0 for no response. To assess the readiness, an interview schedule was used and Farmers were asked to respond to a particular statement. The score was designed as 5=Strongly Agree, 4=Agree, 3=Undecided 2=Disagree; 1=Strongly Disagree.

The degree of relationship between socio-economic variable (x) and farmers' readiness to adopt crop residue management (y) was then assessed using Karl Pearson's product-moment correlation coefficient (r).

$$r_{(X,Y)} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right] - \left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$

Where r is the correlation coefficient, X and Y are the variables, N is the number of observations, and $\sum$= summation.

RESULTS AND DISCUSSION

The descriptive statistics of socio–personal profile for all respondent (n=180) is presented in Table 1. These descriptive data variables were used to find out the relationship with the readiness of respondents regarding crop residue management. The study revealed that more than half of respondents (56.12%) were in the middle category of age. These observations were in line with the finding of Verma (2012). It was observed that some farmers (7.22%) did not attend school and few of them (30.55%) reached high school (Table-1). But most of the respondents were between secondary (31.11%) to senior secondary (30.55%) education. The area under cultivation is a major infuser of farmers' decisions regarding the burning of crop residue. In the study area, nearly half of the respondents were owned medium (30.55%) to semi medium (28.34%) landholding. so, it is difficult to manage labour for harvesting. Slightly more than half (55%) of the respondents belonged to the low-income category that's why maybe respondents were not able to take more economic burden to adopt management practices.

Farm assets owned

The data in Table 2 shows that the majority of the farmers (60%) possessed tractors followed by 53.34 percent of farmers having cultivators, and 52 percent of the farmers owned harrow, 48.82 percent of the farmers owned trolleys, 19.48 percent of farmers had rotators, 10.55 percent of farmers were having zero till drill, 10 percent of farmers owned thresher, 10 percent of farmers had straw reaper. Only 7.74 percent of farmer-owned happy seeders, 5 percent of farmers owned combine harvesters. Among all respondents not only a single respondent was having SMS attach combined harvester and also were not owned Hay Rake, Baler and P.S.C. Assets availability of farmers, to some extent, is a driver of changing from burning of residue to readiness to adopt management practices. Farmers with more income and assets availability are less prone to burn residue.

Table 1: Independent variable used for farmers interviewed in Haryana state of India (n=180)

S. No.	Socio-personal attributes	Category (Range)	Frequency (f)	**Percentage (%)**
1.	Age (years)	Young (up to 35 years)	33	18.33
		Middle (36 to 50 years)	101	56.12
		Old (more than 50 years)	46	25.55
2.	Education	Illiterate	13	7.22
		Primary	32	17.78
		Secondary	56	31.11
		Senior Secondary	55	30.55
		Graduate and above	24	13.34
3.	Operational Land Holding (hec.)	Marginal (< 1)	29	16.11
		Small (1-2)	35	19.44
		Semi-medium (2-4)	51	28.34
		Medium (4-10)	55	30.55
		Large (>10)	10	5.56
4.	Annual Income (in lakh)	Low (< 3.6)	99	50.00
		Medium (3.6-7.78)	61	33.89
		High (>7.78)	20	11.11

Source: Data collected during the study by the author

Source of information

The result in Table 3 reveal that majority (56.66%) of the farmers considered ICAR/SAU/SVU as the most important source of information to update the knowledge on stubble management practices followed by KVK / ATMA personnel and their webpage 48.33 percent, State department of Agriculture / Dairy/ Animal Husbandry personal 42.77 percent, 31.66 percent from T.V. and 23.33 percent from Govt. organizations Kisan Melas, Gosathies, Exposure visit. Only 4.44 percent and 3.33 percent from Govt. organizations published Magazine/ bulletins/folder, etc., and Pasar Bharti Radio/ FM, respectively.

Under private source of information, Mobile Apps, Media, ICT is the major private source of information used by 34.44 percent of farmers followed by Input dealer that 11.11 percent, output buyers as the information source were used by 1.7 percent of farmers, 1.66 percent of farmer used Private practitioners' / Para vets as the information source, rural retails hub.

Further analysis of Table 3 reveals that the majority (81.15%) of the farmers measured public sources as the major sources of information, whereas (18.85 %) of farmers considered private sources as the major sources of information.

Table 2: Farm assets availability to respondent farmers (n=180)

S. No	**Machines**	**Frequency (f)**	**Percentage (%)**
1	Tractor	108	60.00
2	Cultivator	96	53.34
3	Disc harrow	94	52.00
4	Trolley	88	48.82
5	Rotavator	35	19.48
6	Zero till drill	19	10.55
7	Thresher	18	10.00
9	Straw reaper	18	10.00
10	Happy seeder	14	7.74
11	Combine	9	5.00
12	Paddy straw chopper	0	0.00
13	Mulcher	3	1.66
14	Hay rake	0	0.00
15	Baler	0	0.00
16	SMS for Combined harvester	0	0.00

*Multiple Response Allowed

Table 3: Source of information used by respondents (n=180)

Categories	Frequency (f)	Percentage (%)
Public sources		
KVK / ATMA personal	87	48.33
ICAR, SAU, SVU personal	102	56. 66
State Department of Agriculture, Dairy, Animal Husbandry in personal	77	42.77
Govt. organizations published Magazine/ bulletins/folder, etc	8	4.44
Govt. organizations kisan melas, Gosathies, Exposure visit etc	42	23.33
TV channel	57	31. 66
Pasar Bharti Radio/ FM	6	3.33
Private sources		
Input dealers	20	11.11
Output buyers	3	1. 66
Private practitioners / Para vets	3	1. 66
Rural retails Hubs	0	0.00
Mobile Apps, Media, ICT	62	34.44
Public sources	379	81.15
Private sources	88	18.85
Total	467	100

*Multiple Response Allowed

Awareness campaigns of state departments and Better MSP will enhance the popularity of nutrition-rich coarse cereals in the north-western region, also can encouraging farmers for refraining from stubble burning and farmers can be ready to adopt management practice responded by farmers with 91.11 and 84.67 % weighted mean respectively. Nearly more than 50% of the agreed that subsidies should be sufficient and easily accessible by the farmers. Balers are also adopted by some farmers but the problem with balers is that it requires space to store and it has less use. Bailed straw can be easily transported, and some farmers, with a 79.11% weighted mean, say that bales of crop stubble are useful for mushroom growers and livestock owners. Nearly 66.66 % of farmers agreed and strongly agreed that turbo happy seeder will be a useful cheap alternative solution for rice-wheat cropping systems. But we need to provide these machineries at the village or community level. Other than this some farmers with 74.22% weighted mean, responded that crop residues can be used for other purposes like hay preparation and it compensates feed deficit during the dry season. Hence, it can be interpreted that farmers were aware of the ban on residue burning and they can adopt alternative management options, but we need to provide them financial support and technical backup.

Relationship of various independent variables with the readiness of the farmer respondent to adopt crop residue management practices

The relationship between various independent variables and readiness to adopt crop residue management practices of the farmer respondents is presented in Table 4. A negative and significant relationship was found between the age and readiness toward adoption of CRM which indicated that the higher the age of the farmers, the lower readiness for adoption. It indicated that aged farmers do not willing to take any different approaches and risks. A positive and significant relationship was found between the readiness of the farmer respondents and variable viz. operational land holding, annual income, farm assets, and source of information. This was correlated with the readiness of farmers to adopt crop residue management practices at a 0.01 level of Significant. The readiness score of respondents was positively and significantly correlated with the education of respondents at a 5 percent level of significance ($P<0.05$). Hence, farmers' readiness can also be enhanced by educational programs and training on effective management practices. Raza *et al* (2019) found a positive and significant relationship between sources of information and access to extension services in shaping farmers' decisions regarding sustainable residue management practices at the

Table 4: Famers' readiness towards adoption of crop residual management (n=180)

Sl. No.	Statements	SA	A	UD	D	SD	WM(%)
1.	Farmers are willing to use the super straw management system (SMS) if provided at a cheaper rate	28.34	36.12	16.66	10.55	8.33	96.00
2.	Turbo happy seeder will be a useful cheap alternative solution for rice-wheat cropping systems.	26.67	50.0	6.66	12.78	3.89	76.22
3.	Bales of crop stubble are useful for mushroom growers and livestock owners.	29.44	41.11	20.55	5.55	3.33	79.11
4.	Better MSP will enhance the popularity of nutrition-rich coarse cereals in the north-western region.	41.11	51.12	0.00	5.55	2.22	84.67
5.	The crop residues leftover in the field can be used as fertilizer.	46.12	53.88	0.00	0.00	0.00	58.67
6.	Subsidy should be sufficient and easily accessible by the farmers.	26.66	28.88	15.00	22.23	7.23	82.33
7.	Awareness campaigns of state departments are encouraging farmers for refraining from stubble burning.	26.66	53.88	7.22	4.44	2.22	91.11
8.	Providing power from the crop biomass is a lucrative option for the farmers.	46.66	36.66	0.0	12.23	5.55	94.44
9.	Crop residue management has helped to make the soil more fertile.	17.78	42.22	7.78	21.11	11.11	67.89
10.	Better crop residue management results in savings of Rs-2000/hectare from the farmer's manure cost.	9.44	5.55	66.66	18.88	10.55	65.00
11.	Catchy slogans and wall paintings at the prominent locations helped attract people's attention	22.22	35.00	9.44	17.77	10.00	57.00
12.	Capacity building of farmers regarding usage of technologically advanced machines will restore confidence among them	74.44	25.56	0.00	0.00	0.00	94.89
13	The use of microbial sprays that can speed decomposition is also an option for farmers	35.55	46.11	4.44	7.22	6.66	91.56
14	Crop residues can be used for other purposes like hay preparation and it compensates feed deficit during the dry season	40.0	26.66	10.00	15.00	8.34	74.22

Source: Data collected during the study by the author

farm level.

Table 5: Relationship of various independent variables with the readiness ofthe respondents to adopt crop residue management

Variables	Correlation coefficient (r-value)
Age	-0.116*
Education	0.139*
Operational Land Holding	0.394**
Annual Income	0.333**
Farm Assets	0.503**
Source of information	0.253**

*P<0.05 **P<0.01

CONCLUSION

Crop residue burning is not an environmentally acceptable form of agricultural residue management but still, farmers are practicing to quickly clear their land for sowing of the next crop. It can reveal from the study that farmers are ready to adopt crop residue management practices because most farmers were aware of available management alternatives and they also know that burning is restricted by central and state governments. Based on our research findings we can interpret that the present scenario of residue burning can be changed into sustainable residue management if we will take a holistic approach to combat the situation including financial support, technical backup, and education activities.

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