Farmers' Perspective to Mitigate Crop Residue Burning in Haryana State of India

Anuradha[1], K.S. Kadian[2], M.S. Meena[3], H.R. Meena[4] and C.S. Prashanth[5]

1. Sr. Res. Fellow, NFSM on Pulses, 3. PS, ICAR-ATARI, Zone-II, Jodhpur, Rajasthan,
2&4. PS, Division of Dairy Extension, National Dairy Research Institute, Karnal (Haryana),
5. Ph.D Scholar (Agril. Ext.), RPCAU, Samastipur, Bihar, India

Corresponding author e-mail : choudharyanu9928@gmail.com

Paper Received on March 16, 2021, Accepted on May 20, 2021 and Published Online on May 27, 2021

ABSTRACT

*This present study was undertaken in Haryana state to identify the prevailing constraints and suggestive measures from farmers' perceptive to mitigate crop residue burning. The data were solicited from 180 farmers from three major crop residue burning districts of Haryana state. The severity of constraints was analyzed using the Garret ranking technique. These constraints were categorized as technological, straw use constraints, communication constraints, economic and management. Suggestions were delineated using open ended schedule and after screening, categorized as policy, management, Finance and technology related. The study reveals that availability of less time between two crops was found the major constraints with a highest mean score of 81.67 per cent. Secondly, high production cost through hiring of the machinery was ranked as second constraint (73.01%), followed by less availability of practical techniques (69.12%). In present study extension contacts & annual income of farmers was negative and significantly (*P<*0.05) association between perception about constraints. Mainly farmers suggested that bio energy based power plant should be promoted (94.44%) and by increasing industrial use of residue as fuel or input (96.66%) can promote farmers to sell instead of burning. Therefore, for increasing the adoption rate of management alternatives, there is a need to resolve these problems with research, extension and policy measures.*

Key words: *Residue; Burning; Sustainable alternative; Constraints; Garratt ranking;*

India accounts for 17 per cent of the world's population in just 2 per cent of the world area. For feeding such a large population from limited land and resources, intensive cultivation is required. During the green revolution era, a significant shift of cropping system seemed from traditional crops like maize, pearl millet, pulses and oilseeds to rice-wheat cropping system in Punjab, Haryana, and western Uttar Pradesh (UP). High grain production produces huge volume of crop residue in monoculture and intensive cultivation. The residues are estimated around 500 million tons (*IARI, 2012*). *National Policy for Management of Crop Residue (2017)* analyzed in the context of Haryana state, total amount of crop residues is estimated as 27.83 million ton (MT). Wheat straw is mostly used for livestock feeding while surplus residues (i.e., 9.08MT) are burnt every year. The crop residue burning is negatively impacted the air, soil, human, and animal health (*Tripathi et al., 2012)*. The Government of India as taken many initiatives to mitigating crop residue burning. Under Section 144 of the Civil Procedure Code (CPC), crop residue burning is prohibited. The penalty is being imposed on many offending farmers. The National Green Tribunal (NGT) has imposed fines ranging between Rs. 2,500 to Rs 15,000 based on the area under burning. Along with the strict actions, the Government is also trying to convince the farmers by providing incentives and subsidy on purchasing of machinery for crop residue management, and adoption of crops diversification. There are many alternative or residues management options are available using machinery such as happy seeder, zero tiller, baler, etc. Crop residues can be used as raw material and fuels for industries like paper/cardboard, brick kilns, production of bio-energy,

packaging, etc. Despite the many alternatives, farmers are still facing problems in the adoption of crop residue management practices. Hence, a study was conducted to analyze various constraints, that would be help full in amelioration through government policies, research and extension activities. Farmers are main stakeholder or end user of any technology and agriculture policies. Therefore, it is necessary to take their views to gradually mitigate crop residue burning practices, so farmers' suggestions were delineated in present study.

METHODOLOGY

The study was carried out in Haryana state of north India, which was purposively selected as it is one of the major crop residues burning states. The rice-wheat based cropping system is prevalent in Haryana, which generates 27.83 MT crop residues (*NPMCR, 2017*).Stratified random sampling techniques was employed in selection of the farmers. Based on strata as given by Haryana Space Applications Centre (*HSAC, 2018)* report, three top districts where burning is highest, namely Karnal, Kurukshetra, and Fatehabad districts were selected purposively. In the second strata, from each selected district, two blocks were selected randomly. In which, Nissing and Indri from Karnal district, Sahabad, and Thanesar from Kurukshetra district, and Fatehabad and Ratiya from Fatehabad district were selected. In the last strata, from each block, three villages were randomly selected. Farmers who had at least one acre of landholding and cultivating rice and wheat crops from previous five years were chosen for study. Hence, 10 farmers from each village were randomly selected using a stratified random sampling technique. Thus, 180 farmers constituted the sample for the study.

Initially, information on farmers' perception about constraints obtained to prepare the interview schedule through conducting focused group discussions, farmers-scientist interactions, and first-hand information from the field visits. The constraints were conscripted in the consultation with expert/extension agents. The interview schedule was prepared with the finalized list of constraints and then translated into Hindi for better readability to farmers. After that, the farmers were asked to rank the problems being faced by them. Garrett's ranking technique provides the change of orders of constraints and advantages into numerical scores. This technique's prime advantage over simple frequency distribution is that the constraints are arranged based on their severity from respondents' point of view. Outcomes of such ranking have been converted into score value with the help of the following formula.

$$\% \, position = \frac{100 \times (Rij - 0.5)}{Nj}$$

Where;

Rij = Rank given for the i^{th} variable by j^{th} respondents

Nj = Number of variables ranked by j^{th} respondents

Each rank's percent position was converted into scores, referring to the table given by Garrett and *Woodworth (1969)*.Similar method was used by *Jyothi et.al (2020)*.The scores of individual respondents were multiplied by garret value, and then it was added together and divided by the total number of the respondents for whom scores were added. Based on these mean scores for all the constraints, ranks were assigned.

Further, The Pearson statistical coefficient correlation tool was used to measure the relationship between perceived constraints and socio-economic attributes To collect respondents' suggestion, open ended interview schedule was used they were asked "what do you suggest to policy makers, research institutes and government organization so that residue burning can be combat". For effective representation, responses were categorized in themes and proportions under each theme were calculated using descriptive statics tools.

RESULTS AND DISCUSSION

Socio- economic profile : Table 1 includes details on the socio-economic profile of farmers. It shows that a majority of respondents were between 36 to 50 years of age (56.12%). In the study are from the total 180 respondents, 30.55 per cent were educated to senior secondary, 31.11 per cent were educated to secondary level, 13.34 per cent were educated to graduation level and above. The remaining 17.78 per cent of respondents were only educated at the primary level and 7.22 per cent were illiterates. In study area nearly half of the respondents were owned medium (30.55%) to semi medium (28.34%) land holding. These findings were supported by finding of *Verma (2012)*.

More than half of the respondents (55%) were from low-income households, and more than half of the farmer respondents (53.89%) had mass media exposure. The results contradicted *Singh et al (2013)* study, which found that farmers had a moderate level

Table 1. Socio-economic profiles of farmers (N=180)

SE attribute	Category	No.	%
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
Education	Illiterate	13	7.22
	Primary	32	17.78
	Secondary	56	31.11
	Senior secondary	55	30.55
	Graduate and above	24	13.34
Operational landholding (ha.)			
	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
Annual income (in lakh)			
	Low (< 3.6)	99	50.00
	Medium (3.6-7.78)	61	33.89
	High (>7.78)	20	11.11
Extension contacts			
	Low (< 6.80)	51	28.33
	Medium (6.80-13.78)	62	34.44
	High (> 13.78)	67	37.23
Mass media exposure			
	Low (<11.95)	32	17.78
	Medium (11.95-13.94)	51	28.33
	High (>13.94)	97	53..89
Innovativeness			
	Low (< 7.1)	13	7.22
	Medium (7.1-9.7)	91	50.56
	High (>9.7)	76	42.22
Ecological consciousness			
	Low (<13.5)	40	22.22
	Medium (13.5-16.4)	75	41.67
	High(>16.4)	65	36.1

of mass media exposure. More than half of respondents had a high (37.23%) to medium (34.44%) level of extension interaction. Table 1 also shows that approximately half of the farmers interviewed (50.56%) had a medium degree of innovativeness and ecological consciousness. These results are consistent findings of *Roy et al. (2015).*

Constraints : Constraints as perceived by farmers in adoption of crop residue management alternatives were studied in the study. Constraints were categorized under different heads such as technological, uses of straw, communicational, economic, and management, for easy interpretation coding were used (Table 3a). Per cent positioning of individual constraint were determined and score were analyzed using Garrett table (Table 2). The overall ranking to all constraints based on frequency distribution is presented below in Table 3.

Table 2. Percentage position and their corresponding Garett's table value.

Rank	Percentage position		Garrett table
1	100(1-0.5)/15	3.33	86
2	100(2-0.5)/15	10	75
3	100(3-0.5)/15	16.66	69
4	100(4-0.5)/15	23.33	64
5	100(5-0.5)/15	30	60
6	100(6-0.5)/15	36.66	57
7	100(7-0.5)/15	43.33	53
8	100(8-0.5)/15	50	50
9	100(9-0.5)/15	56.66	47
10	100(10-0.5)/15	63.33	43
11	100(11-0.5)/15	70	40
12	100(12-0.5)/15	76.66	36
13	100(13-0.5)/15	83.33	31
14	100(14-0.5)/15	90	24
15	100(15-0.5)/15	96.66	15

Technical constraints : Table 3 shows that less time availability between harvesting of paddy and sowing of wheat (AC3) was observed one of the major constraints with highest mean scone (81.67%) and ranked 1st. Due to these narrow gap farmers are unable to adopt any management practices. Hence, they perceived burning as a less time consuming and cost-effective practices. *Glithero et al (2013)* stated that, the major reasons given by farmers for not baling or selling cereal straw are the short period of operations for the next crop. With 69.12 per cent mean score, low availability of cost-effective technologies (AC1) was considered as 3rd important technical constraint.

Since the available techniques are not suitable to the agro-economic conditions of the farmers to address their management problems. The heavy machineries like happy seeder (AC5), which requires high power tractors, which is not available in every household mainly for small and marginal farmers. It was found 4th important constraints with 62.75 per cent mean score. The lack of technical expertise in handling of machineries on the part of farmers (AC2) was considered as 12th constraints (38.98%). Farmers are not capable to hire or buy the experts. The crop residue interferes with

Table 3. Ranking of the constraints in adoption of sustainable crop residue management (N=180)

Constraints	Frequency distribution of ranking of constraints															TS	MS	Rank
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AC1	1290	750	9315	320	240	114	53	100	94	86	80	0	0	0	0	12442	69.12	3
AC2	0	75	276	128	240	228	106	150	235	344	800	4032	310	48	45	7017	38.98	12
AC3	12298	900	552	448	60	114	106	50	94	43	0	36	0	0	0	14701	81.67	1
AC4	172	75	138	256	180	228	106	200	141	215	400	540	3410	240	75	6376	35.42	13
AC5	172	225	1035	8448	600	171	106	200	47	129	40	36	62	24	0	11295	62.75	4
BC1	172	300	690	512	7740	570	371	150	94	43	40	72	0	24	0	10778	59.88	5
BC2	344	150	345	320	1260	7296	265	200	141	86	0	36	0	0	0	10443	58.02	6
BC3	0	0	138	192	300	342	265	400	470	5160	320	252	155	24	0	8018	44.54	10
CC1	86	0	138	64	120	114	0	50	282	86	160	360	372	360	1830	4022	22.34	15
CC2	0	75	69	0	0	171	530	6200	470	387	320	252	62	72	30	8638	47.99	8
DC1	0	75	138	192	60	171	212	350	376	516	4520	180	248	216	60	7314	40.63	11
DC2	1290	10200	552	384	240	57	106	50	94	129	40	0	0	0	0	13142	73.01	2
DC3	172	150	276	192	300	570	6625	600	470	86	120	36	31	0	0	9628	53.49	7
EC1	86	225	138	64	240	171	265	500	5734	559	320	180	62	24	0	8568	47.6	9
EC2	0	0	0	0	60	114	53	100	235	258	400	504	558	2496	255	5033	27.96	14

(Note: Table 3a, represents coding and statements sheet for above constraints)

Table 3a. Coding of constraint statements

Coding	Constraints
	Technological constraints :
AC1	Lack of cost-effective technologies; AC2Lack of technical expertise in handling of machinery
AC3	Less time gap between harvesting of paddy and sowing of wheat
AC4	Crop residue interferes with seeding operations
AC5	High power tractor requirement to use CRM machineries
	Constraints in the use ofstraw
BC1	Less market demand of paddy straw
BC2	Rice straw contains low protein and high silica, make it less palatable
BC3	Crop residue require moisture for decomposition in soil
	Communication constraints
CC1	Less linkage with ICAR /Govt. institute regarding crop residue management solutions
CC2	Less training facilities available
	Economic constraints
DC1	High transportation cost
DC2	Hiring machineries for crop residue management increases cost of production
DC3	Adoption of management alternative prevents farmers to grow vegetable crop in intermediate time
	Management constraints
EC1	Non-availability of labour to manage paddy straw.
EC2	Crop residue is bulky in nature

tillage/seedling operation (AC4) is less severe constraint which is also supported by *Sofoluwe et al. (2011)*.Hence, it ranked as 13thconstraints.

Constraints in use of paddy straw : The study reveals that farmers were not collecting crop residues due to less market demand at local level (BC1). Hence, this was ranked as 5th important constraints with 59.88 per cent mean score (Table 2). Study reveals that high silica contents and low protein makes it less palatable for milch animals (BC2). This was identified as 6th major constraints with mean score of 58.02 per cent. The rice straw contains low protein and energy so it creates nutrients deficiency, if it is given to livestock alone and may reduce the milk yield in milch animals. The finding is also supported by *Lyngdoh et al. (2018)*. Crop residue requires high moisture for decomposition (BC3) was considered as 10th constraint with 44.54 per cent mean score. Hence, maintaining high moisture was also difficult on part farmers, even extra ploughing was also required.

Communicational constraints : Less training facilities was available for farmers for management of crop residues in the field (CC2). Hence it was considered as 8th important constraints (47.99%). *Patel et al (2016)* reported that major constraints affecting the transfer of technology were inadequate staff strength in department, lack of proper transfer policy, poor infrastructural facility, lack of input supply. Less farmer-extension linkage (CC1) was also found as 15thcommunicational constraint. That's why farmers have less information source regarding selling of straw in paper industries and bio energy plants.

Economic constraints : High cost of production due to adoption of management practices (DC2) was 2nd major economic constraint with 73.01 per cent mean score. *Stevens (2014)* reported that farmers' personal preferences focused mainly on costs and benefits. In the study area, mainly in Karnal and Kurukshetra, many farmers grow vegetables so, they follow burning to take advantage of the time interval. If they invest in management of residues, they perceived that it as an economic loss (DC2). Hence, farmers ranked it as 7th constraint. The high cost of transportation (DC1) was also observed as 11th constraints, which was also observed by *Qian et al., (2014)* and *Roy (2015)*.

Management constraints : Less labour availability for managing the crop residue (EC1) was ranked as 9th constraints with 47.60 per cent mean score. Respondents said that except burning, other alternatives of paddy straw management delay the wheat sowing. Straw is challenging to store and, due to its bulky nature it is a challenge to transport (EC2). Contradictory result was reported by *Subbaiahet.al. (2020)* that using of baler, storage and transportation becomes easy. This constraint obtained 27.96 per cent mean score, and ranked as 14th constraints by the respondents.

Relationship of selected independent variables with the perceived constraints of the farmer : The relationship of various independent variables with the perceived constraints has been presented in Table 4. Constraints score of farmers were not significantly correlated with age. It implies that age, education and land holding does not affect felt constraints because mainly constraints are related with technology and managements. The respondents' perception scores were negatively and significantly correlated with Annual income and extension contact of respondent at 5 per cent level of significance (P<0.05). Perceived problems and independent variables, such as mass media exposure, innovative proneness, and ecological consciousness at 1 percent level of significance (P<0.01) were found to have a negative and significant relationship. It implies that if the respondent is exposed to more mass media and has more conscious about environment he will manage to not burn, and the problems he or she is experiencing will be reduced. While contacting extension professionals, respondents can get access to a variety of resources.

Table 4. Correlation between independent variables and constraints in crop residue management

Variable	Correlation coefficient
Age	0.078
Education	0.134
Operational Land Holding	0.115
Annual Income	0.156*
Mass Media Exposure	-0.371**
Extension Contact	-0.290*
Innovative Proneness	-0.715**
Ecological Consciousness	-0.720**

*$P<0.05$ **$P<0.01$

Suggestion by farmers to combating crop residue burning: Generally, to get high rate of adoption and better results from of any policy, it becomes necessary

Table 5. Suggestion given by farmers to combat crop residue burning (N=180)

Suggestions	No.	%
Policy related		
Establishment of bio energy plants should be promoted	170	94.44
CHC services should be improve	165	92
Promotion of crop diversification by increasing MSP	127	70.54
Finance related		
Crop residue demand in industries as fuel/ input	174	96.66
Subsidy amount should be individual based	147	81.66
Management related		
Straw management should be carried out at community level	151	83.88
CRM related machinery should be available at village Panchayat level	143	79.44
Technology related		
Low power driven machinery manufacturing	138	11.36

to get reviews and feedback from all stalk holders. These suggestion and feedback can be really beneficial for follow ups and reconsideration of implemented programme. In the context of crop residue management policies and approaches, farmers are main stalk holders because these approaches affect farmers' social and economic profile in both scenario adoption and non – adoption of management practices. If farmers are facing genuine difficulties so, there is need to consider their problems in order to mitigate residual burning.

In present study farmers' suggestion were collection and categories into four themes related to policy, finance, management and technical.

Under policy related suggestions 94.44 per cent respondent suggested that establishment of bio mass based power plant should be promoted. Nearly 92 per cent respondent said that CHC services should be improve because it is not working properly that's why needy farmerswerelackingtouseof these machinery. Promotion of Crop diversification by increasing MSP of other crops such as pulses and oilseed can be profitable reason to shift cropping system, 70.54 per cent farmers suggested this in study area. Financial assistance related suggestions, most of the farmers (96.66%) suggested that industrial demand of crop residue as input should be created and 81.66 per cent farmers said every farmer don't have equal economic status, to purchase high cost machinery the amount of subsidy should be based on financial condition of individual. In context of management related suggestions 83.88 per cent farmers said that straw management should be carried out at community level because it would be cost effective. Nearly 80 per cent per cent farmers suggested crop residue management related machinery should be available at village *Panchayat* level for effective utilization of machinery. Technically, happy seeders are heavy to drive with low horse power tractor so effective machinery should be developed, this technical suggestion contributes 11. 36 per cent among all suggestions.

CONCLUSION

A sustainable option for opting a suitable alternative of residue management instead of burning in the open field is the need of hour. These alternatives are not economically viable and practically feasible as perceived by farmers. The major problems are less time availability between the harvesting of rice and showing of wheat crop, followed by cost of cultivation increases, if machinery is used, and lack of cost-effective & viable technologies. Hence, the result can be used to intervene technically to mitigate constraints in residue management. Thorough understanding of these constraints is necessary for practical solutions. Suggestion given by farmers should be consider, mainly policy related suggestion such as implementing biomass based power plant and promotion of crop diversification. Other than this, rice varieties producing minimum biomass &mature in short period can widen the time gap between harvesting of rice and sowing of wheat. Machineries which can be driven with low horse power tractors must be encouraged. The custom hiring centers must be promoted in cluster mode of villages in the state. Awareness campaign and training program should be organized to promote this approach.

REFERENCES

Anonymous (2012).Crop residues management with conservation agriculture: Potential, constraints and policy needs. Pp 56-69. Indian Agricultural Research Institute, New Delhi.

Garret, H.E. and Woodworth, R.S. (1969). Statistics in psychology and education. Vakils, Feffer and Simons Pvt. Ltd., Bombay. 329

Glithero, N. J.; Ramsden, S. J. and Wilson, P. (2013). Barriers and incentives to the production of bio-ethanol from cereal straw: A farm business perspective. *Energy Policy,* **59**: 161-71.

Jyothi, V.; Subbaiah, P.V. and Vijayabhinandana, B. (2020). Preference ranking of agro advisory mobile messages sent in rice crop to farmers via e-group. *Indian Res. J. of Ext. Edu.,* **20** (2&3) : 12-16

Lyngdoh, L. and Dhaliwal, R.K. (2018). Perception of extension personnel and farmers towards effect on open burning in rice and wheat cropping system. *Indian J. of Eco.,* **45** (4) : 881-887.

HSAC Report (2018). Monitoring crop stubble burning in Haryana using satellite data, HSAC, report (2018) accessed from:http://hrsdi.in/activefire/LIST/Note%20Stubble%20burning%202018.pdf (accessed on 12, November, 2019)

NPMCR. (2017). Available online: http://agricoop.nic.in/sites/default/files/NPMCR 1.pdf (accessed on 12, Dec. 2020)

Patel, D.; Devi, M.C.A.; Parameswaranaik, J.; Dhodia, A. J. and Bhatt, A. (2016). Constraints of extension personnel in transferring of dairying technologies in Karnataka. *IndianJ. Dairy Sci.,* **69**: 214.

Qian, X.; Shen, G.; Wang, Z.; Guo, C.; Liu, Y.; Lei, Z. and Zhang, Z. (2014).Co-composting of livestock manure with rice straw: characterization and establishment of maturity evaluation system. *Waste Mangt.*, **34** (2) : 530-535.

Roy, P. and Kaur, M. (2015). Status and problems of paddy straw management in West Bengal. *Intl. J. of Adva. in Agril. & Eviro. Engg.,* **2**(1) : 144–152.

Singh, A; Kaur, M; Kang, J. S and Geol, A (2013). Happy seeder and rotavator technology for in-situ management of paddy straw. *International J. Adva. Res.,* **1**: 372-79.

Sofoluwe, N. A, Tijani, A.A and Baruwa, O.I. (2011). Farmers' perception and adaptation toclimate change in Osun State, Nigeria. *African J. of Agri. Res.,* **6** :89-94.

Stevens, A.T. (2014). Get more from your straw:from theory to field. *Crop Prod. Magazine,* **56**:28-31.

Subbaiah, P.; Jyothi, V. and Vijayabhinandana, B (2020). Perception and acceptability of rice straw baler for on farm residue management. *Indian Res. J. of Ext. Edu.,* **20** (1) : 27-30.

Tripathi, S.; Singh, R.N. and Sharma, S.(2012).Emission from crop /biomassresidue burningrisk to atmospheric quality. *Intl. Res. J. of Earth Sci.,* **1**(1) :1-5.

Verma, H. C. (2012). Productive and reproductive performance of dairy farmers in Faizabad district of Uttar Pradesh, M.V.Sc. Thesis (Unpub.) NDRI, Karnal.

• • • • •