

Adoption of paddy straw management techniques in Haryana: Effective approach on environmental conservation



P Sihan^{a#}, A Kumar^a, S Singh^a, KK Yadav^a, R Kumar^a, A Malik^a and A Kumar^b

Summary

Crop residue burning directly contributes to environmental pollution and releases 149.24 million tonnes of carbon dioxide (CO₂), over 9 million tonnes of carbon monoxide (CO), 0.25 million tonnes of oxides of sulphur (SOX), 1.28 million tonnes of particulate matter and 0.07 million tonnes of black carbon. The burning of paddy straw results in extensive impacts both on and off farm, e.g. losses in soil organic matter, soil nutrients, production and productivity, air quality, biodiversity, water and energy efficiency and on human and animal health. In India, being a largest producer of rice as well as of its residue, the effects from residue burning are more severe (Yadav, R.S.2019). There are diverse set of productive techniques for paddy straw management that can be utilised such as composting, straw as a ruminant fodder, incorporated in the soil, gasification, bailing, mushroom farming, production of bio-fuel, recycling in soil, packing material and bio-char production (Pathaket *al.*, 2010). The study on 'Knowledge and Adoption of Paddy Straw Management Techniques in Haryana' was conducted with following specific objectives of knowledge, adoption and constraints by the farmer in adoption of paddy straw management techniques. Majority (75 %) of the farmers were having low level of adoption regarding Paddy Straw Management Techniques. Whereas full (100%) adoption of paddy straw as animal fodder got 1st rank followed by domestic purpose got rank 2nd. The respondents had a greater level of acceptance adoption of Spreader/Shrub Master with weighted mean score of 0.95 got rank 1st.

JAE Special Issue 2023, Vol 16

Received: 11 March 2023

Accepted: 12 June 2023

Published: 31 July 2023

<https://doi.org/10.58628/JAE-2316-210>

Associated Editor: Dr. SM Haldhar

Copyright © 2023 The Author(s). Published by Society for Agriculture and Arid Ecology Research (SAAER). This is an Open Access article under the Creative Commons Attribution License 4.0 (CC BY-NC-SA).



Keywords: Paddy, Straw, Burning, Crop-residue, Management, Adoption

Introduction

India has one of the world's greatest agro-based economies, with the top ranking in rice and wheat yields. As a consequence, agricultural production and harvesting take place throughout the year. As a result of the growing production of agricultural products, there is more waste and contamination in the environment, resulting in environmental pollution. For the long-term sustainability of agriculture, natural resources and environmental conservation, it is essential that the burning of paddy straw is stopped and other alternatives be used for paddy straw management. The main reasons for the burning of residues are less time available between the rice harvesting and wheat sowing is very narrow (in the range of 20-30 days), low cost and labour scarcity. Burning of crop residues is economic loss in addition to cause's environmental pollution, is hazardous to human health, produces greenhouse gases causing global warming and results in loss of plant nutrients like N, P, K and S. Crop residue burning directly contributes to environmental pollution and released 149.24 million tonnes of carbon dioxide (CO₂), over 9 million tonnes of carbon monoxide (CO), 0.25 million tonnes of oxides of

sulphur (SOX), 1.28 million tonnes of particulate matter and 0.07 million tonnes of black carbon (Yadav 2019; David Israel Mansingh & Suresh 2019).

According to Streets et al. (2003), the Indian states with the most crop-burning quantity are Punjab (20 Mt), Haryana (10 Mt), and Uttar Pradesh (11 Mt). These states are part of the Indo-Gangetic Plains (IGP), where Crop residue burning has caused severe air pollution in recent years (Jethva et al. 2019). Paddy residue in India is expected to reach 97 Tg/year, with 24% of this being burned in fields as surplus (Kaskaoutis et al. 2014). In contrast, Punjab and Haryana account for about half of the annual paddy straw as surplus (Gadde et al. 2009; Kasniya et al. 2022). It is envisaged that appropriate strategies for In-situ crop residue management are planned for effective implementation to enable zero burning. Various equipment/machines, such as super straw management system, happy seeder, zero till drill, straw chopper/mulcher, rotary slasher, reversible MB plough etc., have been developed and successfully demonstrated in the farmers' fields.

There are diverse sets of productive techniques for paddy straw management that can be utilised such as composting, straw as a ruminant fodder, incorporation in the soil, gasification, bailing, mushroom farming, production of bio-fuel, recycling in soil, packing material and bio-char production (Pathak et al., 2010). Conservation agriculture also provides a good promise in

^aDirectorate of Extension Education, ^bK.V.K., Yamunanagar CCS Haryana Agricultural University, Hisar-125004 (Haryana), India

[#]Corresponding author: P Sihan, E-mail: growerashok@gmail.com

utilising this abundant paddy straw through the use of different implements e.g. rotavators, happy seeders, paddy straw choppers, zero-till-drills, etc. for better soil health, increasing productivity, reducing pollution and enhancing sustainability and resilience on agriculture (Haysa et al. 2005). Moreover, India's first plant to convert paddy straw into biogas that can be utilised as CNG in automobiles will come up at Karnal in Haryana as agencies double their effort to stop the burning of crop stubble. Considering the above facts, a study on 'Knowledge and Adoption of Paddy Straw Management Techniques in Haryana' was conducted with the following specific objectives of knowledge, adoption and constraints by the farmer in the adoption of paddy straw management techniques.

Materials and Methods

The study was conducted in the Sonipat and Karnal district of Haryana state in the year 2020-21. This area was selected purposely because both the districts were having large rice cultivated area and near to National Capital Region (NCR). Two blocks were selected randomly from these districts further two villages were selected randomly from each selected block. Thus, four

villages were selected from each block and 15 farmers were selected through simple random sampling technique. Thus, a total number of 120 farmers were interviewed. The data were collected with the help of well-structured interview schedule and analyzed with appropriate statistical tools like frequency, percentage and rank order.

Result and Discussion

The result and discussion have been presented under the following subheads i) Overall adoption level of farmers related to paddy straw management techniques (PSMT) ii) adoption level of farmers regarding PSMT. iii) adoption level of farmers regarding implements in PSMT in Haryana.

i) Overall adoption level of farmers related to paddy straw management techniques (PSMT)

It is revealed from Table 1 show that majority (75%) of the respondents had low level of adoption of paddy straw management techniques. While 20% of the respondents were found with medium level followed by 5% per cent among the farmers had high level of adoption regarding paddy straw management techniques.

Table 1. Overall adoption level about Paddy Straw Management Techniques (n=120)

S. No.	Category	Frequency	Percentage
1.	Low (< 12)	90	75
2.	Medium (12 -24)	24	20
3.	High (> 24)	6	5

ii) Adoption level of farmers towards Paddy Straw Management Techniques

The adoption of PSMT differs from person to person and aspect-wise also. The data from the Table 2 revealed that that all of the respondents had full adoption about animal fodder got 1st rank with 2.00 Weighted mean score (WMS) followed by domestic purpose with 1.85 weighted mean score got rank 2nd. Soil incorporation played vital role in paddy straw management got the 3rd rank with 1.08

weighted mean score. With regard to adoption level of mulching (0.75 WMS), composting (0.3 WMS), packing material (0.18 WMS), mushroom farming (0.09 WMS), bailing (0.06 WMS) with got the ranks IV, V, VI, VII and VIII respectively. Whereas, none of the respondent found to have adoption regarding biochar, biomass plant, biofuel (0.00 WMS) and got last rank i.e. IX. Similar findings were also reported by Pinaki Roy and Manmeet Kaur (2019).

Table 2. Adoption level of farmers towards PSMT (n=120)

S. No.	Statements	Fully Adopted	Partial adopted	No adoption	Total score	Weighted mean score	Rank order
1.	Mulching	8 (6.7)	75 (62.5)	37 (30.83)	91.00	0.75	IV
2.	Soil incorporation	52 (43.33)	26 (22.00)	42 (35.00)	130	1.08	III
3.	Animal fodder	120 (100.00)	0 (0.00)	0 (0.00)	240	2.00	I
4.	Bailing	1 (0.83)	6 (5.00)	113 (94.2)	8.00	0.06	VIII
5.	Composting	11 (9.16)	17 (14.16)	92 (76.7)	39.00	0.32	V
6.	Biochar	0 (0.00)	0 (0.00)	120 (100.00)	0.00	0.00	IX
7.	Mushroom Farming	2 (1.7)	7 (5.83)	111 (92.5)	11.00	0.09	VII
8.	Domestic purpose	105 (87.5)	13 (10.83)	2 (1.7)	223	1.85	II
9.	Packing material	8 (6.7)	6 (5.00)	106 (88.33)	22.00	0.18	VI
10.	Biomass plant	0 (0.00)	0 (0.00)	120 (100.00)	0.00	0.00	IX
11.	Biofuel	0 (0.00)	0 (0.00)	120 (100.00)	0.00	0.00	IX

iii) Adoption level of farmers regarding implements in Paddy Straw Management Techniques

When asked about the adoption about implements use in PSMT, the data in Table 3 revealed that the respondents had greater level of the acceptance adoption of Spreader/Shrub Master with weighted mean score of 0.95 got rank 1st followed by Super SMS (attached with Combine Harvester) with weighted mean score of 0.49

and got the rank II. Whereas adoption level of respondents regarding super seeder (0.36), rotavator (0.34), paddy straw chopper (0.24), happy seeder (0.20), mulcher (0.15), ZT seed drill (0.07) and raker, baler (0.04) got the ranks III, IV, V, VI, VII, VIII and IX, respectively. These results are in the conformity with the results of Roy & Kaur (2019) and Singh (2019) and Pathak et al. (2010).

Table 3. Adoption level of farmers regarding implements in PSMT (n=120)

S. No.	Statements	Fully Adopted	Partially adopted	No adoption	Total score	Weighted mean score	Rank order
1.	Spreader/Shrub Master	51(42.5)	12 (10.00)	57 (47.5)	114	0.95	I
2.	Super SMS (attached with Combine Harvester)	25 (20.83)	9 (7.5)	86 (71.7)	59.00	0.49	II
3.	Paddy straw Chopper	8 (6.7)	13 (10.83)	99 (82.5)	29.00	0.24	V
4.	Mulcher	3 (2.5)	12 (10.00)	105 (87.5)	18.00	0.15	VII
5.	Happy Seeder	6 (5.00)	13 (10.83)	101 (84.2)	25.00	0.20	VI
6.	Rotavator	12 (10.00)	17 (14)	91 (76)	41.00	0.34	IV
7.	Reversible MB plough	9 (7.5)	7 (5.83)	104 (86.7)	25.00	0.20	VI
8.	ZT seed drill	2 (1.66)	5 (4.2)	113 (94.2)	9.00	0.07	VIII
9.	Raker	1 (0.83)	3 (2.5)	116 (96.7)	5.00	0.04	IX
10.	Baler	1 (0.83)	3 (2.5)	116 (96.7)	5.00	0.04	IX
11.	Super seeder	13 (10.83)	18 (15.00)	89 (74.2)	44	0.36	III

Conclusion

The adoption level of Paddy straw management techniques was low to medium. The adoption could have been better in biochar, biomass plant, biofuel and implements raker, baler. All over the adoption of these implements, is beneficial environment-friendly agricultural farm technology, and usage significantly impacted the overall management of paddy straw. This study may provide helpful information for policymakers to effectively manage the burning of paddy straw for economically viable and ecologically sustainable farming.

Declaration of interests

The authors have no conflict of interest to declare.

Data Sharing

All relevant data are within the manuscript.

References

1. Agricultural Statistics at a Glance 2020. Government of India Ministry of Agriculture & Farmers Welfare Department of Agriculture, Cooperation & Farmers Welfare Directorate of Economics and Statistics, pp:49.
2. Anonymous. 2019. Government of Haryana: Statistical Abstract of Haryana, Department of Economic & Statistical Analysis, Haryana. Bhuvaneshwari S, Hettiarachchi H & Meegoda JN 2019. Crop Residue Burning in India: Policy Challenges and Potential Solutions. *Int. J. Environ. Res. Public Health*, 16 (832): 1-19.
3. Gadde B, Bonnetta S, Menke C & Garivait S. 2009. Air pollutant emissions from rice straw open field burning in India, Thailand and the Philippines. *Environmental Pollution*, 157: 1554-58.
4. Haysa MD, Finebm PM, Eronam GCD, Kleemanc MJ, Brian K & Gulletta BK. 2005. Open burning of agricultural biomass: Physical and chemical properties of particle-phase emissions. *Atmos. Environ.*, 39 (36): 6747- 6764.
5. Jethva H, Torres O, Field RD, A. Lyapustin, R. Gautam & Kayetha V. 2019. Connecting crop productivity, residue fires, and air quality over northern India. *Sci. Rep.*, 9 (1), pp. 1
6. Kaskaoutis DG, Kumar S, Sharma D, Singh RP, Kharol SK, Sharma M, Singh AK, Singh S, Singh A & Singh D. 2014. Effects of crop residue burning on aerosol properties, plume characteristics, and long-range transport over northern India.
7. Kaur K, Kaur P & Sharma S. 2019. Management of crop residue through various techniques. *Management*.
8. Pal R, Kumar R, Jalal RK & Kumar A. 2019. Economic and Environmental Performance of Straw Baler for Collection of Rice Residue Generated after Mechanical Harvesting by Combine Harvester. *Current Journal of Applied Science and Technology*, 1-6.
9. Pathak H, Jain & Bhatia A. 2012. Crop Residues Management with Conservation Agriculture: Potential, Constraints and Policy Needsvi, pp. 32
10. Singh JM, Singh Jasdev, Kumar Hardeep, Singh Sukhpal, Sachdeva Jatinder, Kaur Baljinder, Chopra Shruti & Prem Chand. 2019. Management of Paddy Straw in Punjab: An Economic Analysis of Different Techniques Ind. Jn. of Agri. Econ. Vol.74, No.3.
11. Yadav RS. 2019. Stubble burning: A problem for the environment, agriculture and humans, Down to earth Published: Tuesday 04 June 2019.
12. David Israel Mansingh M & Suresh S. 2019. Effect of difference sources and levels of lime application on yield, nutrient availability and uptake of rice in acidic soils. *Journal of Agriculture and Ecology*, 7: 73–87. <https://journals.saaer.org.in/index.php/jae/article/view/205>.
13. Kasniya PK, Singh M & Singh A. 2022. Economic analysis of different rice cultivars against major biotic stresses. *Journal of Agriculture and Ecology*, 14: 146–152. <https://doi.org/10.58628/JAE-2214-221>.