



Dissemination of Agricultural Technology and Constraints Analysis in Paddy-Wheat Residue Management in Punjab, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

As extension personnel are in direct contact with the farmers, methods used and constraints faced by them play an important role in the transfer of technologies. Also, farmer's constraints are significant to bring about the adoption of straw management techniques. The study was conducted in the state of Punjab consisting of 210 respondents (i.e. 150 extension personnel and 60 farmers). During the study, it was found that all the extension personnel made use of visit to farmers' field and meetings/discussions to disseminate information on straw management in the state. The findings revealed that the major constraints faced by the extension personnel in disseminating

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straw management alternatives were inadequate and irregular supply of funds (98.67%), perceived ineffectiveness of technologies (89.33%) and lack of training facilities (86%). While all the farmer respondents agreed that high transportation of the straw, high labor charges and crop residue interference with tillage and seeding operations were the major constraints in adoption of straw management techniques. From the findings, it is important to direct the attention from the government and policy makers to design an effective strategy which can overcome these constraints faced by the extension personnel and farmers to ensure adoption of straw management techniques.

Keywords: Extension methods; constraints; extension personnel; suggestions; straw management; alternatives.

1. INTRODUCTION

The total amount of crop residue generated in India is estimated at 3,7100 kg per year of which wheat residue constitutes about 27 percent and rice residue about 51 percent. Every year almost 15 million tonnes of paddy straw are generated in Punjab [1]. Large amount of paddy straw is burnt in fields in states like Punjab and Haryana where paddy residues are not used as cattle feed [2]. According to various estimates, on an average, almost 7 to 8 million tonnes of rice residue are set on fire in open fields [3]. The recent reports appearing in the media reveal that although the burning of wheat straw was reduced to 70 percent Anonymous, [4] and over 12,000 and 42,000 incidents of paddy straw burning was reported in Haryana and Punjab respectively on 19th December, 2017 Anonymous, [5]. For reducing the time and labour cost farmers adopts the options of open field burning or pile burning, which is majorly responsible for the emission of greenhouse gases [6]. This resulted in the increase of pollution in Punjab as well as the neighboring states which was covered with dense smog from the crop stubble [7]. Agricultural extension plays an important role to promote transfer and exchange of information to its clients. This process involves the use of various extension methods, individually or in a combination of methods to achieve a successful needed impact on the recipient. Some measures to deal with the problem can be creating awareness among farmers about eco-loss and significance of the problem itself at various fora, strict implementation of the law prohibiting the burning of crop residue, custom hiring of expensive machinery for chopping of stubble, off farm utilization as suggested by farmers in industry, power generation, compost making etc. (Arjinder Kaur 2017). According to Sadono, [8], agricultural extension is an education outside of school for farmers and their families, where they learn while doing to be curious and can solve the

problems they face well, profitably and satisfactorily. In spite of the various alternatives available for management of straw, the farmers still burn paddy wheat straw. It is interesting to know, the impediments which hinder the farmers in the adoption and the extension personnel in the dissemination of various paddy straw management alternatives. Since extension personnel have direct contact with farmers, constraints faced by them are very significant. The information on the constraints faced by the extension personnel in discharging their duties and the suggestions to overcome those constraints will be helpful to the planners and administrators in general to provide a suitable environment for increasing the performance and satisfaction of agricultural extension, thereby, contributing for agriculture development.

2. METHODOLOGY

The study was conducted in the state of Punjab and comprised of two types of respondents i.e. farmers and extension personnel. A sample of 150 extension personnel (Agricultural Development Officers) was selected randomly from the state. From the three agro climatic zones of Punjab, viz. Central Plain Zone, Western Zone and Sub Mountain Undulating Zone, one district was selected and further two villages were selected randomly. From each village 10 farmers were randomly selected, thus comprising a sample of 60 farmers and 150 extension personnel as respondents, making the total sample size to be 210. The extension methods are the methods or plans to develop the capability of the people for sustainable development under conditions of uncertainty. It was identified in terms of different extension methods such as, demonstrations, trainings, etc., used during the last one year. While the constraints referred to the problems which hindered or restricted the extension personnel in implementing various straw management

practices in Punjab. For farmers, it refers to the socio-economic, financial and technical aspects which hinder the farmers to adopt various alternatives of paddy and wheat straw management and was measured on a dichotomous scale, i.e. Yes/No.

3. RESULTS AND DISCUSSION

3.1 Identification of Extension Methods Used by the Extension Personnel for the Dissemination of Various Alternatives of Paddy and Wheat Straw Management

A variety of methods are used to disseminate new agricultural technologies effectively. Such methods help in developing credibility among the farmers and help to facilitate the process of adoption. The effectiveness of agricultural

extension can be measured, among others, from the effectiveness achieved, namely the level of achievement of agricultural extension goals which can be seen from empowering farmers in implementing recommended innovations [9]. The respondents were asked to identify the various methods used during the past one year. The extension methods were studied according to use, i.e. individual, group and mass. The information collected has been presented in Table 1.

3.2 Individual Methods

Under this category, the data revealed that all the extension personnel visited farmers' field, 75.67 percent and 26.67 percent of the respondents also make use of farmers' call and personal call to farmer.

Table 1. Distribution of extension personnel respondents according to the methods used for the dissemination of information on straw management in Punjab

S. No.	Methods Used	Extension Personnel (n=150)	
		f	(%)
A. Individual			
1.	Visit to farmers' field	150	100.00
2.	Farmer's call	118	75.67
3.	Personal call to farmer	40	26.67
B. Group			
1.	Meeting/Discussion	148	98.67
2.	Training Camps	2	1.33
3.	Farm Tours	40	26.66
4.	Method Demonstrations	44	29.33
5.	Result Demonstrations	45	30.00
6.	Team Visit	3	2.00
C. Mass			
C (a) Broadcast Media			
1.	Radio programmes	134	89.33
2.	Television programmes	113	75.33
C (b) Digital Media			
1.	WhatsApp group	147	98.00
2.	Facebook group	52	34.67
C (c) Print Media			
1.	Circular letter	3	2.00
2.	Posters	101	67.33
3.	Leaflets	85	56.67
C (d) Event media			
1.	Campaigns	89	59.33
2.	Exhibitions	85	56.67
3.	Farmer's Fair	89	59.33
5.	Workshops	49	32.67

3.3 Group Methods

Meetings and discussions (98.67%) methods were very popular among the extension personnel. Besides this, result demonstrations (30.00%), method demonstrations (29.33%) and farm tours (26.66%) are also being conducted by the extension personnel. Only about 2.00 percent of the respondents made use of team visit and conducted training camps in the past one year.

3.4 Mass Methods

According to types of mass methods available, the methods were classified further into four groups viz. broadcast media, digital media, print media and event media. A perusal of data given in Table 1 revealed that the extension personnel disseminated technologies only through WhatsApp groups (98.00%) and majority of the extension personnel delivered radio and television programmes and also displayed posters (67.33%) to create awareness on the ill effect and to disseminate straw management technologies. It was found that other mass methods like campaigns (59.33%), farmer's fair (59.33%) and exhibitions (56.67%) were organized by the extension personnel. Among other mass media methods, leaflets (56.67%), workshops (32.67%) and circular letters (2.00%) were also used.

It can be concluded from the study that majority of the extension personnel made use of visit to farmers' field as well as farmers' call under individual methods. During the discussion, it was mentioned that methods like visit to farmers' field made a greater impact on the attitudes of the farmers to adopt technologies. Similar findings were reported by Khan and Akram [10]. Under group methods, meetings, discussions and demonstrations were most frequently conducted by the extension personnel. This is due to the reason that such methods served as a two way learning interaction and farmers could learn firsthand of the technologies. These methods were the most cost-effective means for stimulating adoption of simpler practices and extension agent visits were the most cost-effective for extending more complex practices [11]. These results were similar to the findings of Agbarevo and Benjamin [12].

The extension personnel frequently displayed posters, held campaigns and road show to make farmers aware on the effect and alternatives to straw burning as these methods could reach a broader audience and is less expensive

compared to other mass methods. Extension personnel shared information mainly with progressive farmers through Whatsapp groups which were similar to the findings of Kumar and Singh [13].

3.5 Ranking of Extension Methods Used by the Extension Personnel

The rating of various extension methods used by extension personnel for dissemination of various alternatives of paddy and wheat straw management was made by calculating the average mean score for each category and a rank was assigned accordingly. The results about the same is presented in Table 2.

The data analyzed in Table 2 showed that individual methods was ranked first with average mean score of 102.66 followed by mass method at rank second with average mean score of 86.09. While group method was ranked third with average mean score of 47. Similar findings was reported by Baral et al. [14].

3.6 Constraints Faced by the Extension Personnel in Disseminating Paddy and Wheat Straw Management

3.6.1 Technological constraints

The data placed in Table 3 revealed that 89.33 percent of the extension personnel reported that the straw management technologies were perceived as ineffective, 84 percent reported that the straw management alternatives were less efficient and 76.67 percent lack technical expertise in spreading the information. These findings were in line with Apantaku et al., [15]. The reason they mentioned was that the run time for machines was only for a few hours for which community custom hiring was not possible and for effective use of the technologies technical expertise was a must. These findings were similar to the findings of Vishwatej (2012) Balakrishnan et al., (2012) and Afroz et al., (2013).

3.6.2 Physical constraints

About 79.33 percent and 60.00 percent of the extension personnel felt that the lack of input and poor infrastructure obstructed in dissemination of technologies. Apart from this only 38.67 percent accounted for the lack in mobility. Similar findings have been reported by Nagel [16], Kumar and Singh [13] and Patel et al., [17].

Table 2. Overall ranking of methods used for the dissemination of information on straw management according to extension personnel respondents in Punjab

S. No.	Item	Extension Personnel (n=150)	
		Mean score	Rank
A.	Individual methods	102.66	1
B.	Group Methods	47.00	3
C.	Mass Methods	86.09	2

Table 3. Constraints faced by the extension personnel respondents regarding paddy straw management in Punjab

S. No.	Problem	Extension Personnel (n=150)	
		f	(%)
A.	Technological constraints		
1.	Perceived ineffectiveness	134	89.33
2.	Less efficiency of technologies	126	84.00
3.	Lack of technical expertise	115	76.67
B.	Physical constraints		
1.	Poor infrastructure	90	60.00
2.	Lack of input	119	79.33
3.	Lack of mobility	58	38.67
C.	Organizational constraints		
1.	Inadequate staff strength in department	124	82.67
2.	Lack of Political will	86	57.33
3.	Lack of reward and recognition	80	53.33
4.	Lack of Motivation	117	78.00
5.	Inadequate coordination from other line department	35	23.33
6.	Lack of training facilities	129	86.00
D.	Communication constraints		
1.	Lack of access to research publication for field work	69	46.00
2.	Poor research-extension-farmer linkages	75	50.00
3.	Lack of time for demonstration of the technologies	115	76.67
4.	Poor feedback mechanism	127	84.67
E.	Economic constraints		
1.	Inadequate and irregular supply of funds	148	98.67

3.6.3 Organizational constraints

The Table 3 revealed that inadequate staff strength (82.67%) and lack of training facilities (86.00%) were the main constraints under organizational constraints. The extension personnel also reported that lack of motivation (78.00%) and lack of political will (57.33%) also hampered dissemination in technologies to the farmers. Inadequate coordination from other line departments (23.33%) and lack of reward and recognition (53.33%) also attributed to organizational constraints. Similar findings have been reported by Sandhu [18] and Thanh and Singh [19].

3.6.4 Communication constraints

It was observed that 84.67 percent of the extension personnel felt that there exist a poor

feedback mechanism between the extension system and its clients. The data also showed that lack of time for demonstration of technologies (76.67%) and poor research-extension-farmer linkages (50.00%) also contributed to communication constraints. This result was in line with Sandhu [18] and Codjoe et al., [20]. A study conducted by Kaur and Kaur (2013) also revealed that farmers had low linkages with researchers, extensionists and market. Only a little less than half (46.00%) of the extension personnel reported that there was a lack of access to research publication for field work.

3.6.5 Economic constraints

About 98.67 percent of the extension personnel felt that inadequate and irregular supply of funds was a major constraint under economic constraints. Similar findings have been reported

by Sandhu [18] During the discussion, it was found that machines to control straw burning were very expensive especially for small and marginal farmers and the government lacks funds in making costly machines available for demonstrations.

3.6.6 Overall constraints faced by the extension personnel in dissemination of paddy and wheat straw management alternatives

To find out the extent of constraints faced by the extension personnel in dissemination of paddy and wheat straw management alternatives, the average mean score for individual category was calculated and a rank was assigned accordingly. The results about the same is presented in Table 4. It was seen that economic constraints ranked first with average mean score of 148 followed by technical problems at rank second with average mean score of 125. Communication constraints and physical constraints were ranked third and fourth with average mean score of 96.5 and 89 respectively. Organizational constraints were placed at fifth with an average mean score of 88.5. Similar findings was reported by Singh et al., (2015).

3.7 Constraints Faced by the Farmer Respondents Regarding Adoption of Paddy and Wheat Straw Management Alternatives

3.7.1 Technical constraints

The data set in Table 5 revealed that all the farmer respondents agreed that crop residue interfere with tillage and seeding operations. Similar findings were found by Roy [21]. Above 90 percent of the farmer respondents lack cost effective machines, technical expertise and were reluctant to adopt straw management technologies. These results are in line with

Sofoluwe et al., [22]. Also the other constraints faced by the farmer respondent were inability to purchase costly machines (86.66%), lack of awareness on sources to acquire straw management techniques (86.66%), narrow time gap between harvesting of paddy and sowing of wheat (86.66%) and difficulty to manage long stubble left in the fields after harvesting (85.00%) which was also similar to the findings of Singh et al., [23]. During the discussion, it was mentioned that although there are a number of straw management technologies available, the farmers were not aware on different sources to purchase these technologies.

3.7.2 Use of paddy straw

All the farmer respondents under the study reported that the use of straw is not profitable. Majority of the farmer respondents do not make use of the straw due to the coarse nature (96.33%) and high silica content in paddy (93.33%) which makes it not palatable for milch animals. Also, 86.67 percent of the farmer respondents agreed that the use of paddy as feed reduces the milk yield in milch animals and the use of the straw was also not profitable. Similar findings have been reported by Castrillo et al., [24].

3.7.3 Communication constraints

The data presented in Table 5 revealed that 93.33 percent of the farmer respondents reported poor feedback mechanism and 83.33 percent reported poor research-extension–farmer linkages on straw management alternatives in adoption of technologies. During the discussion, the farmer respondents mentioned that awareness and adoption of technologies involves active participation of the farmers and should be based on expressed needs of the farmers through their groups and organizations. Similar finding was reported by Axinn [25].

Table 4. Overall ranking of constraints for the dissemination of information on straw management according to extension personnel respondents in Punjab

S. No.	Items	Extension Personnel (n=150)	
		Mean Score	Rank
A.	Technological constraints	125.00	2
B.	Physical constraints	89.00	4
C.	Organizational constraints	88.50	5
D.	Communication constraints	96.50	3
E.	Economic constraints	148.00	1

Table 5. Constraints faced by the farmers in adoption of paddy and wheat straw management alternatives

S. No.	Problem	Farmer Respondents (n=60)	
		f	(%)
A. Technological constraints			
1.	Lack of cost effective technologies	58	96.67
2.	Inability to purchase costly machines for straw management	52	86.66
3.	Lack of awareness on sources to acquire straw management technologies	52	86.66
4.	Lack of technical expertise	58	96.67
5.	Reluctance of farmers to adopt technologies	58	96.67
6.	Narrow window between harvesting of paddy and sowing of wheat	52	86.66
7.	Difficult to manage long stubble left in the fields the harvesting	51	85.00
8.	Crop residue interferes with tillage operation	60	100.00
9.	Crop residue interferes with seeding operations	60	100.00
B. Uses of paddy straw			
1.	High silica content in paddy makes it not palatable for milch animals	56	93.33
2.	Paddy straw reduces milk yield	52	86.67
3.	Paddy straw use is not profitable	52	86.66
4.	Course nature of paddy straw	58	96.67
C. Communication constraints			
1.	Poor research-extension-farmer linkages	50	83.33
1.	Poor feedback mechanism	56	93.33
D. Economic constraints			
1.	Higher cost of straw management	52	86.66
2.	High labor charges	60	100.00
3.	Non-availability of loans for adopting straw management technology	26	43.33
4.	High transportation cost	60	100.00

Table 6. Overall ranking of constraints faced by the farmers in adoption of paddy and wheat straw management alternatives

S. No.	Items	Farmer Respondents (n=60)	
		Mean Score	Rank
A	Technological constraints	55.66	1
B	Uses of paddy straw	54.50	2
C	Communication constraints	53.00	3
D	Economic constraints	49.50	4

3.7.4 Economic constraints

It is evident from the data in Table 5 that all the farmer respondents agreed that for the management of straw, a high cost of labor during the peak season of harvesting is involved. During the discussion, the farmer respondents revealed that straw management was very costly and the straw becomes difficult to transport due its bulkiness and high cost of diesel. Less than half

of the farmer respondents i.e. 43.33 percent, reported the non-availability of loans for adopting straw management technology. During the discussion, it was found that the farmers were compelled to burn crop residues due to high cost of removing the crop residue by conventional methods as well as high transportation cost. Similar results were reported by Qian et al., [26] and Roy [21].

Table 7. Suggestion of respondents for combating open straw burning

S. No.	Items	Extension Personnel (n=150)			Farmer Respondents (n=60)		
		Agree	Partially agree	Disagree	Agree	Partially agree	Disagree
		f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
1.	Fines and penalties can help to stop open burning straw	80 (53.33)	29 (19.33)	41 (27.33)	20 (33.33)	22 (36.67)	18 (30)
2.	Straw management should be carried out at community level	47 (31.33)	62 (41.33)	41 (27.33)	15 (25)	30 (50)	15 (25)
3.	Machines like happy seeder and balers can tackle the problems of straw burning in Punjab	65 (43.33)	85 (56.67)	--	21 (35)	20 (33.33)	19 (31.67)
4.	Improve availability of straw management machines	150 (100.00)	--	--	60 (100.00)	--	--
5.	Improve coordination among various stakeholders in straw management	150 (100.00)	--	--	60 (100.00)	--	--
6.	Subsidies to purchase straw management machines.	150 (100.00)	--	--	60 (100.00)	--	--

3.7.5 Overall Constraints faced by the farmer respondents in adoption of paddy and wheat straw management alternatives

To find out the extent of constraints faced by the farmer respondents in adoption of paddy and wheat straw management alternatives, the average mean score for individual category was calculated and a rank was assigned accordingly. The results about the same are presented in Table 6. Technological constraints ranked first with average mean score of 55.66. The uses of paddy straw and communication constraints were ranked second and third with average mean score of 54.5 and 53 respectively. The economic constraint was ranked last with an average mean score of 49.5 [27].

3.8 Suggestion from the Respondents for Combating open Straw Burning

A perusal of the data given in Table 7 revealed that all the extension personnel and farmer respondents suggested on the improvement on availability of straw management machines, coordination among various stakeholders in straw management and to provide subsidies to purchase straw management machines. More than half of the extension personnel (53.33%) agreed while more than one third of the farmer respondents (36.67%) partially agreed that fines

and penalties can help stop open burning straw in Punjab. During the discussion, the farmer respondents reported that the fines should be implemented strictly without any biasness, only then straw burning can be curbed. It was also reported that 41.33 percent of the extension personnel and half of the farmer respondents partially agreed that straw management should be carried out at community level. The respondents expressed that factors like a narrow time gap between harvesting of paddy crop and sowing of wheat crop for the next season and variation of farmers having small to large land holdings, acts as barriers to provide cost sharing of straw management machines in a community. It was reported that, 56.67 percent of the extension personnel and 33.33 percent of the farmer respondents partially agreed that machines like happy seeder and balers can tackle the problems of straw management. Both respondents expressed that straw management machines were costly for them to purchase [28].

4. CONCLUSION

From the above study it was found that though individual methods are frequently used by the extension personnel, the use of group methods and mass media should be promoted to make farmers aware of alternate technologies for straw management such as Happy Seeder and Zero-till drill for straw management. It was found that

majority constraints faced by the respondents are mostly under economic and technology constraints. To address this, major states practicing straw burning should implement policies and guidelines for providing financial support for the procurement of the machines to small and marginal farmers and to the extension personnel for demonstration on straw management. Some suggestions for improvement are to improve availability of straw management machines at subsidized rates to be provided to the farmers, improved supply chain coordination among various stakeholders in straw management for the collection, storage and supply the straw to industries as per their consumption.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Lawanrisha Lyngdoh, Ravinder Kaur Dhaliwal and Lopamudra Mohapatra hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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