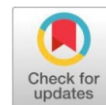


Original Research Article

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Adoption of paddy straw management technologies by potato growers of Jalandhar district of Punjab



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ABSTRACT

The study entitled "Adoption of paddy straw management technologies by potato growers of Jalandhar district of Punjab" was undertaken. A total of 200 potato growers were selected from the five blocks with probability proportional to size sampling method. 73, 50, 31, 31, 15 potato growers were selected from Nakodar, Adampur, Bhogpur, Jalandhar East and Jalandhar West respectively. Interview schedule was prepared and data was collected personally by interviewing potato growers. All the potato growers were found to be aware of PAU super straw management system and Rotavator while the majority of potato growers were aware about the Baler, Paddy straw chopper, Mulcher and Mould board plough. Majority of potato growers adopted PAU Super SMS, Rotavator, and paddy straw chopper in 2017 whereas mulcher and Mould board plough in 2018. Majority of potato growers adopted the PAU-recommended paddy straw management sequence of technologies in potato. Majority of the potato growers adopted mulcher and mould board ploughs in 2018 and rotavators in 2017. PAU Super straw management system has the highest extent of adoption (96.56 per cent) followed by the rotavator (95.68 per cent). Incorporation practice of paddy straw in their potato field followed 75 per cent of the potato growers.

Keywords: Adoption, paddy straw, potato, paddy straw management, stubble burning

INTRODUCTION

Paddy straw management is a key issue to paddy farming in northwestern India (Punjab, Haryana, and Uttar Pradesh). Paddy straw is used as animal bedding and for the production of biogas, fodder, power and compost in states such as West Bengal, Gujarat, Maharashtra, Assam, Bihar, Tamil Nadu, and Jammu & Kashmir. [5]

The burning of rice residues results in significant on- and off-farm impacts, such as losses in soil nutrients, soil organic matter, growth and productivity, air quality, biodiversity, water and energy conservation, human and animal health. In India, air pollution from residue burning can be extreme, with impacts on human health directly causing or exacerbating a variety of health hazards and leading to the incidence of traumatic road accidents by dramatically reducing visibility. One of the recognized hazards to the sustainability of the rice-cropping system is the depletion of organic soil from burning. According to reports, 51% of farmers burn paddy straw to save money, 48% for time savings and 48% for lack of machine availability, while 11% of farmers burn paddy straw for other reasons [7]. For the long-term sustainability of agriculture and natural resources, paddy straw burning must be phased out in favor of other options for paddy straw management.

Burning decreases the amount of straw to livestock, which is still more than 40 per cent in short supply. In the case of combined processing, however, much of the residue is left in the field for burning adversely affecting the rice-wheat cropping

system's overall sustainability. The total stubble burnt on the Punjab region as of 15 May 2005 was found to be about 4,315.35 km². Among these, Amritsar had 673.99 km² of burnt area followed by Jalandhar, Ludhiana, Firozpur and Patiala districts while Roopnagar had the least burnt area (41.36 km²). [6]

To resolve the foregoing straw management issue, Punjab Agricultural University, Ludhiana has proposed several resource conservation technologies, however, these are not being adopted by Punjab farmers. Resource conservation technologies provide many possible benefits including reduced water and energy consumption (fossil fuels and electricity), reduced greenhouse gas (GHG) emissions, soil erosion and natural resource base depletion, improved yields and farm profits, and reduced labor shortages. The paddy straw management technologies have many benefits in potato cultivation such as land becoming more fertile and crop growth also increases. Half of the potato growers adopted Laser land levellers, While the adoption of Tensiometer, Bed/Furrow/Ridge planting was low [9]. While there is a broad data set on the extent of depletion of resources and the impact of these innovations, There has been a lack of significant practical effort to measure the economic effects (such as increased yields and resource depletion and conservation levels). Such a lack of knowledge is perhaps the key reason, the farmers for poor adoption of the technologies, seriously threatening the sustainability of natural resources and the economic viability of farming [8].

In potatoes, the paddy straw management technologies are being used by the potato growers in different ways but it is necessary to know to what extent potato growers adopt these technologies and what are the major hindering factors in the adoption. To find answers to these questions, the present study was conducted.

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MATERIAL AND METHODS

Study Area

The present study was conducted in Jalandhar district of Punjab. This district was selected purposively for the study as it has the highest area (20438 ha) under potato cultivation [2].

Sampling and data collection

List of potato growers was obtained from the District Horticulture Department, Jalandhar. From that list five blocks Nakodar, Adampur, Bhogpur, Jalandhar East and Jalandhar West having a maximum area under potato cultivation were selected. 200 potato growers were selected from the five blocks with probability proportional to the size sampling method. 73, 50, 31, 31, 15 potato growers were selected from Nakodar, Adampur, Bhogpur, Jalandhar East and Jalandhar West respectively. The interview schedule prepared was tested on 20 non-sampled potato growers. Data collection was done personally by interviewing the potato growers by visiting the study area.

Adoption

It refers to the decision of making full use of paddy straw management technologies. In the present study, it refers to the full use of paddy straw management technologies for potato cultivation. The adoption of paddy straw management technologies in potatoes from the present investigation was studied in terms of the percentage of potato growers who were

using paddy straw management technologies, PAU recommended a sequence of technologies adopted by the potato growers. The question was asked on a dichotomous scale yes/no for PAU recommended sequence and other sequence followed were kept open ended.

Extent of adoption w.r.t. area under particular paddy straw management technologies (%age)

$$= \frac{\text{Total area under particular paddy straw management technology}}{\text{Total area under potato cultivation}} \times 100$$

Total area under potato cultivation

Data analysis

Data were compiled by transferring on computer based excel-sheet and data analysed with appropriate statistical tools. Frequency and percentage, range method were used for analysis of data.

RESULTS AND DISCUSSION

Area under potato cultivation

The data in Table 1 showed that out of total operational land holding, 3.5 per cent of potato growers had area under potato in the range of 2.5-5 acres followed by 13.5 per cent of potato growers which had area under potato in the range of 5-10 acre, only 3 per cent of potato growers had area less than 2.5 acres. Nearly 25 per cent of potato growers had area in the range from 10-25 acres followed by 56.5 per cent of potato growers which had area large than 25 acres under potato cultivation.

Table 1: Distribution of potato growers on the basis of area (acre) under potato cultivation

N=200

S.no	Category	Operational land holding f (%)	f	Percentage
1	<2.5 acres	-	6	3
2	2.5 -5 acres	-	7	3.5
3	5-10 acres	14 (7)	27	13.5
4	10-25 acres	27(13.5)	49	24.5
5	> 25 acres	159(79.5)	111	55.5

Awareness about paddy straw management technologies in Potato cultivation

Data given in Table 2 reveal that all the potato growers were aware about PAU super straw management system attached with combines and Rotavator. More than 50 per cent of the potato growers were aware about paddy straw chopper and 87 per cent of them aware of baler. It was found that 90 per cent potato growers were aware about mulcher and 95 per cent potato growers were aware of mould board plough. The findings were contradicted to [4] that 41.48 per cent were aware about mulcher, 100 per cent were aware about baler.

Table 2: Distribution of potato growers according to awareness about paddy straw management technologies in Potato cultivation

N=200

S. no	Technology	f*	Percentage
1	PAU Super straw management system	200	100
2	Baler	174	87
3	Paddy Straw Chopper	112	56
4	Mulcher	180	90
5	Rotavator	200	100
6	Mould board Plough	190	95

(*Multiple Response)

It was found that 90 per cent potato growers were aware about mulcher and 95 per cent potato growers were aware of mould board plough. The findings were contradicted to [4] who found in her study that 41.48 per cent were aware about mulcher, 100 per cent were aware about balers.

Source of information regarding paddy straw management technologies in potato cultivation

Different sources are used by the potato growers get information. There are different sources which are used by potato growers regarding paddy straw management technologies were given as under:

PAU super straw management system

Data presented in Table 3 show the awareness source of PAU Super Straw Management Technologies. Potato growers which were aware from cooperative society were 32 per cent and only 1 per cent were aware from HDO. 4 per cent of them became aware from ADO/AO whereas 3 per cent of them were aware from family and fellow farmers respectively. The potato growers which were aware from source of PAU were 5 per cent followed by KVK which were 23 per cent. The remaining potato growers 25 per cent became aware from friends about the PAU super straw management system and 4 per cent of them were aware from relatives.

Baler

Data presented in Table 3 show the awareness source of Baler. Potato growers who were aware of the cooperative society were 14.95 per cent and 14.37 per cent of them became aware from ADO/AO whereas 6.89 per cent of them were aware from fellow farmers whereas 4.59 per cent were aware from family. The potato growers which were aware from the source of PAU were 11.49 per cent followed by KVK which were 25.29 per cent. Of the potato growers, 2.29 per cent were became aware from relatives about the baler and 20.13 became aware from friends.

Mulcher

Data presented in Table 3 show awareness source of Mulcher which reveals that 36.67 per cent of potato growers became aware of mulcher from the village level cooperative society and 3.34 per cent of them were aware from ADO/AO whereas 12.22 per cent of them became aware from PAU followed by 20 per cent were aware from the source of KVK. 13.34 per cent of them became aware from friends 4.44 per cent of them aware from family and 5.55 per cent of them aware from relatives and the remaining 4.44 per cent of them were aware of mulchers from fellow farmers.

Rotavator

Table 3 showed that the sources of information regarding rotavator awareness source of rotavator which reveals that 39 per cent of potato growers became aware about rotavators from the village level cooperative society and 5 per cent of them were aware from ADO/AO whereas 22 per cent of them became aware from KVK followed by 7 per cent were aware from source of PAU. 12 per cent of them became aware from friends while 7 per cent of them aware from family and 4 per cent of them aware from relatives and the remaining 4 per cent of them were aware of Rotavator from fellow farmers.

Table 3: Distribution of potato growers on the basis of first source of information regarding paddy straw management technologies in potato cultivation

N=200

S. no	Source of information	PAU Super straw management system	Baler	Mulcher	Rotavator	Paddy straw Chopper	Mould board plough
		f (%)					
		n=200	n=174	n=180	n=200	n=112	n=190
1	Cooperative society	64 (32)	26 (14.95)	66 (36.67)	78 (39)	30 (26.79)	70 (36.84)
2	ADO/AO	8 (4)	25 (14.37)	6 (3.34)	10 (5)	6 (5.36)	8 (4.23)
3	HDO	2 (1)	-	-	-	-	-
4	Friends	50 (25)	35 (20.13)	24 (13.34)	24 (12)	12 (10.9)	22 (11.58)
5	Relatives	8 (4)	4 (2.29)	10 (5.55)	8 (4)	6 (5.35)	12 (6.32)
6	Family	6 (3)	8 (4.59)	8 (4.44)	14 (7)	-	4 (2.1)
7	KVK	46 (23)	44 (25.29)	36 (20)	44 (22)	44 (39.28)	56 (29.47)
8	PAU	10 (5)	20 (11.49)	22 (12.22)	14 (7)	10 (8.92)	14 (7.36)
9	Fellow farmers	6 (3)	12 (6.89)	8 (4.44)	8 (4)	4 (3.58)	4 (2.1)

(*n = Number of potato growers who were aware about particular technology)

Paddy straw chopper

Table 3 observed that the source of awareness of paddy straw chopper, reveals that awareness source of Mulcher which revealed that 26.79 per cent of potato growers became aware of paddy straw chopper from the village level cooperative society and 5.36 per cent of them were aware from ADO/AO whereas 39.28 per cent of them became aware from KVK while 8.92 per cent were aware from the source of PAU. 10.9 per cent of them became aware from friends and 5.35 per cent of them aware from relatives and the remaining 3.58 per cent of them were aware of paddy straw chopper from fellow farmers.

Mould board plough

Data presented in Table 3 shows awareness sources of Mould board plough which reveals that 36.84 per cent of potato growers became aware of Mould board plough from the village level cooperative society and 4.23 per cent of them were aware from ADO/AO whereas 7.36 per cent of them became aware from PAU and 29.47 per cent were aware from the source of KVK. 11.58 per cent of them became aware from friends while 2.1 per cent of them aware from family and 6.32 per cent of them aware from relatives and the remaining 2.1 per cent of them were aware about mould board plough from fellow farmers.

Source for Demonstrations of Paddy straw management technologies in potato

Source of demonstration is medium, channel and place. Demonstration helps the potato growers for getting first hand information about the new technologies. Obtain knowledge about how it works and also see results of technology.

Table 4: Distribution of potato growers according to source of demonstrations for Paddy straw management technologies

N=200

S. no	Place of demonstrations	Technologies f (%)					
		PAU Super straw management system	Baler	Mulcher	Rotavator	Chopper	Mould boardplough
		n=195	n=34	n=137	n=195	n=24	n=163
1	Farmer's field	154 (78.97)	13 (38.23)	100 (72.99)	170 (87.17)	21 (87.5)	118 (72.39)
2	PAU	8 (4.11)	10 (29.41)	13 (9.49)	11 (5.64)	-	11 (6.74)
3	KVK	20 (9.25)	7 (20.59)	20 (14.60)	9 (6.56)	3 (12.5)	25 (15.34)
4	Cooperative society	13 (6.67)	4 (11.78)	3 (2.18)	-	-	3 (1.84)
5	TV	-	-	1 (0.72)	5 (2.56)	-	6 (3.68)

(*n= Number of potato growers who had adopted particular technology)

Data in table 4 revealed that the major source of demonstration who adopted PAU super straw management system was farmer's field was observed by 78.97 per cent of the potato growers followed by KVK i.e. 9.25 per cent which was further followed by cooperative society i.e. 6.67 per cent of the potato growers. PAU was the source of demonstration for 4.11 per cent of the potato growers.

The farmer's field was the major source for demonstration by 38.23, 72.99, 87.19, 87.5, 72.39 per cent of potato growers who adopted baler, mulcher, paddy straw chopper, rotavator, and mould board plough respectively. KVK was the source of a demonstration by 20.59, 14.60, 6.56, 12.50, 15.34 per cent of the potato growers for baler, mulcher, paddy straw chopper, rotavator, and mould board plough respectively.

PAU was the source of the demonstration by 29.41, 9.49, 5.64, 6.74 who adopted baler, mulcher, rotavator and mould board plough respectively. Cooperative society was the source of a demonstration by 11.78, 2.18 and 1.84 per cent of potato growers for the baler, mulcher and mould board plough respectively. 0.72, 2.56, 3.68 per cent of potato growers observed that television was the source of demonstration of mulcher, rotavator and mould board plough respectively. The findings were similar to Kaur (2020) who found in her study that the majority of potato growers were participating in demonstrations in Kisan Mela and KVK.

Adoption of paddy straw technologies in potato

Table 5 represents the adoption of the paddy straw management technologies by the potato growers who were aware of these technologies. Here n stands for the number of potato growers who were aware about a particular technology. 97.50 per cent potato growers had adopted the PAU super straw management system and rotavator, 19.54 per cent of potato growers had adopted the baler for managing paddy straw in their potato fields.

Table 5: Distribution of potato growers on the basis of adoption of paddy straw technologies in potato

N=200

S. no	Technology	n	Adoption f*(%)
1	PAU Super straw management system	200	195(97.5)
2	Baler	174	34(19.54)
3	Paddy Straw Chopper	112	24(21.42)
4	Mulcher	180	137(76.11)
5	Rotavator	200	195(97.5)
6	Mould boardPlough	190	163(85.78)

(*Multiple Response)

The paddy straw chopper was adopted by 21.42 per cent of potato growers while 76.11 per cent potato growers had adopted the mulcher for managing paddy straw and 85.78 per cent of potato growers had adopted the mould board plough in potato fields.

The extent of adoption of paddy straw management technologies in potato

The extent of adoption of paddy straw management technologies was calculated by dividing the area under particular paddy straw management technology to the total area under cultivation by the potato growers multiplying it by 100. The area under potato cultivation by 200 respondents in the present study was 4451.2 ha.

Table 6: Extent of adoption of paddy straw management technologies in potato by the potato growers

S. no	Paddy straw management technologies	Area (ha)*	Extent of adoption (%)
1	PAU Super straw management system	4298.4	96.56
2	Baler	152.8	3.43
3	Mulcher	3494	78.49
4	Rotavator	4214	95.68
5	Paddy straw chopper	484	10.87
6	Mould board plough	3717.6	83.51

(*Multiple Responses)

(Total area under Potato cultivation by 200 respondents =4451.2 ha)

Table 6 shows that the PAU Super straw management system has the highest extent of adoption (96.56 per cent) followed by the rotavator (95.68 per cent). Mould board plough was used by potato growers on 83.51 per cent of the total cultivated area while mulcher was used on 78.49 per cent of the total cultivated area. Whereas baler and paddy straw chopper have very low extent of adoption i.e. 3.43 per cent and 10.87 per cent respectively. The findings (3) who found that the direct seeded rice has very low extent of adoption i.e. 3.72 per cent and laser leveller has used upto the extent of 90.13 per cent in the Patiala district.

Adoption of sequence of technology by potato growers

Data in Table 7 revealed that adoption of a sequence of paddy straw technology which were recommended by PAU and non-recommended by PAU. 12 per cent of potato growers adopted the sequence of paddy straw chopper as managing paddy straw, 70.5 per cent of potato growers adopted the sequence of mulcher as managing paddy straw and 17.5 per cent of potato growers adopted of sequence of baler as managing paddy straw which all were recommended by PAU. As the burning sequence which were not recommended by PAU adopted by only 17.5 per cent of potato growers.

Table 7: Distribution of potato growers on the basis of sequence of technology adopted by them

N=200

Sequence no	Sequence of technology	f*	Percentage
A. PAU RECOMMENDED			
I	PAU Super Straw Management System+ Paddy straw chopper + Mould Board plough + Rotavator	24	12
II	PAU super straw management system+ Mulcher + Mould board Plough + Rotavator	141	70.5
III	Combine harvester + Stubble shaver + Rake +Baler	34	17.5
B.NON RECOMMENDED			
IV	PAU Super Straw Management System + stubble shaver + Burning + Rotavator	34	17.5

(*Multiple Response)

Reasons behind the non-burning of paddy straw in potato cultivation

There were different reasons behind non burning of paddy straw like environmental, fine on burning, expecting compensation, peer pressures and a decrease in soil fertility.

Table 8: Distribution of the potato growers according to the reasons for non-burning of paddy straw

n= 172

S. no	Reasons	f*(%)	Rank
1	Fineon burning paddy straw	135 (78.48)	1
2	Expecting compensation provided by govt.	37 (21.51)	5
3	To control air and soil pollution	89 (51.74)	4
4	Decrease in soil fertility	132 (76.74)	2
5	Peer pressure	13 (7.58)	6
6	Health issues	125 (75.58)	3

(*Multiple Response)

Table 8 shows that the potato growers were not doing burning of paddy straw and they were managing paddy straw in eco-friendly ways. 86 per cent of potato growers (n=172) who were managed paddy straw in an eco-friendly, there were many reasons behind it. Only 28 potato growers which did burning of the paddy straw in the potato field. The reasons behind the burning of paddy straw was low cost of managing straw in potato field. More than three forth (78.35 per cent) of potato growers were not burn paddy straw due to fine on burning paddy straw. The paddy straw were non burned by the 21.51 per cent due to the expectation of compensation given by the government to them. Almost half of the potato growers (51.74 per cent) of potato growers were not burnt paddy to control air and soil pollution. The paddy straw were not burnt by the 76.74 per cent, reason behind was the degradation of soil fertility. Three forth (75.58 per cent) of potato growers were not burnt paddy straw to improve their health which was affected by the burning of paddy straw and 7.58 per cent stopped burning of paddy straw due to peer pressures insisted not to burn the paddy straw. The results are contradicted with [4] who found in her study that 50.79 per cent did not burn the paddy straw due to peer pressure and 100 per cent did not burn paddy straw due to fine on stubble burning.

Willingness to Change area under a sequence of paddy straw management technologies in future for potato cultivation

Prospects of technology help to know under which sequence of technology the area in future was going to increase and under which sequence of technology area in future going to decrease. Data in Table 9 show the prospects of a sequence of paddy straw management technologies in potatoes and how many acres potato growers wants to increase or decrease or discontinue under a sequence of paddy straw management technologies in potato.

Table 9: Distribution of the potato growers according to a willingness to change in area of Paddy straw management technologies**N=200**

Sequence. no	Sequence of technology	n	Increase	Decrease	Constant	Discontinue
			f (%)			
A	PAU RECOMMENDED					
I	PAU Super Straw Management System+ Paddy straw chopper + Mould Board plough + Rotavator	24	6(25)	2(8.33)	12(50)	4(16.67)
II	PAU super straw management system+ Mulcher + Mould board Plough + Rotavator	141	79(56.02)	10(7.09)	45(31.91)	7(4.96)
III	Combine harvester +stubble shaver + Rake + Baler	34	18(52.94)	5(14.70)	8(23.52)	3(8.82)
B	NON RECOMMENDED					
IV	PAU Super Straw Management System+ stubble shaver + Burning + disc harrow +plough+ Rotavator	34	4(11.76)	17(50)	7(20.58)	6(17.64)

(n= Number of potato growers who had adopted particular sequence)

Half of the potato growers which were adopting paddy straw chopper sequence as managing the straw in potatoes wanted to remain constant under it. One-fourth of the potato growers wanted to increase the area under it, only 8.33 per cent of potato growers wanted to decrease the area under paddy straw chopper as they wanted to adopt the mulcher and baler as managing paddy straw in potato and only 4 potato growers wanted to discontinue the paddy straw chopper in potato as it had high cost of production or they wanted to adopted mulcher and baler as managing paddy straw in potato.

The majority of the potato growers about 56.02 per cent wanted to increase the area under mulcher as managing paddy straw in potato, and only 7.06 per cent of potato growers who adopted mulcher as managing paddy straw in potatoes wanted to decrease the area under mulcher sequence in potato while 31.91 per cent of potato growers wanted to remain constant under this sequence and remaining 4.96 potato growers wanted to discontinue the mulcher sequence in potato as they wanted to adopt the baler as managing paddy straw in potato and cost of production was high and there was no fixed price of potato in every season.

The majority of potato growers about 2.94 per cent wanted to remain increase under sequence of baler as managing paddy straw in potato, only 8.82 per cent of potato growers wanted to discontinue the baler sequence as they wanted to adopt mulcher or chopper as managing paddy straw in potato and 23.52 per cent of them wanted to remain constant area under sequence of baler in potato and remaining 14.70 per cent of potato growers wanted to decrease the area under baler as managing paddy straw in potato only 17 per cent potato growers were doing burning of paddy straw in potato, out of which 11.76 per cent wanted to increase the area under burning and half of the potato growers decrease the area under burning in potato. Only 7 potato growers wanted to remain constant under burning in potato as it had low cost of production.

CONCLUSION AND RECOMMENDATION

According to findings, majority of the potato growers cultivated the potato from more than 25 acres land. All the potato growers were aware of PAU super straw management system, rotavator and majority of them were aware of mould board plough, baler and mulcher and paddy straw chopper. The major source of information for PAU super straw management system was cooperative society followed by friends while for baler, the major source of information was KVK followed by friends.

The major source of information for mulcher and rotavator was cooperative society followed by KVK. For paddy straw chopper, the major source of information was KVK followed by cooperative society. Majority of the potato growers adopted the PAU super straw management system, rotavator, mulcher for managing paddy straw. The major common source of demonstration for paddy straw management technologies was found to be farmer's field followed by KVK except in case of baler where PAU was the common source of demonstration.

PAU Super straw management system has highest extent of adoption (96.56 per cent) followed by rotavator (95.68 per cent). Mould board plough was used by potato growers on 83.51 per cent of the total cultivated area of potato while mulcher was used on 78.49 per cent of the total cultivated area of potato. Majority of the potato growers adopted the sequence of paddy straw management technologies recommended by Punjab Agricultural University and 17 per cent of them followed the sequence of burning in potato field. Majority of the potato growers did not burn the straw due to fine on burning followed by degradation of soil fertility which further followed by health issues.

Future scope of the study: Study on adoption of paddy straw management technologies used by potato growers in different districts may be planned.

Study on linkages between paddy straw growers and paddy processing industry.

Study on adoption of paddy straw management technologies in different vegetable crops.

Conflicts of interest: All authors declare that they have no conflicts of interest.

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