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An assessment on the Knowledge Level of Farmers regarding Paddy Straw Management in Ludhiana, Punjab.

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ABSTRACT

Managing paddy straw in conservation agriculture is crucial for long-term sustainability of agriculture. Rice straw, which is often scattered or burned in the fields, serves multiple purposes like mushroom production, fuel for cooking, ruminant fodder, stable bedding, and paper-making. The study has put forth the knowledge level of farmers regarding paddy straw management. The present study was carried out in the Ludhiana district of Punjab purposively on the basis of the availability of rice growers using a multistage sampling technique with 100 respondents. The study revealed that 47 percent belong to the middle age group ranging from 35-50 years. Among all, 39 per cent of the farmers have completed senior secondary education. Agriculture was the major occupation of the respondents. It has been reported that more than half of the farmers belonged to nuclear families and the majority of farmers had small-sized families of 2 to 5 members. The operational land holding data of the respondents was categorized into marginal, small, semi-medium, medium and large categories and the majority of farmers have large land holdings of more than 25 acres. Notably, the maximum respondents demonstrated a medium knowledge level regarding paddy straw management. The overall result regarding paddy straw management indicates a mixed level of awareness. The majority of farmers were knowledgeable about certain aspects such as the preferred rice variety for extending time period for straw management and the use of a baler. The study established a positive and highly significant relationship between knowledge level and factors like education and training.

Keywords: *Knowledge level, Training, Paddy Straw Management, Land holding, Ludhiana.*

INTRODUCTION

One of India's staple cereals is rice. India is both the world's second-largest rice producer and rice's top exporter. Rice is a tropical plant that thrives in hot, humid weather, West Bengal, particularly the district of Burdwan, is the state of India that produces the most rice. Rain-fed regions with high annual rainfall are where rice is primarily cultivated. It is hence sometimes referred to as the "kharif crop" in India. Domesticated rice, a cereal grain, is the most popular staple food consumed by more than half of the world's population. The most important food crop in India, rice accounts for about one-fourth of all cultivated land and feeds almost half of the country's population. Over the past 45 years, Punjab has made significant advancements in the productivity and production of rice. A record 121.46 million tonnes of rice are expected to be produced in the 2020–21 crop years, up from 118.87 million tonnes the year before [1].

Rice straw is a byproduct of rice production that is left over after harvest. The biomass of the residue is affected by various factors, including variety, soil and fertilizer management, and weather. Rice straw is heaped or distributed in the field during harvesting, depending on whether stationary threshers or self-propelled combine harvesters are used. The amount of rice straw removed from the field is mostly determined by the cutting height (the height of the stubble left in the field). After harvest, rice straw can be collected, burned, or allowed to degrade (soil integration). The “stubble” the uncut portion of the rice straw after harvest remains and can be burned or incorporated into the soil in preparation for the next crop. The ratio of straw to paddy varies, ranging from 1.0 to 4.3 [2] and 0.74 to 0.79 [3]. Many organizations in Punjab have tried a variety of alternative strategies to reduce straw burning. The straw can be used as an input for businesses such as paper, energy, and packaging if the paddy is not burned. In-situ inclusion of paddy straw as a management strategy is the most efficient method that farmers may simply implement. This improves soil fertility for the next crop and is also financially beneficial to the farmers [4].

Paddy straw management is a key barrier 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, and power and compost in states such as West Bengal, Gujarat, Maharashtra, Assam, Bihar, Tamil Nadu, and Jammu & Kashmir. According to research, in Punjab, 30-70% of paddy residue is burned on fields [5]. On a local, regional, and global scale, burning agricultural biomass pollutes land, air, and water.

Rice straw is either scattered in the field, accumulated in piles, or baled and sold for other purposes such as for mushroom production, fuel for cooking, ruminant fodder, stable bedding, and paper-making. Rice residues are often burned in the field,

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which is a cost-effective method widely used, particularly in Asia [6]. Rice straw burning has advantages in terms of farm operations but constraints from an environmental perspective [7].

The government has launched a number of programs or schemes to encourage farmers to use environmentally friendly paddy straw management technologies. The central government initiated a submission on the agriculture mechanization scheme, with 50% of the subsidy set for individual farmers and 80 percent set for groups of farmers or cooperative societies. [8].

MATERIAL AND METHODS

Study Area: The present study was conducted in the Ludhiana district of Punjab. The study area was purposively selected on the basis of the availability of rice growers. The geographical area of the district is 3790 sq.kms. The cultivated area of rice crop in Ludhiana district is 2.57 lac ha. The district has four sub-divisions viz-Ludhiana, Khanna, Samrala, and Jagraon and eleven development blocks viz.- Ludhiana, Mangat, Doraha, Khanna, Dehlon, Pokhwal, Samrala, Machiwara, Jagraon, Sidhwan Bet and Sudhar.

Sampling and data collection: A multistage sampling design was followed to select the study area and respondents for the study. At first stage, a major rice growing district i.e, Ludhiana was selected on the basis of highest availability of paddy growers. At the second stage, two blocks i.e,Sidhwan Bet and Sudhar were selected randomly from the district. At the last stage, two villages from each block i.e.Bhundri and Khudai Chak from Sidhwan Bet and Raqba and Boparai Kalan from Sudhar were selected randomly. Thus a total of four villages were selected for the study. Further, from each village 25 farmers were selected randomly, thus making a total sample of 100 farmers. The primary data were collected by personally interviewing the respondents. The schedule was prepared to assess farmer's knowledge based on several aspects of managing paddy straw and the constraints faced by them in paddy straw management.

Knowledge level test

Item difficulty index: Difficulty has been presumed to be linearly related. When any respondent correctly responded to any item, it was presumed that the item was less difficult than the ability of the respondent to cope with it. In the present investigation, the items with p p-values more than 12 were considered for a final test.

It was calculated using the formula

$$Pi = \frac{ni}{Ni} \times 100$$

where,

Pi = difficulty index in the percentage of the ith item

ni = number of respondents giving correct answers to the ith item

Ni = the total number of respondents to whom the ith item was administered

Discrimination index: The discrimination index can be obtained by calculating the phi-coefficient. E 1/3 method used to find out item discrimination emphasized that this method was analogous to, and hence, a convenient substitute for the phi-coefficient. The E 1/3 formula was used in the study.

$$E\ 1/3 = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Status of land ownership: This was implemented to measure the land ownership status of the respondents. It was obtained by using the following formula:

$$\text{Status of land ownership} = \frac{own\ land\ cultivated\ in\ ha}{total\ land\ cultivated\ in\ ha} \times 100$$

Coefficient of Correlation (r): It is used to study the relationship between dependent and independent variables and between the independent variables themselves, the coefficients of correlations were worked out with the following formula:

$$r_{xy} = \frac{\sum(xi - x(\sum x)(\sum y)}{\sqrt{[N\sum x2 - (\sum x)2][N\sum y2 - (\sum y)2]}}$$

where,

r = Coefficient of correlation

x, y= The variables between which the relationship is to be worked out.

N= Number of observations

Σ=Summation.

The value of correlation coefficient can be interpreted in the following manner:

If 'r' is equal to 1, then there is perfect positive correlation between two values;

If 'r' is equal to -1, then there is a perfect negative correlation between the two values;

If 'r' is equal to zero, then there is no correlation between the two values.

RESULTS AND DISCUSSION

Socio-economic attributes of respondents: According to Table 1, the maximum number of farmers i.e, 48 percent of farmers in Sidhwan Bet block and 46 percent of farmers in Sudhar block were in the age group of 35-50 years old.The study explored that the younger people might not be as interested in farming, and they may have less experience and expertise agricultural field. This could be due to changing lifestyles, urbanization, and the appeal of non-agricultural careers. [9] and [10] has elaborated that similar findings are consistent with research done by, who also found similar trends in the age distribution of farmers and their involvement in agriculture. In the Sidhwan Bet block, the majority of respondents were qualified up to the secondary level (42%), while in the Sudhar block, 40 percent of farmers had education up to the senior secondary level. It's noteworthy that rice farmers generally had some level of education, with only a few having a low level of education. Interestingly, these findings were similar with the results [11]. A maximum number of respondents, 82 percent in Block Sidhwan Bet and 80 percent in Block Sudhar, belonged to nuclear families. The current study evaluated that most of the farmers surveyed were part of nuclear families, which means they lived with their immediate family members like parents, spouses and children. This aligns with the results reported by [12]. It also indicates that joint families, where extended family members live together, were less prevalent among the respondents in both blocks. It is apparent from the data that the average family size in Sidhwan Bet was 4.7600±1.8245, while in Sudhar, it was 6.0200±3.7443. The majority of respondents in both Block Sidhwan Bet (72%) and Block Sudhar (70%) who were growing rice had small family sizes, with up to five family members. The majority of the farmers, typically consisting of up to five family members,

suggests that most farming households were relatively small. These results are consistent with a study conducted by [13], which also found similar trends in family size among farmers. The size of a farming family can impact various aspects of agricultural practices, often influenced by cultural norms and access to healthcare services, education and awareness can impact family size. It can be noted that only 40 percent of respondents belonged to block Sudhar and 48 percent of respondents of block Sidhwan Bet were large farmers. The findings provide insight into distribution of farmers based on their land holding categories in both Block Sidhwan Bet and Block Sudhar, showing that majority of farmers belonged to large land holding category, suggesting that a significant portion of respondents had substantial land holdings. These results are in line with [14] and [15], reported similar trends in land holding categories of farmers. Land holding pattern is crucial for tailoring agricultural policies and support programs to the specific needs of farmers in each category. The respondents were asked for information about any training or extension programs they have attended. The resulting data shows that in Block Sidhwan Bet, the majority of respondents, 64 percent never attended seminars or lecture programs organized by government officials. However, 36 percent of the respondents did attend such programs. In Block Sudhar, the proportion of farmers who never attended any program on paddy straw management was 62 percent while 38 percent of them had received training on paddy straw management from Punjab Agriculture University, Ludhiana, and PAMETI. It is evident that a significant number of respondents in both blocks were unaware of training or extension programs related to paddy straw management. Instead, they learned about such practices from other farmers and were less aware of the latest innovative technologies regarding paddy straw management.

Table 1: Demographic profile of the respondents

Parameters	Categories	Block Sidhwan Bet n=50	Block Sudhar n= 50	Overall n= 100
Age (in years)	Below 35	6(12.00)	15(30.00)	21(21.00)
	Between 35-50	24(48.00)	23(46.00)	47(47.00)
	Above 50	20(40.00)	12(24.00)	32(32.00)
	Average Age (Mean ± SD)	48.4000±12.3882	42.5400±11.2761	45.4700±12.1476
Education	Illiterate	-	6(12.00)	6(6.00)
	Primary	3(6.00)	3(6.00)	6(6.00)
	Middle	3(6.00)	6(12.00)	9(9.00)
	Secondary	21(42.00)	13(26.00)	34(34.00)
	Senior secondary	19(38.00)	20(40.00)	39(39.00)
	Graduate	4(8.00)	5(10.00)	9(9.00)
	Average education (Mean ± SD)	10.7000±2.2154	10.1000±3.5757	10.4000±2.9746
Family type	Nuclear	41(82.00)	40(80.00)	81(81.00)
	Joint	9(18.00)	10(20.00)	19(19.00)
Family size	Small (2-5)	36(72.00)	35(70.00)	71(71.00)
	Medium (6-9)	12(24.00)	5(10.00)	17(17.00)
	Large (above 9)	2(4.00)	10(20.00)	12(12.00)
	Average family size (Mean ± SD)	4.7600±1.8245	6.0200±3.7443	5.3900±2.9979
Operational land holdings (acres)	Marginal(1-2.5)	-	2(4.00)	2(2.00)
	Small (2-5)	9(18.00)	7(14.00)	16(16.00)
	Semi medium (5-10)	8(16.00)	5(10.00)	13(13.00)
	Medium (10-25)	13(26.00)	17(34.00)	30(30.00)
	Large (Above 25)	20(40.00)	19(38.00)	39(39.00)
	Average operational land (Mean ± SD)	23.3600±18.1085	25.9900±21.7955	24.6750±19.9793
Training attended	Yes	18(36.00)	19(38.00)	37(37.00)
	No	32(64.00)	31(62.00)	63(63.00)

Note: figures in parentheses indicate the percentage
Source: authors' own survey results, 2023

Land ownership status of the respondents: The data presented in table 2 revealed that a significant proportion of farmers in both Block Sidhwan Bet and Block Sudhar have low land ownership status. Specifically, 44 percent of farmers in Block Sidhwan Bet and 60 percent of farmers in Block Sudhar, who were growing rice, had low land ownership status. On the other hand, 36 percent of respondents in Block Sidhwan Bet and 24 percent in Block Sudhar had high land ownership status. Furthermore, only 20 percent of farmers in Block Sidhwan Bet and 16 percent in Block Sudhar belonged to the medium land ownership status category. This study implies that the majority of respondents in both blocks have low land ownership status, indicating the prevalence of smaller land holdings among farmers in the studied area. Low land ownership status can be attributed to several factors such as land fragmentation, land scarcity due to high population density, and urbanization.

Table 2: Land ownership status of the respondents

Land ownership status (%)	Block Sidhwan Bet n=50	Block Sudhar n=50	Overall n=100
Low (<33)	22(44)	30(60)	52(52)
Medium (33-66)	10(20)	8(16)	18(18)
High (>66)	18(36)	12(24)	30(30)

Note: figures in parentheses indicate the percentage
Source: authors' own survey results, 2023

Occupational status of the respondents: Common occupations include roles in agriculture, business, government service, private jobs and various other sectors. The data presented in table 3 revealed the involvement of respondents from Sidhwan Bet block in different sectors: 90 per cent in agriculture, four percent in agriculture + government service, and six per cent in agriculture + business. For farmers in Sudhar block, the distribution was 62 percent in agriculture, only two percent in agriculture + government service, and 34 percent in agriculture + business. Interestingly, the pooled data from both blocks shows that only two per cent of farmers from Sudhar block are involved in agriculture + private job, while none of the farmers from Sudhar block practiced agriculture + private job. These figures indicate the diverse engagement of farmers in various sectors in both blocks, with agriculture being the primary occupation for most, followed by some participation in government service and business. It also highlights the difference in the distribution of farmers across different sectors between the two blocks. When comparing the two blocks, it's evident that agriculture remains the dominant occupation but with varying degrees of involvement in other sectors. The availability of resources such as land, water, and agricultural inputs can influence the choice of occupation. Farmers choose agriculture as their primary income because they have access to farmland.

Table 3: Occupational status of the respondents

Occupation	Sidhwan Bet n=50	Sudhar n=50	Overall n=100
Only Agriculture	45(90)	31(62)	76(76)
Agriculture + Govt. Service	2(4)	1(2)	3(3)
Agriculture + Private Job	-	1(2)	1(1)
Agriculture+ Business	3(6)	17(34)	20(20)

Note: figures in parentheses indicate the percentage
Source: authors' own survey results, 2023

The Knowledge level among respondents regarding paddy straw management: Knowledge level was operationally defined as the level of factual knowledge that farmers had regarding the management of paddy straw. Table 4 demonstrated that the majority of farmers in both blocks were aware of the preferred rice variety for increasing the time period for straw management and the usage of a baler. However, 32 percent and 52 percent of farmers in Sidhwan Bet and Sudhar, respectively, were aware that straw burning entirely destroys nitrogen gas. Only six per cent of farmers in Sidhwan Bet and 40 percent of farmers in Sudhar followed the advice of a happy seeder to sow wheat without burning straw. A similar proportion of respondents in both blocks were aware that rice straw includes 20 percent lignin, while 32 percent and 42 percent of farmers in Sidhwan Bet and Sudhar, respectively, were aware that rice straw has 45 percent cellulose. It was also observed that 34 percent and 30 percent of farmers in blocks Sidhwan Bet and Sudhar, respectively, were aware that paddy straw burning produced methane and carbon monoxide.

Furthermore, 56 percent of farmers in Sidhwan Bet and 62 percent of farmers in Sudhar knew that burning paddy straw makes the land more prone to soil erosion. The proportion of farmers who were aware that heat generated by straw burning penetrated the soil, resulting in the loss of moisture and useful microbes was 54 and 38 percent on block Sidhwan Bet and Sudhar, respectively, whereas 62 percent of Sidhwan Bet farmers and 38 percent of Sudhar farmers were aware that paddy straw act as a mulch negatively affects the weed population and were aware that paddy straw can be used in a specially designed biogas plant for biogas production. Farmers in blocks Sidhwan Bet and Sudhar knew that cotton paddy straw biochar reduces the negative effects of nitrogen deficiency, and 54 percent of Sidhwan Bet and 34 percent of Sudhar were aware that harmful gases released from paddy straw burning blur vision and cause road accidents, and fever is caused by open field burning. It was discovered that 100 percent and 74 percent of farmers in blocks Sidhwan Bet and Sudhar knew that straw integration should be promoted not just to minimise air pollution but also to boost soil fertility. The findings are in line with [16] and [17].

Table 4: Knowledge level of respondents about paddy straw management

Statement	Sidhwan Bet (n=50)		Sudhar (n=50)	
	Yes(f%)	No(f%)	Yes(f%)	No(f%)
PR-126 variety of rice is preferred for increasing time period for straw management	40(80)	10(20)	32(64)	18(36)
Baler is used for baling the paddy straw after combine harvesting	41(82)	9(18)	21(42)	29(58)
Nitrogen gas is completely lost due to burning of paddy straw	16(32)	34(68)	26(52)	24(48)
Happy seeders recommended to sow wheat in combine harvested paddy field without any straw burning	3(6)	47(94)	20(40)	30(60)
Methane and carbon monoxide were produced due to paddy straw burning	17(34)	33(66)	15(30)	35(70)
Paddy straw can be used in a specially designed biogas plant for biogas production	30(60)	20(40)	10(20)	40(80)
Burning of paddy straw leads to the land more vulnerable to soil erosion	28(56)	22(44)	31(62)	19(38)
Heat generated by straw burning penetrates into the soil leading to the loss of moisture and useful microbes	27(54)	23(26)	19(38)	31(62)
compost is prepared from paddy straw	19(38)	31(62)	21(42)	29(58)
Paddy straw act as a mulch adversely affect the weed population	31(62)	19(38)	19(38)	31(62)
In cotton Paddy straw Biochar reduces the ill effect of deficiency of nitrogen	31(62)	19(38)	17(34)	33(66)
Rice straw contain 20% of lignin	25(50)	25(50)	25(50)	25(50)
45 percent of cellulose is present in rice straw	16(32)	34(68)	21(42)	29(58)
Gases released from paddy straw burning blurs vision and result in road accidents	27(54)	23(46)	17(34)	33(66)
Fever is caused due to open field burning	13(26)	37(74)	6(12)	44(88)
Straw incorporation should be promoted to not only reduce air pollution but also to increase soil fertility	50(100)	0	37(74)	13(26)

Note: figures in parentheses indicate %
Source: authors' own survey results, 2023

Categorization of the Knowledge level of the Respondents regarding Paddy Straw Management: Table 5 depicts the knowledge score of the respondents. The knowledge scores of the respondents were categorized into three levels: Low score, Medium, and High score. A total of 16 questions were asked from the respondents regarding paddy straw management. In Block Sudhar, 46 percent of the respondents had the lowest knowledge score, 52% had a medium knowledge score, and only two percent achieved the highest knowledge score. On the other hand, in Block Sidhwan Bet 14 percent of the respondents had the lowest knowledge score, and a majority of 86 percent had a medium-level score. Surprisingly, only two per cent of respondents had a high knowledge score. It is evident that there is varying awareness among farmers regarding different aspects of paddy straw management. Farmers who have access to agricultural extension services, and training programs are more likely to possess accurate information about paddy straw management. Farmers often learn from their peers and the farming community. It can be concluded that the overall knowledge of the farmers about paddy straw management was at a medium level. This suggests that while there is a reasonable level of understanding among farmers, there is still a need for improvement and further awareness-building to enhance their knowledge and practices related to paddy straw management. The results were similar with [18] and [19].

Table 5: Categorization of Knowledge level of the respondents regarding Paddy Straw Management

Knowledge level	Block Sidhwan Bet n=50	Block Sudhar n=50	Overall n=100
Low (below 6)	7 (14)	23(46)	30(30)
Medium (6-12)	43(86)	26(52)	69(69)
High (above 12)	-	1(2)	1(1)

Note: figures in parentheses indicate %
Source: authors' own survey results, 2023

Relationship between the knowledge level of paddy growers and their socio-economic characteristics: The study utilized a correlation coefficient to assess the relationship between the knowledge level of paddy growers and socio-economic factors such as age, education, family size, land holding and training. The data observed in Table 6 revealed a strong and statistically significant positive relationship between the knowledge level and education as well as Training of the respondents. The results show a positive and highly significant relationship between knowledge level and education as well as training of the respondents. This means the farmers who have more education and have received training about managing paddy straw tend to understand and know better. The positive correlation indicates that as education and training levels increase, the knowledge level of the paddy growers also tends to improve. This result supports the importance of providing education and training programs to farmers to equip them with the necessary knowledge and skills for effective and sustainable paddy straw management practices.

Table 6: The relationship between knowledge level of paddy growers and socio- economic variables

Socio economic variable	Correlation coefficient (r value)	p value
Age	-0.139	0.169
Education	0.756**	0.001
Family size	0.160	0.111
Land holding	0.5041	0.687
Training	0.235*	0.019

**correlation is significant at 0.01 level (2-tailed), *correlation is significant at 0.05 level (2-tailed)
Source: authors' own survey results, 2023

CONCLUSION

The current study was conducted in the Ludhiana district of Punjab province of India, which contributes to largest area under rice production. The study showed that the younger age group showed less interest and expertise in agriculture. Most of the respondents rely on agriculture as their primary occupation. The majority of farmers had large land holding and a significant portion of farmers had below 10 lakh annual income. According to the results, most of the farmers had a medium knowledge level regarding paddy straw management. The research found that the relationship between knowledge level and education, and training of respondents was positive and highly significant. Awareness campaigns and training programs should be conducted to educate farmers about the harmful effects of straw burning. Famers' knowledge regarding paddy straw management should be increased by strengthening the agricultural extension services and by formulating the appropriate policies.

Conflict of interest: The authors declare no conflict of interest.

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