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Extent of Adoption of Happy Seeder Technology among the Farmers of Punjab (India)

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ABSTRACT

Cultivation of paddy on large area has resulted in problem paddy straw burning. Although, there are many alternatives available to the farmers but none of these is significantly adopted by them. Happy Seeder Technology (HST) was introduced to tackle the problem of paddy straw burning. The study was conducted to find the rate and extent of adoption of HST among the farmers by characterizing the extension efforts. One hundred and eighty HST adopter farmers were selected from the five agro-climatic zones Punjab. Average area under HST was about 58 per cent of the total operational land holdings of respective farmers. From awareness to adoption average forty months were taken by the farmers to complete the five stages of adoption process. Attributes of the technology viz. relative advantages, trialability, observability and compatibility had positive effect on the rate of adoption. Extension activities, easy availability of HST and large operational land holding had a positive effect on the rate of adoption of HST.

INTRODUCTION

Rice wheat cropping system is most dominant cropping system of South Asian countries. About 13.5 million hectares of land was covered by rice-wheat cropping system in Indo-Gangetic Plains in 2019 (Gupta, 2019). The improvements in irrigation facilities and free electricity to the farmers for agriculture in late 90s enhanced area under rice in Punjab (Singh et al., 2008) but it also caused the genesis of problems such as over exploitation of ground water, reduction in bio diversity, paddy straw burning, severe air pollution (Marasini et al., 2016; Kaur et al., 2021). Burning of paddy straw in the field also leads to nutrient loss up to 100 per cent C, 90 per cent N, 60 per cent S and 25 per cent each P and K (Singh et al., 2020). For the quick management of the loose straw, burning of straw in open field was practiced in Northern states of India including Punjab, Haryana and Uttar Pradesh (Khan et al., 2002). Since the paddy straw burning was a controversial straw managing practice, government introduced many alternatives of straw burning. Some of the available options to the farmers were in-situ incorporation, baling of the paddy straw and use for another economical purposes, use as animal feed, use of paddy straw for bio char production etc. But according to the farmers, none of these options were compatible to the Punjab conditions.

Happy seeder technology (HST) was one of the available alternatives which directly drill the wheat seed into the soil without removing the stubble (Sidhu et al., 2007). The studies on HST had shown that it reduced the cost of cultivation, reduced the weed density due to mulching effect and improved the soil fertility (Singh et al., 2008). To manage the paddy straw, other machineries including HST such as baler, mould board plough (MBP), rotavator tillage (RT) was provided by the government on 50 to 80 per cent subsidy. Although happy-seeder was introduced in Punjab in 2007 on 50 percent subsidy, but it was not significantly adopted by the farmers of Punjab.

Time and attributes of a technology affect its rate of adoption and the rate of adoption of a technology increases with time (Rogers, 2003). Five attributes of the technology pronounced by the Rogers (2003) affect its rate of adoption. Farmers' financial,

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social and psychological factors such as age, education (Dana et al., 2018), annual income, operational land holding, mass media exposure (Singh et al., 2021; Monikha et al., 2021; Shah et al., 2020), extension contacts (Sharma et al., 2021), socio economic background (Shasani et al., 2020), risk orientations, environmental consciousness also affects the rate of adoption of an innovation. The present study aimed to assess the extent and rate of adoption of Happy Seeder technology by characterizing farmers' perception of its attributes and extension efforts done by extension workers to disseminate the technology.

METHODOLOGY

The study was conducted in five agro-climatic zones of Punjab viz. Western zone, Western plain zone, Central plain zone, Undulating plain zone, and Sub- mountain undulating zone. Two districts from each Agro-climatic zone were selected on the basis of maximum number of happy seeder owners in the district. A cluster of two to three villages was identified on the basis of maximum number of happy seeder owners. Owners were contacted to know the number of happy seeder users in their village. On the basis of information provided by them a total of ten (10) villages were selected purposively which had maximum number of happy seeder users.

From the selected villages eighteen farmers, those who had adopted HST minimum two years ago, were selected purposively from each district making a total of 180 farmers. From the selected farmers data were collected using semi-structured interview schedule. The data were analysed with the help of package SPSS (Ver.23). The linear regression model was used to find the magnitude of the relationship among the independent variables and the dependent variable.

$$Y_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} + u_i$$

where, Y_i = number of days; β_0 = Intercept

β_1-β_{15} = regression coefficient of the respective explanatory variables in the model

X_1 = Age; X_2 = Education; X_3 = Operational land holding; X_4 = Farming experience; X_5 = Annual income; X_6 = Extension contacts; X_7 = Mass media exposure; X_8 = Innovativeness; X_9 = Risk orientation; X_{10} = Environmental consciousness; X_{11} = Relative advantage; X_{12} = Compatibility; X_{13} = Complexity; X_{14} = Trialability; X_{15} = Observability

U_i = error term

t-test was used to find out the significance of difference between the time taken by the farmers to adopt HST with respect to their response to different parameters.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{SE}, \; SE = Sp\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

where, X_1 = Mean of first sample; X_2 = Mean of second sample; n_1, n_2 = first and second sample population

Pooled estimate of sample standard deviation

$$Sp = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

where, s_1^2 = Variance of first sample; s_2^2 = Variance of second sample

RESULTS AND DISCUSSION

The extent of adoption of the technology was area under HST out of total operational land holding of the farmer. To find the extent of adoption of HST, average area under HST during the last three consecutive years was studied.

The overall average operational land holding of the respondents, in all the selected districts of Punjab, was 30.20 acre out of which, mean area under HST in the first year of adoption was 11.32 acre (37.42%) followed by 12.22 acre (40.46%) and 17.73 acre (58.60%) acre during second and third year of adoption respectively. Similar findings were reported by Singh and Chahal (2009) who found that when the farmers harvest the profits of any technology, the extent of adoption increased with time.

Rate of adoption of HST

It was determined on the basis of time taken by the farmers to complete the five stages of adoption process described by Rogers (Rogers, 2003). The time was measured both in days and months.

The farmers were asked to mention the year in which they got aware about HST. The farmers were divided into 9 categories on the basis of their year of awareness. The data in Table 2 shows that in 2009 only 1.66 per cent of the respondent farmers were aware which was minimum and it increased with time 2.77 per cent in 2010, 4.44 per cent in 2011, 7.22 per cent in 2012, 8.33 per

Table 1. District wise distribution of average area (in acres) under HST during last three consecutive years (2016–18)

S.No.	District	Mean area (in acres)			
		Operational land holding	2016	2017	2018
1.	Mansa	34.61	8.94	11.61	14.44
2.	Bathinda	36.50	12.05	18.16	22.33
3.	Faridkot	23.27	11.55	15.33	16.27
4.	Ferozepur	25.00	11.16	15.88	18.72
5.	SBS Nagar	33.83	18.33	23.33	26.88
6.	Ropar	41.16	18.33	26.33	34.00
7.	Gurdaspur	34.16	17.94	25.11	29.55
8.	Hoshiarpur	44.44	22.44	31.38	39.83
9.	Ludhiana	39.16	23.22	30.55	36.33
10.	Patiala	20.94	12.33	16.64	20.83
	Mean area	30.20	11.32	12.22	17.7
	Mean percentage area (%)		37.42	40.46	58.60

Table 2. Distribution of the respondent farmers according to the year of awareness

S.No.	Year of awareness	Awareness f (%)	CF	Adoption f (%)
1.	2009	3 (1.66)	3	0 (0)
2.	2010	5 (2.78)	8	0 (0)
3.	2011	8 (4.44)	16	4 (2.22)
4.	2012	13 (7.22)	29	11 (6.11)
5.	2013	15 (8.33)	44	24 (13.33)
6.	2014	22 (12.23)	66	49 (27.22)
7.	2015	36 (20)	102	87 (48.33)
8.	2016	65 (36.12)	167	148 (82.22)
9.	2017	13 (7.22)	180	180 (100)

cent in 2013, 12.22 per cent in 2014, 20 per cent in 2015, 36.11 per cent in 2016 and 7.22 per cent in 2017. The cumulative percentage of data showed a gradual increase in the awareness of the farmers about HST with time. A significant increase in the awareness percentage in the year 2015–16 was recorded. The reason behind this could be the government ban on burning of paddy straw in 2015 and a massive push to promote in–situ management techniques for paddy straw management.

The rate of adoption of HST was measured by calculating the time taken by the farmers to complete each stage of adoption process described by Rogers (Rogers, 2003). The data in Table 3 reveals that most of the time taken by the farmers was to reach from awareness stage to interest stage. Average respondent farmers took 22 months to complete their first stage. Once they got interested in the technology, they completed the further stages more quickly. Farmers took an average 2.6 months to reach from interest to evaluation followed by 4.3 months for evaluation to trial and 13.6 months from trial to adoption. The overall average time taken by the farmers from awareness to adoption stage was 40 months. Maximum time was taken by the farmers to reach from awareness to interest stage and minimum time was taken between interest stages to evaluation stage of adoption process.

Factors affecting the rate of adoption

The factor by which the rate of adoption of HST was affected included attributes of HST and extension activities conducted to disseminate the HST technology among the farmers. The attributes of the technology *viz.* Relative advantage, Compatibility, complexity, trialability and observability were studied. Other factors such as availability of happy seeder, availability of high power tractor and extension activities attended by the farmers, were also studied. A dichotomous response of the farmers was recorded in the form of yes or no, regarding attending any extension activity. The data in Table 4 reveal that the p–value had shown that the attendance of the farmers in different extension activities and easy availability of HST had a significant and positive effect on the rate of adoption of HST. The availability of high powered tractor (55, 60 hp) also had a positive but non-significant effect on the rate of adoption of HST.

The correlation and regression analysis was done to study the factors affecting the rate of adoption of HST.

The data related to correlation analysis presented in Table 5 revealed that among the independent variables, 5 variables found to be statistically significant. These variables were extension contacts (0.201), environmental consciousness (0.147), relative advantages (0.164), complexity (- 0.142) and observability (0.161).

The positive value of 'r' indicated that these variables had positive effect on the rate of adoption. The negative value of the variable complexity (- 0.142*) was indicating the negative effect of complexity on the rate of adoption of HST. The other variables

Table 3. Distribution of respondents on the basis of time taken in stages of adoption process (n = 180)

S.No.	Categories (Time in days)	Awareness to interest	Interest to evaluation	Evaluation to trial	Trial to adoption	Awareness to adoption
				F		
1.	<200	18	114	92	14	3
2.	200-400	30	32	21	3	1
3.	400-600	46	33	51	129	12
4.	600-800	09	1	13	10	14
5.	800-1000	31	0	3	14	44
6.	1000-1200	01	0	0	0	2
7.	1200-1400	23	0	0	7	30
8.	1400-1600	00	0	0	0	0
9.	1600-1800	19	0	0	3	29
10.	1800-2000	03	0	0	0	10
11.	>2000	00	0	0	0	35
	Mean time in days	664	77	128	408	1197
	Mean time in months	22	2.6	4.3	13.6	40

Table 4. Number of days taken by the farmers to adopt HST with respect to different parameters

Parameters	Response of the farmers				t value	p value
	Yes		No			
	Mean time (days)	S.D.	Mean time (days)	S.D.		
Extension activities attended	1052	571.2	1668.78	509.9	6.21	0.00
Availability of HST	1040	597.75	1571.6	471.14	5.28	0.00
Availability of high power tractor	1185.88	639.77	1231.2	326.9	0.31	0.76

Table 5. Correlation and Regression analyses for the factors affecting the rate of adoption

S.No.	Variables	'r' Value	'p' value
1.	Age	-0.001	0.31
2.	Education	0.020	0.47
3.	Operational land holding	0.026	0.18
4.	Farming experience	-0.007	0.07
5.	Annual income	-0.004	0.06
6.	Extension contacts	0.201*	0.35
7.	Mass media exposure	0.056	0.53
8.	Innovativeness	-0.086	0.42
9.	Risk orientation	0.087	0.82
10.	Environmental consciousness	0.147*	0.08
11.	Relative advantage	0.164*	0.02*
12.	Compatibility	0.063	0.65
13.	Complexity	-0.142*	-0.03*
14.	Trialability	0.086	0.29
15.	Observability	0.161*	0.65

'*' significant at 5 per cent level of significance, Dependent variable = Rate of adoption

such as age, farming experience, innovativeness and annual income had negative values but they were found statistically non-significant. The variables such as education, operational land holding, mass media exposure, risk orientation, environmental consciousness and compatibility had the positive values but they were found statistically non–significant.

The results of linear regression analysis revealed the factors affecting the rate of adoption of Happy Seeder technology among farmers. The amount of variation explained by the model has been found significant at 5 per cent level of significance. The results of the linear regression model in Table 5 reveal that out of the total 15 independent variables, two were found statistically significant in influencing the rate of adoption of HST among the farmers. These variables were relative advantage (0.02) and complexity (-0.03). The variable complexity (-0.03) had the negative value which indicates that one per cent increase in the complexity will decrease the rate of adoption about 0.03 per cent.

The variable relative advantage of the technology had the positive value which indicated that with the one percent increase in relative advantages of the technology to the farmers will increase the rate of adoption of HST about 0.02 per cent. Negative regression coefficient estimates was found with age but it was statistically non-significant. The other variables such as education, annual income, operational land holding, mass media exposure, extension contacts, compatibility, trialablity and observability had positive values but these were statistically non–significant. The results obtained were in concordance with findings of Davey and Furtan (2008); Roy and Kaur (2015).

CONCLUSION

About half of the farmers had large operational land holdings and they had purchased happy seeder machines individually. Newspaper was the most used mass media source by the respondent farmers. Agricultural Development Officers of the State Department of Agriculture and Farmer's Welfare were most contacted extension personnel by the farmers. About half of the farmers had medium level of innovativeness and risk orientation and high level of environmental consciousness. Average 58 per cent area of total operational land holding of the farmer was under HST. Regarding the rate of adoption, most of the time was taken between awareness to interest stage. The farmers took average 40 months to complete the all five stages of adoption process. Extension contacts of the farmers, environmental consciousness, relative advantage and observability had positive and statistically significant effect on the rate of adoption of HST. The complexity of the machine had significantly negative effect on the rate of adoption. Availability of happy seeder technology and attendance of farmers in extension activities had significantly positive effect on the rate of adoption. It was found that happy seeder technology was adopted by large farmers and it was unable to make its place among the small farmers.

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