Indian Journal of Extension Education
Vol. 55, No. 1 (January-March), 2019, (59-65)

Factors Influencing the Prospects of Zero Till Technology in Punjab

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ABSTRACT

The zero-tillage technology is widely maintained as an integrated approach to conserve resources that can tackle the problem of wheat yield stagnation in the rice-wheat zone by improving planting time, reducing weed infestation, and enhancing fertilizer and water use efficiency. An attempt was made to assess the factors influencing the prospects of zero till technology in Punjab. A sample of 50 adopter farmers was selected by following cluster sampling design from Faridkot, Fazilka, Ferozepur, Gurdaspur, Hoshiarpur, Ludhiana, Mansa and Sangrur districts of Punjab state. The findings revealed that more than half (56.00%) of the farmers wanted to discontinue zero till drill in coming years. About one fourth (24.00%) of the farmers were willing to keep area constant under zero till drill. Majority of the farmers (68.00%) indicated to have favourable attitude towards zero till drill. Regarding functioning of zero till drill, it can only be used after straw removal (28.00%). Functioning of zero till drill also affected by stubbles (16.00%) as it needs fields to be cleaned properly. Determinants significantly influencing the prospects of zero till technology were age, operational land holding, family type, innovativeness, risk orientation and economic motivation of farmers.

Keywords: Attitude, Impact, Problems, Prospects, Resource conservation technology, Zero till drill

INTRODUCTION

Achieving food security on the rise of population and alleviating poverty under the current scenario of depleting natural resources, spiralling cost of inputs and explosive food prices are the major challenges before Indian agriculture. Intensive farming can be a way to overcome these challenges. Intensive farming is a method that uses higher inputs and advanced agricultural techniques to increase the overall yield. Sustainable intensive crop production system is difficult to be achieved with traditional crop production practices. However, conservation agriculture has risen as a route in this regard. Some of the main features of conservation agriculture are minimal tillage, ensuring soil nutrients and moisture conservation through crop residues and growth of cover crops and adoption of spatial and temporal crop sequencing (Bhan and Behera, 2014). The achievements in resource conservation technologies have been possible with the continuous invasion of technologies like zero tillage, bed planting, residue retention and management, brown manuring, nitrogen management through use of leaf colour chart, direct seeded rice, surface seeding etc. Precision conservation agricultural practices (PCAP) is profitable and can help bridge the yield gap; increase incomes as well facilitate the capacity of smallholder farming households to adapt and mitigate climate change also the need for extension strategies and support cannot be undermined (Shitu *et al.*, 2018) The adoption of resource conservation technologies is expected to yield benefits to the farmers in terms of reduced losses due to soil erosion, saving of energy and irrigation costs, savings on labour, increased productivity and water-use efficiency, reduced pumping of groundwater, increased nutrient-use efficiency and adoption of new crop rotations. In the conventional method of wheat sowing, rice stubbles

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are burned by most of the farmers, due to short window period between harvesting of rice and sowing of wheat. It leads to environmental pollution. The conventional tillage practices after rice harvest also involve extensive ploughing with common cultivator or deep tillage implements for preparation of a fine seedbed for wheat planting which is time consuming as well as costly. In order to save sowing time and the tillage cost, a new seed drill was introduced in the early 1980s that made it possible to sow wheat in freshly harvested and untilled paddy fields utilizing residual moisture. The drill named as zero-tillage drill and the method of wheat sowing with this drill is called as zero-tillage technology (Ali and Erenstein, 2013; Tripathi, 2014). Zero tillage is defined as planting crops in previously unprepared soil by opening narrow slots or trenches of the smallest width and depth needed for proper coverage of the seed. At least 32 per cent of the soil surface remains covered with crop residue. Zero tillage is, in a way, a complete farm management system that should include many agricultural practices including planting, plant residue management, weed and pest control, harvesting and crop rotations (Kumar *et al.*, 2010). The zero-tillage technology is widely maintained as an integrated approach to conserve resources that can tackle the problem of wheat yield stagnation in the rice-wheat zone by improving planting time, reducing weed infestation, and enhancing fertilizer and water use efficiency.

METHODOLOGY

The present study was conducted in Punjab state of India. For the selection of respondents two stage cluster sampling design was used. Twelve clusters were identified with the help of procured data from the concerned departments/ agencies at the first stage. Out of these identified clusters, four clusters were selected randomly for the study. These selected clusters were spread over Faridkot, Fazilka, Ferozepur, Gurdaspur, Hoshiarpur, Ludhiana, Mansa and Sangrur districts of Punjab. At the second stage of sampling design, 50 adopters were selected using probability proportional to number of farmers in each cluster. Thus, the total sample comprised of 50 adopter farmers. In the present study, the prospects of zero till drill was operationalized in terms of attitude of farmers towards zero till technology and willingness of farmers to increase/decrease/ discontinuance/keep the area constant under zero till drill in the coming years. Attitude of farmers toward zero till drill was measured by developing attitude scales based on Likert's method of scale construction. Attitude in this study was operationalized as the predisposition of the farmers towards zero till drill. Attitude score was calculated for each respondent. The mean ± SD method of classification was used to classify the score into four categories i.e. strongly favourable (>4.02), favourable (3.58-4.02), unfavourable (3.14-3.58) and strongly unfavourable (<3.14). Problems were analyzed through open-ended questions. To study the factors which affect prospects of zero till drill, ordinal regression analysis was used. Ordinal regression analysis is an extension of the general linear model to ordinal categorical data. The ordinal logistic model for *i* independent variables is:

$$\ln(\theta_i) = \alpha_i - \beta X$$

Where, $\theta = p/q$

i = 1 to (number of categories-1)

p= probability of score *i*

q= probability score greater than *i*

Scoring was given to dependent variable (prospects) as it was at ordinal level of measurement and it was also a prerequisite to conduct ordinal regression analysis. For response "increase in area", 4 score was assigned. Similarly, 3 score for "keep the area constant", 2 score for "decrease in area" and 1 score for discontinuance of zero till drill. The primary data were collected with help of interview schedule by personal interview method for the crop year 2018-19. After completion of data collection process, collected data were further entered, classified and analyzed on computer based spreadsheet software in order to reach on final results, discussion and conclusion.

RESULTS AND DISCUSSION

Social Personal Characteristics

It relates to the information regarding socio-personal characteristics of the respondents which included age, education, operational land holding, family type, innovativeness, risk orientation and economic motivation. The information relating to the profile of the respondents has been given in Table 1. The results indicate that age of the respondents varied from 22-73 years. About half of the respondents (48.00%) belonged to the age group 22-41 years followed by 42.00 per cent falling in the category of 41-59 years. Rest of the respondents (10.00%) were in the age group of 59-73. It is assumed that educational background of the respondents play a significant role in adoption. It is evident that about one third (34.00%) of respondents were graduated followed by 30.00 per cent who had gained education upto matriculation level and 28.00 per cent were upto senior secondary level. More than half (54.00%) of the respondents had large (more than 10 ha) operational land holdings, followed by 24.00 per cent having medium (4-10 ha) operational holdings and 22.00 per cent respondents had semi-medium (2-4 ha) operational holding. A large majority of the respondents with more than four hectare of landholding indicates that zero till technology is still restricted to large farmers only. More than half (58.00%) of the respondents had joint family and rest of the families (42.00%) were nuclear. About equal proportion of nuclear and joint family system showed the shift of family composition from joint to the nuclear system in Punjab. About two third (62.00%) of the respondents had high degree of innovativeness whereas less than one third of the respondents (32.00%) had medium degree of innovativeness. Only six per cent of the respondents had low degree of innovativeness. The results are in line with Singh (2011a) and Singh (2011b). Risk orientation is an important characteristic of the respondents belonging to different adopters' categories. It is the strength of the individual to take risk in adopting a new technology. Data indicate that 40.00 per cent of the respondents had medium level of risk orientation while 30.00 per cent of the respondents were both at low and high level of risk orientation. These findings are complimentary to those reported by Tiwari (2008) and Singh (2011a). A large majority of the respondents (96.00%) were having high economic motivation whereas only four per cent of the respondents were in medium level of economic motivation.

Table 1: Distribution of respondents on the basis of their social personal characteristics (n=50)

Social Personal Characteristics	Category/Range	Frequency	Percentage
Age	22-41	24	48.00
	41-59	21	42.00
	59-73	5	10.00
Education	Primary	2	4.00
	Matric	15	30.00
	Senior Secondary	14	28.00
	Graduate	17	34.00
	Post graduate	2	4.00
Operational land	Semi medium (2-4)	11	22.00
holding (ha)	Medium (4-10)	12	24.00
	Large (>10)	27	54.00
Family type	Joint	29	58.00
	Nuclear	21	42.00
Innovativeness	Low (1-1.6)	3	6.00
	Medium (1.7-2.3)	16	32.00
	High (2.3-3)	31	62.00
Risk orientation	Low (1-1.6)	15	30.00
	Medium (1.7-2.3)	20	40.00
	High (2.3-3)	15	30.00
Economic motivation	Medium (1.7-2.3)	2	4.00
	High (2.3-3)	48	96.00

Prospects of zero till drill

A prospect is a way of looking ahead and expecting good things. According to the Collins dictionary, "a particular prospect is something that you expect or know is going to happen." "Prospect is a mental picture of something to come, the act of looking forward" as defined by Webster dictionary. Oxford dictionary define prospect as "a mental picture of a future or anticipated event." Prospects of zero till drill were presented in Table 2 and 3. A critical look at the figures presented in Table 2 reveal that majority of the respondents (68.00%) indicated to have favourable attitude towards zero till drill. However, 20.00 per cent of the respondents showed unfavourable attitude. A small proportion of the respondents expressed strongly unfavourable (10.00%) and strongly favourable (2.00%) attitude towards zero till drill, respectively. These findings are in accordance to those reported by Kumar *et al.* (2008), Tripathi *et al.* (2013) and Tiwari (2008)

Table 2: Distribution of respondents on the basis of attitude towards zero till drill (n=50)

Attitude	Frequency	Percentage
Strongly Favourable	1	2.00
Favourable	34	68.00
Unfavourable	10	20.00
Strongly Unfavourable	5	10.00

whereas these results are not in conformity with Cummins (2002). Favourable attitude towards zero till drill was due to the reason that this technology saves sowing time of wheat crop and it also facilitate farmers to sow wheat in freshly harvested and untilled paddy fields utilizing residual moisture. Further, zero till technology increases overall profit by eliminating input costs. From the above findings, it can be concluded that there was a positive prospects of zero till drill as majority of the farmers expressed favourable attitude.

An overview of the data presented in Table 3 show that more than half (56.00%) of the respondents wanted to discontinue zero till drill in coming years. The major reason behind this was adoption of its parallel technology i.e. happy seeder (HS) by majority of the respondents (82.14%) for wheat sowing and also there was reduction in yield (10.71%) of wheat crop. These results are in conformity to those reported by Kaur (2016b). On the other hand, about one fourth (24.00%) of the respondents willing to keep area constant due to the reason that adoption was already on their maximum land holding (50.00%) and they were satisfied with current adoption (50.00%). The results are in disagreement to those reported by Kurnar *et al.* (2017) and Tiwari *et al.* (2008). A small proportion of the respondents (12.00%) wanted to increase the area from 20.5 acres to 25.83 acres (percent change; 26.00%) under wheat crop sown by zero till drill. Eight per cent of the respondents wanted to continue zero tillage technology on 45.00 per cent less area i.e. from 22.5 acres to 12.5 acres. The results are in contradictory to Tripathi *et al.* (2013).

Problems faced by the respondents in adoption of zero till drill

Data in Table 4 depict problems which were faced by the adopter farmers in adoption of zero till technology. The major problem in this regard was in functioning of the machine as zero till drill can only be used after straw removal (28.00%), as such no economic method was available in management of loose straw. Rodents were second major problem (20.00%) in zero till drill sown wheat crop. Further the functioning of zero till drill also affected by stubbles (16.00%) as it needs fields to be cleaned properly. A small proportion (4.00%) of the farmers reported that the machine cannot run in high

Table 3: Distribution of respondents on the basis of prospects of zero till drill (n=50)

Prospects	%	Area 1	Area 2	Per cent Change	Reasons	f*	%
Increase	12.00	20.50	25.83	26.00	Zero till drill is betterthan conventional/HS	5	83.33
					Increase in yield	1	16.67
					decrease in expenditure	4	66.67
Constant	24.00	14.50	14.50	NA	Already on maximum area	6	50.00
					Satisfied with current adoption	6	50.00
Decrease	8.00	22.50	12.50	45.00	Shifted to happy seeder	4	100.00
Discontinue	56.00	17.25	-	NA	Shifted to Happy Seeder	23	82.14
					Reduction in yield	3	10.71
					Weed problem	2	7.14
					Rodents	2	7.14
					Stubbles affects functioning	1	3.57

*Multiple Responses, NA= Not Applicable, Per cent change= from year 2018-19 to 2019-20.
Area 1= Average present area under zero till technology, Area 2= Average prospected area under zero till technology

Table 4: Distribution of respondents on the basis of problems faced in adoption of zero till drill

Problems	Frequency*	Percentage
Zero till drill can only be used after straw removal	14	28.00
Rodents	10	20.00
It cannot run in stubbles	8	16.00
It cannot run in high moisture fields	2	4.00

*Multiple Responses

Table 5: Distribution of respondents on the basis of suggestions for use of zero till drill

Suggestions	Frequency*	Percentage
Could be used effectively after straw burning	5	10.00
Could be used effectively if loose straw burned	3	6.00

*Multiple Responses

moisture fields. These finding confirm the observation of Kumari *et al.* (2018); Singh (2016); Kumar (2002) and Thakur *et al.* (2018). On the other hand, these findings of the study are not in harmony with those reported by Tripathi *et al.* (2013); Tripathi (2014) and Prem *et al.* (2017).

After discussing the problems, the respondents were asked to give suggestions to enhance the overall performance of zero till drill. A total of 16.00 per cent of zero till drill users suggested that machine can be used effectively only after straw burning as this was one of the prerequisites in operation of zero till machine that field should be cleaned properly from straw (Table 5). These results are in conformity with those reported by Sidhu and Beri (2005) and Tiwari (2008).

Factors influencing the prospects of Zero Till Technology

To study the factors affecting prospects of zero till drill, ordinal regression analysis was used. It is clear from the data in Table 6 that age was negatively correlated ($p \leq 0.05$) with the prospects of zero till drill i.e. young aged farmers were more likely to increase the use of zero till drill as compared to old aged farmers. Similarly, operational land holding of the farmers affects the prospects of zero till drill as a significant negative correlation ($p \leq 0.05$) was observed between prospects and operational land holding. It can be concluded that farmers with large operational land holding were having negative prospects towards zero till drill i.e. want to discontinue the adoption or decrease the area under this technology. This was mainly due to the reason of shift of farmers from zero till drill to happy seeder technology for wheat sowing. Innovativeness and economic motivation of the farmers influence positively to the

Table 6: Impact of socio personal factors on prospects of zero till drill

Factors/Covariates	Estimate	Std. error	Wald	Sig.
Intercept (α_i)				
Discontinue (1)	16.304	6.664	5.985	0.014
Decrease (2)	16.847	6.699	6.324	0.012
Constant (3)	18.801	6.801	7.642	0.006
Location (β_i)				
Age	-0.087	0.042	4.38	0.036
Education	-0.376	0.179	4.416	0.096
Operational land holding	-0.082	0.038	4.743	0.029
Innovativeness	5.138	2.002	6.588	0.01
Risk orientation	-3.714	1.409	6.949	0.008
Economic motivation	8.999	2.859	9.905	0.002
Attitude	-0.187	1.214	0.024	0.878
[Family type =joint]	-1.757	0.974	3.255	0.071
[Family type =nuclear]	0*	-	-	-

*This parameter is set to zero because it is redundant.

prospects of zero till drill as correlation was found to be significant ($p \leq 0.01$). Results point toward the conclusion that innovative and economically motivated farmers will increase/keep area constant under zero till drill.

It was interesting to note that risk orientation was negatively correlated ($p \leq 0.01$) with prospects of zero till drill. For high risk-oriented farmer the prospects towards zero till drill will be negative i.e. want to discontinue the adoption or decrease the area under this technology. This was due to the introduction of a parallel technology i.e. happy seeder to the farmers. So, farmers with high risk orientation want to try new technology by decreasing/ discontinuing the adoption of zero till drill. Attitude of farmers towards zero till didn't have any significant impact on prospects regarding zero till drill. Another independent variable "joint family" was categorical variable. It was correlated negatively ($p \leq 0.10$) with prospects of zero till drill i.e. farmers belong to joint family system were more likely to express negative prospects toward zero till drill. It may be due to the reason that in joint family system decision making of an individual is pretentious to family members.

CONCLUSION

The study has identified the prospects of zero-till drill and the different factors affecting its prospects. The results show that more than half of the farmers wanted to discontinue zero till drill in coming years due to the shift towards its parallel technology i.e. happy seeder. About one fourth of the farmers willing to keep area constant under zero till drill. More than two third of farmers indicated to have favourable attitude towards zero till drill. Among the problems, major were that zero till drill can only be used after straw removal and functioning of zero till drill affected by stubbles as it needs fields to be cleaned properly. Determinants significantly influencing the prospects of zero till technology were age, operational land holding, family type, innovativeness, risk orientation and economic motivation of farmers. For the better adoption of technology, suitable equipment and practices need to be developed for the collection of loose straw left in the paddy filed as loose straw emerged as a major problem faced by the respondents.

Paper received on : January 19, 2019
Accepted on : February 24, 2019

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