The Pharma Innovation Journal 2021; SP-10(5): 736-744

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(5): 736-744

www.thepharmajournal.com
Received: 21-03-2021
Accepted: 25-04-2021

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Crop residue management with reference to happy seeder in Kaithal district: A sociological study

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Abstract
The disposal of paddy residue has turn out to be a huge problem resulting farmers prefer to burn the residues in-situ. Paddy residue management is of high importance as it contains plant nutrients and improves the soil-plant-atmospheric continuum. Burning biomass not only pollutes environment and results in loss of appreciable amount of plant essential nutrients. The study was conducted in Kaithal district of Haryana state. From this district, two blocks namely Kaithal and Pundri were selected. On the whole, a total of 80 Happy Seeder adopter farmers were selected. Thirty percent of the respondents had no social participation while 43.75%had low and 26.25% had medium level of social participation. More than one-third (38.75%) of the respondents had low level of socio-economic status. Rest 37.5% and 23.75% respondents had medium and high level of socio-economic status, respectively. Education was also found significantly associated with education level; illiterate respondents (36.36%) had low level of knowledge while respondents educated upto senior secondary (41.17%) and graduation & above (50%) had medium level of knowledge followed by high level of knowledge 29.41% and 25% respectively. Size of land holding and annual family income were found significantly associated. As the land holding increases knowledge level was also found increased. Respondents having income between Rs. 75000-150000 had low knowledge while families with income >300000Rs. had medium (50%) and high level of knowledge (20%). Analysis of study depicted the multiple cumulative socio economic impact of using happy seeder as perceived by farmers. More than 2/3rd of the marginal farmers performed social ceremonies by the benefit amount of Happy Seeder (66.66%), investment on quality education of their children and increase in household assets (33% each). Small farmers also invested on education of children (42.85%) on social ceremonies and household assets (35.71% each) increase in agricultural land on lease (21.42%).

Keywords: Paddy residue management, happy seeder, sociological

Introduction
India is an annual gross crop residue producer of 371 million tons (mt), of which wheat and paddy residues constitutes 27–36% and 51– 57% respectively. Disposal of paddy residue has turn out to be a huge problem in north-west Indian states, resulting farmers prefer to burn the residues in-situ. The practice of paddy residue burning along with the magnitude of pollution caused has detrimental impact on soil health, human health and environment. Moreover, the site specific relevant technologies developed for residue management, energy requirement during residue management practices and alternative use of paddy residue will certainly help and in this context use of happy seeder has proved to be a eco friendly technology. Paddy crop residue includes leaves, straw and husks that are left behind after the crop has been harvested. The quantity of paddy crop residues generated in NW states of India was estimated by crop-to residue ratio (CRR) method. Singh *et al.* (2008) [3, 7] also reported that the Happy seeder approach has considerable potential agronomic benefits, in addition to reducing air pollution and retention of nutrients and organic matter, by avoiding stubble burning. The mulch suppresses weeds and may reduce the need for weed control measures, and reduces soil evaporation (Sidhu *et al.* 2007; Yadvinder Singh *et al.* 2008) [4, 68]. Wheat can be sown immediately after rice harvest, while the straw is still too green to burn. Traditionally, a pre sowing irrigation is applied prior to sowing wheat after rice. This irrigation may not be required with the HS where there is quick turn around before the residual surface soil moisture from the rice crop is lost by soil evaporation. Urmila (2017) [5] also mentioned in her study that the burning of stubble, contrasted with alternatives such as ploughing the stubble back into the ground has a number of consequences and effects on the environment as it quickly clears the field and is cheap, kills weeds, including those resistant to herbicides, kills slugs and other pests and can reduce nitrogen tie–up.

She also reported the harmful effects on environment that is loss of nutrients, pollution from smoke, damage to electrical and electronic equipments from floating threads of conducting waste and ultimately risk of fires out of control. Keeping in view the objectives.

- To assess the nature and extent of knowledge and adoption of Happy Seeder among farmers.
- To know the advantages and socio- economic impact of Happy Seeder on farming families along with constraints in adoption.

Methodology

The study was conducted in Kaithal district of Haryana state. From this district, two blocks namely Kaithal and Pundri were selected where more no. of farmers had adopted Happy Seeder. From Kaithal block Patti Afgan, Khurana, Barta, Sanjunaa, Guhana, Dubbal and Chot villages and from Pundri block Hajwana village was drawn to get information from Happy Seeder adopters. On the whole, a total of 80 Happy Seeder adopter farmers were selected. Interview schedule was prepared to collect the desired information as per objectives of the study. Finally selected farmers were surveyed with the help of interview schedule. Statistical techniques like frequency, chi square, weighted mean scores etc. were used as per the nature of data.

Results and Discussion

Contextual matrix of the respondents

Results revealed (Table 7) that more than half of the respondents (52.50.%) hailed from 35- 50 years of age group. Rest 28.75% and 18.75% respondents were upto 35 years and above 50 years of age respectively.

It was found that more than three-fourth of the respondents (78.75%) belonged to General castes and 12.50% respondents belonged to backward classes, while 8.75% respondents hailed from scheduled castes.

Regarding education of the respondents data revealed that 30% of the respondents were educated upto secondary level while rest of the respondents were educated upto middle level (25.00%), senior secondary (21.25%), illiterate (13.75%) and graduation level and above (10.00%).

It was found that 40.00% of the respondent's families had nil subsidiary occupation, while 38.75% were in business and services and rest 21.25% were engaged in small scale enterprise.

Regarding land holding, maximum number of the respondents (45.00%) had semi-medium size of land holding i.e. between 2.0 - 4.0 ha. followed by medium size of land holding (22.50%) i.e. between 4.00-10.0 ha. Rest 17.5% and 15.00% had small and marginal size of land holding respectively.

Analysis depicted that more than three-fifth of the respondents (67.50%) belonged to nuclear family. On the other hand, nearly one-third of the respondents (32.50%) were from joint families.

It was found that half of the respondents had family income > 300000 Rs per annum while more than 1/3rd of the respondents (35.0%) had annual family income between Rs.1,50,000 to Rs.3,00,000 and rest 15% had between Rs 750000-150000 per annum.

Thirty percent of the respondents had no social participation while 43.75%had low and 26.25% had medium level of social participation.

Analysis clearly revealed that maximum number of the respondents (47.5%) had medium level of exposure to mass-media followed by low (33.75%) and high (18.75%) level of exposure to mass media.

More than one-third (38.75%) of the respondents had low level of socio-economic status. Rest 37.5% and 23.75% respondents had medium and high level of socio-economic status, respectively.

Table 1: Contextual matrix of the respondents (n=80)

Sr. No.	Variables	Frequency	Percentage
1.	**Age**		
	Up to 35 years	23	28.75
	35-50 years	42	52.50
	Above 50 years	15	18.75
	Total	80	100
2.	**Caste**		
	General Caste	63	78.75
	Backward Class	10	12.50
	Schedule Caste	7	8.75
3.	**Education**		
	Illiterate	11	13.75
	Up to middle	20	25.0
	Secondary level	24	30.0
	Senior secondary level	17	21.25
	Graduation and above	8	10.0
4.	**Subsidiary occupation of the Family**		
	Nil	32	40.0
	Business and service	31	38.75
	small scale enterprise	17	21.25
5.	**Size of land holding**		
	Marginal (up to 1 ha)	12	15.0
	Small (1-2 ha)	14	17.5
	Semi-medium (2-4 ha)	36	45.0
	Medium (4-10 ha)	18	22.5
6.	**Type of Family**		
	Nuclear	54	67.5
	Joint	26	32.5
7.	**Size of Family**		
	Up to 4 members	33	41.25
	5-8 members	23	28.75
	Above 8 members	24	30.0
8.	**Annual Income**		
	Between Rs.75,000 - 1,50,000/-	12	15.0
	Between Rs.1,50,000 - 3,00,000/-	28	35.0
	Above Rs. 3,00,000/-	40	50.0
9.	**Social organization Participation**		
	Nil	24	30.0
	Low (1)	35	43.75
	Medium (2-3)	21	26.25
10.	**Mass media exposure**		
	Low (up to 6)	27	33.75
	Medium (7-12)	38	47.50
	High (above 12)	15	18.75
11.	**Socio-economic Status**		
	Low (6-9)	31	38.75
	Medium (10-12)	30	37.50
	High (above 12)	19	23.75

Comparative Benefit between Happy Seeder and Conventional Practice Adoption

Table 8 shows that Happy Seeder is a time saving technology on an average 80% time is being saved than conventional method. Happy seeder takes 2.8 h/ha while by conventional practices it takes 14 h/ha. Approximate 79% of the labour saving (5.8 man h/ha by happy seeder while 28.2 man h/ha) was observed by the respondents. On an average 71 % saving in the cost of sowing was reported. On an average 7% extra yield was observed by the farmers while approximate 20%

total profit (includes cost of preparation, yield and straw) was reported by the respondents. Happy seeder requires 4(6cm) irrigation while by conventional practices 5(cm) irrigations were required which makes 20% saving of irrigation per round. Subsidy rate for the group was 80% while for the individual it was 50 percent on Happy seeder. Some other aspects of Happy Seeder includes that 45-55 HP tractor required for 9-11 tyne of Happy seeder. Mostly farmers were using 10 Tyne Happy seeder with 50 HP tractor in Kaithal district and custom hiring rate was reported 1300 Rs/acre by majority of the farmers. Singh *et al.* (2008) [7] also mentioned in his study the potential benefits to farmers of the Happy seeder are reduced cost of machinery operations for crop establishment in comparison with conventional tillage (but not in comparison with zero till after straw burning) through reduced diesel consumption, reduced machinery repairs and maintenance, and reduced labour for machinery operations, increased yield through improved soil physical, chemical and biological properties, reduced fertilizer inputs through improved soil fertility, reduced weed control costs through suppression of weeds by mulching, irrigation water savings through suppression of soil evaporation, labour savings – through fewer tillage operations, reduced irrigation time, electricity savings – through reduced pumping time.

Table 2: Comparative benefit between happy seeder adoption and conventional practice n=80

	Happy Seeder	Conventional Practices	Saving (%)
Time (h/ha)	2.8	14	80
Fuel (l/ha)	14.8	48.1	69
Labour requirement (man-h/ha)	5.8	28.2	79
Cost of Sowing (Rs /ha)	1600	5600	71
Benefit in cost of saving (Rs)	4000	-	-
Yield (q/ha)	57.5	53.5	7
Increase in yield (q)	4	-	-
Gross return from grain(Rs/ha)	110688	102988	7700
Gross return from straw(Rs/ha)	18112	21012	1440
Total gross return (Rs/ha)	128800	124000	9140
Cost of operation (Rs/ha)	76200	80200	-
Total Benefit over conventional Practice (Rs/ha)	52600	43800	20

All the agronomic practices remains same in both the practices.

Knowledge Level of the respondents

Analysis of data (Fig.1) clearly revealed that half of the respondents (50.0%) had medium level of knowledge regarding Happy Seeder. Rest 32.5% and 17.5% respondents had low and high level of knowledge respectively regarding Happy Seeder technology (Table 9)

Table 3: Knowledge level of respondents regarding Happy Seeder(n=80)

S. No.	Knowledge level	Frequency	Percentage
1	Low	26	32.5
2	Medium	40	50.0
3	High	14	17.5

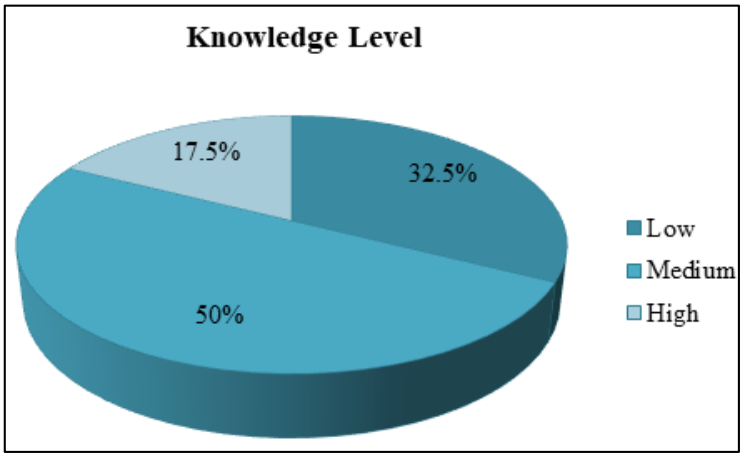

Fig 1: Knowledge Level of the respondents

Knowledge statements regarding Happy Seeder

Data on knowledge aspects before operation revealed that overwhelming majority of the farmers had knowledge about uniformly distribution of loose residues across the field (90%). More than 3/4th of the respondents had fully knowledge regarding laser leveling (80%) and operation of happy seeder after sufficient evaporation of moisture from residues (72.50%). While 42.5% and 56.25% respondents had no knowledge of optimal soil moisture content and about the height of cutter bar of combine harvester respectively. Near about fifty percent of the respondents had no knowledge about uprooting of anchored residues and machine choking; condition of the seeder and adjustments of machine and about proper row spacing and seed quantity i.e. 47.50%, 53.75% and 57.5% respectively.

Data on knowledge during the operation showed that more than 2/3rd of the respondents had fully knowledge about use of double clutch tractor to operate the machine (67.5%). While maximum number of the respondents had no knowledge about adjustment as top link of the machine (42.5%) use of recommended seed and fertilizer rate to calibrating the planter, (46.25%) raising of happy seeder while turning on

headland (56.25%) and engaging the PTO gear of the tractor (57.50%). It was found that 50 percent of the respondents had fully knowledge about the cleaning and washing of all the parts of machine properly after the operation and 43.75% had partial knowledge of the same.

Table 3: Knowledge Statements regarding Happy Seeder (n=80)

Sr. No.	Knowledge Aspects before operation	Fully Knowledge (3)	Partial Knowledge (2)	No Knowledge (1)
1.	Uniformly distribute the loose residues over the anchored residues across the field so that the residue load becomes uniform across the field	72(90)	8(10)	-
2.	Preferably the fields should be laser levelled for direct drilling of crops so as to ensure uniformity in soil moisture across the field.	64(80)	12(15)	4(5)
3.	During the early morning hours, the moist residues (due to due and high surface soil moisture etc) tend to clog the planter. Therefore, Happy Seeder may be operated after sufficient evaporation of moisture from residues.	58(72.50)	12(15)	10(12.50)
4.	Optimal soil moisture content should be ensured at the time of sowing so as to have uniform crop establishment.	32(40.0)	14(17.5)	34(42.5)
5.	The height of cutter bar of combine harvester during harvesting of crops (rice for example)should be such that after harvesting 50% of total straw remain anchored and rest 50%as loose residues.	25(31.25)	10(12.5)	45(56.25)
6.	Soil moisture content is critical for machine operation as excess soil moisture can cause uprooting of anchored resides, followed by machine choking and on the other side low soil moisture affects the wheat germination	15(18.75)	27(33.75)	38(47.50)
7.	Check the condition of the seeder and make any adjustments or repairs necessary. In particular, the fasteners, blade bolts and welds before operating.	13(16.25)	24(30.0)	43(53.75)
8.	Select the proper row spacing, seed quantity, and depth according to the field and crop.(For e.g the optimum depth of seeding should be between 3.5 to 5.0 cm)	10(12.5)	24(30)	46(57.5)
	Knowledge aspects during the operation			
1	Use double clutch tractor to operate the machine in field. 45-55 hp tractors are sufficient to operate 9 to 12 tyne happy seeder.	54(67.5)	10(12.5)	16(20.0)
2.	Adjust top link of the machine to keep machine straight while operating in field	21(26.25)	25(31.25)	34(42.5)
3.	Use recommended seed and fertilizer rate through calibrating the planter.	16(20)	27(33.75)	37(46.25)
4.	Raise Happy seeder while turning on headland without disengaging PTO gear.	15(18.75)	20(25)	45(56.25)
5.	Ensure optimal depth of planting through adjustment of depth control wheels.	13(16.25)	20(25)	47(58.75)
6.	Engage the PTO gear of tractor, set the tractor engine to 1800-2000 RPM and operate the tractor in 1st low or 2nd low gear depending on the residue load in the field.	10(12.5)	24(30)	46(57.50)
	Statements after operation			
1.	After the operation all parts of machine like seed box, fertilizer box, metering mechanism, seed tubes, furrow openers, window drum, ground wheel etc should be cleaned and washed properly.	40(50)	30(37.5)	10(12.5)
2.	Planter should be stored properly.	24(30)	35(43.75)	21(26.25)

Figures in Parentheses indicate percentage

Association between socio economic variables and knowledge level of respondents regarding Happy Seeder

The factors associated with level of knowledge of the respondents are shown in Table 11. Age was found significantly associated with knowledge level. More than fifty percent of the respondents (52.38%) of middle age group had medium knowledge level while in old age 33.33% had it high with chi-square value 9.10*. Education was also found significantly associated with education level; illiterate respondents (36.36%) had low level of knowledge while respondents educated upto senior secondary (41.17%) and graduation & above (50%) had medium level of knowledge followed by high level of knowledge 29.41% and 25% respectively. Size of land holding and annual family income were found significantly associated. As the land holding increases knowledge level was also found increased. Respondents having income between Rs. 75000-150000 had low knowledge while families with income >300000Rs. had medium (50%) and high level of knowledge (20%). Mass media exposure, social participation and socio economic status were found significantly associated with knowledge level. Respondents with nil social participation had medium level of knowledge (58.33%) while with medium level social participation respondents had high level (38.09%) of knowledge. Respondents with high socio economic status had high level of knowledge (42.10%) and low economic status respondents had medium (54.83%) level of knowledge. Caste and subsidy occupation of the family were found non-significantly associated with knowledge level of the respondents.

Table 4: Association between socio-economic variables and Knowledge level of Happy Seeder Adopters (n=80)

Socio-economic variables	Knowledge level			
Age	**Low**	**Medium**	**High**	**Total**
up to 35 yrs.	9(39.13)	11(47.82)	3(13.04)	23 (28.75)
35-50 yrs.	14(33.34)	22(52.38)	6(14.28)	42 (52.50)
above 50 yrs.	3(20.00)	7(46.67)	5(33.33)	15 (18.75)
Total	26(32.5)	40(50.0)	14(17.50)	80(100.0)
χ^2 *Cal*= 9.10*				
Caste				
General Castes	21(33.33)	32(50.79)	10(15.87)	63 (78.75)
Backward Class	3(30.00)	4(40.00)	3(30.00)	10 (12.5)
Scheduled Castes	2(28.57)	4(57.14)	1(14.28)	7 (8.75)
χ^2 *Cal*= 4.23				
Education				
Illiterate	4(36.36)	6(54.55)	1(9.09)	11(13.75)
Middle	8(40.00)	9(45.00)	3(15.00)	20(25.0)
Secondary level	7(29.16)	14(58.33)	3(12.5)	24(30.0)
Senior secondary	5(29.41)	7(41.17)	5(29.41)	17(21.25)
Graduation and above	2(25.0)	4(50.00)	2(25.0)	8(10.0)
χ^2 *Cal*= 14.96*				
Subsidiary occupation of the family				
Nil	12(37.5)	16(50.00)	4(12.5)	32(40.0)
Business and services	9(29.03)	17(54.83)	5(16.12)	31(38.75)
Small scale enterprise	5(29.41)	7(41.17)	5(29.41)	17(21.25)
χ^2 *Cal*= 7.32				
Size of land holdings				
Marginal (up to 1 ha)	5(41.66)	5(41.66)	2(16.66)	12(15.0)
Small (1-2 ha)	4(28.57)	7(50.00)	3(21.42)	14(17.5)
Semi-medium (2-4 ha)	12(33.33)	20(55.55)	4(11.11)	36(45.0)
Medium (4-10 ha)	5(27.77)	8(44.44)	5(27.77)	18(22.5)
χ^2 *Cal*= 18.04*				
Annual family income				
Between Rs.75,000 - 1,50,000/-	6(50.00)	4(33.33)	2(16.66)	12(15.0)
Between Rs.1,50,001 - 3,00,000/-	8(28.57)	16(57.14)	4(14.28)	28 (35.0)
Above Rs. 3,00,000/-	12(30.00)	20(50.00)	8(20.00)	40(50.0)
χ^2 *Cal*= 10.5*				
Mass media exposure				
Low (up to 6)	11(40.74)	14(51.85)	3(11.11)	27(33.75)
Medium (7-12)	11(28.94)	19(50.00)	8(21.05)	38(47.5)
High (above 12)	4(26.66)	7(46.66)	3(20.00)	15(18.75)
χ^2 *Cal*= 11.86*				
Social organization Participation				
Nil	9(37.50)	14(58.33)	1(4.17)	24(30.0)
Low (1)	11(31.42)	19(54.28)	5(14.28)	35(43.75)
Medium (2-3)	6(28.58)	7(33.33)	8(38.09)	21(26.25)
χ^2 *Cal*= 2.46				
Socio-economic Status				
Low (6-9)	12(38.71)	17(54.83)	2(6.46)	31(38.75)
Medium (10-12)	9(30.00)	17(56.66)	4(13.34)	30(37.5)
High (above 12)	5(26.33)	6(31.57)	8(42.10)	19(23.75)
χ^2 *Cal*= 15.86*				

Figures in parentheses indicate percentage
*Significant at 5% level of significance

Adoption level of the respondents

Adoption level of the respondents has been shown in fig 2. More than fifty percent of the respondents (55.0%) had medium level while 23.75% had low and rest (21.25%) of the respondents had high level of the adoption (Table 12) Singh *et al*. (2008) [3, 7] concluded in his study that although the adoption of the technology has numerous benefits but lack of information on the long term impacts of use of the HS on soil fertility, crop yields, saving of machinery, labour, water and other input costs, may slow its adoption. They also reported some of the reasons like the capital cost of farmers buying and operating their own machinery, with limited use on small holdings, together with relatively poor returns on investment for machinery contractors due to its limited use due to a relatively narrow wheat sowing window and low capacity of the machine, may also adversely affect the rate of adoption of the technology.

Table 5: Adoption level of respondents regarding Happy Seeder (n=80)

S. No.	Adoption level	Frequency	Percentage
1.	Low (up to 33%)	19	23.75
2.	Medium (34-66%)	44	55.0
3.	High (more than 66%)	17	21.25

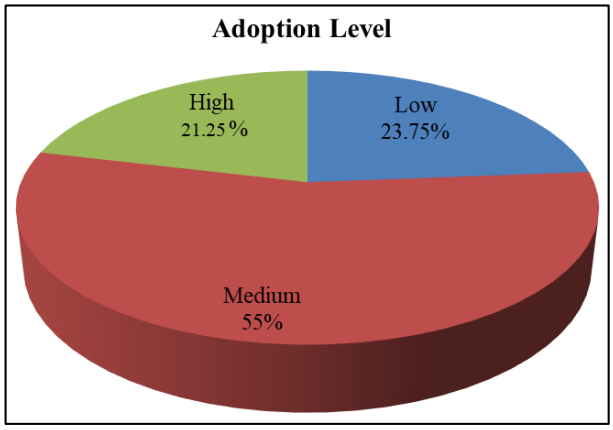

Fig 2: Adoption Level of the Respondents

Association between socio-economic variables and Adoption level of Happy Seeder adopters

Factors affecting adoption level with socio economic status of the farmers have been shown in. Age was found significantly associated with adoption level. In young age group low level of adoption (39.13%) while in old age medium (66.68%) and high level (26.66%) of adoption was found among respondents. Education association showed that illiterate respondents had low level (36.37%) of knowledge while senior secondary educated and graduates & above had medium (76.47%) and high (37.50%) level of adoption respectively significant association was found between education and adoption level of the respondents. Size of land holding was found significantly associated with adoption level. Marginal and small land holders had low level of adoption while medium level i.e. 4-10 ha land holders had medium level of adoption (72.22%). Annual family income, mass media exposure and socio economic status were found significantly associated while caste and subsidiary occupation were non-significantly associated with adoption level of the happy seeder adopters.

Table 6: Association between socio-economic variables and Adoption level ofrespondents (n=80)

Socio-economic variables	Adoption level			
Age	**Low**	**Medium**	**High**	**Total**
up to 35 yrs.	9(39.13)	10(43.48)	4(17.39)	23 (28.75)
35-50 yrs.	9(21.42)	24(57.14)	9(21.42)	42 (52.50)
above 50 yrs.	1(6.66)	10(66.68)	4(26.66)	15 (18.75)
Total	19(23.75)	44(55.0)	17(21.25)	80(100.0)
χ^2 *Cal*= 9.10*				
Caste				
General Castes	14(22.22)	37(58.73)	12(19.04)	63 (78.75)
Backward Castes	3(30.00)	4(40.00)	3(30.00)	10 (12.5)
Scheduled Castes	2(28.57)	3(42.85)	2(28.57)	7 (8.75)
χ^2 *Cal*= 4.23				
Education				
Illiterate	4(36.37)	5(45.45)	2(18.18)	11(13.75)
Middle	5(25.00)	11(55.00)	4(20.00)	20(25.0)
Secondary level	6(25.00)	12(50.00)	6(25.00)	24(30.0)
Senior Secondary	2(11.76)	13(76.47)	2(11.76)	17(21.25)
Graduation and above	2(25.0)	3(37.50)	3(37.50)	8(10.0)
χ^2 *Cal*= 14.96*				
Subsidiary occupation of the family				
Nil	9(28.12)	16(50.00)	7(21.87)	32(40.0)
Business and services	7(22.58)	19(61.29)	5(16.12)	31(38.75)
Small scale enterprise	3(17.64)	9(52.94)	5(29.41)	17(21.25)
χ^2 *Cal*= 11.56*				
Size of land holdings				
Marginal (up to 1 ha)	4(33.33)	5(41.66)	3(25.00)	12(15.0)
Small (1-2 ha)	5(35.71)	6(42.85)	3(21.42)	14(17.5)
Semi-medium (2-4 ha)	9(25.00)	20(55.55)	7(19.44)	36(45.0)
Medium (4-10 ha)	1(5.55)	13(72.22)	4(22.22)	18(22.5)
χ^2 *Cal*= 18.04*				
Annual Income				
Between Rs.75,000 - 1,50,000/-	3(25.00)	7(58.33)	2(16.66)	12(15.0)
Between Rs.1,50,000 - 3,00,000/-	4(14.28)	17(60.71)	7(25.00)	28 (35.0)
Above Rs. 3,00,000/-	12(30.00)	20(50.00)	8(20.00)	40(50.0)
χ^2 *Cal*= 10.5*				
Mass media exposure				
Low (up to 6)	4(14.81)	18(66.66)	5(18.51)	27(33.75)
Medium (7-12)	11(28.94)	18(47.36)	9(23.68)	38(47.5)

High (above 12)	4(26.66)	8(53.33)	3(20.00)	15(18.75)
χ^2 *Cal*= 11.86*				
Social Participation				
Nil	7(29.16)	12(50.00)	5(20.83)	24(30.0)
Low (1)	7(20.00)	23(65.71)	5(14.28)	35(43.75)
Medium (2-3)	5(23.80)	9(42.85)	7(33.33)	21(26.25)
χ^2 *Cal*= 2.46				
Socio-economic Status				
Low (6-9)	9(29.03)	16(51.61)	6(19.35)	31(38.75)
Medium (10-12)	7(23.33)	16(53.33)	7(23.33)	30(37.5)
High (above 12)	3(15.78)	12(63.15)	4(21.05)	19(23.75)
χ^2 *Cal*= 15.86*				

*Significant at 5% level of significance
*Figures in parentheses indicate percentage

Attitude of the respondents

Table 14 shows that all the respondents had positive attitude towards happy seeder technology near about 3/5th of the respondents (58.75%) were strongly agreed that Happy Seeder gives better results than conventional practices. Happy Seeder was strongly reported a profitable technology (57.5%). Respondents were strongly agreed with higher yield (53.75%) and raises socio economic status (45%) due to its benefits. Fifty percent of the respondents were not agreed that advertisement on this technology is totally a waste. Again 3/5th of the respondents were not agreed that Happy Seeder is a risky project. More than fifty percent of the respondents were disagreed that Happy Seeder is not a simple technology and not a diesel saving proposal (51.25%) 3/4th of the respondents were disagreed that it is not a time saving technology. Overall all the respondents were in favour of adoption of Happy Seeder.

Table 7: Attitude towards Happy Seeder n=80

Sr. No.	Statements	Adopters		
		SA	A	D
1.	Happy Seeder gives better results than conventional methods	47(58.75)	21(26.25)	12(15.0)
2	Happy seeder is a profitable technology.	46(57.5)	20(25.0)	14(17.5)
3.	Higher yield can be obtained by adopting Happy Seeder	43(53.75)	20(25.00)	17(21.25)
4.	All the farmers should adopt Happy Seeder	38(47.5)	20(25.0)	22(27.5)
5.	Adoption of Happy seeder raises the SES of the farmer due to its benefits.	36(45.0)	13(16.25)	31(38.75)
6.	Advertisements on this technology is a total waste.	30(37.5)	10(12.5)	40(50.0)
7.	Happy Seeder is not a successful proposal.	25(31.25)	10(12.5)	45(56.25)
8.	Happy Seeder technology is a risky project	16(20.0)	16(20.0)	48(60.0)
9.	Happy Seeder technology is not very simple and requires any special skill.	15(18.75)	24(30.0)	41(51.25)
10.	It is not a diesel saving proposal.	14(17.5)	25(31.25)	41(51.25)
11.	It is not a time saving technology	05(6.25)	15(18.75)	60(75.00)

SA– Strongly Agree, A–Agree, D–Disagree
Figures in Parentheses indicate percentage
Responses were multiple

Reasons for Adoption of Happy Seeder

Analysis of data regarding reasons of adoption of happy seeder (Table 15) revealed as reported by more than 3/4th of the respondents that adoption of Happy Seeder saves time and money as there is possibility of sowing wheat crop just after harvesting of rice crop and higher net return is there (75%) followed by chopped rice residue can be used as much (70%). Regarding other benefits near about 3/5th of the respondents were agreed that it reduces fuel and labour cost; It's environment friendly technology and helps in reducing the rate of stubble burning and more yield can be obtained (68.75%, 61.25% and 60%). Maximum number of the respondents were agreed with the improvement of soil health (45%) and less weedicides leads to labour saving (41.25%). So overall it was observed a beneficial technology in the favour of the farmers. Singh *et al*. (2007) also mentioned in his study that there are many direct and indirect benefits of sowing into rice residues using the Happy Seeder. These include the possibility of earlier establishment immediately after rice harvest, when the rice is still too green to burn. Any reduction in the time between rice harvest and wheat sowing is likely to reduce soil evaporation and the need for presowing irrigation. The opportunity for rapid turn around is particularly beneficial for wheat after late harvested rice crops (as for basmati, which is transplanted later than other varieties), enabling sowing closer to the optimum time for maximum yield.

Table 8: Reasons for adoption of Happy Seeder (n=80)

Sr. No.	Aspects	Reasons for adoption		
		Agree	Neutral	Disagree
1.	Saves time and money as there is possibility of sowing wheat crop just after harvesting of rice.	62(77.50)	15(18.75)	03(3.75)
2	Higher net return by adoption of Happy Seeder	60 (75.0)	10(12.5)	10(12.5)
3.	Choped rice residue can be used as mulch	56(70.0)	18(22.5)	6(7.5)
4.	Reduce fuel and labour cost	55(68.75)	20(25.0)	05(6.25)
5.	It is environment friendly technology as with the burning of rice residue produced gases create a very harmful situations for our environment but it can reduce air pollution	49(61.25)	24(30.0)	7(8.75)
6.	Increased yield than conventional method	48(60.00)	22(27.5)	12(15)
7.	It helps in maintaining soil moisture thus reducing the need for at least one irrigation so it is a water saving technology.	37(46.25)	23(28.75)	20(25.0)
8.	Improves soil health as use of Happy Seeder helps for lock in of important soil nutrients	38(47.50)	28(35.0)	14(17.5)
9.	It is a labour saving technology as less weedicides are reported	33(41.25)	27(33.75)	20(25.0)

Figures in Parentheses indicate percentage.
Responses were multiple.

Cumulative socio economic impact of Happy Seeder

Analysis of study depicted (Table 16) the multiple cumulative socio economic impact of using happy seeder as perceived by farmers. More than 2/3rd of the marginal farmers performed social ceremonies by the benefit amount of Happy Seeder (66.66%), investment on quality education of their children and increase in household assets (33% each). Small farmers also invested on education of children (42.85%) on social ceremonies and household assets (35.71% each) increase in agricultural land on lease (21.42%) and quality of medical treatment and increase in mass media exposure (14.28% each) was reported by the respondents. Semi-medium (52.79%) and medium farmers (61.11%) also reported investment on quality education of their children. About 1/3rd of the medium land holders reported increase in performance of social ceremonies and in mass media exposure. Analysis of study depicted the multiple cumulative socio economic impact of using happy seeder as perceived by farmers. More than 2/3rd of the marginal farmers performed social ceremonies by the benefit amount of Happy Seeder(66.66%), investment on quality education of their children and increase in household assets (33% each). Small farmers also invested on education of children (42.85%) on social ceremonies and household assets (35.71% each) increase in agricultural land on lease (21.42%)

Table 9: Cumulative socio-economic impact of Happy Seeder on farming families (n = 80)

S. No.	Socio-economic impact	Marginal farmers (12)15%	Small farmers (14)17.5%	Semi-medium Farmers (36)45%	Medium farmers (18)22%
1.	Investment on quality education of their children	4 (33.33)	6 (42.85)	19 (52.77)	11(61.11)
2.	Expenditure on Performance of social ceremonies like marriage, death etc. increased	8 (66.66)	5(35.71)	16(44.44)	6 (33.33)
3.	Increase in household assets	4 (33.33)	5 (35.71)	17 (47.22)	7 (38.88)
4.	Increase in quality of medical treatment	-	2 (14.28)	8 (22.22)	3 (16.66)
5	Increase in agricultural land on lease	-	3 (21.42)	5(13.88)	-
6.	Increase in mass media exposure	-	2 (14.28)	7 (19.44)	6 (33.33)
7.	Increase in urban and extension contacts	-	1 (7.14)	5 (13.88)	8 (44.44)
8.	Any others	1 (8.33)	2 (14.28	7 (19.44)	7 (38.88)

Figures in Parentheses indicate percentage.
Responses were multiple.

Constraints about Happy Seeder Technology

Regarding agro technical problems constraints in adoption of Happy Seeder (Table 17) half of the respondents were agreed that sowing of wheat crop is difficult with high moisture in straw and soil condition which got rank I, other constraints reported by respondents were non-availability of Happy Seeder when required and choking of machinery while working got rank II and III respectively. Some of the educational problems reported by the respondents were inadequate extension contacts with ADOs and SDOs (rank I) followed by shortage of information on Happy Seeder and lack of adequate training programmes (rank II and III respectively). In the same way in financial problems 43.75% and 38.75% respondents were agreed and somewhat agreed that higher cost of happy seeder or more custom charges they have to pay for happy seeder with mean score 2.26%. Singh *et al.* (2008) [3, 7] reported in his study the constraints to adoption of the happy seeder is limited use of the Happy seeder due to small size of holdings, need to increase the capacity of machine, less efficient contract arrangement, lack of information on potential benefit and limited capacity of the industry to meet demand.

Table 10: Constraints in adoption of Happy Seeder technology

Sr. no	Constraints	Agree (3)	Somewhat Agree (2)	DA (1)	WMC	Mean score	Rank
1.	**Agro – technical problems**						
a.	Sowing of wheat crop is difficult in high moisture straw and soil condition.	**40(50.00)**	**22(27.5)**	**18(22.5)**	182	2.27	I
b.	Non availability of Happy Seeder when required	**37(46.25)**	**23(28.75)**	**20(25.00)**	177	2.21	II
c.	Choking of machinery while working	**33(41.25)**	**24(30.00)**	**23(28.75)**	170	2.12	III
2.	**Educational problems**						
a.	Inadequate extension contacts with ADOs and SDOs	29(36.25)	20(25.00)	31(38.75)	158	1.97	I
b.	Shortage of information on Happy Seeder	25(31.25)	15(18.75)	40(50.00)	145	1.81	II
c.	Lack of adequate training program	18(22.5)	25(31.25)	37(46.25)	141	1.76	III
3.	**Financial problem**						
a.	Higher cost of Happy Seeder/ More custom charges	35(43.75)	31(38.75)	14(17.5)	181	2.26	I

Figures in Parentheses indicate percentage.
Responses were multiple.

Conclusion

It's concluded that Happy seedy is a beneficial technology for the farmers which saves on an average 80% time than conventional practices. Other savings were; Labour saving (79%), saving in the cost of sowing (71%), extra yield (7%), total benefit (20%), water savings (20%) as reported by the respondents. Regarding knowledge and adoption level 50 % and 55 % of adopters had medium level respectively. All the respondents had positive attitude towards happy seeder. One of the most important advantage of happy seeder is that chopped rice residue can be used as mulch (70%) and it's environment friendly technology. It was found that marginal farmers spend the benefit amount of happy seeder on social ceremonies (66%) and others on quality education of children, on social ceremonies and on household assets etc. Half of the respondents were agreed that sowing of wheat crop is difficult with high moisture in straw and soil condition (Rank-I). but over all happy seeder is a successful proposal. Lohan *et al.* (2017) also reported in his study that the happy seeder technology has encroached area from 8, 100, 370 and 952 ha in 2006–07, 2007–08, 2008–09 and 2009–10 respectively [48,113]. In 2012–13, the number of happy seeder machines in India was 350 which have been increased to 600 in 2014–15. Considering the effective field capacity (EFC) of happy seeder machine, 0.3 ha h−1 and working period of 30 days in a season, a total of 37,298 machines are required for direct drilling of wheat in paddy harvested field which shows the trend that happy seeder is in high demand.

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