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Economics of Super Seeder Technique of Wheat Cultivation in Haryana

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study evaluates the economics of super seeder technology over conventional techniques farmers adopt in wheat cultivation in Haryana state. Multi-stage random sampling was employed in selecting the blocks, villages, and respondents. The study was carried out in the Karnal and Kaithal districts of the Haryana state during 2021-22. A sample of 100 wheat-growing farmers was selected using the various methods of paddy straw management. The super seeder technology was the most economical approach for handling paddy straw without burning it before sowing. The grain yield was higher by 50.74q/ha in super seeder than the conventional method (48.72q/ha). Super seeder produced a better net return by Rs.18724.44/ha (Rs.7688.95/ha in conventional technique). The cost-benefit ratio in Karnal and Kaithal districts in super seeder technology were 2.91 and 2.93, respectively. In nut shell, the cost-benefit ratio was 2.91 in super seeder technology than the conventional method (2.64). The better net return of Rs. 18724.44/ha was obtained from super

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seeder than the conventional technique (Rs.7688.95 /ha). A significant cost saving of Rs.6886.00 was found in super seeder technology, water conservation, preparatory tillage, timely sowing, and environmental benefits, i.e., reduced burning of paddy residue, reducing air pollution. Krishi vigyan kendras/state agricultural universities/state government should facilitate best use of this machine through skilled training. Timely availability of machine can also increase the area under super seeder in the state which reduce the burning cases and enhance the timely sowing of wheat crop.

Keywords: Economics; wheat; super seeder; conventional technique; residue management.

1. INTRODUCTION

Wheat accounts for around 11.79 percent of global wheat output. In India, wheat covers nearly 29.3 Mha (Million hectares), producing 103.6 MT (Million tons) with productivity of 3,533 kg ha-1 (FAOSTAT, 2021). Haryana is the country's fourth most crucial wheat-cultivating state, followed by Uttar Pradesh, Madhya Pradesh, and Punjab. Haryana accounts for 11.28 percent of total wheat production in India, producing 12.36 MT with a yield of 48.36 quintals ha^{-1} [1]. In the late 1970s and early 1980s, Haryana and Punjab switched from conventional crops (pulses, pearl millet, maize, and oilseeds) to a rice-wheat farming rotation. The farming patterns were altered to ensure that the country produced adequate food; thus, there was no concern about resource sustainability. Haryana and Punjab presently have a highly active rice-wheat region in the Indo-Gangetic Plain, accounting for around 69 percent of total food production (nearly 84% wheat and 54% rice) [2]. Despite its importance, there have been issues over residue production and crop management in rice and wheat crops. Although paddy straw burning is a problem in several states, the most notable instances are in Punjab and Haryana. Burning is the most frequent strategy for handling rice crop wastes because of its simplicity, low cost, increasing mechanical harvesting, the short window between rice harvest and wheat sowing, and lack of practical uses for residues. Around 50 MT of rice straw is burned annually, roughly half of which occurs in northwestern India between October/November [3]. Hence, the air quality of Punjab and Haryana has been experiencing a severe plunge. Surface management of crop residues as mulch has a variety of impacts. These save irrigation water by retaining soil, using a prudent thermal regime, controlling weeds, and improving soil health. Saving irrigation water using straw mulch can save up to 70-300 mm in summer crops for equivalent yield [4]. Crop straw mulching reduces water evaporation [5]. Crop residue retention also contributes significantly to an increase in the sustainability index [6-8]. In order to overcome the problem of paddy straw burning, various machinery was developed in the last decade, such as a straw baler, straw chopper-cum-spreader, zero drills, happy seeder, super seeder, etc. So, super seeder is the latest one that needs more popularization and adoption in farmers' fields. Hence, a study was carried out to study the economics of super seeders and conventional technology in Haryana.

2. METHODOLOGY

The research study was conducted in Haryana state. Since Haryana had a major rice-wheat cultivated area and high case of paddy straw burning. From Haryana state, Karnal and Kaithal districts were chosen purposively because of highest area under rice-wheat cropping pattern during 2020-21 [9]. The residue burning cases were found in Karnal and Kaithal districts as 301 and 641, respectively [10]. Five blocks were chosen at random from each district, namely Karnal, Gharaunda, Nissing, Indri, Nilokheri from Karnal district and Pundri, Kaithal, Kalayat, Guhla, Siwan blocks from Kaithal district. From each selected block, one village was selected randomly. From each selected villages ten farmers were chosen randomly from which five adopters and five non adopter of super seeder techniques. Thus, the study sample consisted of fifty farmers from each district, out of which twenty-five adopter and twenty-five non-adopters of super seeder techniques. Thus, a total of 100 farmers were interviewed. The statistical tools used to examine the results are presented below.

1. Total cost = Total variable cost+ Total fixed cost
2. Gross return = Main product value + by-product value
3. Return over total cost (Net return) = Gross return – Total cost
4. Benefit-cost ratio over total cost = $\frac{Gross\ return}{Total\ cost}$

3. RESULTS AND DISCUSSION

3.1 Economics of Conventional Technique and Super Seeder Technology in Karnal and Kaithal Districts

The cost of wheat cultivation under the conventional technique and super seeder technology of wheat in the Karnal district of Haryana is presented in Table 1. The total cost of cultivation in the conventional technique of wheat (Rs.109937.83/ha) was estimated to be higher than the super seeder technology, i.e. Rs.102954.56/ha. The differences between total cost in both technology is mainly due to the preparatory tillage operation and pre-sowing irrigation. These operations are done in the conventional technique, while in super seeder technology it is not required. More nitrogen is required in the case of super seeder technology which may be a result of the benefits of straw mulching, which improved growth conditions and increased nodulation as well as more likely nitrogen fixation and subsequent nitrogen availability.

The share of the variable cost of 37.64 percent (Rs. 41378.17/ha) and fixed costs of 62.36 percent (Rs. 68559.66/ha) in the total cost of the conventional technique of wheat was observed. Similarly, in the super seeder technology for wheat, the shares of variable and fixed costs were determined to be 34.17 percent (Rs. 35182.69/ha) and 65.83 percent (Rs. 67771.87/ha), respectively. In variable cost items included are preparatory tillage, irrigation, seed, fertilizer, sowing, etc. item were included. Similar results were obtained by Grover et al. [11] in their study on comparative analysis of traditional /conventional planting systems with zero tillage farms in Haryana.

The cost of wheat cultivation under conventional technique and super seeder technology in wheat in the Kaithal district of Haryana is presented in Table 2. The total cost of cultivation in conventional technique of wheat (Rs.107041.03/ha) was estimated to be higher than super seeder technology, i.e. (Rs. 100251.12). The share of the variable cost of 38.36 percent (Rs. 41061.59/ha) and fixed costs of 61.64 percent (Rs. 65979.45/ha) in the total cost of conventional technique of wheat was observed. Similarly, in the super seeder technology for wheat, the shares of variable and fixed costs were determined to be 34.70 percent (Rs. 34790.84/ha) and 65.30 percent (Rs. 65460.28/ha), respectively. The reason behind the differences in the cost of cultivation was same as discussed above in case of Karnal. Similar results were obtained by Grover et al., [11] Singh et al., [12] in their study.

3.2 Return from Conventional and Super Seeder Technology in Karnal and Kaithal Districts

Profitability from wheat cultivation in the Karnal district of Haryana is presented in Table 3. Gross returns (Rs. 121036.40/ha), as well as net returns (Rs.18081.84/ha), were estimated to be higher in super seeder technology as compared to conventional technique (Rs.116970.60/ha) and (Rs.7032.77/ha), respectively. The difference between the gross return and net return in both techniques may be to the straw from the preceding crop (rice), which served as a mulch and improved soil moisture and crop temperature throughout the crop cycle, may have contributed to the increased production in the case of super seeder sown wheat. Regarding the benefit-cost ratio, super seeder technology was observed to be profitable (2.91) over conventional technique (2.61) in the study area. The findings of the studies by Sidhu et al., [13]; Grover et al., [11]; Raju et al., [14]; Yogi et al., [15]; NAAS, [16]; Lohan et al., [17]; Singh et al., [12] and Kirandeep et al., [18] were closely correlated with these results.

Profitability from wheat cultivation in the Kaithal district of Haryana is presented in Table 4. Gross returns (Rs. 119620.70/ha), as well as net returns (Rs. 19369.58/ha), were estimated to be higher in super seeder technology as compared to conventional technique (Rs. 115388.20) and (Rs. 8347.17/ha), respectively. Regarding the benefit-cost ratio, super seeder technology was observed to be profitable (2.93) over conventional technique (2.66) in the study area. A quick transition between rice harvest and wheat sowing is one advantage of the super Seeder. When conventional sowing of wheat would need to delay until after the climatically dependent critical date because it would take too long for the straw to dry up before burning or cultivating, this could lead to decrease yield in conventional techniques. These results are confirmatory with Grover et al., [11] & Raju et al., [14] in their study.

Table 1. Cost of wheat cultivation in Karnal district of Haryana during 2021-22 (Rs./ha) (N=50)

Sl.No.	Inputs	Conventional technique (N=25)		Super seeder technology (N=25)	
		Numbers. /quantity	Value (Rs.)	Numbers /quantity	Value (Rs.)
1	Preparatory tillage (Numbers)	4.50	6945.57 (6.32)	-	-
2	Pre-sowing irrigation (Numbers)	1.00	650.68 (0.59)	-	-
3	Seed (kg.)	107.00	2889.00 (2.63)	112.00	3024 (2.94)
4	Seed treatment		122.51 (0.11)		126.46 (0.12)
5	Sowing		1783.34 (1.62)		4663.36 (4.53)
6	Ridging		229.71 (0.21)		245.02 (0.24)
7	Farm yard manure (quintals)	26.08	1043.33 (0.95)	-	-
8	Fertilizer nutrients				
	(a) Nitrogen (Kg.)	155.00	2015.00 (1.83)	165.00	2145.00 (2.08)
	(b) Phosphorus (Kg.)	54.44	2558.68 (2.33)	54.33	2553.51 (2.48)
	(c) Potash (Kg.)	12.00	364.80 (0.33)	9.48	288.19 (0.28)
	(d) Sulphur (kg.)	6.50	585.00 (0.53)	5.34	480.60 (0.47)
	Total fertilizer investment		5523.48 (5.02)		5467.30 (5.31)
9	Fertilizer application cost		680.31 (0.62)		690.12 (0.67)
10	Irrigation (Numbers)	4.04	2628.75 (2.39)	4.07	2648.27 (2.57)
11	Hoeing/ weeding				
	(a) Chemical cost		1317.99 (1.20)		1045.11 (1.02)
12	Weedicides application cost		449.54 (0.41)		399.65 (0.39)
13	Pesticide cost		701.48 (0.64)		660.92 (0.64)
14	Pesticides application cost		264.29 (0.24)		245.51 (0.24)
15	Harvesting		4574.44 (4.16)		4584.32 (4.45)
16	Wheat straw making		4352.14 (3.96)		4421.30 (4.29)
17	Miscellaneous		298.87 (0.27)		304.30 (0.30)
	Total 1 to 17		39978.91 (36.37)		33992.94 (33.02)
18	Interest on working capital @ 3.5 percent		1399.26 (1.27)		1189.75 (1.16)
	Variable cost (A)		41378.17 (37.64)		35182.69 (34.17)
19	Transportation		1264.64 (1.15)		1294.00 (1.26)
20	management charges @10 percent		4137.82 (3.76)		3518.27 (3.42)
21	Risk factor		1012.00 (0.92)		1012.00 (0.98)
22	The rental value of land		62145.20 (56.53)		61947.60 (60.17)
	Total fixed cost (B)		68559.66 (62.36)		67771.87 (65.83)
	Total cost (A+B)		109937.83 (100.00)		102954.56 (100.00)

The figure in the parenthesis represents the percent of the total cost

3.3 Cost and Return from Conventional Technique and Super Seeder Technology in Haryana

The cost of wheat cultivation under conventional technique and super seeder technology in wheat in Haryana is presented in Table 5. The total cost of cultivation in conventional technique of wheat (Rs.108490.45/ha) was estimated to be higher than super seeder technology, i.e. (Rs. 101604.11). The share of the variable cost of 37.99 percent (Rs. 41220.80/ha) and fixed costs of 62.01 percent (Rs. 67269.65/ha) in the total cost of conventional technique of wheat was observed. Similarly, in the super seeder technology for wheat, the shares of variable and fixed costs were determined to be 34.44 percent (Rs. 34987.92/ha) and 65.56 percent (Rs. 66616.19/ha), respectively. Similar results were obtained by (Grover et al., 2011) in their study. Profitability from wheat cultivation in Haryana is presented in Table 6. Gross returns (Rs. 120328.55/ha), as well as net returns (Rs. 18724.44/ha), were estimated to be higher in super seeder technology as compared to conventional technique (Rs. 116179.40) and (Rs. 7688.95/ha), respectively. Regarding the benefit-cost ratio, super seeder technology was

observed to be profitable (2.91) over conventional technique (2.64) in the study area. The differences between the yield in both techniques is due to the sowing time in case of the super seeder sowing of the wheat is possible at optimum time of wheat but in the case of the conventional techniques sowing of the wheat crop late as compared to optimum time due to paddy straw burn and through out of the field etc. which cause the reduction in the yield of the wheat crop. Additionally, the mulch decreased soil evaporation and decreased weed biomass by almost 60% [19]. These results are confirmatory with Grover et al., [11] & Raju et al., [14] in their study [20-23].

Table 2. Cost of wheat cultivation in Kaithal district of Haryana during 2021-22 (Rs. /ha) (N=50)

Sl.No.	Inputs	Conventional technique (N=25)		Super seeder technology (N=25)	
		Numbers. /quantity	Value (Rs.)	Numbers. /quantity	Value (Rs.)
1	Preparatory tillage (Numbers)	4.80	6700.00 (6.26)	-	-
2	Pre-sowing irrigation (Numbers)	1.00	740.00 (0.69)	-	-
3	Seed (kg.)	106.00	2862.00 (2.67)	110.00	2970.0 (2.96)
4	Seed treatment		107.69 (0.10)		115.60 (0.12)
5	Sowing		1721.59 (1.61)		4297.80 (4.29)
6	Ridging		232.18 (0.22)		217.36 (0.22)
7	Farm yard manure (quintals)	28.00	1102.61 (1.03)	-	-
8	Fertilizer nutrients				
	(a) Nitrogen (Kg.)	152.00	1976.00 (1.85)	160.00	2080.00 (2.07)
	(b) Phosphorus (Kg.)	52.86	2484.42 (2.32)	52.00	2444.00 (2.44)
	(c) Potash (Kg.)	11.05	335.92 (0.31)	8.47	257.49 (0.26)
	(d) Sulphur (kg.)	4.64	417.60 (0.39)	4.25	382.50 (0.38)
	Total fertilizer investment		5213.94 (4.87)		5163.99 (5.15)
9	Fertilizer application cost		680.31 (0.64)		690.12 (0.69)
10	Irrigation (Numbers)	4.00	2960.00 (2.77)	4.02	2974.80 (2.97)
11	Hoeing/ weeding				
	(a) Chemical cost		1275.05 (1.19)		1120.94 (1.12)
12	Weedicides application cost		390.26 (0.36)		357.20 (0.36)
13	Pesticide cost		824.98 (0.77)		737.04 (0.74)
14	Pesticides application cost		318.63 (0.30)		310.00 (0.31)
15	Harvesting		3735.10 (3.49)		3754.40 (3.74)
16	Wheat straw making		5276.12 (4.93)		5410.12 (5.40)
17	Miscellaneous		318.63 (0.30)		330.98 (0.33)
	Total 1 to 17		39673.03 (37.06)		33614.34(33.53)
18	Interest on working capital @ 3.5 percent		1388.56 (1.30)		1176.50 (1.17)
	Variable cost (A)		41061.59 (38.36)		34790.84 (34.70)
19	Transportation		1284.89 (1.20)		1294.00 (1.29)
20	Management charges @10 percent		4106.16 (3.84)		3479.08 (3.47)
21	Risk factor		1012.00 (0.95)		1012.00 (1.01)
22	The rental value of land		59576.40 (55.66)		59675.20 (59.53)
	Total fixed cost (B)		65979.45 (61.64)		65460.28 (65.30)
	Total cost (A+B)		107041.03 (100.00)		100251.12 (100.00)

The figure in the parenthesis represents the percent of the total cost

Table 3. Returns from wheat cultivation in Karnal district of Haryana during 2021-22 (Rs. /ha) (N=50)

Sl.No.	Outputs	Conventional technique (N=25)		Super seeder technology (N=25)	
		Numbers/quantity	Value (Rs.)	Numbers/ quantity	Value (Rs.)
1	Production (quintals.)				
	(a) Main	49.03	99040.60	51.07	103161.40
	(b) By product		17930.00		17875.00
2	Gross returns		116970.60		121036.40
3	Returns over variable cost		75592.43		85853.71
4	Net returns		7032.77		18081.84
5	B: C Ratio		2.61		2.91

Table 4. Returns from wheat cultivation in the Kaithal district of Haryana during 2021-22 (Rs. /ha) (N=50)

Sl.no.	Outputs	Conventional technique (N=25)		Super seeder technology (N=25)	
		Numbers. /quantity	Value (Rs.)	Numbers/quantity	Value (Rs.)
1	Production (quintals)				
	(a) Main	48.41	97788.20	50.41	101828.20
	(b) By product		17600.00		17792.50
2	Gross returns		115388.20		119620.70
3	Returns over variable cost		74326.61		84829.86
4	Net returns		8347.17		19369.58
5	B: C Ratio		2.66		2.93

Table 5. Cost of wheat cultivation in Haryana during 2021-22 (Rs. /ha) (N=100)

Sl.no.	Inputs	Conventional technique (N=50)		Super seeder technology (N=50)	
		Numbers. /quantity	Value (Rs.)	Numbers. /quantity	Value (Rs.)
1	Preparatory tillage(Numbers	4.65	6822.79 (6.29)	-	-
2	Pre-sowing irrigation (Numbers	1.00	695.34 (0.64)	-	-
3	Seed (kg.)	106.50	2875.50 (2.65)	111.00	2997.0 (2.95)
4	Seed treatment		115.10 (0.11)		121.03 (0.12)
5	Sowing		1752.47 (1.62)		4480.58 (4.41)
6	Ridging		230.95 (0.21)		231.19 (0.23)
7	Farmyard manure (quintals)	27.04	1072.97 (0.99)	-	-
8	Fertilizer nutrients				
	(a) Nitrogen (Kg.)	153.50	1995.50 (1.84)	162.50	2112.50 (2.08)
	(b) Phosphorus (Kg.)	53.65	2521.55 (2.32)	53.17	2498.76 (2.46)
	(c) Potash (Kg.)	11.53	350.36 (0.32)	8.98	272.84 (0.27)
	(e) Sulphur (kg.)	5.57	501.30 (0.46)	4.80	431.55 (0.42)
	Total fertilizer investment		5368.71 (4.95)		5315.65 (5.23)
9	Fertilizer application cost		681.51 (0.63)		690.32 (0.68)
10	Irrigation(Numbers)	4.02	2795.27 (2.58)	4.05	2812.65 (2.77)

Sl.no.	Inputs	Conventional technique (N=50)		Super seeder technology (N=50)	
		Numbers. /quantity	Value (Rs.)	Numbers. /quantity	Value (Rs.)
11	Hoeing/ needing (a) Chemical cost		1296.52 (1.20)		1083.03 (1.07)
12	Weedicides application cost		419.90 (0.39)		378.43 (0.37)
13	Pesticide cost		763.23 (0.70)		698.98 (0.69)
14	Pesticides application cost		291.46 (0.27)		277.76 (0.27)
15	Harvesting		4154.77 (3.83)		4169.36 (4.10)
16	Wheat straw making		4814.13 (4.44)		4915.71 (4.84)
17	Miscellaneous		308.75 (0.28)		317.64 (0.31)
	Total 1 to 17		39826.8 (36.71)		33804.76 (33.27)
18	Interest on working capital @ 3.5 percent		1393.94 (1.28)		1183.17 (1.16)
	Variable cost (A)		41220.80 (37.99)		34987.92 (34.44)
19	Transportation		1274.77 (1.18)		1294.00 (1.27)
20	Management charges @10 percent		4122.08 (3.80)		3498.79 (3.44)
21	Risk factor		1012.00 (0.93)		1012.00 (1.00)
22	The rental value of land		60860.80 (56.10)		60811.40 (59.85)
	Total fixed cost (B)		67269.65 (62.01)		66616.19 (65.56)
	Total cost (A+B)		108490.45(100.00)		101604.11(100.00)

The figure in the parenthesis represents the percent of the total cost

Table 6. Return from wheat cultivation in Haryana during 2021-22 (Rs. /ha) (N=100)

Sl.no.	Outputs	Conventional technique (N=50)		Super seeder technology (N=50)	
		Numbers./quantity	Value (Rs.)	Numbers./quantity	Value (Rs.)
1	Production (quintals)				
	(a) Main	48.72	98414.40	50.74	102494.80
	(b) By product		17765.00		17833.75
2	Gross returns		116179.40		120328.55
3	Returns over variable cost		74958.60		85340.63
4	Net returns		7688.95		18724.44
5	B: C Ratio		2.64		2.91

4. CONCLUSION

The super seeder technology proved profitable in terms of return, cost & time-saving compared to the conventional techniques of wheat sowing. The higher benefit-cost ratio (2.91) by the super seeder compared to the conventional technique (2.64) showed its importance. Considering its importance, the area under super seeder is expected to grow in the coming year. Providing the farm machinery services on rental as well as on custom hiring to the farmers is the most practical solution. The use of these machines is knowledge-centric, therefore, hands-on training is very important. In this regard, Krishi Vigyan Kendras, state agricultural universities, and state government should facilitate the best use of this machine. The timely availability of machine can also increase the area under super seeder in the state, which reduces the burning cases and enhance the timely sowing of wheat crop.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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