OASIS OF CONSERVATION AGRICULTURE IN PUNJAB, INDIA: A CASE STUDY OF HAPPY SEEDER TECHNOLOGY

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ABSTRACT

Punjab has 1.5 percent of the total land area of India and the state produces 20 and 12 percent of country's wheat and rice respectively. The state alone contributes 60 percent of wheat and 40 per cent of rice to central food grains reserves. Paddy is grown on 2.6 million ha (75% cultivable area) in the state. Out of the 20 million tonnes of paddy straw left in the fields after mechanical paddy harvesting, 15 million tonnes is burnt annually by farmers for timely and convenient sowing of subsequent sowing crop, largely the wheat. Due to such burning enormous quantity of particulate matter (especially PM 2.5) and other noxious gases are released in the atmosphere. The presence of fog during winters further escalates the problem by trapping pollutants and hampering their dispersal. In order to curb this menace the central government sanctioned Rupees 6950 million to the Punjab for the awareness drive and subsidized purchase of in-situ residue management machinery.

Among various in-situ residue management technologies, Happy Seeder technology had a major breakthrough due to its exponential expansion in the past two years. Present study was conducted in cluster of four villages viz Jatana, Katani, Mehdoodan and Begowal in Ludhiana district of Punjab where the technology was rapidly adopted. The aim of this study was to explore factors affecting adoption, impact and prospects of the technology in rice wheat cropping system. Single intervention of Happy Seeder last year in a small area of 18 ha at one location increased to 800 ha in the adjoining areas during current year i.e. 2018-19.

The lower cost of cultivation, zero burning of paddy straw, significant control of Phalaris minor etc. were the major motivational factors for the farmers to adopt this technology. Mr. Harjeet Singh, a progressive farmer and opinion leader of the area, has also played key role in ensuring rapid adoption of the technology. He not only motivated fellow farmers to gain technical assistance from the KVK but also assisted them in purchasing 26 Happy Seeders. Responses of 100 farmers showed that this technology was easy to operate, environment friendly and economical (saving Rupees 3500/- per ha) due to saving of labour and fuel, along with very low mechanical breakdown etc. It was also found that sowing of wheat with Happy Seeder resulted in rejuvenation of soil micro-flora and fauna, reduction of weeds especially the obnoxious Phalaris minor to an extent of 65 percent and better crop health as compared to conventionally sown ones. However, the long-term impacts of this technology on soil flora & fauna, natural resources (land and water), role of opinion leaders in rapid diffusion of technology and its contribution towards poverty alleviation needs to be explored further.

Keywords: Conservation Agriculture, Happy Seeder Technology, Crop Residue Management

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1. INTRODUCTION

Rice- wheat is a major cropping system followed in North West India viz. Punjab, Haryana and Uttarpradesh. This cropping system is heavily supported by both the central as well as State Government by providing large number of subsidies i.e. on Machinery, fertilizers, electricity and credit (Devenport et al. 2009) and minimum support price (USDA 2004). The area under rice-wheat system accounts for more than 60 per cent of total net sown area (Singh et al, 2008). The Punjab State having only 1.5 percent of the total land area produces 20 and 12 percent of country's wheat and rice respectively. This state alone contributes 60 percent of wheat and 40 per cent of rice to central food grains reserves. Paddy is grown on 2.6 million ha (75% cultivable area) in the state.

Rice-wheat cultivation in the state is highly mechanized and about 90 per cent of paddy area is harvested by the combine harvesters which generates heavy straw load i.e. upto 6 tonnes per ha. Thus in total out of 20 million tonnes of paddy straw is produced after mechanical paddy harvesting, 15 million tonnes is burnt annually by farmers for timely and convenient sowing of subsequent crop largely the wheat. The reasons for this stubble burning are due to its ease, rapid and relatively cheaper means for field clearance. However, this practice of burning posing long-standing concerns both on and off-farm (Singh et al. 2008). As in the state more than 60% of the population lives in the rice growing areas so they are directly exposed to air pollution due to burning of stubbles (Kumar and Kumar 2010). This burning practice results in production of enormous quantity of fine particulate matter (especially PM 2.5) and other noxious gases in the atmosphere which causes acute asthmatic, lung disease, cardio vascular problems etc. in elderly people and children. The stubble burning practice also contributes significantly to greenhouse gas emissions (Gujral et al. 2010). The presence of fog during winters further escalates the problem by trapping pollutants and hampering their dispersal and the thick clouds of smoke engulf roads, causing an increase in the number of accident, blocking or slowing down traffic etc. (Milham et al. 2011).

Apart from the damage caused by air pollution, burning paddy residue also results in deterioration of soil health due to loss of plant nutrients, organic carbon of the soil, micro flora and fauna. As per estimates 25 per cent of nitrogen, 50 per cent sulphur and 75 per cent Potassium remained in the straw are lost through such burning thus costing more than Rs. 200 crores at the prevailing prices (Sidhu et al., 2007).

In order to address the above issues in the state, number of crop residue management technologies have been invented, modified and demonstrated at the farmers' fields since long. In order to curb this menace of residue burning the central government also sanctioned Rupees 6950 million to the Punjab state for the awareness drive and subsidized purchase of in-situ residue management machinery. Among various *in-situ* residue management technologies, Happy Seeder technology had a major breakthrough due to its exponential expansion in the recent past. This machine was developed in the department of Farm Power and Machinery, Punjab Agricultural University Ludhiana in collaboration with CSIRO Land and Water Australia under the financial assistance from ACIAR. Happy seeder machine is combination of straw managing unit and a sowing unit. This machine is having hinged flails mounted on the rotating shaft for cutting the standing stubbles and loose straw coming in front of the furrow opener with simultaneous tyne cleaning for proper seed placement and adjusting the residue in between the sowing tynes.
Research finding reveal that, sowing of wheat with Happy Seeder the farmer can save time 5.38 hrs, fuel 16.03 liters and money Rs. 3250/- per ha over the conventional practice (Singh et al 2013). Under the current scenario where farmers of

the state are in debt there is need to study the success rate of these crop residue management technologies in the nitches and also enhance the adoption in other areas for larger benefits to the society and the environment.

Thus the present study was under taken to explore factors affecting adoption, impact and prospects of the technology in rice wheat cropping system.

2. METHODS

The study was conducted in cluster of four villages *viz* Jatana, Katani, Mehdoodan and Begowal in Ludhiana district of Punjab where the technology was demonstrated by the Krishi Vigyan Kendra in the year 2017-18. A single intervention of Happy Seeder in a small area of 18 ha at one location increased to 800 ha in the adjoining areas current year i.e. 2018-19. A sample of 100 farmers i.e. 25 farmers adopter of happy seeder technology from each village were selected for their responses on structured interview schedule. In addition to this physical observations on various paratmeters such as weed count, straw load, crop stand, grain quality etc. were also recorded at 50 locations each for happy seeder sowing plots as well as conventional sown plots for comparison by the KVK's experts.

3. RESULTS AND DISCUSSION

3.1 Comparative Economic Analysis of Different Methods of Crop Residue Management for Sowing of Proceeding Wheat Crop

The data presented in Table 1 shows the results input cost, gross returns, net returns and benefit cost ratio for different methods of wheat sowing. In this table an attempt has been made to examine the different cost incurred on different sowing methods vis-a-vis Happy Seeder Technology, incorporation and conventional practice (straw burning) followed by the farmers. The cost for managing the loose straw under happy seeder was found to be less (Rs. 750/-) as compared to incorporation (Rs. 4500/-). The cost incurred on conventional method of loose straw was also on lower side (Rs. 750/-) but not eco-friendly. As field preparation is not required under happy seeder so there was saving Rs. 7000 and Rs. 4500 in comparision to incorporation and conventional method of field preparation respectively. There is not much significant diffence for the costs incurred on sowing, seed used, fertilizer, insect pests management and harvesting of crop under different methods of wheat sowing. However, the findings reveals that there is significant less cost incurred on weedicides under happy seeder sown wheat (Rs. 2275/-) as compared to incorporation (Rs. 3825/-) and Conventional practice (Rs. 3875/-).

There was saving of atleast 1 irrigation under happy seeder sown wheat resulting lesser labour cost and saving water in comparison to the two methods. The overall comparision for total input cost shows that lesser amount Rs. 22013 were spent on wheat sown under happy seeder then incorporation (Rs. 33313/-) and conventional practice (Rs. 26838/-). Thus apart from burning happy seeder technique was able to save Rs. 11300/- as compared to incorporation and Rs. 4825/- then conventional means of sowing. The highest incremental B:C ratio was found to be 4.5 under happy seeder sown wheat then incorporation (3.0) and conventional practice (3.6). These results are in-line with the findings of Naresh et al. (2013) and, Dhillon GS (2016).

Table1: Operation wise cost incurred on happy seeder v/s incorporation and conventional methods of wheat sowing

Sr. no.	Parameters	Cost incurred (Rs/ ha)		
		Happy seeder	Incorporation	Conventional
Input cost				
1.	Management of loose paddy straw	750	4500	750
2.	Field preparation (Tillage)	NIL	7000	4500
3.	Sowing	3750	3000	3000
4.	Seed cost+ treatment	3900	3150	3150
5.	Weedicide used	2275	3825	3875
6.	Fertilizers used	5625	5625	5625
7.	Irrigation	750	1125	1125
8.	Insect pest management	1962.5	2087.5	1812.5
9.	Harvesting with combine	3000	3000	3000
Total cost incurred		22013	33313	26838
Gross return (crop yield + straw yield)		99384	101202	95546
Net returns		77371	67889	68708
BC Ratio		4.5	3.0	3.6

3.2 Comparative Analysis of Various Crop Parameters Under Different Methods of Wheat Sowing

The data presented in Table 2 shows the comparision of weed count, percentage lodging, grain quality, grain and straw yield under happy seeder, incorporation and conventional methods of wheat sowing. The observation recorded on 50 locations clearly shows that due to straw retension on the surface under happy seeder technique there was reduction of 50-65% of weed flora especially the obnoxious Phalaris minor in the wheat crop. These findings are in accordance with (Singh et. al 2013). It was also observed that the water requirement for wheat crop sown under happy seeder was lesser (175.8 mm) then the others two means. The per centage lodging of mature wheat crop was significantly lower then the incorporation and conventional means of sowing. It was also observed that happy seeder sown what had taken 7-10 days more towards maturity as compared to other two methods resulting in more grain weight due bolder size. As far as the grain and straw yield are concerned they were found to comparable.

Table 2: Comparative observation recorded on crop paratmeters under happy seeder v/s incorporation and conventional methods of wheat sowing

Sr. no.	Parameters	Methods of wheat sowing		
		Happy seeder	Incorporation	Conventional
1.	Weed count per sq meter	22.9	53.8	54.8
2.	Water requirement (mm)	175.8	245.0	280.0
3.	Percentage lodging	5-7	12-15	15-25
4.	Days to maturity	165	158	155
5.	Grain quality (1000 grain wt.)	45	43	41
6.	Grain yield (q/ ha)	49.3	50.1	47.3
7.	Straw yield (q/ha)	31.02	30.06	28.38

4. CONCLUSIONS

From the overall results discussed in the paper it can be concluded that happy seeder technology is a viable alternative to on field paddy residue burning without compromising with yield. Rather this technology is becoming efficient method to

reduce cost of production, in-situ management of residue as mulch for conserving moisture, reduced weedicide load and compatibility with the environment. However, the long-term impacts of this technology on soil flora & fauna, natural resources (land and water), role of opinion leaders in rapid diffusion of technology and its contribution towards poverty alleviation need to be explored further.

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