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Evaluation of Turbo Happy Seeder for Sowing of Wheat in Standing Rice Stubbles

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ABSTRACT:

With the increasement in the uses of combine harvester in rice field, a stubble was left in the field. To get free from these stubble from the field before wheat sowing, farmer start burning. With the burning of these stubble, a problem of air pollution was arising and knowingly or unknowingly farmers are damaging soil properties by decreasing a farmer friendly microorganism. Similar scenario was seen in in Punjab, Haryana and Uttar Pradesh state of India promoting environmental pollution, causing soil moisture losses and damaging soil characteristics and addition in greenhouse gas. With an objective of addressing above problems an Indian based land Force Company made 4-wheel tractor (55 hp) driven turbo happy seeder (NRs.3,00,000/-) had been procured and tested at Agriculture Implement Research Station, Madesh Pradesh, Ranighat, Parsa in about 0.1 ha. Different data and studied were done on stubble parameter as well as on soil along with performance evaluation of machine. The turbo happy seeder is similar to zero tillage machine with a difference in advancement that it slices/ cuts standing stubbles height from 40-60 cm. This climate smart technology used to sow wheat seed without burning rice stubble and save water during sowing in no till condition of land. The sliced stubbles act as moisture conservation, saves seed from birds and reduces weed growth. There is slight increment of organic content, PH value, increase in percentage of nitrogen, K2O & P2O5 of the soil. Its performance was found satisfactory with field capacity of 0.43 ha /hr and fuel consumption of 4.3 lit./hr. at 540 rpm (PTO) with coverage width of 1.2m. This machine slices stubble well when the stubbles moisture is very low.

Keywords: Mechanization, Stubble, Turbo Happy Seeder, combine harvester, Burning Issues

Introduction:

Rice-wheat cropping system (RWCS) is the common practiced system in the Nepal which covers about 0.5 million ha of land and has share of about 65.8% and 72.1% of total area and total production of cereal crops [1]. The economy of any country can be changed by adopting mechanization in agriculture. The level of mechanization had been increased in our country over a period of time. Under Ministry of Agricultural Development of Nepal, agriculture and livestock farms import and experiment with modern farm equipment found from the study of [2]. The Agriculture Implement Research Station (AIRS) is mandated to generate agricultural machinery technologies suitable for terai region. This station has been engaged in reducing production cost and increasing production of rice, wheat, maize, potato, sugarcane and legumes through the introduction of machinery-based resource conserving technologies as well as climate smart technologies since last 25 years stated in [3].

With the mechanization in agriculture in terai region of Nepal, the harvesting of rice and wheat in Bara, Parsa, Rautahat, Rupandehi, Chitwan etc. is now done using reaper and combine harvesters. Due to labour shortage the farmers are unable to withdraw straw of rice and wheat from the field harvested and left by the combine harvester studied by [4]. As a result, the farmers are burning their crop residue in the field similar to as done in Punjab, Haryana, Uttar Pradesh of India causing reduction of soil moisture content which is not favorable for resource conservation practices and also causing environmental pollution which is not good for health. The burning of crop residue is growing day by day and there is deterioration of soil characteristics i.e., activity of microorganism in the soil which enhances soil nutrients. On the other hand, there is scarcity of fodder for cattle due to burning and hence affecting the dairy farming also. There is reduction in adoption area of Resource Conservation Technologies last year due to burning of crop residues. Thus, there is no proper management of crop residues in the farmers' field these days and hence, these sorts of residue burning problems by testing and evaluation of happy seeder.

In terai region, Rice-wheat cropping pattern is main and sowing of wheat depend upon the ways of rice harvesting techniques and continued by the land preparation in time which is shown by [5]. In Terai region late sowing of wheat provides shrunken wheat grains as hot air blown in March/ April due to a short period of growth and maturity time for wheat stated in [6]. Due to this reason farmer burn rice residue in the field as there is only 10-15 days gap before sowing of wheat. 5.5 kg Nitrogen, 25 kg K2O, 2.3 kg P2O5, 1.2 kg S, 50-70% of micronutrients along with 400 kg Carbon contain in about 1 ton of rice residue and can be beneficial for wheat crop where their shortage of fertilizer. When burning the stubble wastage of these micronutrients and it reduces the soil health led to additional addition of artificial fertilizer stated by [7]. Rice stubble has been a serious issue in Madesh Pradesh of Nepal due to use of combine and reaper which cuts paddy 15-20 cm above the ground and huge quantity of residues are left in the field [8]. Figure 1 represents the burning of rice stubble by farmers thinking as the solution of straw management. But burning of rice stubble causes environmental hazards and degrades soil fertility as well destroys the microbial activity in the soil [8].

Figure 1. Burning of rice stubble in paddy field

Methodology:

Site Location and Turbo Happy Seeder details:

The Turbo Happy Seeder, a climate smart technique for sowing wheat in paddy fields without burning rice stubble, was purchased and evaluated at Agriculture Implement Research Centre, Birgunj, Parsa which is situated at 27º1'22" North latitude and 85º52'40" East longitude having average annual precipitation is about 1550 mm. The soil type of the experimental field was silty loam. The average bulk density is 1.3 kg/cc, and the average moisture content was found 25.37 % (db). The detailed specification of the used Turbo happy seeder is presented in the Table 1.

Table 1: Detailed Technical specifications of 4-Wheel Tractor Driven Turbo happy seeder Machine

S.N.	Particulars	Specification
1.	Horse Power Requirement, hp	55 hp tractor with double clutch
2.	Weight of machine, kg	760
3.	Working width of machine, mm	2200
4.	Row to row distance, mm	22
5.	No. of rows	9
6.	Type of Furrow openers	Inverted “T” type
7.	Fertilizer Mechanism	Fluted rollers
8.	Seed Mechanism	Fluted rollers
9.	Rotor diameter, mm	140
10.	Ground clearance of furrow opener, m	0.30 with working PTO
11.	Rotor speed, rpm	1360 at 540 rpm of tractor PTO
12.	Types of flail blades	Reversible straight gamma type
13.	Flails length from rotor surface, mm	240
14.	Blade length, mm	165
15.	Bottom width of blade, mm	85
16.	Top width of blade, mm	50
17.	Blade Overlap with furrow openers, mm	60
18.	Horizontal clearance between the edges of the blades, mm	75
19.	No. of Depth wheels	Two nos. with adjustable depths
20.	Minimum Diameter of Ground Wheel, mm	550
21.	No. of lugs on periphery of GW	15 (with sharp and long edges)

Field performance evaluation:

The field tests were performed for three fiscal years on-station viz. 2017/2018, 2018/19 & 2019/20. The machine was mounted with 55hp tractor with power and transmission points (P-and T- connections) and run at the speed of 2.8 km/hr in the chosen low third gear. After obtaining a steady state speed condition, test run was followed. At the end of the test run, observations were recorded for the time taken to cover the test run and fuel consumed respectively. The several parameters were considered to evaluate the performance of the Turbo Happy Seeder, a climate smart machine designed for no-tillage farming. Theoretical field capacity, field efficiency, fuel consumption and cost of operation were evaluated. Additionally, this study analysed the total cost of operating the Turbo Happy Seeder to understand its economic benefits after its usage.

Performance Parameters:

Theoretical Field Capacity (TFC): The theoretical field capacity was calculated to determine the rate of field coverage achieved by the Turbo Happy Seeder The theoretical field capacity was calculated using equation (1),

TFC (ha/hr) = (W × S) / 10 … (1) [9]

where, W = Width of the machine (m) and S = Forward Speed (km/hr)

Effective Field Capacity (EFC): The actual rate covered by the machine based on the total field time is Effective Field Capacity which can be calculated using equation (2),

EFC (ha/hr) = (A/T) × TFC … (2) [9]

where, A = Area covered (ha) and T = Total time taken (hr)

Field Efficiency (FE): Field efficiency can be calculated using equation (3) which is the ratio of effective field capacity to theoretical field capacity.

FE = (EFC / TFC) × 100 … (3) [9]

Fuel Consumption: The topping method was used to calculate fuel consumption where fuel tank was filled full before and after the operation. The volume to refill the full tank was recorded as the fuel consumption.

Results

Wheat (variety-Tilotoma) sown with the Turbo happy seeder into the soil after rice harvesting with a cutting stubble height 40 to 60 cm and germination of wheat after 15 days is shown in Figure 2. During field operation the stubble parameters were observed which is shown in Table 3. Actual field capacity, theoretical field capacity, effective field capacity, and field efficiency was found to be 0.43 ha/hr, 0.50 ha/hr , 0.22 ha/hr and 42.86%, respectively as presented in Table 2. The result findings were similar to the study done by [10].

Figure 2. Field Testing of Turbo Happy Seeder at On-station

Table 2. Theoretical Field Capacity, Effective Field Capacity and Field Efficiency of Turbo Happy Seeder

SN	Particulars	Values
1	Working width, m	1.8
2	Forward Speed, km/hr	2.8
3	Area, ha	0.6
4	Time taken, hr	1.4
5	Actual Field Capacity(A/T), ha./hr.	0.43
6	Theoretical Field Capacity (TFC), ha./hr.	0.50
7	Effective Field Capacity (EFC), ha./hr.	0.22
8	Field Efficiency (FE),%	42.86
9	Fuel Consumption, l/hr	4.3

Table 3. Rice Stubble parameter

SN	Parameter	Values (cm)
1	Stubble length	40-60
2	Row-row Distance	20
3	Stubble -stubble distance	20

Figure 3. shows that Turbo Happy Seeder produced more tillers (265) compared to farmers, practice (243). [11] reported that maximum tillers were recorded in Turbo Happy Seeder. This might be due to better nutrient uptake from Turbo Happy Seeder field and thus resulting higher number of tillers. The data presented in Figure 3 depicts that maximum grain yield of 2862 kg/ha was produced when wheat was sown maintain row to row distance of 20cm.

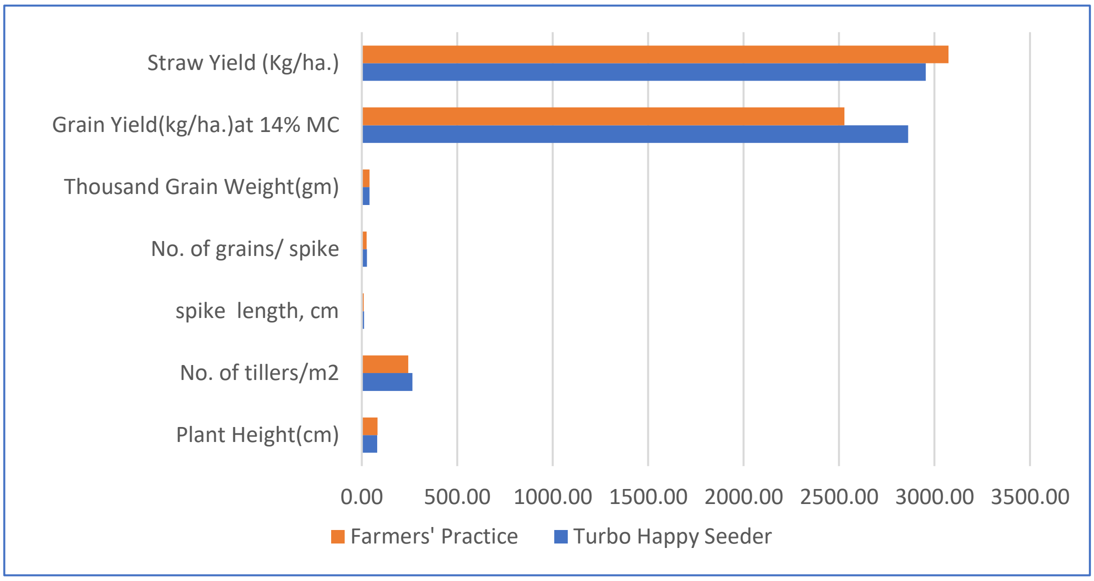

Figure 3. Graph Sowing Different Crop Parameters

Table 5 illustrates the detailed calculation for cost analysis of Turbo happy Seeder. The total cost of operation was calculated by adding the operation cost of the tractor to the operation cost of the Happy Seeder, resulting in Rs. 1240.3/hr. The total cost of sowing wheat with the Turbo Happy Seeder was calculated to be Rs. 3200 per hectare.

Table 5. Cost Analysis of Turbo happy Seeder

SN	Particulars	Values
1	Purchasing cost of Turbo happy Seeder, NRs. (P)	300000
2	Annual use of Turbo happy Seeder, hrs	250
3	Life of the Turbo happy Seeder, Year (L)	10
4	Salvage value of Turbo happy Seeder, NRs. (S)	30000
5	Annual Overhead Cost for Turbo happy Seeder	
6	Fixed costs:	
	Total fixed annual costs (NRs/year)	58575
	Hourly fixed cost (NRs/hr)	234.3
7	Variable Cost (NRs/hr)	6
8	Total operating cost for Turbo happy Seeder (NRs/hr)	240.3
9	Hiring charge for tractor	1000
10	Total operating costs (NRs/hr)	1240.3
11	Sowing cost for Turbo happy Seeder, NRs./ha	3199.19 $\approx$ 3200

Conclusion And Recommendation

Turbo Happy seeder is a good option for farmers adopting rice-wheat cropping pattern, as it ensures in timely sowing of wheat. In conclusion, this study addresses the challenges of rice stubble burning issues. The results demonstrated the Turbo Happy Seeder's is viable and climate smart technology which can be alternative to the farmers' method for wheat sowing. Overall, the study's findings highlight the Turbo Happy Seeder's role in mitigating environmental hazards (burning issue), improving soil healthiness, and thereby contributing to the. Adopting the Turbo Happy Seeder can be the long-term residue management and resource conservation technology The technology seemed to be fruitful to overcome the residue burning issues of the country.

References:

[1] S. Lamsal, and R. Khadka, "Rice Wheat Cropping System in Nepal: Issues Concerning Sustainability," International Journal of Environment, Agriculture and Biotechnology, vol. 4, pp. 1913-1922, 12/30, 2019.

[2] M. Jha, S. Jha, G. Bhandari, and S. Shrestha, Evaluation of Rice Harvesting Practices at Parsa District in Nepal, 2022.

[3] Annual Report, Agricultural Implements Research center, Nepal Agricultural Research Council, Ranighat, Parsa, Nepal., 2012/2013.

[4] S. Shrestha, "An overview of agricultural mechanization in Nepal," Kathmandu University Journal of Science Engineering and Technology, vol. 16, pp. 7, 12/01, 2022.

[5] Annual Report Agricultural Implements Research center, Nepal Agricultural Research Council, Ranighat, Parsa, Nepal, 2017/2018.

[6] M. Sah, P. Shah, R. Yadav, A. Shrestha, B. Yadav, and A. Mishra, Evaluation of Various Sowing Dates on Wheat Cultivars in the Central Terai Region, 2023.

[7] A. Arigela, "Super Seeder -An Alternate for Crop Residue Management," pp. 3, 03/01, 2023.

[8] P. Pandey, K. Adhikari, J. Gairhe, B. Adhikari, R. Shrestha, and D. Khanal, "Rice Straw Management Practices in Rupandehi District, Nepal," Journal of the Institute of Agriculture and Animal Science, pp. 82-90, 08/25, 2023.

[9] H. S. Sidhu, M. Singh, Y. Singh, J. Blackwell, S. K. Lohan, E. Humphreys, M. L. Jat, V. Singh, and S. Singh, "Development and evaluation of the Turbo Happy Seeder for sowing wheat into heavy rice residues in NW India," Field Crops Research, vol. 184, pp. 201-212, 2015/12/01/, 2015.

[10] V. Mishra, Patel, S. Singh, and R. Rawat, "Performance evaluation of turbo happy seeder: A review," vol. 11, pp. 1390-1395, 01/01, 2022.

[11] M. F. Iqbal, M. Hussain, N. Faisal, J. Iqbal, A. Rehman, M. Ahmed, and J. Padyar, Happy seeder zero tillage equipment for sowing of wheat in standing rice stubbles, 2017.