

IMPACT OF ZERO-TILLAGE TECHNOLOGY : AN OVERVIEW

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ABSTRACT

The Zero-tillage technology is economic, time saving, increase fertilizer use efficiency and acceptable to the farmers of district Maharajganj of U.P. Good performance of wheat crop sown with Zero-tillage during Rabi 2001-2002 and 2002-2003 in the district Maharajganj of Uttar Pradesh resulted in positive attitude of farmers as well as field functionaries toward this technology. The finding have clearly established that wheat sowing can be advanced at least 10-12 days over conventional tillage (broadcasting method), enabling to harvest an advantage that can not be obtained by using varieties recommended for late sown condition. The critical examination of field observation revealed that the technology has merit for promotion and technical feasibility with an opportunity for providing self-employment through custom hiring services. Subject to further investigation on long term impact of the technology on soil health and productivity of the system, it definitely provides answer for economic security in future specially with multifarious use of the machine in the district Maharajganj of U.P. and also opening new vistas for resource conservation whether fuel, crop residues, seed, water, fertilizer, manpower or wear and tear of machinery are concerned. The results have also shown an increase in productivity of the wheat ranging from 0.8 to 3.00 q/ha. In addition to that saving in fuel consumption to the tune of 26.25 to 43.75 litres/ha, economizing cost of seed and its seeding up to 33% and 10 to 40%, less irrigation water requirement over conventional practices. Thus, the overall net profitability gain of worth Rs 3215.00 per ha in 2001-02 and Rs 3350.00/ha in 2002-03, appears good attraction for the farmers to adopt the technology on large scale.

Keywords : Zero-Tillage Technology, Conventional Tillage

INTRODUCTION :

The rice-wheat cropping system occupies 12 million hectares of land in the Indo-Gangatic Plains comprising of the state of Punjab, Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, Delhi and parts of Uttaranchal and contributes to over 80 percent of total food grain production in the country. The rice-wheat system gained prominence in the country only during post green revolution period. Changes in the Varietal scenario supported by area expansion under irrigation and increased use of agro-chemicals resulted in a massive shift in cropping pattern in the district Maharajganj of Uttar Pradesh and ultimately into growth of the system in terms of area, production and productivity.

Need of Zero-Tillage—The rice-wheat sequence is not only widely acceptable crop rotation of the division of Gorakhpur, but also considered to be an important production system in the region. About 29 lakh hectares of land is occupied under the sequence in the eastern region of Indo-Gangatic plains. The productivity of the system is stagnating or even in few years showing a downward trend mainly because of the delayed sowing of wheat after harvest of rice on one hand and due to certain typical agro-ecological situations of cultivation on other. The varieties especially of rice cultivated by the farmers of district Maharajganj and Uttar Pradesh are of different nature and duration ranging from 115 to 160 days depending upon the various micro-farming situations. Delay in rice transplanting affects the sowing

of succeeding wheat crop adversely. Under prevailing situation the production and productivity can get boost to a considerable extent besides cutting down the expenditure on land preparation by adopting the low cost technology like Zero-tillage. Time lines of farm operations play vital role in crop production. In order to harvest optimum yield, it is recommended that wheat crop must be sown up to end of November. It is concluded that delayed sowing i.e. after 30th November, drastically reduces the yield to the tune of 40-45 kg/ha per day. The late crop sown is more prone to be adversely affected by hot westerly wind causing forced maturity. This is a phenomenon most common in eastern Uttar Pradesh. It is pertinent to mention that approximately 40-45 percent area is sown timely. Thus, major area is sown in the month of December and even some times in first week of January, which results in considerable, yield reduction in wheat. Some of the important reasons for delayed sowing of wheat are most of the area of rice cultivation is under water logging condition resulting wetness of the soil for longer duration extending up to December. Rains at the time of the wheat sowing and multiplicity of tillage operations for making the soil workable vis-à-vis to incorporate rice residues in the fields are also responsible for delay in wheat crop establishment. It is, thus, apparent that the time available for wheat seed-bed preparation is very limited. The total turn around time available between the rice harvest and timely sowing of wheat is only 15-20 days, under the circumstances of

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conventional method (broad casting methods) of wheat sowing, which varies from 3-5 ploughing /harrowing would further delay the sowing resulting into loss of yield. This time gap needs to be shortened to obtain the advantage of early crop establishment.

The Zero-tillage technology that performs the opening of furrow, placement of fertilizer and seed sowing in one go, offers such an opportunity. Different tillage and crop establishment practices suitable for rice-wheat cropping system, is available which could help to improve the system sustainability and productivity. However, our experience by conducting demonstration on 106.00 ha land in villages of the district Maharajganj (U.P.) on the innovative technology of the Zero-tillage in the farmers participatory mode, shows that wheat sowing can be advanced about 10-15 days over conventional method fetching net saving of resources worth Rs 3250/- per hectare. In number of cases, yield advantage in the range of 0.80 to 3.00 q/ha have also been obtained as a result of fertilizer placement and prevention of crop from lodging. The conservation of fuel during land preparation, saving in seeds and it's seeding, water requirement and weed management have shown positive change in attitude of farmers and field functionaries towards this technology. The data obtained indicate scope for paradigm shift from conventional tillage, yield enhancement with promoted merit and opportunity for custom hiring services providing gainful self-employment.

METHODOLOGY:

Zero-tillage technology based wheat cultivation expanding with an emphasis for making its production more profitable in the new millennium, the Indian Council of Agricultural Research launched a challenging project entitled "Accelerating the Adoption of Resource Conservation Technology (RCT) for Farm Level Impact on sustainability of Rice-wheat systems of the "Indo Gangetic Plains" under NATP since Rabi 2001-02.

Based on Rice-wheat cropping system and other important factors like soil type and existing irrigation sources in all, 22 villages falling in the district Maharajganj of U.P. were selected and various factors were studied for the purpose. The opinion of field functionaries of line departments was given due consideration in selection of sites and villages as and when required.

The Zero-tillage machine were arranged and supply by CIMMYT and CIAE, Bhopal under collaborative approach of NDUA & T, Faizabad, U.P. to the Remandated ZARS-KVK, Basuli, Maharajganj. UP. Thus, remandated ZARS-KVK, Basuli, Maharajganj, U.P. has

made a good beginning to introduce the Zero-tillage technology on farmers field of the district. The details of area covered under Zero-tillage technology in the district Maharajganj, U.P. are given in the table-1.

Table 1. Area under Zero-tillage technology during rabi season

Agro-climatic Zone:- NEPZ, Situation:- Irrigated

S.N.	Year	No of adopted villages	Wheat area sown under Zero-tillage (ha)
1.	Rabi 2001-2002	9	12.9
2.	Rabi 2002-2003	14	53.1

RESULTS AND DISCUSSION :

(1) **Economic gains in zero-tillage**—The Zero-tillage technology is not only remunerative but also eco-friendly. Table 2 shows that it envisages 100 percent saving in land preparation as wheat sowing is done just after harvesting of preceding rice crop without any ploughing of the field. Thus in Zero-tillage the soil is left undisturbed from harvest of rice to sowing of wheat. Diagnostic survey of farmer's practices in wheat cultivation clearly brought out that farmers generally do 3-5 ploughing/harrowing. Considering the existing practices, it has been estimated that there is on an average two litre per hectare of diesel saving when sowing was done by Zero till seed-cum-ferti drill machine in both the year.

Initially farmers were reluctant to sow wheat without land preparation. They were anticipating poor seed germination and crop stand but after seeing the encouraging performance of Zero-tillage wheat they were fully convinced with the technology.

Table 2. Economic gains in Zero-tillage (ZT) over conventional tillage (CT)

S. N.	Particulars	Year	
		Rabi 2001-2002	Rabi 2002-2003
1.	Area (ha)	12.9	53.1
2.	Participatory farmers	9	14
3.	Cost of field preparation under ZT (Rs/ha)	-	-
4.	Cost of field preparation under CT (Rs/ha)	1900	1875
5.	Saving in diesel in field preparation under ZT (lit/ha)	36	38
6.	Saving in diesel in sowing of wheat under ZT (lit/ha)	5	6
7.	Saving in seed (Kg/ha)	45	50
8.	Saving in seed cost and its seedings(Rs/ha)	540	600
9.	Cost of irrigation in CT(Rs/ha)	1600	1600
10.	Cost of irrigation in ZT(Rs/ha)	1325	1395
11.	Saving over CT in inputs (Rs/ha)	2715	2680
12.	Average yield in ZT (q/ha)	33.00	45.63
13.	Average yield in CT (q/ha)	32.00	44.29
14.	Additional yield over CT (q/ha)	1.00	1.34
15.	Additional gain in yield (Rs/ha) *	500.00	670.00
16.	Total profitability gain over CT (Rs/ha) (11+15)	3215.00	3350.00

* Cost of grain yield has been estimated at prevailing market rate i.e. Rs 500.00/q

(2) **Saving in seeds and seeding**—It is apparent from the data recorded in table-2 that there was good saving in seeds i.e. 45 kg/ha in 2001-02 and 50 kg/ha in 2002-03. Similar trend was also observed in saving of seed cost and it's seeding which amount Rs 540.00 in 2001-02 and Rs 600.00 in 2002-03 per hectare.

(3) **Saving in irrigation**—Table 2 also shows that the zero-tillage allows 38% saving in water in the first irrigation followed by 34% in second and 25.00 % in third irrigation. It indicates an ample saving in irrigation water. The advantage may be further enhanced when sowing is done early i.e. just after harvesting of rice crop on residual moisture. This will have much beneficial advantage in terms of water saving specially in our operational area of district Maharajganj of U.P. where sowing can be done on available residual moisture immediate after harvesting of preceding rice crop.

In the areas with the problem of water stagnation, tillth is attained after several days rice harvest. Besides, other advantage, saving in number of irrigation vis-à-vis time for conceiving one irrigation is inevitable in Zero-tillage as compare to conventional tillage.

(4) **Overall economic gains**—The over all picture of profitability gains ranges from Rs. 2050.00/- to Rs 4175.00 per hectare due to adoption of Zero-technology depending upon the soil type and micro-farming situation. Thus, it clearly reveals that the technology is not only economical but also fully technologically feasible and viable in the district Maharajganj of Uttar Pradesh where rice-wheat cropping system is widely adopted by resource rich and reasonable poor farmers.

- The farmers and field functionaries of line

department were positive in their attitude about this technology.

- Farmers felt that the technology is acceptable being simple and economical.
- Seed and fertilizer tubes need clamping to avoid detachment during operation.

(5) **Advantage in wheat seeding**—The results of nine(9) trials in Rabi 2001-02 and fourteen (14) trials in Rabi 2002-03 conducted in district Maharajganj of U.P. showed that under Zero-tillage about 10-15 days early sowing of wheat is possible over conventional method of sowing (broad casting and mixing of seed in soil by one cross ploughing after field preparation). It is conspicuous from the participatory data recorded in table-4 that there is an increase of 3.00 q/ha yield over conventional method when sowing was done during November (timely). Similarly, an additional yield of 2.00q/ha was recorded when sowing was done in December (late sown condition).

(6) **Effect of zero-tillage technology on intensity of *Phalaris minor***—Study reveals that *phalaris minor* in wheat has become a serious problem-reducing yield considerably. Continuous use of isoproturon for its control has resulted in to development of herbicidal resistance in state like Haryana. Thus, creating serious threat to wheat productivity.

The population of *Phalaris minor* was recorded less in Zero-tillage plot. Non disturbed soil condition did not provide favourable conditions to seed buried in soil to emerge. Though the number of *Phalaris minor* per unit area in ZT and CT varied from location to location but the most of the cases number was reduced considerably.

Table 3. Effect of sowing time on *Phalaris minor* intensity and yield of wheat in district Maharajganj, U.P.

Village	Sowing date		Advancement in days over CT	P. minor intensity (sq-m)		Yield (q/ha)		Increase in yield over CT (q/ha)
	ZT	CT		ZT	CT	ZT	CT	
(1) Bani	10-Nov-02	17-Nov-02	7 days	12	34	52	49	3.00
(2) Barwadwarika	13-Nov-02	18-Nov-02	5 days	15	36	55	53.2	1.80
(1) Kaulahin	22-Nov-02	30-Nov-02	8 days	18	33	44	42.1	1.90
(2) Belava	22-Nov-02	30-Nov-02	8 days	34	46	42	41.1	0.90
(3) Belava	15-Nov-02	24-Nov-02	9 days	28	40	30	30	-
(1) Khurd Babhanauli	28-Nov-02	10-Dec-02	12 days	32	49	42	41.1	0.80
(2) Khurd Babhanauli	06-Dec-02	17-Dec-02	11 days	31	52	42	40	2.00

It may further be pointed out that the population of *Phalaris minor* in timely sow plot was recorded about 45 percent lesser than late sown condition. However, 34 percent *Phalaris minor* intensity have been found less in ZT as compare to conventional tillage technology.

(7) **Yield Gains**—It may be highlighted that 0.80 to 3.00 q ha⁻¹ more yield of wheat gain was found in Zero-tillage plots as compare to conventional tillage plots.

CONCLUSION :

The results have also shown an increase in

productivity of the wheat ranging from 0.8 to 3.00 q/ha. In addition to that saving in fuel consumption to the time of 26.25 to 43.75 litres/ha, economizing cost of seed and it's seeding up to 33% and 10 to 40%, less irrigation water requirement over conventional practices. Thus, the overall net profitability gain of worth Rs 3215.00 per ha in 2001-02 and Rs 3350.00/ha in 2002-03, appears good attraction for the farmers to adopt the technology on large scale.

