Contribution of Conservation Agriculture for Wheat Productivity Improvement in Eastern Indo-gangetic Plains of India

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Background

Indo-Gangetic Plains (IGP) of South Asia characterized as small and fragmented farm holding, poor input and output marketing infrastructure, poor access to new technologies and frequent climatic aberration (floods, drought and temperature), shorter wheat growing season compared to Western IGP. Ever increasing input, energy and labour cost , poor access to mechanization and knowledge, forced farmers to opt sub-optimal crop management practice which leads less crop yield and farm profit. In recent years, the impact of climate change also affecting smallholder production system in the region. The traditional method of wheat planting in eastern IGP is 2-3 tillage operations followed by broadcasting of wheat seed and again mixing the seed by tillage operation. Temporary water stagnation in conventional tilled plots due to un-even topography leads to yellowing of wheat crop after first irrigation is a common problem causes less tillers and declined the crop yield.

Material and methods

Since the year 2000, the state agriculture universities, ICAR, CGIAR institutes and several NGO were promoting the conservation agriculture practices especially DSR in Rice and zero tillage in wheat.

Large number of demonstrations were conducted in rice-wheat cropping systems mainly focused on

1. Early planting of long-duration rice varieties or medium duration rice varieties to early vacate the field which facilitate in timely planting of wheat.
2. Direct seeding of rice which matures one week earlier than the transplanted rice.
3. Inclusion of zero-tillage planting of wheat which facilitate in early planting in high soil moisture and save the time required for tillage preparations.

- Long duration rice varieties (140-155 days) planted in first week of June and medium duration varieties (130-140 days) planted last fortnight of June under direct seeding with Seed rate of 10 kg per hectare.
- Same duration varieties used for transplanting ensuring the harvesting of rice before November 15. Wheat planting was shifted earlier November 1-30 with Zero till machine using 100 kg seed per hectare.

Results

- Introduction of ZT changes the mindsets of the farmers, which leads to shifting the farmers from several tillage operation (3-4 tillage) to no tillage or reduced tillage (one tillage), broad casting to line sowing with ZT drill and reduced crop residue burning.
- Bihar significantly increased the wheat productivity from 1.75 t/ha in 2004 to 2.99 t/ha in 2019 and the Bihar state received national level award (Krishi Karman Award) two times for improving the wheat productivity in 2012-13 and 2017-18.
- A diagnostic survey of farmers from different districts of Bihar showed that ZT increased 20-25% wheat productivity. ZT saves 7-10 days required for tillage operation and facilitate the early plating of wheat. On an average ZT saves USD 50-60/ha tillage cost, 25-30% irrigation water (during first irrigation), 40-50 L/ha fuel and 6-8 labor hours/ha.

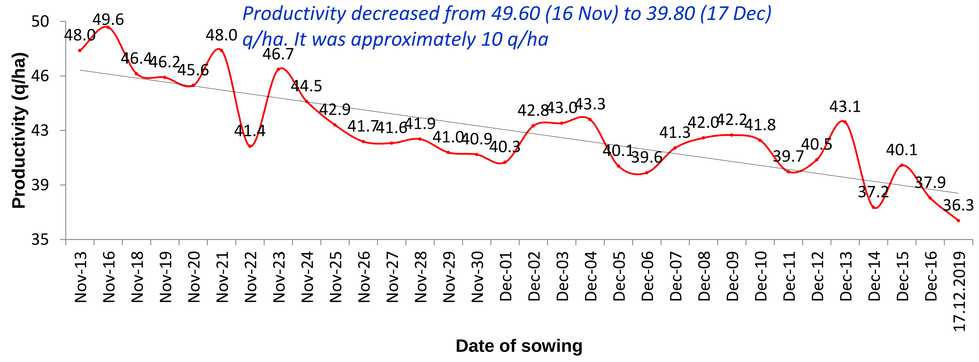

Figure 1 Impact of early sowing on wheat productivity

Variety	Name of Technology	Area (ha)	Average Productivity (t/ha)		% increase in yield	Net return (USD/ha)		B:C Ratio	
			Improved Practice	Farmers practice		Improved Practice	Farmers practice	Improved Practice	Farmers practice
HD-2967	ZT /HS	138	5.49	4.24	29.48	1056	677.7	3.14	2.31
HD-2733	ZT /HS	14	4.457	3.75	18.77	764.6	539.5	2.55	2.04
DBW-187	ZT /HS	2.8	5.94	4.18	42.11	1169	660.8	3.4	2.27
DBW-107	ZT /HS	3.2	4.732	3.62	30.71	842.2	502.8	2.7	1.96

(Note: ZT=Zero tillage, HS= Happy seeder, B:C= Benefit cost ratio)

Figure 2 Productivity and economics of rice under CA in rice-wheat system

➢ Timely planting of improved wheat varieties with ZT and Happy seeder increased the wheat productivity by 18 to 42% as compared to farmers practice

Variety	Name of Technology	Area (ha)	Yield (t/ha)		% increase in yield	Net return		B:C Ratio	
			Improved Practice	Farmers Practice		Improved Practice	Farmers Practice	Improved Practice	Farmers Practice
Variety 27P-31	DSR	57.4	6.20	4.72	31.4	1153	724	2.29	2.35
Arise 6444	DSR	22.4	6.80	4.95	37.4	1297	774	3.50	2.41
PHB-71	DSR	1.6	6.15	4.60	33.7	1130	673	3.20	2.21
R.Bhagwati	DSR	7.6	5.20	4.15	25.3	881	604	2.89	2.13
Kranti	Transplanted	2.8	5.83	4.32	15.1	1067	621	3.10	2.16
R.Sweta	Transplanted	3.0	5.25	4.36	20.4	913	651	2.86	2.27
Sahbhagi	Transplanted	4.0	4.55	3.70	23.0	739	477	2.55	1.94
Swarna sub-1	DSR	2.4	5.06	4.31	17.4	856	626	2.73	2.19
Sugandha-5	Transplanted	2.0	4.28	3.83	11.8	664	495	2.38	1.94
Sabour Ardhjal	DSR	2.0	4.75	3.80	25.0	794	50	2.67	1.97

Figure 3: Productivity and profitability of timely long and medium duration rice varieties as compared to farmers practice.

➢ Timely planting of long-duration and medium duration rice varieties under DSR increased the productivity by 25 to 33.7% and under transplanting by 11 to 23% .

Conclusions

- Facilitating of early planting of wheat by early planting of long duration rice varieties, use of medium duration rice varieties, DSR helped in avoiding the terminal heat and improved the productivity of wheat
- Zero tillage in wheat and improved wheat variety along with early seeding significantly improved the wheat productivity up-to 42% yield gain over farmers practices.
- Timely planting of DSR with suitable duration rice varieties increase the rice productivity by 34%