Conservation Agriculture Technologies Increase Production and Productivity of Cereal Based Farming System in Eastern Plains of Nepal

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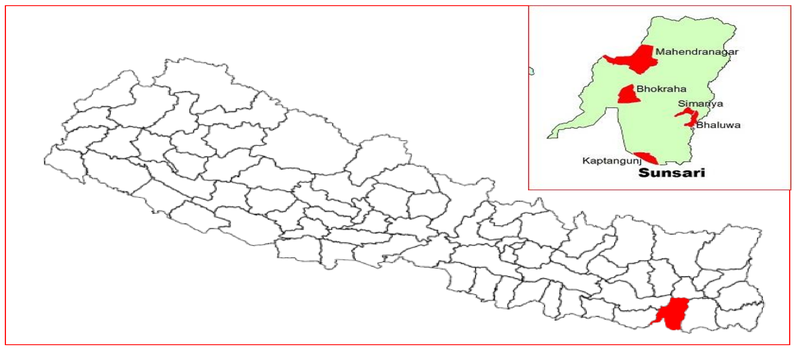
Introduction:

Indo Gangetic Plains (IGP) is a vast area of fertile land with about 255 million hectares across India, Pakistan, Nepal, and Bangladesh. The productivity of rice-wheat farming system is low (6.2 tons/ha) as compared with Western (W) IGP (10 tons/ha) (SRFSI, 2016). The terai and plain areas has a potential to national and regional food security. However the crop productivity is very low, high yield gap, sparse agricultural knowledge and service networks, and lack of sustainable and climate smart agricultural technologies.

The development of integrated resource management strategies is urgently needed for sustainable food production in the region. The Sustainable and Resilient Farming Systems Intensification in the Eastern Gangetic Plains (SRFSI) has been working in responses to concerns about the sustainability of the cereal based farming systems. In Nepal, it has been testing in Sunsari and Dhanusha district.

Methodology:

Fig 1. Map of Nepal Indicating Sunsari district and SRFSI project nodes.



The primary data were collected jointly by the DADO, Sunsari and RARS, Tarahara. More than 150 farmers opting CA in the district. A semi-structured questionnaire was developed to explore the advantages experienced, input costs, management costs, problems with the RCT on cereal based farming system with the 60 farmers of Sunsari district.

Results and Discussions:

Grain yields of Rice, Wheat and Maize

Most of the farmers growing with DSR and UnTPR experienced two to three weeks early harvest. Average grain yield advantage of 5.4% over conventional tillage and manual transplanted rice. Farmers growing with ZTW experienced two weeks early in harvesting of the crop and bold size grain. Maize yield was found highest in UPTPR-ZTM system with grain yield 6.86 tons/ha with harvest index 0.50.

Partial Economics of Rice-Wheat and Rice-Maize farming systems in Sunsari (Long term trials)

The partial economics of long term trials on rice-wheat farming system 2015-16 is shown in Table 2. The CTTPR+ZTW has the highest grain yield 8.19 tons/ha with biomass yield 16.09 tons/ha. The net profit was highest in UPTPR+ZTW treatment NRs. 1, 57,514 per ha with B: C ratio 2.96.
Similarly for rice-maize farming system 2015-16 is shown in Table 3. The UPTPR+ZTM has the highest grain yield 13.1 tons/ha with biomass yield 26.54 tons/ha with net profit of NRs. 2,37,440 per ha with B:C ratio 3.47.

Advantages associated with CA practices

Table 1. Advantages experienced with CA based practices of sampled households in 2015-16 of Sunsari district (n=60)

S.N.	Factors	ZT-Wheat	ZT-Maize	DSR-Rice
1.	Optimum sowing time	58(96.67)	42(70.00)	52(87.00)
2.	Less seeds per unit area	54(90.00)	54(90.00)	57(95.00)
3.	Seed germination high	58(96.67)	55(91.67)	35(58.34)
4.	Crop establishment good	57(95.00)	57(95.00)	30(50.00)
5.	Low weed infestation	54(90.00)	54(90.00)	26(43.44)
6.	Pond time low	60(100.00)	60(100.00)	52(87.00)
7.	Increased irrigation efficiency	60(100.00)	60(100.00)	60(100.00)
8.	Increased fertilizer efficiency	57(95.00)	51(85.00)	47(78.34)
9.	Disesase/Insect infestation low	33(55.00)	37(61.67)	26(43.34)
10.	Days to maturity early	54(90.00)	49(81.67)	60(100.00)
11.	Increase in yield	41(68.34)	32(53.34)	37(61.67)

Extent of Adoption of CA Technologies (CAT)

The number of farmers adopting different CA practice varies from node to node depending upon the socio-economic characteristics and topography of the land. 170 ha in Bhokraha, 100 ha in Kaptanjung, 105 ha in Mahendranagar, 28 ha at Simariya and 22 ha at Duhabi, and 80 ha at adjacent areas in 2016.

Problems associated with the CAT

- Availability of appropriate machineries on time
- Clay attachment in seed and fertilizer drill pipe (in more clayey soil)
- Best application of N fertilizers and weed management.

Steps for Up Scaling of CA Technologies in EIGP, Nepal

- Sensitization of extension agents on CAT
- Establish demonstration plots and mobilization of technicians
- Facilitate the activities through Innovation Platform
- Conduct on farm research to develop novel tools and technologies.
- Conduct farmers' exchange, on-farm and farmer to farmer trainings
- Mobilize farmers cooperatives in cooperative farming with CAT
- Establish custom hiring center to assist a large number of farmers with machineries and agricultural equipments.

Major Inputs used in different farming practices

Fig 2. Quantity of Inputs (Seeds, fertilizers) used in Rice, Wheat and Maize respectively under different cultivation system in Sunsari district 2015-16.

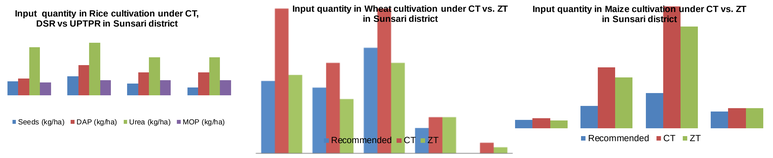


Table 2 : Partial economics of long term trials on Rice-Wheat farming system 2015-16 in Sunsari district of Nepal (n=18)

Treatment	Grain yield	Biomass	Harvest Index	Crop establishment cost	Total variable cost	Gross return	Net profit	Benefit cost ratio	Labor use (person/day /ha)
	tons/ha			NRS/ha					
Aman rice 2015									
CTTPR	6.57	12.89	0.51	26588	47939	144140	96201	3.01	59
ZTDSR	5.61	11.21	0.50	7010	31986	123433	91447	3.86	27
UPTPR	6.69	12.58	0.53	11683	33356	145509	112153	4.36	41
Wheat 2015-16									
CTTPR-CTW	1.51	3.02	0.50	16920	54788	88627	33839	1.62	41
CTTPR-ZTW	1.62	3.2	0.51	7171	46328	93783	47456	2.02	30
ZTDSR-ZTW	1.54	3.21	0.48	7171	46408	94347	47939	2.03	30
UPTPR-ZTW	1.42	3.14	0.45	7171	47053	92414	45361	1.96	30
Rice-Wheat system 2015-16									
CTTPR+CTW	8.08	15.91	0.51	43508	102727	232767	130040	2.27	100
CTTPR+ZTW	8.19	16.09	0.51	33759	94267	237923	143656	2.52	89
ZTDSR+ZTW	7.15	14.42	0.50	14180	78395	217781	139386	2.78	57
UPTPR+ZTW	8.11	15.72	0.52	18853	80409	237923	157514	2.96	71

Table 3: Partial economics of long term trials on Rice-Maize farming system 2015-16 in Sunsari district of Nepal (n=6)

Treatment	Grain yield	Biomass	Harvest Index	Crop establishment cost	Total variable cost	Gross return	Net profit	Benefit cost ratio	Labor use (person/ day/ha)
	tons/ha			NRS/ha					
Aman rice 2015									
CTTPR	5.26	11.35	0.46	17323	39560	117390	77831	2.97	47
ZTDSR	5.2	10.92	0.48	8460	41091	115376	74286	2.81	31
UPTPR	6.24	12.89	0.48	10232	34323	138016	103694	4.02	38
Maize 2015-16									
CTTPR-CTM	6.49	12.78	0.51	16275	66470	168150	101679	2.53	59
CTTPR-ZTM	5.81	12.79	0.45	6123	54868	154614	99746	2.82	35
ZTDSR-ZTM	5.86	12.59	0.47	5882	53982	155017	101035	2.87	34
UPTPR-ZTM	6.86	13.65	0.50	7010	61717	195463	133746	3.17	36
Rice-Maize system 2015-16									
CTTPR+CTM	11.75	24.13	0.49	33598	106030	285540	179510	2.69	106
CTTPR+ZTM	11.07	24.14	0.46	23446	94428	272004	177576	2.88	82
ZTDSR+ZTM	11.06	23.51	0.47	14341	95073	270393	175320	2.84	65
UPTPR+ZTM	13.1	26.54	0.49	17242	96039	333479	237440	3.47	74

Conclusion:

The study confirms that CA based practices in Rice-Wheat and Rice-Maize farming system especially in the EIGP of Nepal can be a potential option for the farmers. It improves the crop productivity, reduces cost of cultivation, increased net benefits, reduces irrigation time for most of the crops and decreases labor use per hectares. Climate adaptation potential is a major benefit which is not discussed here. It may therefore help the EIGP rural poor farmers' adaptation to changing climate and enhancing sustainable intensification of cereal based farming system for food and nutrition security in EIGP of Nepal.

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