



Research Article

DOUBLING THE FARMERS INCOME THROUGH ZERO-TILLAGE TECHNOLOGY AND RESIDUES MANAGEMENT: A CASE STUDY OF WHEAT GROWERS IN BRINGING PRACTICE AND SCIENCE TOGETHER

CHAUDHARY H.C.¹, SINGH A.K.^{*2}, KUMARI R.³, KUMARI A.¹, ADARSH A.¹ SINGH A.K.²

¹ICAR-Krishi Vigyan Kendra, Saraiya, 843126, Dr Rajendra Prasad Central Agricultural University, Pusa, 848125, Bihar, India

²ICAR-Krishi Vigyan Kendra, Pipra Kothi, 845429, Dr Rajendra Prasad Central Agricultural University, Pusa, 848125, Bihar, India

³NCOH, Bihar Agricultural University, Sabour, 813210, Bihar, India

*Corresponding Author: Email - anilraupusa@gmail.com

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Abstract: Zero tillage/No-till (ZT) cropping systems provide an opportunity to protect the soil from erosion and its residue management while contemporaneously maintaining high yields and contributing to food security. The historical aspects and the remarkable development of Zero-till systems in Muzaffarpur district of Bihar are reviewed. The adoption of Zero-till under the resource conservation technology has been a major turning point in reducing the cost of input and minimizes the soil erosion which leads to sustainable crop production in rice wheat cropping system. The process of adoption of Zero-till systems under the resource conservation technology in wheat cultivation is studied for knowing the effect of rice residue management under resource conservation technology on wheat productivity and their income after the adoption of zero till machine. It is full mechanized system for rice residue management in Rice-Wheat system at selected site of Muzaffarpur dist. of Bihar.

In India, dissemination of conservation-based agricultural technologies has been underway for nearly two decades that made significant progress in agriculture even though there are several constraints that affect its adoption at local level and tremendous efforts have been made on Zero-till in wheat under a rice-wheat cropping system the Indo-Gangetic plains of Bihar. There are more payoffs than trade offs for adoption of conservation agriculture but the equilibrium among the two was understood by both adopters and promoters. It is observed that zero till technologies or conservation agriculture increase yields and income after adoption of RCT through improving the efficient use of resources and minimizes the cost of input as illustrated in figure and table. However, there are lot of constraints for promotion of conservation agriculture technologies, such as lack of appropriate seeders especially for small and medium scale farmers, competition of crop residues between conservation agriculture use and livestock feeding, burning of crop residues, non-availability of skilled and scientific manpower and overcoming the bias or mindset about tillage.

Keywords: Sustainability, Productivity, Soil erosion, Cover crops, Zero till, Crop production

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Introduction

Mr. Satish Kumar Dwivedi is a true pioneer taking degraded and low land unsuitable for production of wheat on proper time and turning it into high-yielding, productive land, for wheat cultivation employing the principles of Zero tillage technology and residue management bringing practice and science together. His capacity for observing and working with nature, his understanding and application of scientific agricultural principles, and his innate talents to teach and mentor other farmers has positioned him to make some major contributions to the continued search for more sustainable agricultural production in Muzaffarpur district. His love for the soil and his recognition of the resilience of natural systems when nurtured with proper management provided him with a conservation ethic that is recognized in Bihar state.

The Zero-till system (also referred to as direct seeding, no tillage, and sometimes conservation tillage) is the only strategy and farming technology to protect the soil while at the same time enabling seeding for subsequent crops. The four main principles of Zero-till systems implied here are minimum soil disturbance, continuous crop residue cover, diverse crop rotation, and the use of cover/synergy crops. These residues are intentionally left on the soil surface from the previous year/crop. Zero-till requires a new inspiration or philosophical concept that is based on complete conservation of the soil resource, which is possible only when crop residues are permanently accumulated on the surface, and are managed with minimal incorporation or soil movement.

While conservation tillage is a major improvement over conventional inversion tillage, it still disturbs the soil and the soil biology, minimizes carbon accumulation, and can result in substantial erosion.

Agro-ecology, Farming Situation Analysis with Problem Statement (Area of Study) The district Muzaffarpur comes under North Alluvial Plain Zone-I and Rice-Wheat cropping system is followed by several farmers of Muzaffarpur district. This Zone is located in the North of the state between 25°54' to 26°23' N latitude and 84°55' to 85°45' E longitude with the altitude ranging from 170' above the mean sea level. Total geographical area of the district is 3.176 lakh ha and total cultivable area 2.477 lakh ha. Out of which net sown area is 2.20 lakh ha. The area under irrigation 0.83 lakh ha. (Source: District Profile). Average rainfall of the district is 1046 mm and temperature 25.20. In last five year, the district is suffering from flood and draught and sometimes frequent rain in kharif season. Due to climatic change scenario and bad cultivation practices the wheat crop are severely affected and yield are drastically reduced year after year.

Table-1 Area, Production, Productivity of wheat of Muzaffarpur district (Bihar)

Year	Area (ha)	Production (MT)	Productivity (Kg/ha)
2013-14	92734	330375	3563
2014-15	88358	129818	1469
2015-16	80082	124266	1552
2016-17	92181	257333	2792
2017-18	91868	258180	2810

Source: Directorate of Statistical and evaluation, Govt. of Bihar.

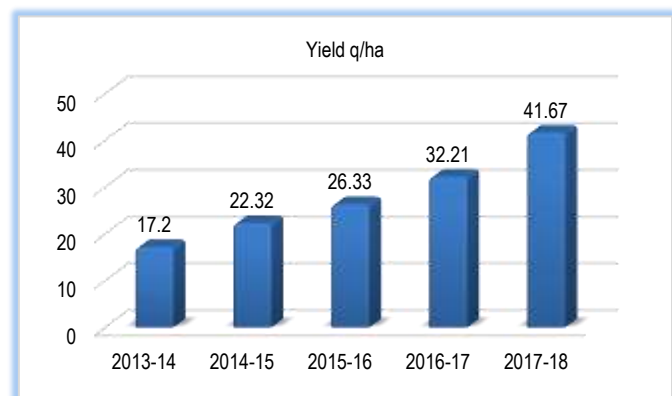
Table-2 Impact Analysis: Adoption of Technology

Impact factor	Before Adoption	After Adoption
Farmer Practice	Sowing of seed through rotavator, only two irrigation is given by the farmers.	Sowing of seed through Zero till seed drill cum fertilizer machine, weed management, residues management and one additional irrigation at terminal heat stress.
Area (ha)	3	10
Yield of Product (q/ha)	17.20	41.67
Gross cost	27000.00	42000.00
Income		
Wheat seed (2200.00/q and 2500.00/q)	37480.00	104175.00
Wheat straw (300.00/q and 500.00/q)	5160.00	20835.00
Gross income	42640	125010.00
Net Profit	15640.00	83010.00
B:C Ratio	1.58	2.98
Marketing	Selling to the farmers as seed	Selling to the farmers and company as seed
Dissemination of knowledge in the locality	Motivate the farmers for adopting new package and practices.	Giving the idea for Zero tillage wheat, residues management and irrigation at terminal heat stress nearby farmers as well as ATMA and DAO and providing demonstration facility to the farmers through govt. and semi govt. organization. Now this technology followed by 56000 farmers of the district around 13000 ha of land.

Last five years Muzaffarpur district of Bihar was expected to receive below normal rainfall and farmers are practiced to cultivate wheat 25 Nov to 31 Dec by using Rotavator. because farmers of the district sown long duration variety of paddy so yield are drastically reduced 142.5% during 2014-15. Yield are reducing through lodging of the crop after 2nd irrigation, due to climate changing scenario. After 2014-15 some scheme and awareness programme organized for cultivation of wheat yield was significantly increases. At the mean time CSISA (CIMMYT) project was launched and farmers get benefited from this project, productivity was increases up to 79.89% from the year 2016-17 in respect to 2015-16

Material and Methods

Mr. Dwivedi is a progressive farmer and doing cultivation of cereal crop through use of farm machinery. Before interpretation of CSISA project he was sowing wheat traditionally by using Rotavator up to 2013-14 and yield was 17.20 q/ha recorded in his own field. But in the year 2014-15 with the interpretation of CSISA project at first hard pan was destroyed. The hard pan his field was developed due to regular practice of Rotavator. That's why the targeted yield was not achieved. During the year 2014-15 with the help of KVK Scientist and CSISA project he had start Zero till wheat and the yield was increase up to 22.32 q/ha (2014-15) to 32.21 q/ha (2016-17). In the meantime, after knowing of the residue's management in Zero tillage wheat to leave paddy residues up to 20 % with the help of combine harvester and shifting the sowing time 1 to 10th Nov., yield was increased from 32.21 q/ha (2016-17) to 41.67 q/ha (2017-18). This was the maximum yield of wheat in their locality by reducing cost of cultivation up to Rs 4200.00 to Rs 4500.00/ha. After achievement Mr. Dwivedi started to spread the technology among the progressive farmers of the district. His achievement is also recognized by district level officers and the technology sprayed throughout the district. Scientist of KVK Saraiya and CSISA (CIMMYT) giving better technology



time to time so that, they can adapt this technology and may able to minimize to

risk as well as attain a better income to uplift their economics and social condition, Saraiya, Muzaffarpur has given better technology time to time so that, they can adopt this technology and may able to minimize to risk as well as attain a better income to uplift their economic and social condition.

Result and Discussion

Impact Analysis [Table-2]

Benefits (Economic and Social)

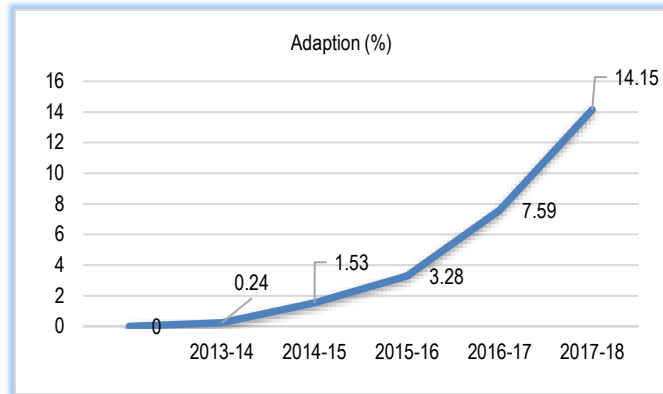
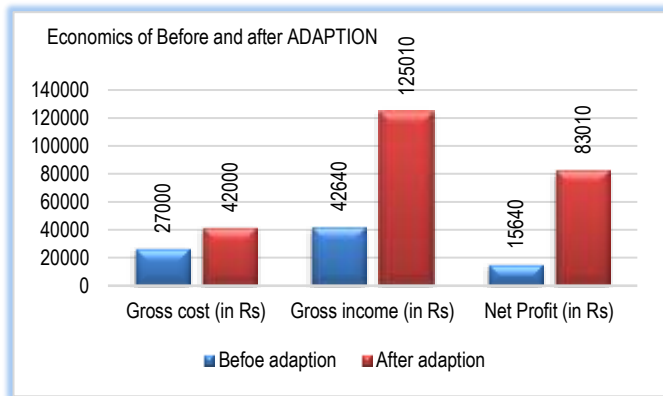
Zero tillage wheat has several economic and social benefits Zero till seed drill cum fertilizer machine has several benefits in economical as well social term. This technology has led to minimize the risk of crop failure due to reduction of lodging in adverse climatic condition that their income increases which able them to maintain good social condition in society. He sells the wheat seed to the company and also nearby the villages and other blocks as seed to maintain good economic condition. Overall, their income increases which serves as a best medium to double farmer's income.

This technology brought positive impact on different aspects of livelihood of the beneficiaries. Annual income, standard of living and household condition of Mr. Dwivedi were increased as compared to the previous year. Considering all these it can be said that this technique is beneficial both for social and economic improvement.

Table-3 Adoption, Spread, Up Scaling of Technology and Future Projection

Year	Total cultivated area (ha)	Zero tillage Wheat(ha)	Adaption(%)
2013-14	92734	225	0.24
2014-15	88358	1352	1.53
2015-16	80082	2630	3.28
2016-17	92181	7000	7.59
2017-18	91868	13000	14.15

KVK, Saraiya, Muzaffarpur and CSISA (CYMMIT) project plays a better role in dissemination of this technology with Mr. Dwivedi to farmers in better way by organizing training programmers, group meeting, demonstrations and trial, so that they can understand their benefits in terms of uplifting their economic status. They provide knowledge by doing result demonstrations so that they haven't any doubt in their mind. Time to time extension agent upgrade their knowledge about recent technology in production. The technology was spread to other villages of the Muzaffarpur district. Now he developed self-confident and motivation to other needy farmers and farm women and Rural youth as well as Government and semi government organization. Future of this technology is very bright and needy in present climatic change scenario because of low rainfall and temperature variation year after year. Mr. Dwivedi observed that, if most of the farmers adopted this technology, they will able to achieve their goal of better status in society and save the cost of cultivation up to Rs 4200.00 to Rs 4500.00 per ha as well as water require irrigation.



Relevant action photographs related to Zero till technology



CSISA- KVK Network team visited at Mr. Dwivedi field



Farmers visited in Mr. Dwivedi field



Mr. Dwivedi happy to see the performance of Zero tillage wheat



CSISA team visited Mr. Dwivedi field

Conclusion

Mr. Satish Kumar Dwivedi, Vill-Chandpura; P.O: Chandpura Sakari; Block.-Bandra, Dist.-Muzaffarpur (Bihar); Pin code- 848125 is a true pioneer taking degraded and low land unsuitable for production of wheat on proper time and turning it into high-yielding, productive land, for wheat cultivation employing the principles of Resource Conservation Technology (RCT) and residue management bringing practice and science together. His capacity for observing and working with nature, his understanding and application of scientific agricultural principles, and his innate talents to teach and mentor other farmers has positioned him to make some major contributions to the continued search for more sustainable agricultural production under RCT in Muzaffarpur district. His love for the soil and his recognition of the resilience of natural systems when nurtured with proper management provided him with a conservation ethic that is recognized in Bihar state. Mr. Satish Kumar Dwivedi observed that nature requires that there should always be some organic residue on the soil surface, and that this principle is the fundamental base of soil productivity and conservation and for the maintenance of continued life on this planet. Employing the concept that you must "measure to manage", coupled with continual monitoring and evaluation of results, were critical elements in the success of cultivation of wheat through Zero till machine in low lying area. He showed that no-till and strategic use of cover crops can lead to a reduced reliance on herbicides, pesticides and mineral fertilizers, and less use of fossil fuels, thereby making wheat production more profitable and sustainable and enhance the income of farmers many folds.

Application of research

No-till and strategic use of cover crops can lead to a reduced reliance on cost of input thereby making wheat production more profitable and sustainable and enhance the income of farmers many folds. It improves the wheat productivity and their income after the adoption of zero till machine under RCT. It is full mechanized system for rice residue management in Rice-Wheat system at selected site of Muzaffarpur dist. of Bihar.

Research Category: Rice-Wheat cropping system

Abbreviations: ZT: Zero Tillage, RCT: Resource Conservation Technology

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****Principal Investigator or Chairperson of research: Dr Anupama Kumari**

University: Dr Rajendra Prasad Central Agricultural University, Pusa, 848125, Bihar, India

Research project name or number: Implementation of Cereal System Initiatives for South Asia (CSISA)-III

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Chandpura, Bandra, Muzaffarpur, Bihar

Cultivar / Variety / Breed name: HD 2967

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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