Complementary practices adopted by farmers of Haryana (India) for conservation agriculture

P. Kumar¹, P.S. Shehrawat¹, R. Kumar² and M. Khan^{3*}

¹Department of Extension Education, CCS Haryana Agricultural University, Hisar-125 004, India

²Department of Agricultural Economics, CCS Haryana Agricultural University, Hisar-125 004, India

³Agricultural Research Station (SKN Agriculture University, Jobner), Fatehpur-Shekhawati-332 301, India

*Corresponding Author Email : mkhanstat@gmail.com

Paper received: 13.06.2020

Revised received: 03.10.2020

Accepted: 30.10.2020

Abstract

Aim: To study different complementary practices like zero tillage, agroforestry, crop diversification etc., adopted for conservational agriculture.

Methodology: The study was conducted in the year 2018 in Haryana state of India, which is divided into two agro-climatic zones, i.e., North-Eastern Zone and South-Western Zone. A total of 240 respondents were personally interviewed for the present study.

Results: The farmers were highly aware of the fact that the zero tillage reduces the field preparatory cost, agroforestry provides healthy environment and extra income whereas crop diversification reduces the risk of crop failure. Major constraints in zero tillage, agroforestry and crop diversification were 'straw burning', 'lack of interest among respondents due to long duration of return' and 'lack of educational and training facilities', respectively.

Interpretation: Conservation agriculture opens new doors towards mitigating the effects of conventional agricultural systems and to improve the health of our degrading soil. Substantial improvement may be required in research on agriculture policy formulation involving training of scientists, extension workers and farmer leaders.

Key words: Agroforestry, Complementary practices, Conservation agriculture, Crop diversification, Zero tillage

How to cite : Kumar, P., P.S. Shehrawat, R. Kumar and M. Khan: Complementary practices adopted by farmers of Haryana (India) for conservation agriculture. *J. Environ. Biol.*, **41**, 1648-1654 (2020).

Introduction

India has 328.72 million hectare of geographic area out of which 96.4 million hectare land has been assessed as degraded, which is 29.32 per cent of geographic area. It appears that most of our land is degraded, is undergoing degradation or is at the risk of being degraded. Therefore, we need to focus on conservation agriculture practices so that this increase in land degradation can be minimized and to make soil healthy for crop production. Conservation agriculture depends on three standards: soil disturbance should be minimum, crop residue detainment using dead or living plant materials and diversification using crop associations and rotations (Hobbs, 2007; Kassam *et al.*, 2009). Notwithstanding these three important standards, there is a scope of some good agricultural approaches and practices expected to help short-term and longer-term profitability and productivity of the system. There is general understanding that these great agriculture practices are fundamental for conservation agriculture to work in the longer term (Sommer *et al.*, 2014; Vanlauwe *et al.*, 2014).

Cropping systems of conservation agriculture profit by the expansion of tree-based components, which back the system's diversification, functioning and resilience (Garrity *et al.*, 2010; Mutua *et al.*, 2014). Around, 20% more significant returns of wood and grains have been accounted for agroforestry service regions of Western Uttar Pradesh and Haryana rather than from pure agriculture (Dwivedi and Sharma, 1989). Nitrogen fixing trees present in the agroforestry systems are fit for fixing around 50-100 kg N ha⁻¹ year⁻¹ (Tewari, 1995). Agroforestry, which is a type of various land/use frameworks, ought to be encouraged and adopted in this specific situation. Johar *et al.* (2017) revealed the significance of agroforestry based system for enhancing the soil health by expanding the organic carbon content and other significant soil nutrients. Bhardwaj *et al.* (2017) reported the value of agroforestry based systems in relation to reclamation and improvement of saline soil under a eucalyptus based agroforestry system.

Farmers for most part focus on single activity based farming systems that lead to increased danger of crop failure, decaying of soil health and downward patterns in productivity from the Green Revolution onwards (Rahman and Sarkar, 2012). The alternate land use farming system is viewed as a potential method for stabilizing and raising profitability and productivity levels in the rainfed agriculture (Gopinath *et al.*, 2014; Venkateswarlu *et al.*, 2012). The Ministry of Agriculture and Farmers' Welfare has additionally given significant accentuation on multipurpose land use frameworks/systems while getting ready for doubling farmers' income by 2022 (GOI, 2014). Be that as it may, planning and execution of various firms in integrated farming system in our nation lacks systemic and scientific methodology. Also, appropriate awareness of linkages and associations between the various components would improve

food security.

Diversification into farming system method of agriculture on small land holding can give proofing to anticipate climate change related hazard in agriculture. This can likewise help in generating rural employment and can also acquire food and nutritional security at farm level, in this manner forestalling extreme migration to urban areas, which is a typical issue in developing countries (Singh, 2012). Also, the nutrient status of field crops can be improved through crop diversification as trees provide a more variable and diverse habitat (Baudron *et al.*, 2017). So, there is immense need of complementary practices for keeping the soil healthy and to enhance the production and productivity through conservation agriculture. In view of the above, the study was under taken to assess the farmers' awareness level and constraints faced by them in adoption of conservation agricultural practices.

Materials and Methods

The study was conducted into two agro-climatic zones, North-Eastern Zone and South-Western Zone of Haryana state in the year 2018. Two districts were selected purposively from each zone. Further two blocks were selected purposively from each selected district such that the blocks were highest nutrient deficient and 30 respondents were selected randomly from each selected block. Thus, 240 farmers were interviewed for the present study.

For assessing the awareness, constraints and causes for soil degradation about conservation agriculture practices, data were obtained by conducting personal interview with the respondents. Each of the selected respondents was interviewed personally at their farm or home. The data gathered through the responses as given by the respondents was reasonably coded and analyzed to draw significant information by utilizing statistical tools such as frequency distribution, percentage, mean, Weighted Mean Score (WMS) and rank orders.

Results and Discussion

Farmers' awareness and constraints towards zero tillage :

The data presented in Table 1 and Fig. 1 shows that the farmers were highly aware about the fact that zero tillage can help to cut down the field preparatory cost (WMS 1.80), labour and fuel costs (WMS 1.78). However, the awareness level among the farmers towards the importance of zero tillage for the utilization in improvement of soil moisture and other properties was observed to be low. Whereas, awareness level was minimum for zero tillage helps in sequestrations of soil carbon (WMS 1.23). Use of zero tillage leads to improvement in productive efficiency as adoption of this practice led to 93% decrease in the risk of getting efficiency levels below 40% (El-Shater *et al.*, 2020). But the results show that there is an immense need to raise the awareness level among farmers about the potential of zero tillage in various

Table 1 : Farmers' awareness towards zero tillage

Statements	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
Zero tillage reduce the field preparatory cost	66(27.50)	60(25.00)	114(47.50)	432	1.80	I
Zero tillage reduce the irrigation requirement	44(18.33)	76(31.67)	120(50.00)	404	1.68	IV
Zero tillage reduce the labor and fuel costs	66(27.50)	56(23.33)	118(49.17)	428	1.78	II
Zero tillage helps to maintain adequate soil moisture content in soil	50(20.83)	76(31.67)	114(47.50)	416	1.73	III
Zero tillage maintains soil structure	38(15.83)	86(35.83)	116(48.34)	402	1.68	IV
Zero tillage helps cropping frequency/ timeliness	35(14.58)	82(34.17)	123(51.25)	392	1.63	V
Zero tillage helps to reduce the infestation of weed	30(12.50)	72(30.00)	138(57.50)	372	1.55	VII
Zero tillage decrease soil erosion	30(12.50)	85(35.42)	125(52.08)	385	1.60	VI
Zero tillage helps in carbon Sequestrations	10(4.17)	35(14.58)	195(81.25)	295	1.23	VIII

(n=240)

Table 2: Constraints related to zero tillage

Statements	Not so serious (%)	Serious (%)	Very serious (%)	Total weighted score	Weighted mean score	Rank order
Straw burning	93 (38.75)	40 (16.67)	107 (44.58)	494	2.06	I
Problem of standing stubble	115 (47.92)	103 (42.92)	22 (9.16)	387	1.61	VI
Loose straw management is problem	37 (15.42)	168 (70.00)	35 (14.58)	478	1.99	II
Non availability of quality seed drill	106 (44.17)	42 (17.50)	92 (38.33)	466	1.94	III
High population of weed at the time of sowing	46 (19.17)	184 (76.67)	10 (4.16)	444	1.85	IV
Late harvesting of rice	126 (52.50)	95 (39.58)	19 (7.92)	373	1.55	VII
Late emergence of wheat seedlings	101 (42.08)	114 (47.50)	25 (10.42)	404	1.68	V

(n=240)

Fig. 1 : Awareness (%) of farmers for various statements towards zero tillage.

contexts and more understanding of zero tillage systems. Similar, findings were also delineated by Evers and Agostini (2001) who also reported that there is a need to raise awareness of potential towards no or zero tillage. Zero tillage besides providing

multifarious benefits to farmers adds up with certain constraints which makes it difficult for the farming community to follow them. The data presented in Table 2 clearly depicts that the major constraints towards the utilization of zero tillage were straw burning (WMS 2.06) and loose straw management (WMS 1.99) which were ranked 1st and 2nd, respectively. Our results are in line with the findings of Kumari et al. (2018) who reported that loose straw management (84.44%) was the most significant problem and ranked on 1st position, lack of local mechanic to repair the machine (82.22%) got 2nd rank and straw burning (77.77%) got 3rd rank.

Awareness and constraints towards agroforestry : It is apparent from the information introduced in Table 3 and Fig. 2 that the farmers' awareness about the importance and uses of agroforestry varied from high to medium. It may be due to the fact that the agricultural department has an active participation in providing awareness among the farming community. It was observed that 1st rank was obtained by the fact that agroforestry provides healthy environment and extra income (WMS 2.22) followed by the fact that agroforestry systems are advantageous over conventional agriculture (WMS 2.15), which was ranked 2nd. The results show a collaborative association with the findings of Pant (2011) and Gyau et al. (2014). Further, it was observed that lack of interest among respondents due to long duration of return

Fig. 2 : Awareness (%) of farmers for various statements towards agroforestry.

Fig. 3 : Awareness (%) of farmers for various statements towards crop diversification.

Table 3 : Farmers' awareness towards agroforestry

Statements	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
Agroforestry systems advantageous over conventional agricultural	53 (22.08)	171 (71.25)	16 (6.67)	517	2.15	II
Restoring the soil fertility	27 (11.25)	109 (45.42)	104 (43.33)	403	1.68	IV
Reduces land degradation and soil erosion	33 (13.75)	108 (45.00)	99 (41.25)	414	1.73	III
Reduces irrigation requirement	25 (10.42)	109 (45.42)	106 (44.16)	399	1.66	V
Provide healthy environment and extra income	88 (36.67)	117 (48.75)	35 (14.58)	533	2.22	I

(n=240)

Table 4 : Constraints related to agroforestry

Statements	Not so serious (%)	Serious (%)	Very serious (%)	Total weighted score	Weighted mean score	Rank order
Cost of tree production is very high	146 (60.83)	86 (35.83)	8 (3.34)	342	1.43	IX
Protection of trees from animals require a lot of labour cost	158 (65.83)	80 (33.34)	2 (0.83)	324	1.35	X
Lack of subsidy and plant material for agroforestry	88 (36.67)	46 (19.17)	106 (44.16)	498	2.08	V
Problem of proper market for small scale agroforestry	84 (35.00)	47 (19.58)	109 (45.42)	505	2.10	IV
High initial cost of agroforestry	74 (30.83)	139 (57.92)	27 (11.25)	433	1.80	VII
Lack of knowledge of tree management practice	114 (47.50)	42 (17.50)	84 (35.00)	450	1.88	VI
Lack of knowledge about proper selection of tree species and their management	72 (30.00)	51 (21.25)	117 (48.75)	525	2.19	II
Lack of awareness of right stage of harvesting of trees	133 (55.42)	30 (12.50)	77 (32.08)	424	1.77	VIII
Lack of availability of market for agroforestry produce at local level	80 (33.33)	49 (20.42)	111 (46.25)	511	2.13	III
Lack of interest among respondents due to long duration of return	6 (2.50)	72 (30.00)	162 (67.50)	636	2.65	I
No assurance for agroforestry produce	88 (36.67)	46 (19.17)	106 (44.16)	498	2.08	V

(n=240)

Table 5: Farmers' awareness towards crop diversification

(n=240)

Statements	Fully aware (%)	Aware (%)	Not aware (%)	Total weighted score	Weighted mean score	Rank order
Crop diversification helps to sustain soil health	29 (12.08)	88 (36.67)	123 (51.25)	386	1.61	IV
It helps to generate employment and income round the year	30 (12.50)	96 (40.00)	114 (47.50)	396	1.65	III
Crop diversification helps to reduce risk of crop failures	70 (29.17)	68 (28.33)	102 (42.50)	448	1.87	I
Crop diversification promotes use of resources	60 (25.00)	60 (25.00)	120 (50.00)	420	1.75	II
It helps to increase the production	19 (7.92)	94 (39.16)	127 (52.92)	372	1.55	V

Table 6: Constraints related to crop diversification

(n=240)

Statements	Not so serious (%)	Serious (%)	Very serious (%)	Total weighted score	Weighted mean score	Rank order
Lack of educational and training facilities	10 (4.17)	70 (29.16)	160 (66.67)	630	2.63	I
Lack of credit and government aids	13 (5.42)	85 (35.42)	142 (59.16)	609	2.54	II
Gram Panchayats ineffective role in agricultural diversification	73 (30.42)	52 (21.66)	115 (47.92)	522	2.18	VI
Lack of effective community leaders in the village	93 (38.75)	47 (19.58)	100 (41.67)	487	2.03	VIII
Lack of microfinance agencies and self-help groups	93 (38.75)	40 (16.67)	107 (44.58)	494	2.06	VII
High rates of interest of private money lenders	93 (38.75)	47 (19.58)	100 (41.67)	487	2.03	VIII
Lack of knowledge about price and market information	93 (38.75)	40 (16.67)	107 (44.58)	494	2.06	VII
Crop diversification needs introduction of new machinery	47 (19.58)	62 (25.84)	131 (54.58)	564	2.35	III
No facilities for processing and value addition	46 (19.17)	70 (29.16)	124 (51.67)	558	2.33	IV
Poverty	46 (19.17)	70 (29.16)	124 (51.67)	558	2.33	IV
Resistance in adoption of new technology due to fear of failure	50 (20.84)	71 (29.58)	119 (49.58)	549	2.29	V
Bribery and leakages in subsidies	106 (44.17)	42 (17.50)	92 (38.33)	466	1.94	IX

(WMS 2.65), lack of knowledge about proper selection of tree species and their management (WMS 2.19) and lack of availability of market for agroforestry systems produced at local level (WMS 2.13) were found to be serious constraints towards growth of agroforestry based systems as given in Table 4. Mahmood *et al.* (2020) also concluded that mostly farmers have positive attitude towards agroforestry practices, as they understand multiple benefits from growing trees in comparison to cropping. Whereas farmers face various constraints, including poor access to credit, natural hazards and little support from local authorities. The awareness about agroforestry and adoption of agroforestry can be increased by conducting training programmes on planting density and management strategies to assure that agroforestry has the most extreme constructive outcome (Gyau *et al.*, 2014). Similarly, Ekta *et al.* (2015) suggested that proper training should be provided to the farmers to acquaint them with proper inter-cropping and agroforestry practices. Farooq *et al.* (2017) suggested that forest department

need to conduct regular proper trainings, seminars and awareness programs at village level to educate farmers. Ghouse (2019) also reported that inadequate credit/subsidy facility and lack of awareness about government policies are few constraints faced by the farmers towards agroforestry.

Awareness and constraints towards crops diversification :

Awareness among the farmers towards crop diversification varied from low to high (Table 5 and Fig. 3). It was observed that awareness about the fact that crop diversification helps to reduce risk of crop failures (WMS 1.87) and crop diversification promotes use of resources (WMS 1.75) obtained 1st and 2nd position, respectively. Anuja *et al.* (2020) revealed that crop diversification of high-value crops plays a significant role in enhancing farm income, consumption expenditure and reducing poverty. Growers need to allocate at least 40% area for high value crops to have significant enhancement in income and poverty reduction. Variations in the awareness level from low to high may be due to the reason that agriculture department is still working on the

framework and guidelines for the diversification of crops. However, the data introduced in Table 6 shows that the lack of education and training facilities (WMS 2.63) and lack of credit and government aids (WMS 2.54) were serious constraints which hampers proper diversification of crops by the farmers which clearly states that it is a matter of fact that the educational standard directly affected the adoption of diversification as a profitable entrepreneur. Salau and Ayanda (2014) also emphasized towards providing proper training and guidelines for the farming community to strengthen crop diversification. Further, it is also suggested that training programmes on crop diversification should be conducted at village level and government should take proper steps to disseminate diversification technique and provide capital to encourage crop diversification among the farming community (Tirath et al., 2015; Bosma et al., 2005).

To attain the Government of India's goal of doubling the farmers' income by 2022, the conservation practices like zero tillage, agroforestry and crop diversification should be adopted by the farmers for improving soil health. Ensuring minimum support price for all the agricultural commodities, providing credit/subsidy facilities to the farmers and timely availability of inputs would encourage them to adopt these practices. Hence, government should make the existing policies more accountable and also make new policies for overcoming the existing constraints and conduct training and demonstration programs at local level regularly. It is also recommended that more extension staff should be trained to enhance effective extension contact to farmers.

Acknowledgments

The author(s) sincerely thank the Head and Faculty members of the Department of Extension Education, Chaudhary Charan Singh Haryana Agricultural University, Hisar for granting and providing necessary facilities.

References

- Anuja, A.R., A. Kumar, S. Saroj and K.N. Singh: The impact of crop diversification towards high-value crops on economic welfare of agricultural households in eastern India. *Curr. sci.*, **118**, 1575-1582 (2020).
- Baudron, F., J.Y.D. Chavarria, R. Remans, K. Yang and T. Sunderland: Indirect contributions of forests to dietary diversity in Southern Ethiopia. *Eco. Soc.*, **22**, 28 (2017).
- Bhardwaj, K.K., R.S. Dhillon, S. Kumari, V. Johar, V. Dalal and S.B. Chavan: Effect of Eucalyptus bund plantation on yield of agricultural crops and soil properties in semi-arid region of India. *Int. J. Curr. Microbiol. App. Sci.*, **6**, 2059-2065 (2017).
- Bosma, R.H., H.M.J. Udo, J.A.J. Verreth, L.E. Visser and C.Q. Nam: Agriculture diversification in the Mekong Delta: Farmers' motive and contributions to livelihood. *Asian Jour. Agri. Dev.*, **2**, 49-66 (2005).
- Dwivedi, A.P. and K.K. Sharma: Agroforestry: Its potential. In: Seminar on Eucalyptus, FRI, Dehradun (1989).
- Ekta, A.K. Godara and P.S. Shehrawat: Attitude of farmers towards sustainable agro-forestry cultivation in Haryana. *Ind. Jour. App. Res.*, **5**, 395-399 (2015).
- El-Shater, T., A. Mugera and A. Yigezu: Implications of adoption of Zero Tillage (ZT) on productive efficiency and production risk of wheat production. *Sustainability*, **12**, 3640 (2020).
- Evers, G. and A. Agostini: No-tillage farming for sustainable land management: Lessons from the 2000 Brazil study tour. FAO Investment Center Occasional Paper Series No. 12, pp. 1-26 (2001).
- Farooq, T.H., M.F. Nawaz, M.W. Khan, M.M. Gilani, S. Buajan, J. Iftikhar, N. Tunon and P. Wu: Potentials of agroforestry and constraints faced by the farmers in its adoption in district Nankana Sahib, Pakistan. *Int. Jour. Dev. Sust.*, **6**, 586-593 (2017).
- Garrity, D., F. Akinnifesi, O. Ajayi, G.W. Sileshi, J.G. Mowo, A. Kalinganire, M. Larwanou and J. Bayala: Evergreen agriculture: A robust approach to sustainable food security in Africa. *Food Security*, **2**, 197-214 (2010).
- Ghouse, L.M. and S.N. Hassan: Constraints of crop diversification in Tirunelveli district of Tamil Nadu. *Int. Jou. Agri. Sci. Res.*, **9**, 35-38 (2019).
- GOI: Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Govt. of India, New Delhi (2014).
- Gopinath, K.A., C. Srinivasarao, G.R. Chary, S. Dixit, M. Osman, B.M.K. Raju, D.B.V. Ramana, D.G.M. Saroja, G. Venkatesh and M. Maheswari: Improving the productivity of rainfed farming systems of small and marginal farmers in Adilabad district, Telangana. *Ind. J. Dry. Agri. Res. Dev.*, **29**, 52-56 (2014).
- Gyau, A., K. Smoot, C. Kouame, L. Diby, J. Kahia and D. Ofori: Farmer attitudes and intentions towards trees in cocoa (*Theobroma cacao* L.) farms in Cote d'Ivoire. *Agroforestry Systems*, **88**, 1035-1045 (2014).
- Hobbs, P.R.: Conservation agriculture: What is it and why is it important for future sustainable food production? *J. Agric. Sci.*, **145**, 127-137 (2007).
- Johar, V., R.S. Dhillon, K.K. Bhardwaj, V. Bisht and T. Kumar: Effect of light intensity on yield of wheat under *Eucalyptus tereticornis* based agri-silvi-horticultural system. *Ind. J. Ecol.*, **44**, 95-99 (2017).
- Kassam, A., T. Friedrich, F. Shaxson and J. Pretty: The spread of conservation agriculture: Justification, sustainability and uptake. *Int. J. Agric. Sustain.*, **7**, 292-320 (2009).
- Kumari, A.R., K. Meena, S.K. Dubey, A. Pundir and U.S. Gautam: Know-hows of zero tillage technology and the associated constraints experienced by the farmers in rice-wheat cropping system of Eastern Uttar Pradesh. *Ind. Jour. Ext. Edu.*, **54**, 1-7 (2018).
- Mahmood, M.I. and M. Zubair: Farmer's perception of and factors influencing agro forestry practices in the Indus river basin, Pakistan. *Small-scale Forestry*, **19**, 107-122 (2020).
- Mutua, J., J. Muriuki, P. Gachie, M. Bourne and J. Capi: Conservation agriculture with trees: Principles and practice. A simplified guide for extension staff and farmers. World Agroforestry Center, Nairobi (2014).
- Pant, N.: Motivational factors in activities of agroforestry- A case study. *Ind. Fores.*, **137**, 363-369 (2011).
- Rahman, F.H. and S. Sarkar: Efficient resource utilization through integrated farming system approach in the farmers' field at Burdwan district of West Bengal. In: Third International Agronomy Congress held during 26-30 November 2012 at New Delhi, p. 997-998 (2012).

- Salau, S.A. and I.F. Ayanda: The influence of cropping intensification on vulnerability to floods among farming households in Kwara state, Nigeria. *Jour. Sust. Dev. in Africa*, **16**, 142-152 (2014).
- Singh, G.: Integrated farming systems: Option for diversification to manage climate change related risk and livelihood security. In: Third International Agronomy Congress held during 26-30 November at New Delhi, p. 93-94 (2012).
- Sommer, R., C. Thierfelder, P. Tittonell, L. Hove, J. Mureithi and S. Mkomwa: Fertilizer use should not be a fourth principle to define conservation agriculture. *Field Crop Res.*, **169**, 145-148 (2014).
- Tewari, D.N.: Agroforestry for increased, productivity, sustainability and poverty alleviation. International Book Distributors, Dehradun (1995).
- Tirath, R., P.S. Badal, O.P. Singh and R. Singh: Constraints to agricultural diversification in Mirzapur district of Uttar Pradesh. *Econ. Affairs*, **60**, 273-276 (2015).
- Vanlauwe, B., J. Wendt, K. Giller, M. Corbeels, B. Gerard and C. Nolte: A fourth principle is required to define conservation agriculture in sub Saharan Africa: The appropriate use of fertilizer to enhance crop productivity. *Field Crop Res.*, **155**, 10-13 (2014).
- Venkateswarlu, B., A.K. Singh, C.S. Rao, G. Kar, A. Kumar and S.M. Virmani: Natural resources management for accelerating agricultural productivity. Stadium Press Pvt. Ltd., New Delhi, India, p. 234 (2012).