ECO-FRIENDLY AGRICULTURAL PRACTICES AND THEIR ASSENT BY FARMERS IN HARYANA STATE OF INDIA

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Abstract. Intensive agricultural practices coupled with better input services has resulted in exponential growth in crop production in India, particularly in northern region states of the country like Haryana. Though self-sufficiency has been achieved, it was accompanied by negative environmental effects such as serious non-target agricultural pollution. Implementation of eco-friendly smart agricultural practices can effectively overcome such pollution. However, the major constraints in assent and adoption of these practices are not limited only to associate risks and potential benefits, but farmers' attitudes towards knowledge of scientifically validated practices too came into picture. In the presented study, opinions of 180 respondents were explored in personal interviews using a three-point continuum scale for the major constraints (very serious, serious and not so serious) and scores were given as 3, 2 and 1, respectively. Weighted mean score (WMS), rank orders, standard deviation, correlation and regression were computed for the better understanding. Results concluded that major constraints for smart agricultural practices in their assent were non-familiarization with improved practices (WMS = 2.46), procedure of registration for weather forecasting (2.37), conservation agriculture is more labour intensive (2.24), lack of training to access e-information (2.39), Climate change effects the seasonal temperature and rainfall (2.76), Slow result of eco- friendly practices (2.54), high initial cost of protected structure (2.52), and lack of proper training for agro-processing and value addition practices (2.42). The results also indicated that 11 independent variables which were included in the study jointly contributed 37.00% variations in the constraints faced by the farmers in adoption of smart agricultural practices.
Keywords: *agriculture, adoption, climate, constraints, management and production*

Introduction

The major challenge of Indian agriculture is to produce sufficient food grains as it has long been a priority of the country to achieve food security, as it one of the major challenges posed by shrinking landholdings and the over increasing population. About two-third population of Indian population is directly or indirectly depends on related activities for their livelihoods and this sector occupies almost 43% of India's total geographical area (Arjun, 2013). About, 85 percent farmer comes under the category of small and marginal landholding. Demands are continuously increasing on agricultural land for food, fibre, and fuel is predicted to increase exponentially in coming decades with continued population growth (Bommarco et al., 2013). Population growth and dietary changes will drive the global food demand to extraordinary levels in the coming

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decades. To keep pace, food production will have to increase 60% by 2050 (FAO, 2013). Thus, population growth rate of 1.58%, India is predicted to have more than 1.7 billion people by the end of 2050.

India, with a total of 160 m ha of cultivated land comprises of only 39 million hectare irrigated by ground water and 22 million hectare by canals whereas about two third of cultivation in India is still depending on monsoon (Dhawan, 2017) and now there is a well-established fact and figures that natural resources such as land, water, forests, livestock, fisheries are deteriorating and degrading at a very fast rate which may be attributed to unmindful agricultural intensification, imbalanced use of fertilizers, overuse and inefficient use of irrigation water and deforestation.

While, other constraints like inadequate marketing channels and infrastructure, long intermediation, lack of accurate and timely market information system etc. are major challenges to the agricultural marketing system in the country. To prevent agricultural non-target pollution, ameliorate its effects and protect the environment in India, while maintaining or increasing crop yields, traditional practices are being re-evaluated and new eco-friendly agricultural practices are being intensively researched and developed (Shen and Du, 2009).

Therefore, there is immense need of adoption of smart agricultural practices (SAPs) to enhance the production and productivity to feed the continuous increasing population through sustainable use of natural resources along with to reduce the input cost, increase the net profit, and generate employment. SAPs, further, takes into consideration the diversity of social, economic and environmental contexts including agro-ecological zones/farming systems where it is to be applied. Implementation herein requires identification of integrated package of climate resilient technologies and practices for management of water, energy, land, crops, livestock, aquaculture etc. at the farm level while considering the linkage between agricultural production and ecosystems services at the landscape level. However, the real picture of overall sustainability and adoption of smart agricultural practices seems to be continued to face many challenges. Keeping in view the above concerns, study was conducted with objective to assess the constraints in adoption of smart agricultural practices.

Materials and methods

The study was conducted in Haryana state of India during 2017 (*Fig. 1*). Data were collected from From Hisar and Kaithal because main campus and sub campus of the university is situated in these districts. All respondents were recruited randomly from two districts viz. Hisar from South-West zone and Kaithal from North-East zone and three villages were selected from each district i.e. *Ladwa*, *Shahrwa* and *Rawalwas Khurd* villages from Hisar, whereas, *Kaul, Rasina* and *Bhana* villages were selected from Kaithal. Thirty farmers from each selected village were selected randomly. A well-structured and pre-tested questionnaire (see *Appendix*) was designed and used to survey opinions of a stratified sample of 180 farmers which were engaged in small-scale production. The data was analysed by Statistical Package for the Social Sciences (SPSS). Weighted mean score, rank orders, standard deviation, correlation and regression were computed for the better understanding. The responses of farmers' were obtained on three-point continuum scale in case of constraints (very serious, serious and not so serious) and scores were given as 3, 2 and 1, respectively. After that frequency was multiplied with the score (3, 2 or 1) and total weighted score was obtained and total

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weighted score was divided by total respondents (180) for obtaining weighted mean score (WMS) and according to weighted mean score rank order were given.

$$\text{Weighted Mean Score (WMS)} = \frac{w1 * x1 + w2 * x2 + w3 * x3}{n}$$

where
w = number of respondents
x = value of seriousness i.e. Very Serious (x_1)-3, Serious (x_2)-2 and Not so serious (x_3)-1
n = total number of respondents

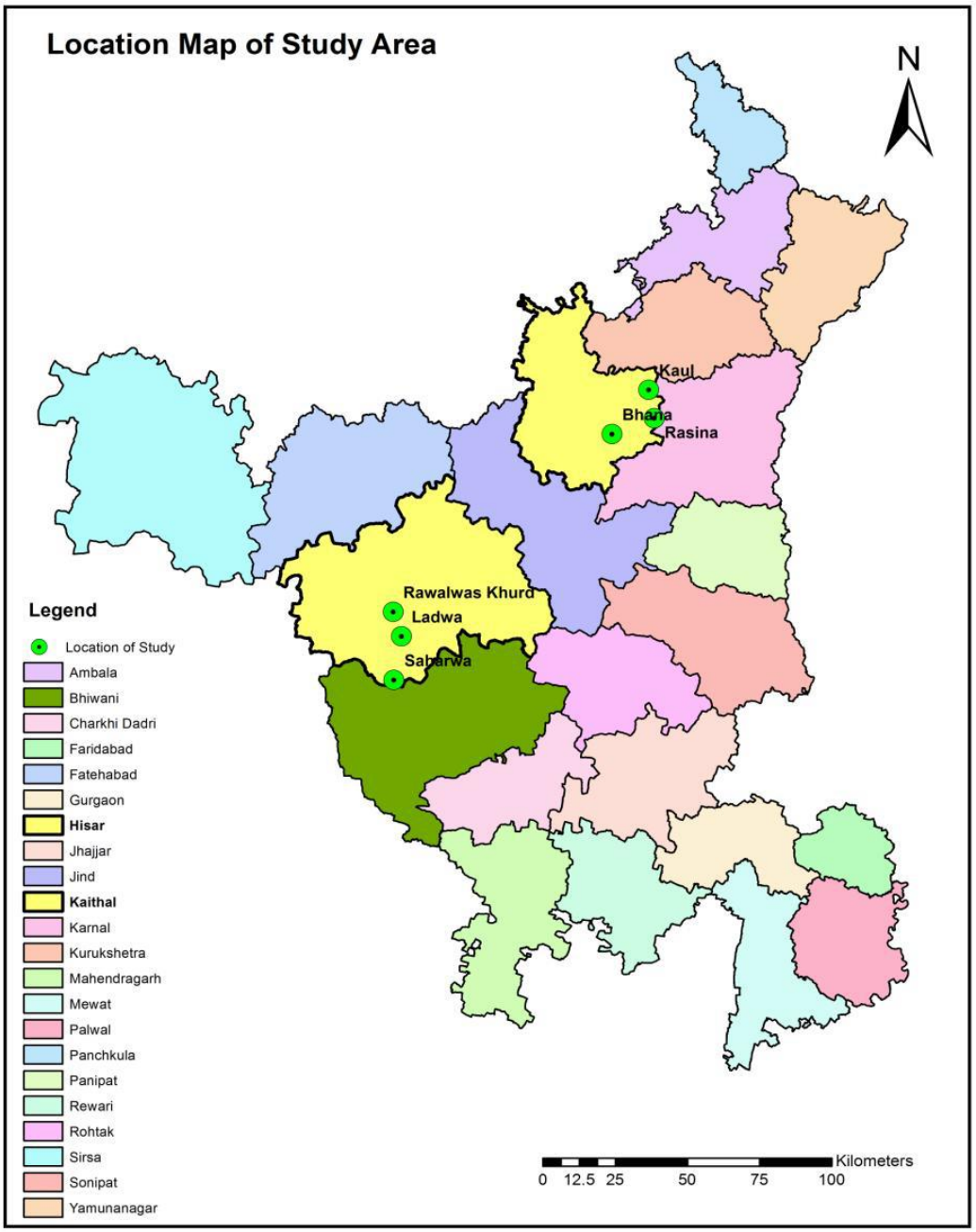

Figure 1. *Map of Haryana showing the locale of study*

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Results and discussion

Profile of respondents

Results pertaining to the personal profile of the farmers indicated in *Table 1*. It was found that vast majority of the farmers (78.34%) belonged to productive age group i.e. young to middle. The age-wise distribution of the respondents is quite natural and expected that working farmers usually come from young and middle aged group. More than 85% farmers were found to literate from primary to post graduate. Educational status is important and plays a key role in enhancing the knowledge, encouraging and motivating them towards adopting the innovative technologies and their applications. It is generally presumed that higher the educational status higher will be the adoption level. Majority of the farmers had land holding up to 5 acres, followed by 6-10 acre (36.67%).

Table 1. *Profile of respondents (n = 180)*

Category	Frequency	Percentage
Age		
Young (21-39 Years)	75	41.67
Middle (39-57 Years)	66	36.67
Old (57-76 Years)	39	21.66
Education		
Illiterate	21	11.67
Primary	13	7.22
Middle	19	10.56
Metric	63	35.00
Higher secondary	29	16.11
Graduate	27	15.00
Postgraduate	8	4.44
Land holding		
Less than one acre	15	08.33
Up to 5 acres	83	46.11
6 to 10 acres	66	36.67
11 to 15 acres	9	5.00
16 to 20 acres	1	0.56
More than 20 acres	6	3.33

n = 180 represents the total number of respondents

Constraints in adoption of sustainable farming

The examination of the data presented in *Table 2* indicated the constraints in adoption of sustainable farming viz., 'not familiar with improved practices' as overall major and serious constraint (52.78%) and ranked 1st with highest weighted mean score (WMS) 2.46, followed by 'small and fragmented land holding', 'not aware about training for sustainable farming', 'lack of skill to adopt sustainable farming' and 'lack of finance to adopt improved practices' ranked 2nd, 3rd, 4th and 5th with WMS 2.41, 2.29, 2.24 and 2.21, respectively. The major constraint comes in adoption of smart

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agricultural practices is that farmers are not familiar with improved practices and it might be possible due to the fact that clearly farmers develop and use cultural practices they are comfortable with and therefore minimize production risk associated with crop failure or yield reductions. Most farmers perceive these practices to be too costly. While Dsouza et al. (1993) concluded that adoption of sustainable agricultural practices is affected most by the environmental characteristic. Ikerd (1990) states that economic considerations and incentives are needed to encourage change to a different system. Secondly lack of awareness, training and skills about these practices are another factor. So, it is important to organize continuous awareness programs and provide the skill oriented training at local level in farming community. These results are in confirmation with those reported by Kumari (2012).

Table 2. *Constraints in adoption of sustainable farming (n = 180)*

S. No.	Sustainable constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Small and fragmented land holding	95 (52.78)	63 (35.00)	22 (12.22)	433	2.41	II
2	Lack of skill to adopt sustainable farming	57 (31.67)	110 (61.11)	13 (7.22)	404	2.24	IV
3	Lack of finance to adopt improved practices	50 (27.78)	118 (65.56)	12 (6.66)	398	2.21	V
4	Not aware about training for sustainable farming	63 (35.00)	107 (59.44)	10 (5.56)	413	2.29	III
5	Not familiar with improved practices	95 (52.78)	72 (40.00)	13 (7.22)	442	2.46	I

n = 180 represents the total number of respondents

Constraints in adoption of weather forecasting

A perusal of data presented in *Table 3* indicated the weather forecasting viz., 'not aware about the procedure of registration' ranked 1st with highest weighted mean score (WMS) 2.37, followed by 'irregularity in message' ranked 2nd with WMS 2.23. 'Information is useful only for until crop production', 'lack of resources and internet etc.' and 'not proper language of message' ranked 3rd, 4th and 5th with WMS 2.22, 2.19 and 2.12, respectively. Farmers were not aware about the procedure of registration was ranked top and this may be possibly due to the region that extension personnel do not regularly interact with farmers to discuss climate forecasts. These constraints can be trimmed by providing proper guidance from the experts to the farmers with the help of literature, awareness campaign and mass media about weather forecasting advisory services to the farmers. Oyekale (2015) also reported that infrastructure and human capacities that are needed for attaining such efficiency were acutely lacking. This has also been reported by Murthy (2008) with respect to weather forecasts in Andhra Pradesh. Agricultural extension agents, working with farmers and forecasters could help forecasters to focus on the climate variables and spatial resolutions that matter to farmers and provide feedback from farmers to the forecasters about the performance and utility of the forecasts. They could assist farmers to interpret and apply forecasts for

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making decisions such as the time of planting, choice of crops and crop varieties, application of fertilizers, herbicides, pesticides and irrigation water. These constraints can be overcome by frequent visits by extension personnel along with use of different teaching materials and methods, as extension personnel, rarely interact with farmers as well as the use of different teaching materials like display boards, bulletins (Feleke, 2015) and methods like personal contacts, informal discussion (Rajesh et al., 2016) on changing weather conditions were not given the deserved attention. Weather forecasting advisory services to the farmers and Climate Field Schools are discussed in this context by Stigter (2008).

Table 3. *Constraints in adoption of weather forecasting (n = 180)*

S. No.	Weather forecasting constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Not aware about the procedure of registration	95 (52.78)	56 (31.11	29 (16.11)	426	2.37	I
2	Irregularity in message	57 (31.67)	108 (60.00)	15 (8.33)	402	2.23	II
3	Not proper language of message	49 (27.22)	104 (57.78)	27 (15.00)	382	2.12	V
4	Lack of resources and internet etc.	50 (27.78)	114 (63.33)	16 (8.89)	394	2.19	IV
5	Information is useful only for until crop production	47 (26.11)	126 (70.00)	7 (3.89)	400	2.22	III

n = 180 represents the total number of respondents

Constraints in adoption of conservation agriculture (CA)

Data presented in *Table 4* indicated the conservation agriculture (CA) constraints viz., 'conservation agriculture is more labour intensive' ranked 1st and major constraints with weighted mean score (WMS) 2.24, followed by 'increasing weed infestation', 'poor soil quality' and 'fragmented land holding' ranked 2nd, 3rd and 4th with WMS 2.21, 2.18 and 1.43, respectively. The conservation agriculture (CA) constraints viz., conservation agriculture is more labour intensive as well as prominent among farmers because full implementation of the principles of conservation agriculture involves a drastic change in many farm operations. So, there is immense need of proper training programs and policy about CA promotions (Grabowski, 2011; Kudi et al., 2011). A new knowledge base is needed by farmers to establish crops, manage weeds, manage crop residues, respond to newly emerging diseases and insect pests, and manage diverse crops that make the conservation agriculture more labour intensive (Pieri et al., 2002). Moreover, it cannot be reduced to a simple standard technology and thus pioneers and early adopters' face many hurdles before the benefits of conservation agriculture can be revealed (Derpsch, 2008). Also, it is appeared that conservation agriculture is as yet a relatively unknown concept (Kassam et al., 2009). Indeed, conservation agriculture is not an easily transferable single component technology; the appropriateness of conservation agriculture depends on both biophysical and socioeconomic factors and their interactions.

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Table 4. *Constraints in adoption of conservation agriculture (CA) (n = 180)*

S. No.	Conservation agriculture constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Fragmented land holding	22 (12.22)	34 (18.89)	124 (68.89)	258	1.43	IV
2	Poor soil quality	47 (26.11)	119 (66.11)	14 (7.78)	393	2.18	III
3	Increasing weed infestation	45 (25.00)	128 (71.11)	7 (3.89)	398	2.21	II
4	Conservation agriculture is more labour intensive	53 (29.44)	118 (65.56)	9 (5.00)	404	2.24	I

n = 180 represents the total number of respondents

Constraints in adoption of information and communication technologies (ICTs)

Table 5 described the constraints in adoption of ICTs viz., 'lack of training to access e-information' ranked 1st with highest weighted mean score (WMS) 2.39, followed by 'low internet access and electricity', 'inadequate infrastructural facilities', 'lack of resources and tools', and 'fear that ICTs provides irrelevant content' ranked 2nd, 3rd, 4th and 5th with WMS 2.30, 2.25, 2.22 and 2.18, respectively. The first rank was ascribed to the statement that there is lack of training to access e-information and this could be possibly due to the reason that regulatory frameworks for ICTs are not necessarily conducive to widespread scale up of ICT in rural areas. Processes take several years and require many regular visits to monitor and encourage progress, without assurance of success. This can be achieved through information and training campaigns, suitable legislations and policy along with regulatory frameworks, research and development, incentive and credit programs (Friedrich and Kassam, 2009). Therefore, training programs should be organized to overcome the constraints along with to provide infrastructure facilities, resources, tools and internet (Albert, 2014). While Rohila et al. (2017) suggested that low cost ICT tools such as mobile phones etc. should be promoted to provide agricultural information.

Table 5. *Constraints in adoption of ICTs (n = 180)*

S. No.	ICTs constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Inadequate infrastructural facilities	55 (30.56)	115 (63.89)	10 (5.55)	405	2.25	III
2	Lack of resources and tools	51 (28.33)	118 (65.56)	11 (6.11)	400	2.22	IV
3	Low internet access and electricity	64 (35.56)	106 (58.89)	10 (5.55)	414	2.30	II
4	Fear that ICTs provides irrelevant content	52 (28.89)	108 (60.00)	20 (11.11)	392	2.18	V
5	Lack of training to access e-information	79 (43.89)	92 (51.11)	9 (5.00)	430	2.39	I

n = 180 represents the total number of respondents

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Constraints related to climate change

Table 6 narrated that climate change constraints viz., 'climate change effects the seasonal temperature and rainfall' ranked 1st with highest weighted mean score (WMS) 2.76, followed by 'rapid change in weather conditions' ranked 2nd with WMS 2.49. Whereas, 'deterioration in the quality of crop produce', 'environmental degradation', 'effect on plant population and yield', and 'probability of droughts and floods' ranked 3rd, 4th, 5th and 6th with WMS 2.47, 2.35, 2.28 and 2.22, respectively. The statement climate change effects the seasonal temperature and rainfall was ranked 1st with highest weighted mean score by the respondents and this might be due to the reason that climate change is arguably one of the most important challenge which is faced by farmers, largely due to their geographic exposure, low income, greater reliance on climate-sensitive sectors such as agriculture, and weak capacity to adapt to the changing climate. Farmers are adversely affected by climatic variability and change because of their dependency on rain-fed agriculture, with variability in rainfall and temperature directly affecting crop and livestock yields. Empirical results show that climate variability has significant economic costs as a result of periodic floods and droughts, which lead to major macro-economic costs and reductions in economic growth. This increased complexity requires a degree of experience and knowledge, which has to be acquired and learned. For early adopters this learning process and experiential knowledge has therefore involved a lot of trial and error until sufficient local experience and knowledge is accumulated to make the adoption easier (FAO, 2010; Mahato, 2014).

Table 6. *Constraints related to climate change (n = 180)*

S. No.	Climate change constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Rapid change in weather conditions	92 (51.11)	85 (47.22)	3 (1.67)	449	2.49	II
2	Environmental degradation	68 (37.78)	107 (59.44)	5 (2.78)	423	2.35	IV
3	Climate change effects the seasonal temperature and rainfall	137 (76.11)	42 (23.33)	1 (0.56)	496	2.76	I
4	Deterioration in the quality of crop produce	93 (51.67)	79 (43.89)	8 (4.44)	445	2.47	III
5	Effect on plant population and yield	54 (30.00)	123 (68.33)	3 (1.67)	411	2.28	V
6	Probability of droughts and floods	52 (28.89)	115 (63.89)	13 (7.22)	399	2.22	VI

n = 180 represents the total number of respondents

Constraints in adoption of greenhouse gas mitigation practices

The data in *Table 7* depicted the greenhouse gas mitigation constraints viz., 'slow result of eco-friendly practices' ranked 1st with highest weighted mean score (WMS) 2.54, followed by 'ignorance about the bed effect of chemical hazardous on health' ranked 2nd with WMS 2.45. While, 'no reward for adoption of environmental measures', 'non-

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availability of package of practices' and 'mostly farmers burn crop residue in the fields' ranked 3rd, 4th and 5th with WMS 2.38, 2.22 and 1.88, respectively. The statement slow result of eco-friendly practices ranked 1st may be because of the reason that eco-friendly practices contradicts the knowledge a farmer which he have learned from his experience and been told that the benefits offered by these practices are not obvious in the beginning. However, once the step-wise adoption begins, an eco-friendly practice improves its performance over time (Tebrugge and Bohrnsen, 2000). From the results of the study, it is clear that farmers will more readily adopt sequestration of GHGs if the agricultural extension services, planning and strategies could be improved. These findings are in line with findings of Mukteshawar and Seharawat (2016).

Table 7. *Constraints in adoption of greenhouse gas mitigation practices (n = 180)*

S. No.	Greenhouse gas mitigation constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Non-availability of package of practices	47 (26.11)	126 (70.00)	7 (3.89	400	2.22	IV
2	No reward for adoption of environmental measures	86 (47.78)	76 (42.22)	18 (10.00)	428	2.38	III
3	Ignorance about the bed effect of chemical hazardous on health	84 (46.67)	93 (51.67)	3 (1.66)	441	2.45	II
4	Slow result of eco- friendly practices	105 (58.33)	68 (37.78)	7 (3.89)	458	2.54	I
5	Mostly farmers burn crop residue in the fields	52 (28.89)	55 (30.56)	73 (40.55)	339	1.88	V

n = 180 represents the total number of respondents

Constraints in adoption of protected cultivation

The data contained in *Table 8* showed the protected cultivation constraints viz., 'high initial cost' ranked 1st as major constraint with highest weighted mean score (WMS) 2.52, followed by 'poor quality of material' ranked 2nd with WMS 2.41. While, 'frequent occurrence of wind storms, hailstorms, rain etc.' and 'problem of nematodes and diseases' ranked 3rd and 4th with WMS 2.23 and 2.04, respectively. The statement high initial cost ranked 1st might be possibly due to the reason that polyhouse cultivation requires quality planting material, inputs, etc. which adds economic burden to the farmers. Singh and Sirohi (2006) also reported that the basic cost of fabrication and the operational cost of the climate-controlled greenhouses are very high, which are not suitable to the growers in India. Therefore, high initial investment, lack of availability of quality planting materials and inputs, poor post-harvest infrastructure and absence of price policy have led to very limited adoption of this technology by few farmers in certain pockets of the country. Above constraints can be countered to enhance farmers' adoption level with the help of manufacturing and financial sector support. It can be increased through capacity building of farmers, research and development coupled with adequate marketing system. Present study got support from the past research study of Ghanghas et al. (2015).

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Table 8. *Constraints in adoption of protected cultivation (n = 180)*

S. No.	Protected cultivation constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	High initial cost	99 (55.00)	76 (42.22)	5 (2.78)	454	2.52	I
2	Poor quality of material	78 (43.33)	97 (53.89)	5 (2.78)	433	2.41	II
3	Frequent occurrence of wind storms, hailstorms, rain etc.	46 (25.56)	129 (71.67)	5 (2.77)	401	2.23	III
4	Problem of nematodes and diseases	25 (13.89)	137 (76.11)	18 (10.00)	367	2.04	IV

n = 180 represents the total number of respondents

Constraints in adoption agro-processing and value addition practices

Table 9 elaborated the agro-processing and value addition constraints viz., 'lack of proper training' ranked 1stas major constraint, followed by 'lack of agro-processing unit' ranked 2nd with WMS 2.38. Whereas, 'lack of procurement policy' and 'lack of proper facilities' ranked 3rd and 4th with WMS 2.25 and 2.23, respectively. However, 'lack of consumption of agro processed food' ranked 5th with lowest WMS 2.13. Lack of proper training among the farmers was encountered as major constraints possibly due to the number of notable factors like socio-economic, contact with extension workers, provision of infrastructure and other institutional factors, which influenced the adoption. Other factors are also reported including society membership, education (Lapar and Pandey, 1999; Weir and Knight, 2000) and household income (Lapar and Simeon, 2004), education levels (Irungu et al., 1998; Lapar and Simeon, 2004) that contribute in adoption of new agricultural technologies. However, these constraints can be adequately addressed through extension agencies by formation of SHGs and by adopting bottom-up approach. While considering these facts, the need-based and skill oriented training awareness campaign including credit support, market-driven and decentralized extension system of the agro-processors to upgrade their knowledge and skills in modern post-harvest technology is strongly recommended. Moreover, provision of credit facilities could change the perceived constraints into enabling factors for adoption of modern post-harvest technology enterprises (Meena et al., 2009; Musebe et al., 2013).

Correlation and regression coefficients of farmers' personality traits with constraints encountered in adoption of smart agricultural practices

Table 10 narrated that correlation coefficient between the farmers' personality traits like education, land holding, cropping system, farming system, mass media exposure, extension contact, risk orientation, economic motivation and innovation proneness had positive and significant correlation. However, remaining traits namely age and irrigation facilities did not show any significant association at 0.05 level of probability. While in case of the partial regression coefficient, the farmers' education and mass media exposure were found significant, whereas, age, land holding, cropping system, farming system, irrigation facilities, extension contact, risk orientation, economic motivation and

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innovation proneness did not show significantly contribution. These finding were found to partially support by the reports of Rajashekar et al. (2017). Further, it is revealed that all the eleven independent variables included in the study jointly contributed 37.00% variation in the constraints of the respondents regarding in adoption of smart agricultural practices when other factors were kept constant. This means that only 37.00% of the variation in the dependent variable was due to these variables and remaining 63.00% variations is due to other variables.

Table 9. *Constraints in adoption agro processing and value addition practices (n = 180)*

S. No.	Agro processing and value addition constraints	Constraints			Total weighted score	Weighted mean score	Rank order
		Very serious (%)	Serious (%)	Not so serious (%)			
1	Lack of proper facilities	46 (25.56)	130 (72.22)	4 (2.22)	402	2.23	IV
2	Lack of procurement policy	53 (29.44)	119 (66.11)	8 (4.44)	405	2.25	III
3	Lack of agro-processing unit	75 (41.67)	98 (54.44)	7 (3.89)	428	2.38	II
4	Lack of proper training	82 (45.56)	92 (51.11)	6 (3.33)	436	2.42	I
5	Lack of consumption of agro processed food	38 (21.11)	90 (50.00)	52 (28.89)	384	2.13	V

Table 10. *Correlation and regression coefficients of farmers' personality traits with constraints encountered in adoption of smart agricultural practices*

S. No.	Variables	S.D	Correlation coefficient	Regression coefficient	't' values
1	Age	0.772	0.082^{NS}	0.207	0.154^{NS}
2	Education	1.619	-0.356^{*}	-2.182	-3.198^{*}
3	Land holding	0.977	-0.366^{*}	-1.459	-1.291^{NS}
4	Cropping system	0.787	-0.145^{NS}	-2.705	-2.2^{NS}
5	Farming system	0.508	-0.349^{*}	-3.544	-1.409^{NS}
6	Irrigation facilities	0.524	-0.042^{NS}	1.269	0.727^{NS}
7	Mass media exposure	1.819	-0.447^{*}	-1.948	-3.092^{*}
8	Extension contacts	0.914	-0.356^{*}	-1.51	-1.054^{NS}
9	Risk orientation	2.782	-0.110^{NS}	0.524	1.53^{NS}
10	Economic motivation	3.998	-0.246^{*}	-0.478	-1.899^{NS}
11	Innovation proneness	1.028	-0.344^{*}	-0.723	-0.667^{NS}

Dependent variable-constraints
*Significant at 0.05 levels
$R^2 = 0.37$, Constant value = 132.78

Conclusion

The results of this study showed that many factors can affect the decisions of farmers to accept and adopt the smart agricultural practices (SAPs), but cost is the most

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important, followed by risks. Therefore, government should emphasize on the problems faced by farmers in adoption of smart agricultural practices (SAPs). Moreover, the action plans which may be more efficient and effective must be formulated and implemented at ground level by the government.

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APPENDIX

DEPARTMENT OF EXTENSION EDUCATION
CCS HARYANA AGRICULTURAL UNIVERSITY, HISAR-125004

The Investigator:
Anil Kumar Rohila
Admission No: 2014A21D

Appendix 1

Sr. No.__ **Mobile N. _____**

1. Name of Respondent: _____ **2. Father's Name: _____**

3. Village: _____ **4. Block: _____**

5. District: _____ **6. Age:_____**

7. Education

S. No.	Qualification	
1	Illiterate	
2	Primary	
3	Middle	
4	Metric	
5	Higher Secondary	
6	Graduate	

8. Land Holding

S. No.	Particular	
1	Landless	
2	Less than one acre	
3	Up to 5 acres	
4	6 to 10 acres	
5	11 to 15 acres	
6	16 to 20 acres	
7	More than 20 acres	

9. Cropping System

S. No.	Particulars	Yes	No
1	Rice-Wheat		
2	Cotton-Wheat		
3	Sugarcane Based		
4	Rice-Other crops		
5	Other crops-Wheat		
6	Cotton-Other crops		

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7	Bajra/Jwar/Gwar-Wheat		
8	Bajra/Jwar/Gwar-Fallow		
9	Fallow-Wheat		
10	Bajra/Fallow-Mustard		
11	Bajra/Fallow-Pulses		
12	Other Rotation		

10. Farming System

S. No.	Particulars	Yes	No
1	Livestock		
2	Poultry		
3	Fisheries		
4	Forestry		
5	Agro-forestry		
6	Mushroom cultivation		
7	Bee keeping		
8	Organic farming		
9	Floriculture		
10	Poly house nursery		
11	Poly house vegetable production		

11. Irrigation Facilities

S. No	Particulars	Yes	No
1	Submersible Pump		
2	Tube well		
3	Canal		
4	Others		

12. Farm Power

S. No	Particulars	
1	No draft animal	
2	1-2 draft animal	
3	3-4 draft animal	
4	one or more prestige animal	
5	Tractor	

13. Mass Media Exposure

S. No	Particulars	
1	Do you listen radio?	Yes/No
2	If yes. How frequently?	Daily/often/sometimes
3	Do you watch agriculture related T.V. programms?	Yes/No
4	If yes. How frequently?	Daily/often/sometimes

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5	Do you read newspaper?	Yes/No
6	If yes. How often?	Daily/often/sometimes
7	Do you read farm magazines?	Yes/No
8	Do you call Kisan Sewa Kendra for queries?	Yes/No
9	Do you search online solution for your problems?	Yes/No

14. Extension Contact

S. No.	Extension Official	Frequency of Contact				
		Weekly	Fortnightly	Monthly	Whenever needed	None
1	ADOs					
2	SDAO/SMS					
3	Scientists					
4	Progressive farmer					
5	NGO					
6	Others					
	Total					

15. Economic Motivation

S. No.	Statements	SA	A	N	D	SD
1	A farmer should work toward larger yields and economic profit					
2	The most successful farmer is one, who makes the most profit					
3	A farmer should try any new farming idea which may earn him more money					
4	A farmer should grow cash crops to increase monetary profits in comparison to growing of food crops for home consumption					
5	It is difficult for the farmers' children to make good start, unless he provides them with economic assistance					
6	A farmer must earn his living but the most important thing in life cannot be defined in economic terms					

16. Innovation proneness

S. No	Statements	Most Like	Least like
(A)1	I try to keep myself up to date with information of any improved farm practice, but that does not mean that I try out all the new methods on my farm.		
2	I fell restless, till I try out the improved farm practice, I heard about.		
3	They talk of many improved farm practices these days but who knows if they are better than the old one.		
(B)1	I am cautious about trying a new practice.		
2	After all our forefathers were wise about their farm practices and I don't see any reason for changing the old methods		
3	Often improved farm practices are not successful. However, they are promising I would surely like to accept them.		

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(C)1	From time to time, I have heard from several improved farm practices and I have tried out most them in last few years,		
2	I usually wait to see what results my neighbours obtain before I try out the improved farm practices.		
3	Somehow, I believe that the traditional ways of farming are the best.		

Appendix 2

Constraints in adoption of sustainable farming

S. No.	Sustainable constraints	Constraints		
		Very serious	Serious	Not so serious
1	Small and fragmented land holding			
2	Lack of skill to adopt sustainable farming			
3	Lack of finance to adopt improved practices			
4	Not aware about training for sustainable farming			
5	Not familiar with improved practices			

Constraints in adoption of weather forecasting

S. No.	Weather forecasting constraints	Constraints		
		Very serious	Serious	Not so serious
1	Not aware about the procedure of registration			
2	Irregularity in message			
3	Not proper language of message			
4	Lack of resources and internet etc.			
5	Information is useful only for until crop production			

Constraints in adoption of conservation agriculture (CA)

S. No.	Conservation agriculture constraints	Constraints		
		Very serious	Serious	Not so serious
1	Fragmented land holding			
2	Poor soil quality			
3	Increasing weed infestation			
4	Conservation agriculture is more labour intensive			

Constraints in adoption of ICTs

S. No.	ICTs constraints	Constraints		
		Very serious	Serious	Not so serious
1	Inadequate infrastructural facilities			
2	Lack of resources and tools			
3	Low internet access and electricity			

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4	Fear that ICTs provides irrelevant content			
5	Lack of training to access e-information			

Constraints related to climate change

S. No.	Climate change constraints	Constraints		
		Very serious	Serious	Not so serious
1	Rapid change in weather conditions			
2	Environmental degradation			
3	Climate change effects the seasonal temperature and rainfall			
4	Deterioration in the quality of crop produce			
5	Effect on plant population and yield			
6	Probability of droughts and floods			

Constraints in adoption of greenhouse gas mitigation practices

S. No.	Greenhouse gas mitigation constraints	Constraints		
		Very serious	Serious	Not so serious
1	Non-availability of package of practices			
2	No reward for adoption of environmental measures			
3	Ignorance about the bed effect of chemical hazardous on health			
4	Slow result of eco- friendly practices			
5	Mostly farmers burn crop residue in the fields			

Constraints in adoption of protected cultivation

		Very serious	Serious	Not so serious
1	High initial cost			
2	Poor quality of material			
3	Frequent occurrence of wind storms, hailstorms, rain etc.			
4	Problem of nematodes and diseases			

Constraints in adoption agro processing and value addition practices

S. No.	Agro processing and value addition constraints	Constraints		
		Very serious	Serious	Not so serious
1	Lack of proper facilities			
2	Lack of procurement policy			
3	Lack of agro-processing unit			
4	Lack of proper training			
5	Lack of consumption of agro processed food			

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