Received : 21.09.2022 | Accepted : 18.11.2022 | Online published : 15.12.2022
https://doi.org/10.54986/irjee/2022/dec_spl/24-29
IRJEE SOCIETY OF EXTENSION EDUCATION

RESEARCH ARTICLE

Constraint Analysis in Usage of Artificial Intelligence Application in Agricultural Production

Vikash[1], P.S. Shehrawat[2], Aditya[2] and Babu Lal[3]

1&3. Research Scholar
2. Principal Scientist,
Deptt. of Ext. Edu.,
CCSHAU, Hisar, India
Corresponding author e-mail: rathi.anamika455@gmail.com

ABSTRACT

Artificial intelligence tools and techniques play an important role in enhancing agricultural production. Farmers need advance tools and techniques on every critical stage of crop cultivation. The present study was conducted at KVK of CCS-HAU located in different districts of Haryana. Further, a total of 150 respondents were interviewed personally at their respective places for the study. The present study revealed that constraints faced by agricultural professionals in using robots, costlier to implement considered most severe constraint and ranked first. In constraint in using weather forecast, availability of historical and real time data was considered most severe constraint and ranked first. In constraint related to policy, no supporting budget to buy equipment was considered most severe constraint and ranked first. In constraint related to accessibility of reliable information, accessibility problem in rural areas was considered most severe constraint and ranked first. In constraint related to cost, cost of using smart system was high was considered most severe constraint and ranked first. In constraint in ease of use and training, less knowledge of operating the equipment was considered most severe constraint and ranked first. In non-physical constraint in using Artificial Intelligence (AI) technique, inadequate information was considered most severe constraint and ranked first. In constraint in implementation of AI technique, untrained manpower was considered most severe constraint and ranked first. In constraint in using laser land leveller, high cost of the equipment cannot be maintained by small farmers was considered most severe constraint and ranked first. In socio-psychological constraints, low socio-economical condition was considered most severe constraint and ranked first.

Key words: *Artificial intelligence tools; Farmers; Constraints; Weighted mean score.*

Artificial Intelligence (AI) is an area of extreme Importance in agriculture where about 30.7 per cent of the world population is directly engaged on 2781 million hectares of agricultural land. The application of computers in agriculture was first reported in 1983. Different approaches have been suggested to solve the existing problems in the agriculture starting from the database to decision support systems. Out of these solutions, systems that apply AI have been found to be the most excellent performers as far as the accuracy and robustness are concerned (*Meena, 2003*). AI with simulated algorithmic computer models that mimic human behaviour can be considered. In this process, an installed application guides farmer through the process of growing, sowing, harvesting and sale of produce. AI is a program that can adapt itself to execute tasks in real time situations using cognitive processing as the human mind. Interestingly, it does not require constant supervision (*Bannerjee et al., 2018*).

Utilization of ICT service in agriculture and rural development is in the takeoff stage and farmers experienced many problems. Among the various constraints experienced by the respondent farmers in utilization of ICT, insufficient regional specific information emerged as most prominent constraint and based on RBQ value (67.36) given highest priority (*Dhaka and Chayal, 2016*).

A social constraint highlighted, comprises lack of awareness, lack of motivation to the farmers towards training, communication gap among the scientist,

farmers and extension workers, lack of education, lack of interests to get modern techniques, poor social status and small land holding of untrained farmers. 88.67% farmers come under the communication gap among the scientist farmers and extension workers followed by 80.67% lack of motivation towards training. Lack of awareness also major constraints faced by the untrained farmers in relation to training (*Singh, 2008*).

AI is silently but increasingly entering Indian agriculture, hence affecting our society at large. Even though machine learning has been used for classifications and prediction purposes for, to cite a few, food grading and crop yield forecasting, recently, the new set of deep learning algorithms have heralded the possibilities of taking the research and applications of AI to much higher levels and with much more accuracy. Similarly, other AI techniques are making inroads in all fields including agriculture (*Ganguli, 2006*).

Thus, the present investigation was an attempt to study the constraints faced by the agricultural professionals in using the AI tools and techniques.

METHODOLOGY

The present study was conducted in CCS-HAU, Hisar, KVKs of CCS-HAU located in different districts of Haryana, ATIC of CCS-HAU, Hisar and ADT of CCS-HAU, Hisar. Further, minimum three and total 80 respondents were selected randomly from each department of the CCS-HAU, Hisar, 70 respondents were selected from 16 KVKs of CCS-HAU, Hisar, ATIC of CCS-HAU, Hisar and ADT of CCS-HAU, Hisar randomly. Thus, a total of 150 respondents were interviewed personally at their respective places. The data were collected with the help of a well-structured and pre-tested interview schedule comprising the various items for this study. A schedule was developed to measure the constraints after paying a deep discussion with experts and professionals. The responses of agricultural professionals were obtained on three-point continuum scale as 'very serious' 'serious' and 'not so serious' and weightage was given as 3, 2 and 1, respectively. Aggregate total weightage score was calculated for each statement about constraint separately and on the basis of calculated Total Weighted Score, weighted mean score and Z-Score were obtained to show the seriousness of each statement and rank order was calculated. Constraints were ranked from high to low based on Z-score (s).

RESULTS AND DISCUSSION

The results along with the relevant discussion have been presented in prime heads as technical constraints, policy related constraints, accessibility related, cost related constraints, ease of use and training related constraints, non-physical constraints, constraints related to implementation, socio-psychological constraints. These results helped in understanding the main barriers in using AI tools and techniques. These constraints are discussed individually one by one in detail.

Technical constraints perceived by the agricultural professionals :

Constraints faced by agricultural professionals in using robots : The Table 1 revealed that It is costlier to implement (Z score= 0.09) was very serious constraint, Whereas complexity is increased (Z score= 0.09), electricity shortage (Z score= -0.86), high cost of procuring imported hardware components (Z score= -0.15), repair and maintenance become an issue (Z score= 0.81), high cost of research and development (Z score= -0.15), lack of access to poor farmers (Z score= 0.33) and robots cannot improve with experience (Z score= -0.26) were serious constraints encountered in using robots in agriculture.

While on the other hand, the robots can change the culture (Z score= -1.69) was encountered as not so serious constraint. These findings were found to partially support by reports of *Kumar et al. (2016).*

Constraints in using weather forecast : The Table 1 revealed that complex maintenance (Z score= 1.29) and availability of historical and real time data (Z score= 1.38) were very serious constraint, Whereas complex physical features (Z score= -0.76), cost distribution of the service (Z score= -0.76), capacity of forecasters to receive and use the available products (Z score= -0.38) and supporting policies and capacities of users to apply the information (Z score= 0.27) were serious constraints encountered in using weather forecast in agriculture.

While on the other hand, human resource and computing capacities (Z score= -1.04) was encountered as not so serious constraint.

The results revealed that language problems, difficulty in understanding forecast terminology, lack of coordination and downscaling weather information at local level along with inconsistency in the time of information provision were major constraints in using weather information (*Feleke, 2015*).

Constraints in using laser land leveller : The Table

1 revealed that high cost of the equipment cannot be maintained by small farmers (Z score= 1.67) was very serious constraint, Whereas training required for operation of laser land levelling machine (Z score= -0.38), difficulty in preparation of land before using laser land leveller (Z score= -0.23), lack of availability of spare parts of the machine in various location (Z score= -1.00) and technology is not suitable for small land holdings (Z score= -0.07) were serious constraints encountered in using laser land leveller in agriculture.

The present study got support from the past research findings of *Kumar et al. (2016)* who reported that major constraints were higher prices, insufficient funds for small entrepreneurs, lack of skill and awareness, higher cost of machinery and poor support on marketing.

Constraints related to policy : The Table 1 revealed that no supporting budget to buy equipment (Z score= 1.44) was very serious constraint, whereas government funds are not available (Z score= 0.00), no separate budget for the promotion of AI (Z score= 0.72), no subsidy available for AI tools (Z score= -0.36) and no separate government department for training (Z score= 0.60) were serious constraints related to policy in using artificial intelligence in agriculture.

While on the other hand, no support from authorities (Z score= -1.20) and increasing unemployment (Z score= -1.20) were encountered as not so serious constraint.

Similarly, some of the identified constraints were lack of talents with align skills, budget constraints, lack of leadership awareness, cultural resistance, and access to data (*Dasgupta and Wendler, 2019*). Lack of skilled talents to use AI was the most common constraint faced.

Constraint related to accessibility of reliable information : The Table 1 revealed that accessibility problem in rural areas (Z score= 2.00) was very serious constraint, whereas no internet connection available in rural areas (Z score= -0.63), availability of the gadgets and equipment is less (Z score= -0.15), availability of electricity is low (Z score= -0.71), lack of knowledge about smart machines (Z score= 0.57), lack of familiarity with AI tools (Z score= -0.63) and lack of ICT tools (Z score= 0.57) were serious constraints related to accessibility of reliable information in using artificial intelligence in agriculture.

While on the other hand, some information needed further explanation (Z score= -1.02) and increasing unemployment (Z score= -1.20) were encountered as not so serious constraint. Results are also supported by the report of *Dhaka and Chayal (2016).*

Constraints related to cost : The Table 1 revealed that the cost of using smart system is high (Z score= 1.46) and maintenance cost is high (Z score= 1.21) were very serious constraint, whereas, import tax is high (Z score= -0.43), Lack of information about import policy (Z score= -0.37), fund availability is less (Z score= -0.12) and insufficiency of institutional finance resources (Z score= -0.37) were serious constraints related to cost.

While on the other hand, insufficient rewards and recognition for scientists who produce smart machines for agriculture (Z score= -1.38) was encountered as not so serious constraint. The present study got support from the past research study of *Tata and McNamara (2016)* and *Shashikala et al. (2012)* the reported that non-availability of inputs, followed by lack of credit, lack of assured irrigation, non-availability of inputs at appropriate time and high cost of inputs were major constraints.

Constraint in ease of use and training : The Table 1 revealed that don't know how to operate the equipment (Z score= 1.93) and lack of adequate knowledge about hardware and software (Z score= 1.06) were very serious constraint, whereas, lack of proper training (Z score= 0.48), expert's advice is not clear (Z score= -0.46), not yet covered all farmers practices (Z score= -0.53), research is not yet approved by all users (Z score= -0.68), gap between the perspective of both developer and users (Z score= -0.75) and lack of required skill (Z score= 0.12) were serious constraints related to ease of use and training in using artificial intelligence in agriculture.

While on the other hand, difficult to understand (Z score= -1.18) was encountered as not so serious constraint. Similarly, *Anavrat (2015)* also reported that lack of information was one of the major and important factors, with required information and technology timely for accelerating their better adoption.

Non-Physical Constraints in using AI Technique : The Table 1 revealed that inadequate information (Z score= 1.64) was very serious constraint, whereas, inadequate knowledge (Z score= 0.38), Lack of appropriate technology (Z score= 0.12), unfavorable land tenure (Z score= -0.14) and unfavorable weather conditions (Z score= -0.77) were serious constraints in non-physical constraints in using AI technique.

Table 1. Technical constraints perceived by the agricultural professionals

Statement	Very Serious (3)	Serious (2)	Not so Serious (1)	TWS	WMS	Z-Score	Seriousness	Rank
Constraints faced in using robots								
It is costlier to implement	53(159)	77(154)	20(20)	333	2.22	1.88	VS	I
Complexity is increased	37(111)	94(188)	19(19)	318	2.12	0.09	S	IV
Electricity shortage	40(120)	80(160)	30(30)	310	2.07	-0.86	S	VIII
High cost of procuring imported hardware	39(117)	88(176)	23(23)	316	2.11	-0.15	S	V
Repair and maintenance become an issue	53(159)	68(136)	29(29)	324	2.16	0.81	S	II
The robots can change the culture	37(111)	79(158)	34(34)	303	2.02	-1.69	NSS	IX
The high cost of research and development	50(150)	66(132)	34(34)	316	2.11	-0.15	S	V
Lack of access to poor farmers	48(144)	74(148)	28(28)	320	2.13	0.33	S	III
Robots cannot improve with experience	43(129)	79(158)	28(28)	315	2.10	-0.26	S	VII
Constraints faced in using weather forecast								
Complex maintenance	41(123)	71(142)	38(38)	303	2.02	1.29	VS	II
Complex physical features	22(66)	87(174)	41(41)	281	1.87	-0.76	S	V
Cost distribution of the service	32(96)	67(134)	51(51)	281	1.87	-0.76	S	V
Human resource and computing capacities	20(60)	88(176)	42(42)	278	1.85	-1.04	NSS	VII
Availability of historical and real time data	37(111)	80(160)	33(33)	304	2.03	1.38	VS	I
Capacity of forecasters to receive and use products	20(60)	95(190)	35(35)	285	1.90	-0.38	S	IV
Supporting policies and capacities of information	27(81)	88(176)	35(35)	292	1.95	0.27	S	III
Constraints faced in using laser land leveller								
High cost of the equipment	62(186)	67(134)	21(21)	341	2.27	1.67	VS	I
Training required for operation of laser levellor	34(102)	83(166)	33(33)	301	2.01	-0.38	S	IV
Difficulty in preparation of land before using leveller	46(138)	62(124)	42(42)	304	2.03	-0.23	S	III
Lack of availability of spare parts of the machine	27(81)	85(170)	38(38)	289	1.93	-1.00	S	V
Technology is not suitable for small land holdings	42(126)	73(146)	35(35)	307	2.05	-0.07	S	II
Policy related constraints faced in using AI								
No supporting budget to buy equipment	50(150)	76(152)	24(24)	326	2.17	1.44	VS	I
No support from Authorities	32(96)	90(180)	28(28)	304	2.03	-1.20	NSS	VI
Increasing unemployment	43(129)	68(136)	39(39)	304	2.03	-1.20	NSS	VI
Government funds are not available	41(123)	82(164)	27(27)	314	2.09	0.00	S	IV
No separate budget for the promotion of AI	47(141)	76(152)	27(27)	320	2.13	0.72	S	II
No subsidy available for AI tools	38(114)	85(170)	27(27)	311	2.07	-0.36	S	V
No separate government department for training	45(135)	79(158)	26(26)	319	2.13	0.60	S	III
Accessibility of reliable information related constraints								
Accessibility problem in rural areas	53(159)	84(168)	13(13)	340	2.27	2.00	VS	I
Some information needed further explanation	23(69)	106 (212)	21(21)	302	2.01	-1.02	NSS	VIII
No internet connection available in rural areas	42(126)	73(146)	35(35)	307	2.05	-0.63	S	V
Availability of the gadgets and equipment is less	33(99)	97(194)	20(20)	313	2.09	-0.15	S	IV
Availability of electricity is low	37(111)	82(164)	31(31)	306	2.04	-0.71	S	VII
Lack of knowledge about smart machines	42(126)	88(176)	20(20)	322	2.15	0.57	S	II
Lack of familiarity with AI tools	38(114)	81(162)	31(31)	307	2.05	-0.63	S	V
Lack of ICT tools	44(132)	84(168)	22(22)	322	2.15	0.57	S	II
Cost related constraints								
The cost of using smart system is high	65(195)	69(138)	16(16)	349	2.33	1.46	VS	I
Import tax is high	40(120)	89(178)	21(21)	319	2.13	-0.43	S	VI
Lack of information about import policy	48(144)	74(148)	28(28)	320	2.13	-0.37	S	IV

Maintenance cost is high	60(180)	75(150)	15(15)	345	2.30	1.21	VS	II
Fund availability is less	45(135)	84(168)	21(21)	324	2.16	-0.12	S	III
Insufficient rewards and recognition for scientists	34(102)	86(172)	30(30)	304	2.03	-1.38	NSS	VII
Insufficiency of institutional finance resources	42(126)	86(172)	22(22)	320	2.13	-0.37	S	IV
Ease of use and training related constraint								
Don't know how to operate the equipment	58(174)	79(158)	13(13)	345	2.30	1.93	VS	I
Lack of proper training	41(123)	93(186)	16(16)	325	2.17	0.48	S	III
Difficult to understand	38(114)	76(152)	36(36)	302	2.01	-1.18	NSS	IX
Expert's advice is not clear	38(114)	86(172)	26(26)	312	2.08	-0.46	S	V
Not yet covered all farmers practices	39(117)	83(166)	28(28)	311	2.07	-0.53	S	VI
Research is not yet approved by all users	35(105)	89(178)	26(26)	309	2.06	-0.68	S	VII
Gap between the developer and users	37(111)	84(168)	29(29)	308	2.05	-0.75	S	VIII
Lack of knowledge about hardware and software	47(141)	89(178)	14(14)	333	2.22	1.06	VS	II
Lack of required skill	40(120)	90(180)	20(20)	320	2.13	0.12	S	IV
Non-physical constraints in using of AI intelligence technique								
Inadequate information	57(171)	78(156)	15(15)	342	2.28	1.64	VS	I
Inadequate knowledge	34(102)	100 (200)	16(16)	318	2.12	0.38	S	II
Lack of appropriate technology	40(120)	83(166)	27(27)	313	2.09	0.12	S	III
Unfavorable land tenure	34(102)	90(180)	26(26)	308	2.05	-0.14	S	IV
Gender inequalities	30(90)	77(154)	43(43)	287	1.91	-1.24	NSS	VI
Unfavorable weather conditions	27(81)	92(184)	31(31)	296	1.97	-0.77	S	V
Constraints in implementing of AI Techniques								
Untrained manpower	65(195)	75(150)	10(10)	355	2.37	1.98	VS	I
Fear of new technology	31(93)	93(186)	26(26)	305	2.03	-1.17	NSS	IX
High investment	59(177)	70(140)	21(21)	338	2.25	0.91	S	II
Coverage and connectivity issue	50(150)	80(160)	20(20)	330	2.20	0.41	S	III
Fragmented market	55(165)	68(136)	27(27)	328	2.19	0.28	S	IV
Interference	34(102)	92(184)	24(24)	310	2.07	-0.86	S	VIII
Choice of Technology	39(117)	85(170)	26(26)	313	2.08	-0.67	S	VII
Localization	39(117)	86(172)	25(25)	314	2.09	-0.60	S	VI
Regulatory Challenges	44(132)	81(162)	25(25)	319	2.13	-0.29	S	V
Socio-psychological constraints in using AI technique								
Low socio-economical condition	69(207)	64(128)	17(17)	352	2.35	1.13	VS	I
Low purchasing power	48(144)	88(176)	14(14)	334	2.23	-0.78	S	III
Lack of co-operation and co-ordination	63(189)	62(124)	25(25)	338	2.25	-0.35	S	II

Weighted score in parenthesis

While on the other hand, gender inequalities (Z score= -1.24) was encountered as not so serious constraint. *Panganiban (2019)* in their study describing how the Philippines Deptt. of Agri. e-govt. mandate to promote agril. development and the lives of farmers, argues that lack of physical access and inability to use the innovations provided by the govt. led to the digital divide. This was specifically noted in the rural poor areas and in the developing countries. This contributes to minimal opportunities for the citizens to achieving the full benefits derived from govt. efforts in making the ICT services accessible and useful.

Constraints in Implementation of AI technique : The Table 1 revealed that untrained manpower (Z score= 1.98) was very serious constraint, whereas, high investment (Z score= 0.91), coverage and connectivity issue (Z score= 0.41), fragmented market (Z score= 0.28), interference (Z score= -0.86), choice of technology (Z score= -0.67), localization (Z score= -0.60) and regulatory challenges (Z score= -0.29) were serious constraints related to implementation of AI technique in agriculture.

While on the other hand, Fear of new technology (Z score= -1.17) was encountered as not so serious constraint. The present study got support from the past research findings of *Singh et al. (2007*).

Socio-psychological Constraints : The Table 1revealed that low socio-economical condition (Z score= 1.13) was very serious constraint. Whereas, low purchasing power (Z score= -0.78) and Lack of co-operation and co-ordination among farmers (Z score= -0.35) were serious constraints in socio-psychological constraints in using artificial intelligence in agriculture.

The present study got support from the past research findings of *Albert (2014)* who reported that lack of resources, low level knowledge of computer and low literacy level of the farmers were major constraints in case of information and communication technology (ICT).

Degree of seriousness of constraints encountered by agricultural professionals in adoption of artificial intelligence techniques : It is **c**lear from Table 2 that when all the constraints taken as a whole, these constraints were found very serious as perceived by 12 per cent of agricultural professionals followed by perceived these constraints as serious by 74.67 per cent of agricultural professionals and perceived these constraints as not so serious by 13.33 per cent of agricultural professionals respectively.

Table 2. Degree of seriousness of constraints in adoption of AI techniques

Degree of seriousness	Score range	No.	%
Very serious	173-205	18	12.00
Serious	123-172	112	74.67
Not so serious	70-122	20	13.33

CONCLUSION

It could be concluded that that if agricultural professionals get need-based trainings, govt. will provide supporting budget to purchase the advance tools of AI, provide subsidy on the advance tools of AI and help in starting custom hiring centers from where the agricultural professionals can take these advance machines on rent, so that the agriculture professionals can use these advance tools and techniques to enhance the production in agriculture.

CONFLICTS OF INTEREST

Authors declare that they have no conflict of interest.

REFERENCES

Albert, C/O. (2014). Constraints to effective use of ICT among extension professionals and farmers in extension delivery in Rivers state, Nigeria. *Singaporean J. Busi. Eco. and Mngt. Studies*. **2** (11) :135-142.

Anavrat, V. (2015). Adoption of improved technologies among Nagpur mandarin growers in Vidarbha. *Indian J. Ext. Edu.*, **51** (3&4): 101-103.

Bannerjee, G.; Sarkar, U.; Das, S. and Ghosh, I (2018). Artificial intelligence in agriculture : A literature survey. *Intl. J. Sci. Res. in Computer Sci. Appli. and Mngt. Studies,***7** (3) : 1-2.

Dasgupta, A. and S. Wendler, (2019) AI Adoption Strategies, No. 9, pp. 1- 13.

Dhaka, B.L. and Chayal, K. (2016). Farmers' experience with ICTs on transfer of technology in changing agri-rural environment. *Indian Res. J. Ext. Edu.*, **10** (3) : 114-118.

Feleke, H.G. (2015). Assessing weather forecasting needs of smallholder farmers for climate change adaptation in the central rift valley of Ethiopia. *J. Earth Science Climate Change,* **6** (10) : 1-8.

Ganguli, D. (2006). Use of educational technology in teaching of veterinary science and related constraints. *Indian Res. J. Ext. Edu.*, **6**(3) : 40 - 41

Kumar, P.; Shehrawat, P.S.; Rohila, A.K.; Ghanghas, B.S. and Kumar, A. (2016). Constraints faced by farmers of Haryana state in adoption of masumbi (*Citrus sinensis*) cultivation. *J. Applied and Natural Sci.* **8** (2) : 785-789.

Meena, K.C. (2003). Constraints faced by the farmers in adoption of improved cultivation of cabbage in Udaipur district of Rajasthan.*Indian Res. J. Ext. Edu.*, **3**(2), 69-71.

Panganiban, G.G.F. (2019). E-governance in agriculture : Digital tools enabling Filipino farmers. *J. Asian Public Policy,* **12** (1) : 51-70.

Shashikala, S.G.; Shankaraiah, N.; Sumathi; Kumar, P.; Kavitha, V. and Govinda, G.V. (2012). Constraints of small farmers for their agricultural development. *Intl. J. Sci. and Nature.* **3** (2) : 442-446.

Singh, B. (2008). Technological gap in wheat production technology in Arid zone in Rajasthan. *Indian J. Ext. Edu.*, **43** (3&4) : 44-47.

Singh, D.K.; Gautam, U.S. and Pandey, S.N. (2007). Constraints analysis of technological awareness of the farmers. *Indian Res. J. Ext. Edu.*, **7**(1), 60-62

Tata, J.S. and McNamara, P. E. (2016). Social factors that influence use of ICT in agricultural extension in Southern Africa. *Agriculture,* **6** (2) : 15.

• • • • •