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Structural and functional analysis of cotton growing farmers: Knowledge and Adoption

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Abstract
Cotton is one of the most important commercial and fiber crops which is grown throughout the world and India is the 2nd largest consumer of cotton *i.e.* 5.39 MMT in 2023-24 after China (COCPC 2024). It contributes greatly to the community of cotton farmers in order to support their way of life and supplies about 60% of the raw materials needed by Indian textile factories with a total area 12469 thousand Hectare under cultivation in India in 2023-24 (COCPC 2024). The present study was accompanied in Jind district of Haryana state in and the derived data of 120 farmers was analyzed with different statistical tools such as correlation coefficient, multiple regression analysis, step wise regression analysis and path analysis etc. The results revealed that younger respondents have low level of knowledge and adoption status as compare to experienced old farmers. All causal variables together had contributed 39.10 per cent of variance in Farmer's Knowledge level and 34.02 per cent of variance in Farmer's Adoption level.

Keywords: Farmers, knowledge, adoption, cotton, path analysis

Introduction

Cotton is a vital commercial crop grown extensively in India, contributing approximately 24% to global cotton production. India is the 2nd largest producer of cotton. Cotton has been utilized in India since the Indus valley civilization where cotton threads were recovered (Ramesh *et al.*, 2020) [15]. India produces 5.50 million metric tonnes of cotton in 2023-24 *i.e.* 23.83% of world cotton production of 1429 lakh bales (24.31 Million Metric Tonnes). (COCP, 2024). All India cotton sowing area for the crop year 2024-2025 has reached to 112.947 Lakh Hectares against last year's 123.709 Lakh Hectares which is 8.70% lower than last year. In terms of productivity, India is on 33rd rank with yield of 441 kg/ha (Committee on Cotton Production and Consumption). Because of the cotton crop is attacked by a number of insect, pests, diseases, nematodes and weeds. Yield losses due to these pests range from 15 to 25 per cent (Patel, 2008a) [13].

It's interesting to remember that over 50% of India's pesticide usage is for cotton, which accounts for only 5% of all cultivable land. The use of chemical pesticides excessively and carelessly has resulted in a number of problems, including the development of resistance, resurgence, secondary pest outbreaks, toxicity to beneficial organisms, residue in food, feed, fodder, etc., and most importantly, environmental contamination. These challenges including agricultural productivity and sustainability can be overcome by digital technologies (*Gorai et. al.* 2022) [5].

It significantly supports the livelihoods of nearly 6 million cotton farmers and an additional 40-50 million people involved in associated industries like processing and trading of cotton. The fiber of the cotton plant is an essential part of the global textile industry and makes up a sizeable portion of the country's foreign exchange earnings (Deepika *et. al.* 2020) [4]. Due to its high importance in agricultural and industrial sectors this is considered as "White Gold" (Ahmed *et al.*, 2018, Prasad *et al.*, 2018, Sun *et al.*, 2019; Khan *et al.*, 2020) [3, 14, 16, 8].

Methodology

Considering the last few years' insect-pest attack in cotton crop and farmer's knowledge and adoption towards this problem, this study was conducted in the Jind district of Haryana state. One hundred twenty (120) respondents in total were chosen randomly to fulfill the need of this study. Data collection was carried out by administering personal interview schedules. Prior to actual fieldwork, a pilot study was conducted to understand the area, its people, communication and social system in order to establish an overall picture for conducting the study. Appropriate operationalization and measurement of the variables helped the researcher to land upon the accurate conclusions.

Therefore, the selected variables for this study had been operational and measured in the following manner i.e., (i) Independent variables and (ii) Dependent variable. Independent variables selected for the study were age, education, land holding, mass media exposure (MME), extension contact and socio-economic status (SES).

Dependent variables selected for the study were knowledge and adoption level of farmers regarding different improved cotton production practices. Appropriate statistical tools had been used to carry out the study *viz*. correlation coefficient, multiple regression analysis, step wise regression analysis and path analysis.

Results and Discussion

The subjective information was measured utilizing explicit numerical methodology. Then data analysis i.e. coefficient of correlation, multiple regression analysis, stepwise regression analysis and path analysis have been done to understand the functionality of the selected variables for the study.

Relationship between knowledge level and adoption level of farmers with selected socio-economic variables

Table 1 presents the coefficient of correlation between knowledge level and adoption level of farmers with selected socio-economic variables. It was found that education, MME and SES recorded positive significant correlation with knowledge and adoption level of farmers. It was found that the age of farmers is negatively correlated with knowledge and adoption level of farmers.

Table 1: Relationship between knowledge level and adoption level of farmers with selected socio-economic variables

Sr. No.	Independent Variables	Correlation coefficient values	
		Knowledge	Adoption
1	Age	-00.10	-0.12
2	Education	0.60***	0.55***
3	Land holding	00.08	0.09
4	MME	0.34***	0.29***
5	Extension Contact	00.13	0.10
6	SES	0.43***	0.43***

The coefficient of correlation revealed that respondents having high education level, MME and SES have been found high knowledge level regarding different improved practices of cotton cultivation and they also have high adoption level for different improved practices of cotton cultivation. These findings are partially in line with Kumar *et al*. (2021) [9], Jeya (2020), [6] Niranjan *et. al.* 2018 [11] and Patel *et al*. (2008) [12].

Table 2 presents the full model of regression analysis between criterion variable *i.e.* Knowledge levels of farmers with respect to 6 causal variables. The variables Age, Education, Extension contact and SES had positive contribution, whereas, the variables land holding and MME had negative contribution on knowledge of farmers regarding different improved cotton production practices. It was found that all causal variables together had contributed 39.10 per cent of variance in Farmer's Knowledge level. These findings are partially supported by Patel *et. al.* (2008a) [13].

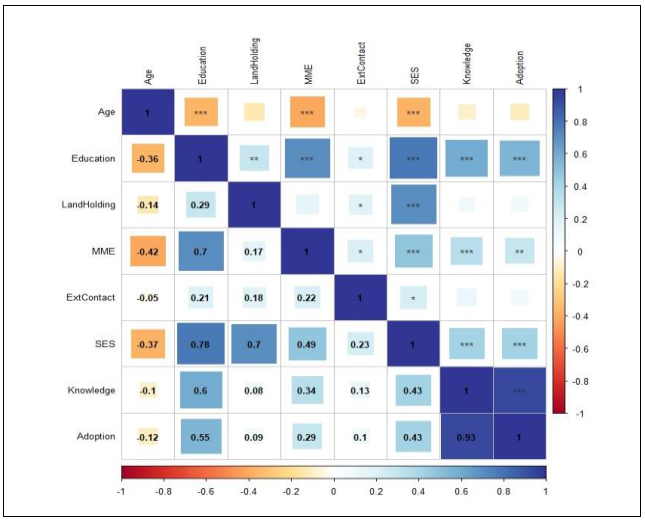

Fig 1: Correlation coefficient between Knowledge and Adoption level of farmers with different independent variables

Table 2: Multiple regression analysis for knowledge of farmers with other independent variables

Sr. No.	Variables	Regression coefficient (β)	Standard Error	t – value	p – value
1	Intercept	28.92	6.17	4.68	<0.00**
2	Age	0.69	0.49	1.41	0.16
3	Education	1.08	0.27	3.98	<0.00**
4	Land holding	-0.59	0.46	-1.30	0.20
5	MME	-0.25	0.24	-1.07	0.29
6	Extension Contact	0.03	0.13	0.26	0.79
7	SES	0.22	0.37	0.59	0.55

Multiple R square value: 39.10%

Table 3: Multiple regression analysis for adoption of farmers with other independent variables

Sr. No.	Variables	Regression coefficient (β)	Standard Error	t – value	p – value
1	Intercept	28.53	5.95	4.79	<0.00**
2	Age	0.46	0.47	0.97	0.33
3	Education	0.85	0.26	3.25	<0.00**
4	Land holding	-0.64	0.44	-1.45	0.15
5	MME	-0.31	0.23	-1.33	0.18
6	Extension Contact	0.00	0.12	-0.02	0.98
7	SES	0.39	0.36	1.08	0.28

Multiple R square value: 34.02%

Table 3 presents the full model of regression analysis between criterion variable *i.e.* Adoption levels of farmers with respect to 6 causal variables. The variables Age, Education, Extension contact and SES had positive contribution, whereas, the variables land holding and MME had negative contribution on adoption of farmers regarding different improved cotton production practices. It was found that all causal variables together had contributed 34.02 per cent of variance in Farmer's Adoption level. The study is partially supported by Kumar *et. al.* (2024) [10] and Patel *et al*. (2008) [12].

Table 4: Stepwise Regression Analysis for knowledge level of farmers

Sr. No.	Variables	Regression coefficient (β)	Standard Error	t – value	p – value
1	Intercept	29.11	2.01	14.45	<0.00**
2	Education	1.04	0.13	8.22	<0.00**
3	Age	0.78	0.46	1.72	0.09

R square value: 37.30%

Table 4 presents the stepwise regression analysis. In stepwise regression analysis, it was found that the variables, Education and Age had been retained in the last step. It implies that education is not just about the years of schooling, beyond that it enhance the skill and knowledge of farmers. Therefore, in order to scale up the knowledge level of farmers, the prime focus should be on providing need based training and different awareness programmes. The R square value being 37.30 per cent, these two variables had together contributed to 37.30 per cent of total variance in knowledge level of farmers. The findings of this study are in line with Nishitha *et al*. (2017) [7].

Table 5: Stepwise Regression Analysis for adoption level of farmers

Sr. No.	Variables	Regression coefficient (β)	Standard Error	t – value	p – value
1	Intercept	34.77	1.93	18.04	<0.00**
2	Education	1.02	0.16	6.43	<0.00**
3	MME	-0.38	0.21	-1.79	0.08

R square value: 32.40%

Table 5 also presents the stepwise regression analysis. In stepwise regression analysis, it was found that the variables, Education and MME had been retained in the last step. It implies that both education and MME helps in improving the adoption level of farmers which further motivate them to collect more information and then enhance their adoption level. The R square value being 32.40 per cent, these two variables had together contributed to 32.40 per cent of total variance in adoption of different practices of cotton cultivation.

Table 6: Path analysis for knowledge of farmers with other independent variables

Sr. No.	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
1	Age (x_1)	-0.10	0.12	-0.22	0.05 (x_4)
2	Education(x_2)	0.60	0.68	-0.08	0.09 (x_6)
3	Land holding(x_3)	0.08	-0.17	0.25	0.20 (x_2)
4	MME(x_4)	0.34	-0.12	0.46	0.48 (x_2)
5	Extension Contact(x_5)	0.13	0.02	0.11	0.14 (x_2)
6	SES(x_6)	0.43	0.12	0.31	0.52 (x_2)

Residual Effect = 0.609, Highest Indirect Individual Effect: Education

Table 6 evinced that the variable Mass Media Exposure exerted the highest indirect effect on knowledge level of farmers. This is well discernible that Education had exerted substantive impact, i.e., direct effect on knowledge level of farmers. It is also interesting to note that education had enrooted the highest indirect effect through as many as four variables (land holding, MME, Extension contact and SES) to ultimately characterize knowledge level of farmers. Education had exerted the highest total effect. The residual effect being 0.609, it is to conclude that even with the combination of 6 exogenous variables, 60.9 per cent variance in knowledge level could not be explained. This suggests the inclusion of more numbers of relevant and consistent variables for this framework of study. Partially similar observations were reported by Acharya *et al*. (2023) [1] and Acharya & Roy (2021) [2]

Table 7: Path analysis for adoption of farmers with other independent variables

Sr. No.	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
1	Age (x_1)	-0.12	0.09	-0.20	0.06(x_4)
2	Education(x_2)	0.55	0.58	-0.02	0.17(x_6)
3	Land holding(x_3)	0.09	-0.19	0.29	0.17(x_2)
4	MME(x_4)	0.29	-0.15	0.45	0.41(x_2)
5	Extension Contact(x_5)	0.10	0.00	0.10	0.12(x_2)
6	SES(x_6)	0.43	0.22	0.20	0.45(x_2)

Residual Effect = 0.660, Highest Indirect Individual Effect: x_2

Table 7 evinced that the variable MME exerted the highest indirect effect on adoption level of farmers. This is well discernible that Education had exerted substantive impact, i.e., direct effect on adoption level of farmers. It is also interesting to note that education had enrooted the highest indirect effect through as many as four variables (land holding, MME, Extension contact and SES) to ultimately characterize the adoption level of farmers. Education had exerted the highest total effect. The residual effect being 0.660, it is to conclude that even with the combination of 6 exogenous variables, 66.0 per cent variance in dependent variable *i.e*. Adoption level could not be explained. This suggests the inclusion of more numbers of relevant and consistent variables for this framework of study.

Conclusion

The findings of study concluded that Education, Mass Media Exposure and Socio Economic Status have significant correlation with knowledge and adoption level of farmers. Therefore, in order to scale up the knowledge level of farmers, the prime focus should be on providing need based training and different awareness programmes. Similarly, to enhance the adoption level of farmers there is need to motivate the farmers to collect more information about different modern technologies and practices by improving their mass media exposure and extension contact with different extension functionaries. There is need of creating awareness and extension services on Best Farm Practices to Improve Yield, Quality and Sustainability including ginning and processing practices. This type of study can be used in different agro-ecological and socio-economic conditions so that an effective policy framework can be generated for the welfare of farming community and also for growth of nation's economy.

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