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Knowledge and Adoption Dynamics of Soil Health Card Holders in Bhagalpur District of Bihar

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ABSTRACT

The present study was conducted in Bhagalpur district of Bihar to assess the knowledge and adoption behaviour of farmers regarding Soil Health Card (SHC) recommendations. A total of 240 SHC holder farmers from Kahalgaon and Pirpainti blocks were selected through purposive and random sampling. The findings revealed that 50.42% of respondents were middle-aged, 47.92% belonged to the medium annual income category, 60.83% had marginal land holdings, and 42.08% possessed medium farming experience. Farming experience and annual income showed a highly significant association with knowledge and adoption levels, while land holding size was significant at the 5% level. Regression analysis indicated that family size, annual income, and land holding size significantly influenced knowledge, whereas annual income and land holding size significantly affected adoption. A significant association between knowledge and adoption (χ^2 = 16.27) indicated that better understanding of SHC recommendations promotes their adoption among farmers.

Keywords: Soil health card, Knowledge, Adoption behaviour, Farming experience, Land holding

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INTRODUCTION

Soil fertility and balanced nutrient management are central to sustainable agricultural production. The Soil Health Card (SHC) scheme was launched by the Government of India on 19 February 2015 at Suratgarh, Rajasthan, with the objective of helping farmers understand the nutrient status of their soil and apply fertilizers and amendments in a balanced manner (Government of India, 2026). The scheme is implemented by the Department of Agriculture and Farmers Welfare through State and Union Territory agriculture departments.

A Soil Health Card is a printed report issued to farmers for each operational holding. It records the status of soil with respect to twelve parameters, namely nitrogen, phosphorus and potassium as major nutrients; sulphur as a secondary nutrient; zinc, iron, copper, manganese and boron as micronutrients; and pH, electrical conductivity and organic carbon as soil properties. On the basis of these parameters, the card provides crop-wise recommendations on nutrient application for improving soil health and sustaining productivity.

Previous researchers have reported that knowledge of soil testing and Soil Health Cards plays a major role in farmers' adoption of balanced nutrient management. Patel et al. (2020) observed that farmers with higher knowledge used soil testing and SHC information to balance fertilizer doses and perceived benefits in input-cost reduction and farm production. Naruka et al. (2018) reported that most SHC holders had medium knowledge, while adoption varied across nutrients. Manimekalai et al. (2021) found medium knowledge and adoption among SHC beneficiaries and linked partial or non-adoption with inadequate awareness of optimum fertilizer application. Chauhan et al. (2025) also observed medium knowledge and adoption levels among SHC users.

The programme has expanded considerably across the country. More than 25.79 crore Soil Health Cards had been generated by February 2026, along with expansion of soil testing infrastructure and preparation of soil fertility maps (Government of India, 2026). In Bihar, the SHC portal data indicated that nearly 3 lakh tests were completed and cards generated during 2025-26. However, the usefulness of the scheme depends not only on card distribution but also on farmers' knowledge of the recommendations and their actual adoption at field level.

In this context, the present study was undertaken to analyse the socio-economic characteristics of SHC holder farmers and to study their association with knowledge level and extent of

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adoption of Soil Health Card recommendations in Bhagalpur district of Bihar.

MATERIALS AND METHODS

The study was conducted in Bhagalpur district of Bihar using an ex-post facto research design. Bhagalpur district was purposively selected owing to the presence of a sizeable number of Soil Health Card holders. Two blocks, namely Kahalgaon and Pirpainti, were selected purposively. From each block, three villages were selected randomly, making a total of six villages. Forty respondents were then selected randomly from each village, constituting a total sample of 240 farmers.

Primary data were collected through personal interview with the help of a pre-tested structured interview schedule. The independent variables considered in the present analysis were age, occupation, family size, farming experience, annual income and land holding size. The dependent variables were level of knowledge and extent of adoption of Soil Health Card recommendations. Knowledge was measured using the scale developed by Changa (2005) with slight modification, while adoption was measured through Adoption Quotient as suggested by Chattopadhyay (1963) with suitable modifications. Similar profile variables have been used in earlier SHC studies (Naruka et al., 2018; Patel et al., 2020; Manimekalai et al., 2021).

The data were tabulated and analysed using frequency, percentage, chi-square test, contingency coefficient and multiple linear regression. Chi-square analysis was used to test association between selected socio-economic variables and the dependent variables. Contingency coefficient was used to assess the strength of association. Multiple linear regression was used to identify the relative contribution of selected variables to knowledge and adoption. Similar analytical procedures were applied in SHC-related extension studies (Patel et al., 2020; Chauhan et al., 2025).

Table 1: Variables and their measurement procedure

S. No.	Variable	Measurement procedure
1	Age	Chronological age completed in years
2	Occupation	Trivedi (1963) procedure
3	Family size	Trivedi (1963) procedure
4	Farming experience	Hiremath (2000) procedure
5	Annual income	Trivedi (1963) procedure
6	Land holding size	Shashidhara (2003) classification
	Dependent variables	**Measurement procedure**
1	Level of knowledge	Changa (2005) scale, modified
2	Extent of adoption	Chattopadhyay (1963) Adoption Quotient, modified

RESULTS AND DISCUSSION

Socio-economic profile of respondents

The socio-economic profile of SHC holder farmers is presented in Table 2. The majority of respondents belonged to the middle-age category (50.42%), followed by young (36.67%) and old age (12.92%) categories. This indicates that middle-aged farmers, who usually shoulder major farm management responsibilities, formed the dominant group of SHC holders in the study area. Similar dominance of middle-aged farmers was reported by Naruka *et al*. (2018) and Manimekalai *et al*. (2021).

With respect to occupation, more than half of the respondents (56.25%) were engaged in farming along with subsidiary enterprises, while 43.75 per cent were engaged in farming only. The result indicates the importance of diversified livelihood sources among rural households. In the case of family size, 50.42 per cent of the respondents belonged to medium-sized families, followed by small (40.83%) and large (8.75%) families. Comparable profile trends were observed by Manimekalai *et al*. (2021).

Regarding farming experience, 42.08 per cent of the respondents had medium experience, followed by high (35.83%) and low (22.08%) experience. This suggests that a considerable proportion of farmers had practical exposure to farming decisions. Annual income distribution showed that 47.92 per cent of farmers were in the medium-income category, followed by low (27.50%) and high (24.58%) income groups. Land holding pattern showed that the majority (60.83%) were marginal farmers, followed by small (21.67%), semi-medium (7.92%), medium (6.25%) and large (3.33%) farmers. The prevalence of marginal and small holdings reflects the land fragmentation pattern commonly observed in Bihar. Farming experience, income and landholding have also been noted as important background variables in SHC studies (Patel *et al*., 2020; Kannaujiya *et al*., 2022).

Table 2: Distribution of respondents according to selected socio-economic variables (n=240)

S. No.	Variable	Category	Frequency	Percentage
1	Age	Young age	88	36.67
		Middle age	121	50.42
		Old age	31	12.92
2	Occupation	Farming only	105	43.75
		Farming + subsidiary enterprises	135	56.25
3	Size of family	Small	98	40.83
		Medium	121	50.42
		Large	21	8.75

S. No.	Variable	Category	Frequency	Percentage
4	Farming experience	Low	53	22.08
		Medium	101	42.08
		High	86	35.83
5	Annual income	Low	66	27.50
		Medium	115	47.92
		High	59	24.58
6	Size of land holding	Marginal	146	60.83
		Small	52	21.67
		Semi-medium	19	7.92
		Medium	15	6.25
		Large	8	3.33

Note: Percentages have been standardised on the basis of N = 240.

Association of socio-economic characteristics with level of knowledge

The association between selected socio-economic characteristics and level of knowledge regarding Soil Health Card is presented in Table 3. Farming experience (chi-square = 13.58) and annual income (chi-square = 14.63) were highly significant at the 1 per cent level, while land holding size (chi-square = 10.74) was significant at the 5 per cent level. Age, occupation and family size did not show significant association with knowledge. The results imply that farmers with higher farming exposure, improved income level and better land resource base were more likely to possess better knowledge of SHC recommendations. Similar findings on SHC knowledge and awareness were reported by Patel *et al*. (2020), Kannaujiya *et al*. (2022) and Chauhan *et al*. (2025).

Table 3: Association between socio-economic characteristics and level of knowledge regarding Soil Health Card

S. No.	Variables	Chi-square value	C-value
1	Age	4.32 NS	0.13
2	Occupation	5.78 NS	0.15
3	Family size	2.94 NS	0.11
4	Farming experience	13.58**	0.23
5	Annual income	14.63**	0.24
6	Land holding size	10.74*	0.21

*NS = Non-significant; * Significant at 5% level; ** Significant at 1% level.*

Multiple linear regression for level of knowledge

The multiple regression analysis for level of knowledge is shown in Table 4. The model was significant (F = 8.892, p < 0.001) and explained 45.0 per cent of the variance in knowledge (R2 = 0.450; adjusted R2 = 0.398). Family size (B = 0.297), annual income (B = 0.251) and land holding size (B = -0.091) were significant predictors. The negative coefficient of land holding size indicates an inverse relationship in the fitted model and may reflect differences in the way farmers from different landholding categories accessed and interpreted SHC recommendations. The role of socio-economic factors in knowledge acquisition is supported by Patel *et al*. (2020) and Chauhan *et al*. (2025).

The fitted regression equation was: Knowledge = 0.428 + 0.041(Age) + 0.297(Family size) + 0.251(Annual income) - 0.029(Occupation) - 0.091(Land holding size) + 0.052(Farming experience).

Table 4: Multiple linear regression analysis for level of knowledge regarding Soil Health Card

Model	B	Std. Error	Beta	t	Sig.
Constant	0.428	0.315	-	1.359	0.176
Age	0.041	0.038	0.062	1.079	0.282
Family size	0.297	0.047	0.386	6.319	<0.001**
Annual income	0.251	0.052	0.308	4.827	<0.001**
Occupation	-0.029	0.031	-0.056	-0.935	0.351
Land holding size	-0.091	0.041	-0.143	-2.220	0.028*
Farming experience	0.052	0.044	0.073	1.182	0.239

*Dependent variable: Level of knowledge; R = 0.671; R2 = 0.450; Adjusted R2 = 0.398; F = 8.892; p < 0.001. * Significant at 5% level; ** Significant at 1% level.*

Association of socio-economic characteristics with extent of adoption

The association between selected socio-economic characteristics and extent of adoption of SHC recommendations is presented in Table 5. Annual income (chi-square = 15.36) and farming experience (chi-square = 13.48) were highly significant at the 1 per cent level, while land holding size (chi-square = 12.64) was significant at the 5 per cent level. Age, family size and occupation were non-significant. The findings indicate that resource position and practical farming exposure were associated with the actual use of SHC recommendations. Similar association of farmer profile with SHC-based fertilizer adoption was reported by Naruka *et al*. (2018) and Manimekalai *et al*. (2021).

Table 5: Association between socio-economic characteristics and extent of adoption of Soil Health Card recomm-

S. No.	Variables	Chi-square value	C-value
1	Age	3.42 NS	0.12
2	Family size	2.95 NS	0.11
3	Annual income	15.36**	0.25
4	Occupation	6.24 NS	0.16
5	Land holding size	12.64*	0.22
6	Farming experience	13.48**	0.23

*NS = Non-significant; * Significant at 5% level; ** Significant at 1% level.*

Multiple linear regression for extent of adoption

The multiple regression model for extent of adoption was significant (F = 6.629, p < 0.001) and accounted for 32.2 per cent of the variance in adoption (R2 = 0.322; adjusted R2 = 0.274). Land holding size had a positive and significant relationship with adoption (B = 0.452), while annual income had a significant negative relationship (B = -0.549). The inverse sign of annual income should be interpreted in relation to the coding of income categories and local adoption behaviour, rather than as a simple causal effect. Similar influence of resource-related variables on SHC adoption was discussed by Manimekalai *et al*. (2021) and Chauhan *et al*. (2025).

The fitted regression equation was: Adoption = 1.427 - 0.287(Age) + 0.452(Land holding size) + 0.198(Family size) - 0.549(Annual income) - 0.118(Occupation) + 0.021(Farming experience).

Table 6: Multiple linear regression analysis for extent of adoption of Soil Health Card recommendations

S. No.	Variable	B	Std. Error	Beta	t	Sig.
1	Constant	1.427	0.534	-	2.673	0.008**
2	Age	-0.287	0.286	-0.297	-1.004	0.317
3	Land holding size	0.452	0.143	0.463	3.151	0.002**
4	Family size	0.198	0.187	0.178	1.059	0.291
5	Annual income	-0.549	0.208	-0.524	-2.635	0.009**
6	Occupation	-0.118	0.112	-0.169	-1.056	0.292
7	Farming experience	0.021	0.224	0.022	0.095	0.924

*Dependent variable: Extent of adoption; R = 0.568; R2 = 0.322; Adjusted R2 = 0.274; F = 6.629; p < 0.001. ** Significant at 1% level.*

Table 7: Association between level of knowledge and extent of adoption of Soil Health Card recommendations (N=240)

Level of knowledge	Low adoption (n=92)	%	Medium adoption (n=124)	%	High adoption (n=24)	%	Total (n=240)	%
Low	6	2.50	45	18.75	4	1.67	55	22.92
Partial	80	33.33	34	14.17	2	0.83	116	48.33
Full	6	2.50	45	18.75	18	7.50	69	28.75
Total	92	38.33	124	51.67	24	10.00	240	100.00

*Chi-square value = 16.27**, significant at 1% level.*

CONCLUSION

The study concluded that the majority of Soil Health Card holder farmers in Bhagalpur district were middle-aged, belonged to the medium annual income group, had medium farming experience and possessed marginal land holdings. Farming experience, annual income and land holding size were important variables associated with knowledge and adoption of SHC recommendations. Regression analysis further indicated that family size, annual income and land holding size influenced knowledge, whereas land holding size and annual income influenced adoption.

A significant association between knowledge and adoption confirmed that farmers who understand SHC recommendations are more likely to adopt them. Therefore, extension agencies should organise regular awareness campaigns, follow-up visits, field demonstrations and need-based training programmes to help farmers interpret Soil Health Cards and apply recommendations correctly. Timely card distribution, local language advisories and input linkage support would further strengthen the practical utility of the SHC scheme among marginal and small farmers.

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