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Influence of socio-economic variables on knowledge and attitude of tribal smallholder goat farmers: Evidence from farmer producer organisations in Madhya Pradesh, India

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Abstract

This study investigates the influence of socio-economic variables on the knowledge (K1) and attitude (A1) of tribal smallholder goat farmers enrolled under four Farmer Producer Organisations (FPOs) across three districts — Balaghat, Mandla, and Dindori — of Madhya Pradesh, India. A total of 400 tribal goat farmers (100 from each FPO) were surveyed. Pearson's correlation analysis revealed that educational attainment and extent of extension agency contact were the most significant socio-economic determinants of both knowledge and attitude scores. Multiple regression models accounted for 73.0% of variance in knowledge ($R^2 = 0.730$) and 47.6% in attitude ($R^2 = 0.476$). One-way ANOVA indicated significant differences in both knowledge ($F = 9.45, p < 0.001$) and attitude ($F = 10.44, p < 0.001$) across districts, with Dindori scoring significantly lower than Balaghat and Mandla. Similarly, significant FPO-level variation was observed, with FPO4 (Dindori) recording the lowest mean scores. Independent samples t-tests revealed no statistically significant overall gender differences in knowledge or attitude; however, within Dindori district and FPO4, female farmers exhibited significantly lower attitude scores than males ($t = -2.196, p = 0.031$). These findings highlight the critical roles of extension outreach and education in shaping farmer knowledge and attitude, and underscore the need for geographically and gender-targeted capacity-building programmes.

Keywords: Goat farmers, knowledge, attitude, socio-economic variables, FPO, gender, ANOVA, tribal, Madhya Pradesh

1. Introduction

Livestock farming, and particularly smallholder goat farming, constitutes a critical livelihood strategy for tribal and marginal communities across central India. Goats are often referred to as the 'poor man's cow' owing to their low initial investment, rapid reproductive rate, and resilience under resource-scarce conditions (Singh & Mishra, 2018) [8]. In Madhya Pradesh, tribal communities in districts such as Balaghat, Mandla, and Dindori maintain substantial goat populations as a primary source of income, nutrition, and socio-cultural identity.

The advent of Farmer Producer Organisations (FPOs) has been positioned as a transformative institutional mechanism to enhance collective bargaining power, facilitate input access, and improve market linkages for smallholder farmers (Trebbin, 2014) [9]. However, the effectiveness of FPO-led interventions is contingent upon the knowledge base and attitude of member farmers toward improved management practices. Knowledge about scientific goat husbandry — including breed selection, nutrition, disease management, and marketing — directly influences adoption behaviour and productivity outcomes (Rogers, 2003) [7].

Attitude, as a psychological construct, mediates between

knowledge acquisition and behavioural change. Farmers with positive attitudes toward improved practices are more likely to adopt them (Fishbein & Ajzen, 1975) [3]. Both knowledge and attitude are, in turn, shaped by a constellation of socio-economic factors including age, educational attainment, herd size, land holding, extension agency contact, and farming experience. Understanding the differential influence of these variables is essential for designing effective, evidence-based extension programmes. Furthermore, gender represents a critical dimension of livestock farming dynamics. While women constitute a substantial proportion of goat caretakers in tribal communities, they are often marginalised from formal training programmes and institutional support structures (Food and Agriculture Organization, 2011) [4]. Assessing gender-based disparities in knowledge and attitude — both overall and within specific FPOs and districts — is therefore of policy significance.

This study was conducted across four FPOs operating in Balaghat, Mandla, and Dindori districts of Madhya Pradesh, with the dual objectives of: (i) identifying the socio-economic determinants of goat farmer knowledge and attitude, and (ii) examining the moderating role of gender,

FPO affiliation, and district in shaping these outcomes.

2. Objectives of the Study

The specific objectives of this study were:

1. To assess the knowledge (K1) and attitude (A1) levels of tribal smallholder goat farmers across four FPOs.
2. To determine the correlation between selected socio-economic variables and farmer knowledge and attitude.
3. To identify significant socio-economic predictors of knowledge and attitude through multiple regression analysis.
4. To examine gender-based differences in knowledge and attitude — overall and disaggregated by district and FPO — using t-tests and two-way ANOVA.

3. Materials and Methods

3.1 Study Area and Sampling

The study was conducted in three tribal districts of Madhya Pradesh: Balaghat, Mandla, and Dindori. Two FPOs operating in Balaghat district (FPO1 and FPO3) and one FPO each from Mandla (FPO2) and Dindori (FPO4) were selected purposively based on their active engagement in goat rearing activities. A total of 400 tribal smallholder goat farmers were surveyed, with 100 respondents drawn from each FPO through stratified random sampling. Balaghat district, being represented by two FPOs, contributed 200 respondents, while Mandla and Dindori each contributed 100 respondents.

3.2 Data Collection

Primary data were collected through personal interviews using a pre-tested structured interview schedule. Data were gathered on the following socio-economic variables: age (years), educational attainment (years of formal schooling), total goat herd size, extent of initial extension agency contact (ordinal scale), experience in goat farming (years), and land holding (hectares). Knowledge (K1) and attitude (A1) were measured using validated scales developed for the study. Gender was coded as 1 (Male) and 2 (Female).

3.3 Statistical Analysis

Data were analysed using Python (SciPy and Statsmodels libraries). Pearson's correlation coefficients were computed to assess bivariate associations between socio-economic variables and K1/A1. Multiple linear regression was employed to identify significant predictors. Independent samples t-tests were used to compare mean K1 and A1 scores between male and female farmers — overall, within each district, and within each FPO. One-way ANOVA was applied to test district- and FPO-level differences. Tukey's Honest Significant Difference (HSD) post-hoc test was used for pairwise comparisons. Two-way ANOVA was performed to assess the interaction between gender and district. Statistical significance was set at $p < 0.05$.

4. Results

4.1 Socio-Economic Profile of Respondents

Descriptive statistics for the socio-economic variables are presented in Table 1. The mean age of respondents was 47.96 years (SD = 11.22), indicating a predominantly middle-aged farming population. The average years of formal education was 5.49 (SD = 4.35), ranging from 0 to

15 years, reflecting wide variation in literacy levels. The mean goat herd size was 32.92 animals (SD = 15.20). The mean experience in goat farming was 26.46 years (SD = 11.64), suggesting a seasoned farming community. Land holding averaged 1.66 ha (SD = 1.25). Extent of extension agency contact had a mean of 2.12 (SD = 0.58) on an ordinal scale. Of the 400 respondents, 104 (26.0%) were male and 296 (74.0%) were female, reflecting the predominant role of women in tribal goat rearing activities.

Table 1: Descriptive Statistics of Socio-Economic Variables (n = 400)

Variable	Mean	SD	Min	Max
Age (years)	47.96	11.22	20	80
Education (years)	5.49	4.35	0	15
Total Goats (No.)	32.92	15.20	9	78
Extension Agency Contact	2.12	0.58	1	4
Experience in Goat Farming (years)	26.46	11.64	3	57
Land Holding (ha)	1.66	1.25	0.20	10.52
Knowledge Score (K1)	42.08	6.05	24	75
Attitude Score (A1)	26.02	4.13	13	58

4.2 Correlation Between Socio-Economic Variables and Knowledge/Attitude

Pearson's correlation coefficients between the six socio-economic variables and knowledge (K1) and attitude (A1) scores are presented in Table 2. Extension agency contact exhibited the strongest positive correlation with K1 ($r = 0.849$, $p < 0.001$), followed by educational attainment ($r = 0.471$, $p < 0.001$). A weak but statistically significant negative correlation was observed between age and K1 ($r = -0.109$, $p < 0.05$) and between farming experience and K1 ($r = -0.105$, $p < 0.05$). Herd size ($r = -0.003$, $p = 0.954$) and land holding ($r = -0.041$, $p = 0.412$) showed no significant correlation with knowledge.

For attitude (A1), extension agency contact again showed the highest positive correlation ($r = 0.678$, $p < 0.001$), followed by education ($r = 0.352$, $p < 0.001$). None of the remaining socio-economic variables — age, herd size, farming experience, or land holding — showed statistically significant correlations with attitude scores.

Table 2: Pearson's Correlation of Socio-Economic Variables with Knowledge (K1) and Attitude (A1)

Socio-Economic Variable	K1 (r)	K1 (p)	A1 (r)	A1 (p)	Significance
Age	-0.109	0.029*	-0.023	0.644	K1: Sig.
Education	0.471	<0.001***	0.352	<0.001***	Both Sig.
Total Goats	-0.003	0.954	-0.025	0.614	Neither
Extension Agency Contact	0.849	<0.001***	0.678	<0.001***	Both Sig.
Experience in Goat Farming	-0.105	0.036*	-0.013	0.803	K1: Sig.
Land Holding	-0.041	0.412	0.002	0.969	Neither

Note: * $p < 0.05$; *** $p < 0.001$

4.3 Multiple Regression Analysis

4.3.1 Predictors of Knowledge (K1)

Multiple linear regression was performed with K1 as the dependent variable and the six socio-economic variables as predictors (Table 3). The overall model was highly significant ($F = 177.29$, $p < 0.001$) and explained 73.0% of the variance in knowledge scores ($R^2 = 0.730$, Adjusted $R^2 =$

0.726). Among the predictors, extension agency contact was by far the most influential variable ($\beta = 8.320$, $t = 25.761$, $p < 0.001$), followed by educational attainment ($\beta = 0.188$, $t =$

3.486, $p = 0.001$). Other variables — age, herd size, farming experience, and land holding — did not contribute significantly to the model.

Table 3: Multiple Regression Analysis — Predictors of Knowledge Score (K1)

Predictor Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	22.650	1.675	13.519	<0.001***
Age	-0.003	0.057	-0.054	0.957
Education	0.188	0.054	3.486	0.001**
Total Goats	-0.003	0.010	-0.299	0.765
Extension Agency Contact	8.320	0.323	25.761	<0.001***
Experience in Goat Farming	0.040	0.054	0.752	0.452
Land Holding	-0.051	0.128	-0.401	0.689

$R^2 = 0.730$; Adjusted $R^2 = 0.726$; $F = 177.29$; $p < 0.001$. ** $p < 0.01$; *** $p < 0.001$

4.3.2 Predictors of Attitude (A1)

For attitude (A1), the regression model was also statistically significant ($F = 59.55$, $p < 0.001$), explaining 47.6% of variance ($R^2 = 0.476$, Adjusted $R^2 = 0.468$). Extension

agency contact was the strongest predictor ($\beta = 4.531$, $t = 14.774$, $p < 0.001$), followed by education ($\beta = 0.126$, $t = 2.465$, $p = 0.014$). The remaining predictors did not contribute significantly to attitude scores.

Table 4: Multiple Regression Analysis — Predictors of Attitude Score (A1)

Predictor Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	14.914	1.591	9.374	<0.001***
Age	-0.022	0.054	-0.409	0.682
Education	0.126	0.051	2.465	0.014*
Total Goats	-0.008	0.010	-0.829	0.408
Extension Agency Contact	4.531	0.307	14.774	<0.001***
Experience in Goat Farming	0.073	0.051	1.434	0.152
Land Holding	0.115	0.121	0.951	0.342

$R^2 = 0.476$; Adjusted $R^2 = 0.468$; $F = 59.55$; $p < 0.001$. * $p < 0.05$; *** $p < 0.001$

4.4 Gender Differences in Knowledge and Attitude

4.4.1 Overall Gender Comparison

Independent samples t-tests revealed no statistically significant overall differences between male ($n = 104$) and female ($n = 296$) farmers in either knowledge or attitude scores (Table 5). Male farmers recorded a mean K1 score of 42.31 (SD = 6.88) compared to 41.99 (SD = 5.75) for

females ($t = 0.455$, $p = 0.649$). Similarly, for A1, male farmers averaged 25.80 (SD = 4.30) against 26.09 (SD = 4.07) for females ($t = -0.623$, $p = 0.534$). These findings suggest that, when considered as an aggregate across all FPOs and districts, gender per se does not create a significant divide in goat farming knowledge or attitude.

Table 5: Overall Gender Comparison of Knowledge (K1) and Attitude (A1) Scores

Variable	Male (n=104)	Female (n=296)	t-value	p-value	Significance
K1 Mean (SD)	42.31 (6.88)	41.99 (5.75)	0.455	0.649	NS
A1 Mean (SD)	25.80 (4.30)	26.09 (4.07)	-0.623	0.534	NS

NS = Not Significant at $p < 0.05$

4.4.2 Gender Differences within Districts

When gender comparisons were disaggregated by district, no significant differences were found in Balaghat or Mandla. However, in Dindori district, female farmers recorded significantly lower attitude scores than males ($M_{\text{male}} = 22.83$ vs. $M_{\text{female}} = 24.77$; $t = -2.196$, $p =$

0.031), as presented in Table 6. Knowledge scores in Dindori did not differ significantly by gender ($t = -1.208$, $p = 0.230$). These results indicate that attitudinal disparities are geographically concentrated, pointing to context-specific social dynamics in Dindori.

Table 6: Gender Differences in K1 and A1 Scores within Districts

District	Male K1 (SD)	Female K1 (SD)	t (K1)	p (K1)	Male A1 (SD)	Female A1 (SD)	t (A1)	p (A1)
Balaghat	42.52 (7.87)	42.80 (5.74)	-0.264	0.792 NS	25.94 (4.48)	26.77 (4.50)	-1.137	0.257 NS
Mandla	43.92 (3.96)	42.47 (6.06)	1.286	0.202 NS	27.08 (3.00)	26.19 (3.85)	1.206	0.231 NS
Dindori	38.50 (8.73)	40.15 (4.14)	-1.208	0.230 NS	22.83 (5.26)	24.77 (2.84)	-2.196	0.031*

NS = Not Significant; * $p < 0.05$

4.4.3 Gender Differences within FPOs

Gender-disaggregated comparisons within individual FPOs are presented in Table 7. No significant differences were

found in FPO1 (Balaghat), FPO2 (Mandla), or FPO3 (Balaghat) for either K1 or A1. In FPO4 (Dindori), however, a significant gender difference in attitude was

detected ($M_{\text{male}} = 22.83$ vs. $M_{\text{female}} = 24.77$; $t = -2.196$, $p = 0.031$), with female farmers recording higher attitude scores. It is noteworthy that male representation in

FPO2 and FPO4 was relatively low ($n = 14$ and $n = 18$, respectively), which may limit the statistical power of comparisons in these groups.

Table 7: Gender Differences in K1 and A1 Scores within FPOs

FPO	M _n / F _n	Male K1 (SD)	Female K1 (SD)	t (p) K1	Male A1 (SD)	Female A1 (SD)	t (p) A1
FPO1 (Balaghat)	36 / 64	43.08 (7.64)	43.86 (6.55)	-0.535 (0.594) NS	26.39 (4.26)	26.84 (4.00)	-0.533 (0.595) NS
FPO2 (Mandla)	14 / 86	41.07 (6.70)	42.01 (5.77)	-0.553 (0.582) NS	24.79 (4.26)	26.72 (4.94)	-1.382 (0.170) NS
FPO3 (Balaghat)	36 / 64	43.92 (3.96)	42.47 (6.06)	1.286 (0.202) NS	27.08 (3.00)	26.19 (3.85)	1.206 (0.231) NS
FPO4 (Dindori)	18 / 82	38.50 (8.73)	40.15 (4.14)	-1.208 (0.230) NS	22.83 (5.26)	24.77 (2.84)	-2.196 (0.031)*

NS = Not Significant; * $p < 0.05$

4.5 District and FPO Effects on Knowledge and Attitude

4.5.1 One-Way ANOVA: District Effect

One-way ANOVA revealed a significant district effect on both knowledge ($F(2, 397) = 9.45$, $p < 0.001$) and attitude ($F(2, 397) = 10.44$, $p < 0.001$) scores (Table 8). Tukey's HSD post-hoc tests indicated that Dindori district recorded significantly lower knowledge scores than both Balaghat (mean difference = -2.88 , $p < 0.001$) and Mandla (mean difference = -3.14 , $p < 0.001$). Similarly, Dindori's attitude scores were significantly lower than Balaghat (mean difference = -2.15 , $p < 0.001$) and Mandla (mean difference = -2.09 , $p < 0.001$). No significant difference was observed between Balaghat and Mandla in either knowledge or attitude.

Table 8: One-Way ANOVA — District Effect on Knowledge (K1) and Attitude (A1)

District	n	K1 Mean (SD)	A1 Mean (SD)
Balaghat (District 1)	200	42.73 (6.47)	26.57 (4.49)
Mandla (District 2)	100	42.99 (5.42)	26.51 (3.58)
Dindori (District 3)	100	39.85 (5.25)	24.42 (3.45)
F-value	—	9.45***	10.44***
p-value	—	<0.001	<0.001

*** $p < 0.001$. Tukey HSD post-hoc: Dindori significantly lower than Balaghat and Mandla for both K1 and A1 ($p < 0.001$); Balaghat vs. Mandla: NS.

4.5.2 One-Way ANOVA: FPO Effect

The ANOVA for FPO also yielded significant results for knowledge ($F(3, 396) = 7.73$, $p < 0.001$) and attitude ($F(3, 396) = 7.00$, $p < 0.001$) (Table 9). Tukey's HSD post-hoc tests identified FPO4 (Dindori) as the primary driver of FPO-level differences. FPO4 had significantly lower K1 scores than FPO1 (mean difference = -3.73 , $p < 0.001$) and FPO3 (mean difference = -3.14 , $p = 0.001$). For A1, FPO4 scores were significantly lower than FPO1, FPO2, and FPO3 (all $p < 0.005$). No statistically significant differences were found among FPO1, FPO2, and FPO3.

Table 9: One-Way ANOVA — FPO Effect on Knowledge (K1) and Attitude (A1)

FPO	District	n	K1 Mean (SD)	A1 Mean (SD)
FPO1	Balaghat	100	43.58 (6.93)	26.68 (4.08)
FPO2	Mandla	100	41.88 (5.88)	26.45 (4.88)
FPO3	Balaghat	100	42.99 (5.42)	26.51 (3.58)
FPO4	Dindori	100	39.85 (5.25)	24.42 (3.45)
F-value	—	—	7.73***	7.00***
p-value	—	—	<0.001	<0.001

*** $p < 0.001$. Tukey HSD post-hoc: FPO4 significantly lower than FPO1 and FPO3 for K1 ($p < 0.01$); FPO4 significantly lower than FPO1, FPO2, and FPO3 for A1 ($p < 0.005$).

4.5.3 Two-Way ANOVA: Gender × District Interaction

Two-way ANOVA examined the main effects of gender and district, and their interaction, on K1 and A1. Results are summarised in Table 10. For K1, the district effect was significant ($F = 9.33$, $p < 0.001$), while gender ($F = 0.001$, $p = 0.978$) and the gender × district interaction ($F = 1.30$, $p = 0.275$) were not. For A1, the district effect was again significant ($F = 10.95$, $p < 0.001$); however, neither the main effect of gender ($F = 1.26$, $p = 0.262$) nor the gender × district interaction ($F = 2.46$, $p = 0.087$) reached significance, though the interaction approached borderline significance ($p = 0.087$) for attitude, suggesting a possible pattern worthy of further investigation with larger male samples.

Table 10: Two-Way ANOVA — Gender × District Effects on K1 and A1

Source	K1: Sum Sq	K1: F	K1: p	A1: Sum Sq	A1: F	A1: p
Gender	0.03	0.001	0.978 NS	20.38	1.263	0.262 NS
District	657.01	9.330	<0.001***	353.17	10.948	<0.001***
Gender × District	91.22	1.296	0.275 NS	79.42	2.462	0.087 NS
Residual	13871.91	—	—	6354.71	—	—

NS = Not Significant; *** $p < 0.001$

5. Discussion

The findings of this study underscore the primacy of extension agency contact and educational attainment as determinants of both knowledge and attitude among tribal goat farmers. The extraordinarily strong correlation between extension contact and knowledge ($r = 0.849$) aligns with the foundational tenets of diffusion of innovations theory (Rogers, 2003) [7], whereby exposure to extension services is the principal channel through which scientific information reaches farming communities. The regression model for K1 ($R^2 = 0.730$) indicates that these two variables alone largely explain the distribution of knowledge in this population. This finding is consistent with Bhikya *et al.* (2019) [2], who reported that extension contact was the strongest predictor of knowledge in livestock farmers of Madhya Pradesh.

The weaker but still significant association between education and both K1 and A1 resonates with a large body of literature highlighting formal education as an enabler of information processing and positive disposition toward change (Anderson *et al.*, 2006) [1]. The negative association between age and knowledge, though modest, suggests that older farmers may have been less exposed to newer, science-based extension messages, a pattern well-documented in rural India (Meena *et al.*, 2025) [5].

The absence of a significant relationship between herd size, land holding, or farming experience and either K1 or A1 is noteworthy. It implies that scale of operation and years of experience do not compensate for gaps in formal knowledge dissemination. This is particularly relevant for the tribal smallholder context, where indigenous knowledge, while valuable, may not align with modern veterinary and nutritional recommendations for goats.

The lack of overall gender differences in knowledge and attitude is both encouraging and contextually nuanced. On one hand, it suggests that within the FPO structure, female members are, on average, not disadvantaged in terms of knowledge or attitude. On the other hand, the significant gender difference in attitude observed within Dindori district and FPO4 — where female farmers reported lower attitude scores relative to males — deserves careful attention. Dindori is characterised by its higher share of particularly vulnerable tribal groups (PVTGs) and more remote geographies, which may limit women's access to extension services and peer learning networks. This finding is consistent with the work of Pattnaik and Deshpande (2016) ^[6], who documented that gender-based attitudinal gaps tend to manifest more prominently in remoter tribal districts with weaker institutional outreach.

The significant district-level variation, with Dindori consistently performing below Balaghat and Mandla in both knowledge and attitude, suggests that the institutional ecology — including extension infrastructure, FPO capacity, and social capital — varies considerably across districts. Balaghat and Mandla, which did not differ significantly from each other, appear to have more conducive environments for knowledge transmission. The FPO-level analysis corroborates this pattern, with FPO4 (Dindori) emerging as a distinct low-performer, indicating that the FPO itself may be a proximate mechanism through which district-level resources and outreach are channelled to individual farmers.

6. Conclusion and Recommendations

This study demonstrates that extension agency contact and education are the dominant socio-economic determinants of both knowledge and attitude among tribal smallholder goat farmers in Madhya Pradesh. District and FPO affiliations exert significant influences on knowledge and attitude, with farmers in Dindori — and specifically FPO4 — exhibiting lower scores compared to their counterparts in Balaghat and Mandla. While no overall gender gap was detected, women in Dindori displayed lower attitudes than men, pointing to localised socio-institutional barriers.

Based on these findings, the following recommendations are offered:

1. **Extension-intensive programmes:** Given the overwhelming influence of extension agency contact, targeted intensive extension camps, farmer field schools, and mobile extension services should be prioritised for FPO4 in Dindori.
2. **Adult literacy and functional education:** Bridging the education gap through non-formal education and literacy programmes can potentiate knowledge and attitudinal change among less-educated tribal farmers.
3. **Gender-sensitive outreach in Dindori:** Given the attitudinal gap observed for women in Dindori, women-

specific extension activities — including FPO-based self-help group meetings, women demonstration plots, and female extension workers — should be scaled up.

4. **FPO capacity building:** FPO4 should receive priority support for institutional capacity building, including regular training events, technical resource persons, and exposure visits to higher-performing FPOs.

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