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Relational analysis of farmers' profile with their perception on capacity needs under NICRA villages

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Abstract

This study investigated the link between farmers' personal and farming characteristics and their perception on capacity needs under the NICRA programme in Kerala and Karnataka. Data were collected from 160 farmers across four villages using interviews and analysed with descriptive statistics, correlation, and regression. Results showed that most farmers were smallholders, male, and had limited education, with marginal landholdings and mixed or diversified farming systems. Farmers' perception of capacity needs was mainly influenced by extension contact, participation in training, education, and association with KVK activities. Extension contact was the strongest factor, especially in Karnataka, while education and KVK linkages were more important in Kerala. The findings suggest that frequent extension interaction, practical training, and suitable educational support are key for building farmer capacity in climate-resilient agriculture.

Key words: Capacity building, climate resilience, extension contact, farmers' perception, national innovations on climate resilient agriculture, profile characteristics, training needs

Introduction

Agriculture remains the foundation of India's economy, supporting millions of rural families by providing food, income, and ecological stability (Haverkort, 2022; Nazeerudin and Kanth, 2023). However, the sector is increasingly exposed to the risks of climate change such as irregular rainfall, rising temperatures, droughts, and floods (Vijai *et al.*, 2023). These challenges call for the adoption of climate-resilient practices that can sustain productivity and protect farm livelihoods. The Indian Council of Agricultural Research (ICAR) launched the National Innovations on Climate Resilient Agriculture (NICRA) in 2011 to address these concerns by developing and promoting climate-resilient technologies through research, technology demonstration, capacity building, and knowledge sharing (Thakor, and Joshi, 2022; Barman, and Baruah, 2024).

Understanding the capacity needs of farmers

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is essential for the success of NICRA interventions. These needs represent the knowledge, skills, and institutional support that farmers require to effectively adopt and maintain climate-resilient agricultural practices. Farmers' perception of their own capacity needs determines how effectively they can respond to climate risks and take advantage of the opportunities created under NICRA. This perception is strongly influenced by farmers' profile characteristics such as age, gender, education, family size, landholding, type of farming, farming experience, annual income, extension contact, association with KVK activities, mass media utilization, participation in capacity-building activities, and information-seeking behaviour. Studying these relationships helps in identifying the key factors that shape farmers' outlook towards capacity building and in designing more need-based extension and training programs.

Several studies have shown that socio-economic and institutional factors play a decisive role in shaping farmers' perception of their capacity needs and training priorities Momodu *et al.,* 2024; Cheng *et al.,* 2024; Wonde, *et al.,* 2023). However, research specifically focusing on the relational analysis of farmers' profile with their perception on capacity needs under NICRA villages in Kerala and Karnataka is limited. Identifying these relationships can provide useful insights for policymakers, research institutions, and extension systems to strengthen climate-resilient agriculture in vulnerable regions.

With this background, the present study was undertaken with the objective of analysing the relationship between selected profile characteristics of farmers and their perception on capacity needs under NICRA villages of Kerala and Karnataka.

Materials and Methods

Locale of the Study: The study was carried out in four NICRA villages located in Kerala and Karnataka. In Kerala, Pattithara village in Palakkad district (drought-prone) and Edathua village in Alappuzha district (flood-prone) were selected. In Karnataka, two drought-prone villages were selected: Hanumaigarahalli in Chikkaballapur district and Durgadanagenahalli in Tumkur district. These villages were selected because of their distinct climatic challenges, providing suitable conditions to study farmers' perceptions of capacity needs under NICRA interventions.

Sampling Procedure: A multistage sampling technique was adopted. Districts and villages were purposively selected based on NICRA interventions, while simple random sampling was used for farmer selection. A total of 160 farmers were selected, comprising 40 respondents from each of the four villages. In addition, other stakeholders and KVK officials were consulted for supplementary information.

Data Collection and Analysis: Primary data were collected using a structured interview schedule. Descriptive statistics such as frequency, percentage, mean, standard deviation, and quartile deviation were used to categorize farmer characteristics. To study the relationship between farmers' profiles and their perception of capacity needs, Pearson's correlation coefficient and multiple regression analysis were employed.

Measurement of Variables

Dependent variable: Farmers' perception of capacity needs under NICRA. Based on mean and standard deviation, farmers were grouped into low, lower medium, upper medium, and high perception categories.

Independent variables: Farmers' profile characteristics such as age, gender, education, family size, landholding, type of farming, farming experience, annual income, extension contact, association with KVK activities, mass media utilization, participation in capacity-building activities, and information-seeking behaviour. Standardized scales and classifications were used with minor modifications.

Results and Discussion

Farmers from Kerala and Karnataka showed similarities in many socio-demographic characteristics, though some clear differences were also observed. In terms of age, Kerala had a higher share of farmers in early adulthood (41.25%), while Karnataka showed a more balanced distribution across late and senior adulthood. The overall median age of farmers was 52 years, suggesting that most farmers were middle-aged. Regard-

Table 1. Profile characteristics of farmer respondents (Kerala, Karnataka and Overall)

(n=160)

Domain	Category	Kerala (f)	Kerala (%)	Karnataka (f)	Karnataka (%)	Overall (f)	Overall (%)
Age	Early adulthood (≤ Q1)	33	41.25	22	27.50	42	26.25
	Middle adulthood (Q1–Q2)	24	30.00	18	22.50	41	25.62
	Late adulthood (Q2–Q3)	13	16.25	20	25.00	39	24.37
	Senior adulthood (≥ Q3)	10	12.50	20	25.00	38	23.75
Gender	Male	68	85.00	62	77.50	130	81.25
	Female	12	15.00	18	22.50	30	18.75
Education	Illiterate	14	17.50	27	33.75	41	25.62
	Primary	14	17.50	13	16.25	27	16.87
	Middle	17	21.25	16	20.00	33	20.62
	High school	19	23.75	15	18.75	34	21.25
	Intermediate	11	13.75	6	7.50	17	10.62
	Graduate	3	3.75	2	2.50	5	3.12
	Postgraduate	2	2.50	1	1.25	3	1.87
Family members	Small (≤ 3)	17	21.25	23	28.75	40	25.00
	Lower-medium (4)	36	45.00	36	45.00	72	45.00
	Upper-medium (5)	15	18.75	11	13.75	19	16.25
	Large (>5)	12	15.00	10	12.50	26	13.75
Landholding	Marginal (≤ 2.5 ac)	78	97.50	63	78.75	141	88.12
	Small (2.6–5 ac)	2	2.50	16	20.00	18	11.25
	Semi-medium (5.1–10 ac)	0	0.00	1	1.25	1	0.62
	Medium/Large	0	0.00	0	0.00	0	0.00
Type of farming	Specialized	11	13.75	7	8.75	18	11.25
	Diversified	68	85.00	24	30.00	92	57.50
	Mixed	1	1.25	49	61.25	50	31.25
Experience	Novice (≤ Q1)	28	35.00	26	32.50	47	29.37
	Adv. beginner (Q1–Q2)	22	27.50	26	32.50	45	28.13
	Competent (Q2–Q3)	16	20.00	17	21.25	38	23.75
	Proficient (≥Q3)	14	17.50	11	13.75	30	18.75
Annual income	Low (≤ Q1)	20	25.00	21	26.25	48	30.00
	Lower-middle (Q1–Q2)	23	28.75	19	23.75	36	22.50
	Upper-middle (Q2–Q3)	17	21.25	22	27.50	38	23.75
	High (≥Q3)	20	25.00	18	22.50	38	23.75
Extension agency contact	Low (≤ $\mu - \sigma$)	9	11.30	11	13.80	20	12.50
	Lower Medium (Low to mean)	43	53.80	38	47.50	81	50.60
	Upper Medium (Mean to high)	20	25.00	27	33.80	47	29.40
	High (≥ $\mu + \sigma$)	8	10.00	4	5.00	12	7.50
Association with KVK activities	Low (≤ $\mu - \sigma$)	4	5.00	4	5.00	35	21.87
	Lower Medium (Low to mean)	0	0	27	33.75	0	0
	Upper Medium (Mean to high)	75	93.75	49	61.25	124	77.50
	High (≥ $\mu + \sigma$)	1	1.25	0	0	1	0.62
Mass media utilization	Low (≤ $\mu - \sigma$)	0	0	7	8.75	3	1.87
	Lower Medium (Low to mean)	50	62.50	58	72.50	125	78.12
	Upper Medium (Mean to high)	18	22.50	8	10.00	9	5.62
	High (≥ $\mu + \sigma$)	12	15.00	24	30.00	23	14.37
Participation in capacity building	Low (≤ $\mu - \sigma$)	0	0	22	27.50	38	23.75
	Lower Medium (Low to mean)	37	46.25	35	43.75	49	30.62
	Upper Medium (Mean to high)	28	35.00	14	17.50	48	30.00
	High (≥ $\mu - \sigma$)	15	18.75	9	11.25	25	15.62
Information seeking behavior	Low (≤ $\mu - \sigma$)	17	21.25	7	8.75	24	15.00
	Lower Medium (Low to mean)	24	30.00	32	40.00	79	49.37
	Upper Medium (Mean to high)	30	37.50	30	37.50	36	22.50
	High (≤ $\mu + \sigma$)	9	11.25	11	13.75	21	13.12

Table 1. *Continued ...*

(n=160)

Domain	Category	Kerala (f)	Kerala (%)	Karnataka (f)	Karnataka (%)	Overall (f)	Overall (%)
Perception of farmer respondents on capacity needs under NICRA	Low (≤ μ - σ)	16	20.00	10	12.50	26	16.25
	Lower medium (Between μ - σ and μ)	21	26.25	28	35.00	38	23.75
	Upper medium (Between μ and μ + σ)	29	36.25	28	35.00	72	45.00
	High (≥ μ + σ)	14	17.50	14	17.50	24	15.00

ing gender, farming was largely male-dominated, with 81.25% of the respondents being men, although Karnataka had relatively more women farmers (22.50%) than Kerala (15.00%).

Education levels differed between the two states. Illiteracy was higher in Karnataka (33.75%) compared to Kerala (17.50%), while only about 5% of the farmers across both states were graduates or postgraduates. Most families were of moderate size, with four-member households being the most common (45.00%). The mean household size was about four members. Landholding patterns revealed that marginal farms of less than 2.5 acres dominated in both states (88.12% overall), and no medium or large farms were recorded. Farming patterns also differed: Kerala farmers mostly practiced diversified farming (85.00%), whereas Karnataka farmers were largely engaged in mixed farming (61.25%).

In terms of farming experience, novices and advanced beginners together made up more than half of the respondents, with an overall median experience of 32 years. Annual income distribution was fairly even across all groups, with a median annual income of around 2.0 lakh. All farmers reported contact with extension agencies, with Krishi Vigyan Kendra (KVK) officials being the most frequently approached. When classified by intensity, most farmers fell under the lower-medium category of contact, followed by upper-medium, and only a few reported high contact.

Association with KVK activities increased during the NICRA period. Awareness of KVK activities was already high before NICRA (93.75%) and reached almost universal levels during NICRA (99.37%). Farmers regularly or occasionally participated in training programmes, front-line demonstrations, and facilitation activities, though visits to custom hiring centres were very limited. The overall intensity of association with KVK was mostly in the upper-medium category (77.50%).

Mass media use was largely limited to television, with 26.25% watching regularly and 70.62% occasionally. The use of radio, newspapers, online sources, and smartphones for agricultural purposes was very low. In terms of participation in capacity-building programmes, most farmers engaged in integrated farming system training (50.62% overall and 88.75% in Karnataka), followed by crop management training (41.87%). Participation in resource conservation technologies was very limited. The main reason farmers reported for attending training was to improve income and living standards (85.62%).

Information-seeking behavior showed that most farmers relied on moderately localite sources (88.75%) and had moderate levels of personal cosmopolite behavior (65.00%). The use of mass media and social media was also at a moderate level for the majority of respondents. Extension education methods were moderately used by most farmers, with Kerala showing relatively higher levels. Overall, nearly half of the respondents fell into the lower-medium category of information-seeking, while smaller proportions were placed in upper-medium, high, and low categories.

The distribution of farmers' perception of capacity needs under NICRA showed that in Kerala, most farmers fell in the upper medium category (36.25%), while in Karnataka, perceptions were more evenly split between lower medium (35%)

and upper medium (35%). Overall, nearly half of the farmers (45%) had an upper medium perception, followed by lower medium (23.75%), low (16.25%), and high (15%).

Correlation Analysis: The perception of farmers regarding capacity needs under NICRA showed significant positive relationships with a few key profile characteristics (Table 2). Extension agency contact had the strongest correlation ($r = 0.434$, $p<0.01$), highlighting that farmers who interacted more frequently with extension personnel had higher awareness and recognition of capacity needs. Participation in capacity-building programmes ($r = 0.248$, $p<0.01$), education level ($r = 0.204$, $p<0.01$), and association with KVK activities ($r = 0.200$, $p<0.05$) were also positively associated with perception. On the other hand, gender, income, landholding size, and mass media utilization did not show any significant relationships, indicating that these factors did not play a strong role in shaping farmers' perception of capacity needs.

Regression Analysis: The regression analysis further clarified the predictors of farmers' perception (Table 5). The pooled model explained 35.8% of the variation ($R^2 = 0.358$; adj. $R^2 = 0.301$), with four variables emerging as significant. Extension agency contact ($\beta = 2.165$, $p<0.01$) was the stron-

Table 2. Pearson's correlation coefficient between perception of capacity needs under NICRA and independent variables related to farmers

Sl. No.	Variables	Correlation coefficients		
		Kerala (n=80)	Karnataka(n=80)	Overall(n=160)
1	Age	0.161	0.112	0.149
2	Gender	-0.026	-0.04	-0.038
3	Education	0.348**	0.051	0.204**
4	Number of family members	0.11	0.084	0.113
5	Operational land holding	-0.001	0.124	0.053
6	Type of farming	-0.01	0.266*	0.088
7	Farming experience	0.112	0.156	0.141
8	Annual income	0.007	-0.108	-0.047
9	Extension agency contact	0.122	0.839**	0.434**
10	Association with KVK activities	0.344**	0.055	0.2*
11	Mass media utilization	-0.016	-0.017	-0.018
12	Information seeking behavior	0.145	0.083	0.08
13	Participation in capacity building	0.176	0.43**	0.248**

** Significant at 1 per cent level of probability * Significant at 5 per cent level of probability

Table 3. Multiple regression analysis between profile characteristics of farmers and their perception on capacity needs under NICRA in Kerala

Sl. No.	Variables	Estimate	Std.Error	t value	P-value
	Intercept	38.801	19.734	1.966	0.053
1	Age	0.147	0.096	1.536	0.129
2	Gender	-0.006	1.074	-0.005	0.996
3	Education	0.842	0.319	2.640	0.010*
4	Number of family members	0.336	0.352	0.954	0.343
5	Operational land holding	0.065	0.403	0.161	0.873
6	Type of farming	0.457	1.116	0.410	0.683
7	Farming experience	-0.097	0.086	-1.123	0.266
8	Annual income	0.000	0.000	0.897	0.373
9	Extension agency contact	0.505	0.553	0.913	0.365
10	Association with KVK activities	0.850	0.305	2.786	0.007**
11	Mass media utilization	-0.981	0.413	-2.377	0.020*
12	Information seeking behavior	1.139	0.517	2.203	0.031*
13	Participation in capacity building	0.691	0.547	1.263	0.211

** Significant at 1 per cent level *Significant at 5 per cent level n=160

gest predictor, followed by association with KVK activities (β = 0.698, p<0.01), participation in capacity building (β = 0.609, p<0.05), and education (β = 0.501, p<0.05). This suggests that institutional support and farmers active involvement in training and extension networks were key drivers of perception.

When analyzed separately by state, some differences were observed. In Kerala (Table 3), perception was positively influenced by education, association with KVK activities, and information-seeking behavior, while mass media utilization had a negative effect. In contrast, Karnataka farmers' perception was largely shaped by extension agency contact (β = 4.434, p<0.01) and participation in capacity-building activities (β = 0.621, p<0.05). The Karnataka model had a high explanatory power (R^2 = 0.764), suggesting that extension contact and training were particularly crucial in shaping farmers' awareness and capacity needs in drought-prone areas.

Discussion

The study shows that smallholder farmers in Kerala and Karnataka are predominantly male, cultivate marginal landholdings, and have limited formal education. These results are in line with Samba and Gupta (2019), who reported low

Table 4. Multiple regression analysis between profile characteristics of farmers and their perception on capacity needs under NICRA in Karnataka

Sl. No.	Variables	Estimate	Std.Error	t value	P-value
	Intercept	86.157	9.530	9.041	0.000
1	Age	-0.057	0.055	-1.027	0.308
2	Gender	-0.435	0.725	-0.601	0.550
3	Education	0.175	0.181	0.968	0.337
4	Number of family members	-0.095	0.285	-0.333	0.740
5	Operational land holding	0.194	0.177	1.098	0.276
6	Type of farming	0.518	0.298	1.737	0.087
7	Farming experience	0.065	0.050	1.317	0.192
8	Annual income	0.000	0.000	-1.662	0.101
9	Extension agency contact	4.434	0.392	11.316	0.001**
10	Association with KVK activities	-0.089	0.311	-0.285	0.777
11	Mass media utilization	-0.064	0.207	-0.309	0.758
12	Information seeking behavior	-0.020	0.147	-0.138	0.891
13	Participation in capacity building	0.621	0.266	2.333	0.023*

** Significant at 1 per cent level *Significant at 5 per cent level n=160

Table 5. Multiple regression analysis between profile characteristics of farmers and their perception on capacity needs under NICRA overall in both states

Sl. No.	Variables	Estimate	Std.Error	t value	P-value
	Intercept	69.661	8.771	7.942	0.000
1	Age	0.060	0.059	1.011	0.314
2	Gender	-0.315	0.732	-0.430	0.668
3	Education	0.501	0.193	2.591	0.011*
4	Number of family members	0.368	0.242	1.520	0.131
5	Operational land holding	0.004	0.216	0.018	0.986
6	Type of farming	0.548	0.360	1.521	0.130
7	Farming experience	-0.007	0.054	-0.124	0.902
8	Annual income	-0.000	0.000	-0.096	0.923
9	Extension agency contact	2.165	0.359	6.031	0.001**
10	Association with KVK activities	0.698	0.234	2.977	0.003**
11	Mass media utilization	-0.313	0.211	-1.484	0.140
12	Information seeking behavior	0.181	0.195	0.930	0.354
13	Participation in capacity building	0.609	0.294	2.072	0.040*

** Significant at 1 per cent level *Significant at 5 per cent level n=160

levels of female participation in farming. They also agree with Khuvung[10], who found that most respondents were illiterate with only a small share being literate. Similarly, Mohan *et al.* (2019) reported that the majority of farmers belonged to the marginal landholding category, supporting the present findings. Farming systems were predominantly diversified in Kerala and mixed in Karnataka. The study's findings also support those of Shindu and Govindaru (2014) and Juyal *et al.* (2010). These socio-economic and structural characteristics are important because they directly influence farmers' access to information, participation in training, and their overall perception of capacity needs for climate resilience.

Extension contact and linkage with KVKs clearly emerged as the strongest drivers of perception. Extension agency contact showed the highest correlation and predictive strength, especially in Karnataka, while association with KVK activities was significant in Kerala and in the pooled analysis. This underlines the importance of structured and repeated engagement, such as visits to KVKs, participation in front-line demonstrations (FLDs), on-farm trials, and trainings. In contrast, passive exposure through mass media did not significantly influence perception. The increase in awareness and participation observed during the NICRA period further demonstrates how systematic outreach can rapidly improve farmers' understanding of climate-resilient capacity needs.

Education was another important factor influencing perception. It was positively associated with perception in the pooled analysis and remained significant in Kerala's model. This finding suggests that education amplifies the benefits of extension, as literate farmers are better able to process and apply the information they receive. Developing simplified learning tools and delivering content in local languages can enhance the effectiveness of extension among less-educated farmers.

Mass media and smartphones, while widely available, contributed little to shaping perceptions. Although television was commonly accessed, it did not have a significant effect on perception, and purposeful use of smartphones or online platforms for agriculture was very low. This indicates that while mass media may increase general awareness, it is not sufficient to influence deeper understanding or capacity needs without complementary interpersonal or experiential learning through extension networks and demonstrations.

State-level differences were also observed. In Kerala, perception was influenced by education, association with KVKs, and active information seeking, while mass media showed a negative effect, possibly reflecting farmers' reliance on interpersonal information sources. In Karnataka, perception was shaped almost entirely by extension contact and participation in capacity building, reflecting the importance of direct service delivery in drought-prone regions where farming is less diversified.

The findings suggest several practical implications. Strengthening high-contact extension approaches, such as cluster demonstrations, regular KVK–farmer meetings, and farmer facilitators, will be vital. Extension strategies should also be customized to farmer literacy levels, using simple advisories with visual aids and involving peer champions for local translation of information. Group-based approaches such as farmer interest groups (FIGs) or farmer producer organizations (FPOs) can support small and marginal farmers through shared access to resources and training. Finally, programme monitoring should focus not only on the number of farmers reached but also on the quality of engagement and the actual absorption of knowledge.

Conclusion

The study showed that farmers in NICRA villages of Kerala and Karnataka are predominantly smallholders with marginal landholdings, modest education, and male dominance in farming activities. Their perception of capacity needs was shaped mainly by institutional and educational factors rather than socio-economic traits like income or landholding size. Extension agency contact emerged as the most powerful determinant, followed by association with KVK activities, participation in capacity-building programmes, and education.

The results highlight that sustained farmer-extension engagement is crucial for strengthen-

ing climate resilience. While mass media and smartphones had wide reach, their limited role in shaping perception suggests that interpersonal and experiential learning through extension, training, and demonstrations are more effective. Custom-tailored strategies, such as simplified advisories, peer-based learning, and group approaches for marginal farmers, are needed to translate awareness into actionable capacity building. These observations can guide policymakers and extension systems to strengthen farmer-oriented interventions under NICRA and similar climate-resilient programmes.

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Informed Consent Statement

Informed consent was obtained from all participants involved in the study prior to data collection. The respondents were clearly informed about the purpose of the research, and their participation was entirely voluntary. All procedures followed the ethical standards applicable in India and conformed to the principles of confidentiality and privacy of human subjects. No personal identifiers were disclosed at any stage of the study or in its publication.

Clinical Trial Registration

This research does not involve any clinical trials.

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