



Effectiveness of Community Approaches for Millet-based Entrepreneurial Promotion in Odisha, India

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HIGHLIGHTS

- The community approach has the potential to foster millet based entrepreneurship. Stakeholders have a positive perception towards the community engagement.
- KMO value (0.934) and Bartlett's test ($\chi^2=1324.788$, $p<0.001$) showed that the dataset were suitable for Principal Component Analysis.
- PCA extracted major indicators are leadership ability, fund management and risk orientation in the study.
- Targeted capacity building interventions in financial management and leadership development are need to be addressed for entrepreneurial development.

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ABSTRACT

Millet is emerging as a powerful solution for tackling malnutrition and promoting economic development in rural communities. Milletpreneurship is a key to reduce poverty, sustaining livelihoods and fostering agricultural resilience. Community approaches are critical for promoting milletpreneurship, yet empirical evidence on their effectiveness remains limited. This study addresses how diverse stakeholders' interactions influence entrepreneurial outcomes in the millet value chain. 120 purposively selected milletpreneurs engaged in millet production and enterprises across the value chain of high millet producing areas of Odisha were interviewed in the year 2024. Thirteen effectiveness indicators were developed through expert judgement using a normalization method. Principal Component Analysis (PCA) technique was used, validated through Kaiser-Mayer-Olkin (KMO=0.934) and Bartlett's test ($\chi^2=1324.788$, $p<0.001$), revealed that individual entrepreneurial competencies like leadership ability, fund management and risk orientation drove 64.1% of the variance in perceived effectiveness. While 41.7% perceived moderate effectiveness and 26.6% high effectiveness, 72.1% cumulative variance suggested heterogeneous community profiles. Results indicated deficiencies in social media exposure and marketing channels. Policymakers need to intervene through capacity building in financial management and leadership development, multidimensional support integrating infrastructure, finance and market linkage and differentiated interventions acknowledging diverse operational realities rather than uniform approaches.

INTRODUCTION

Millet is a group of small-grain cereals that are emerging as a powerful solution for tackling malnutrition and promoting economic

development, particularly in rural communities (Deevi et al., 2024). India's population has topped the world, and the responsibility of food growers has increased as they need to produce more on a shrinking patch of land every subsequent year. Thus, policymakers'

attention is towards sustainability. The resurgence of millets is driven not only by their nutritional and environmental benefits but also by a growing awareness of their potential to contribute to sustainable livelihoods. Household demand for bajra, jowar, ragi and minor millets is 2.65, 2.55, 1.06 and 0.09 million tons (mt) respectively, which is expected to rise by 5-10%, leading to 2.8-2.9, 2.7-2.8, 1.11-1.7 and 0.1 mt, respectively, by 2029, creating a demand-supply gap (Sreekala et al., 2022). Driven by health-conscious and gluten-free trends, the millet-based snacks market is projected to grow from US\$43.52 million in 2023 to US\$ 85.91 million by 2030 at a 10.2% CAGR (Dole, 2026). Empowering entrepreneurs to create value-added millet products is essential for reducing poverty, generating sustainable rural livelihoods and fostering a resilient agricultural economy (Ranjan & Jahan, 2023; Dzingirai, 2021; Fortunato & Alter, 2015). Fostering milletpreneurship requires structured channels like Farmer Producer Companies (FPCs) to provide collective action and facilitate necessary market development around underutilized crops (Pani et al., 2023; Notaro et al., 2017).

Community approaches are key to unlocking the potential with the involvement of local cultures (Lawrence et al., 2021) and there is a need to make national policies to support group approaches (Mhembwe & Dube, 2017). Government initiatives promote millets through incentives, awareness campaigns, PDS inclusion for food security, export promotion and cultural integration like temple *prasadam* (Prasad, 2023; Srivastava, 2023). The Odisha Millet Mission, which is renamed as Shree Anna Abhiyan, works in a group approach to provide snacks to preschoolers (Fortunato & Alter, 2015). This approach also highlights the success and improvement of the livelihood of persons involved in the SHGs (Patel et al., 2014).

The millet production in Odisha had a decreasing trend between 2013 and 2022 from 201 thousand ha to 187 thousand ha, respectively; but the productivity has increased from 819 kg/ha to 964 kg/ha (Mandal et al., 2023). These challenges can be addressed by a collaborative community approach involving government agencies, private companies, NGOs and local farmers. A critical knowledge gap exists regarding the effectiveness of these diverse stakeholders in executing promotional initiatives. It is essential to understand the factors influencing farmers' millet choices, as there are insufficient empirical data capturing the specific perceptions of milletpreneurs and associated partners concerning their mutual support and interaction (Ojha et al., 2025). Without structured insight into these stakeholders' perceptions (Vattekkad et al., 2025), systematic bottlenecks and misalignment remain hidden, which hinders the ability to address operational constraints, optimize community extension approaches and build a robust, scalable framework for sustainable milletpreneurial promotion. Therefore, the study will delineate various enabling factors that are effective for promotion of milletpreneurship through community initiatives.

METHODOLOGY

The data collection was done in Rayagada and Sundargarh districts, where people have been engaged in a community approach for many years, as well as has a high millet production. The interview was conducted in 2024. Total sample size was 120, consisting of millet growers or people engaged in millet-based

business, as well as the people engaged in enterprises across the millet value chain, who were selected purposively and these people are termed as milletpreneurs. The interview varied in duration from 45 minutes to 60 minutes per respondent. All the respondents were actively involved during the interview and prior consent was taken. The interview schedule was designed based on the literature review and pilot study. The thirteen indicators under the effectiveness index were developed based on 130 expert judgement relevance weightage under a three-point continuum.

$$\text{Relevancy weightage (RW)} = \frac{\text{Most Relevant} \times 3 + \text{Relevant} \times 2 + \text{Irrelevant} \times 1}{\text{Max possible score}}$$

Indicators having weightage below 0.75 were excluded, resulting in the selection of thirteen indicators. After data collection, the indicator values were normalized using the max-min method to bring all indicators to a comparable range using formula:

$$\text{Normalization } X_{ij} = \frac{X_{ij} - \text{Min } X_i}{\text{Max } X_i - \text{Min } X_i}$$

Where, X_{ij} is the value of indicator 'j' corresponding to respondent 'i'

Before applying Principal Component Analysis (PCA) the suitability of the data set was measured using the Kaiser-Meyer-Olkin (KMO) value and spherical testing of Bartlett's K-Square ($p < 0.05$). PCA was used to derive the communality value, and the weights of each indicator was obtained by using factor loadings of the rotated component matrix and multiply with their respective eigen values. Further, the sum of the normalized value of extracted indicators was divided by the grand total weight to obtain the index value. The index value came within '0' to '1' as normalized data were used.

RESULTS

PCA suitability measure

The sufficiency of the dataset for principal component analysis was confirmed through the KMO and Bartlett's test (Table 1). The KMO value of 0.934 exceeded the threshold of 0.90, indicating exceptionally high sampling adequacy and a compact correlation structure among the thirteen indicators.

Table 1. KMO and Bartlett's Test for PCA Suitability

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.934
Bartlett's Test of Sphericity	Approx. Chi-Square (χ^2)	1324.788
	df	78
	Sig.	.000

The Bartlett's test of sphericity was highly significant ($\chi^2 = 1324.788$, $df=78$, $p < 0.001$), confirming that the indicators were sufficiently intercorrelated to justify factor extraction. These results validate the appropriateness of PCA and confirm that effectiveness is a multidimensional construct.

Interpretation of the variance of components

PCA extracted two components with eigenvalues exceeding the KMO of 1.0 (Table 2). The first two components recorded an

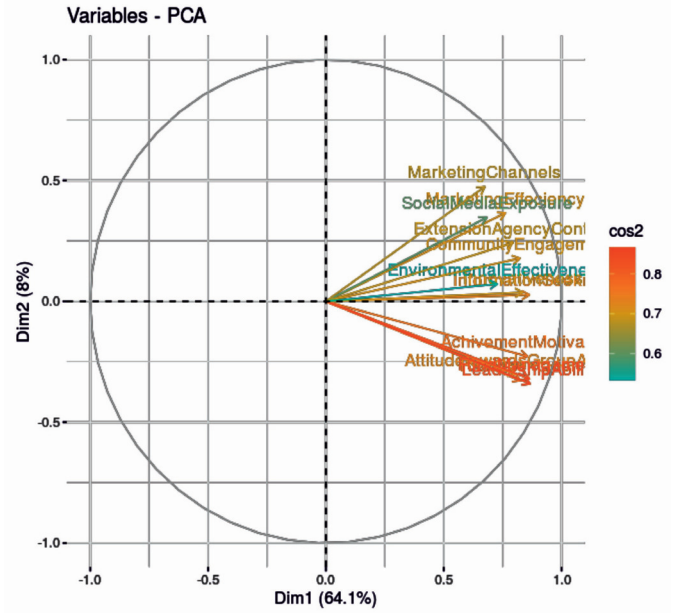
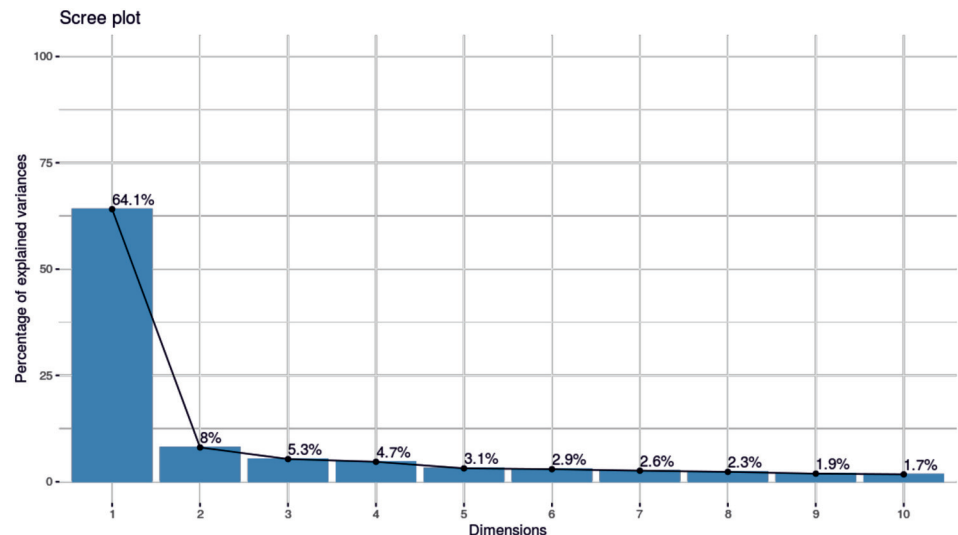
Table 2. Total variance explained by extracted components

Component	Initial Eigenvalue	Extraction Sums of Squared Loadings % of Variance	Rotation Sum of Squared Loadings % of Variance
1	8.331	64.084	39.138
2	1.046	8.048	32.994
3	0.691	.	.
4	0.608	.	.
5	0.407	.	.
6	0.382	.	.
7	0.335	.	.
8	0.300	.	.
9	0.246	.	.
10	0.223	.	.
11	0.169	.	.
12	0.155	.	.
13	0.107	.	.

eigenvalue of 8.831 and 1.046, explaining 64.084 and 8.048% variance, respectively. The remaining eleven components, with eigenvalues between 0.107 and 0.691, were excluded as they explained less variance than a single original variable.

The scree plot (Figure 1) visually confirms this pattern through a sharp elbow after Component 1, reflecting that the effectiveness of community-based millet development initiatives is governed by an integrated framework rather than isolated factors. This dominance reflects the convergence of multiple stakeholder interactions into a unified influence on entrepreneurial development.

The biplot (Figure 2) illustrates that both components together account for 72.1% of the variance, with indicators positioned closer together representing higher mutual correlation. Leadership ability, fund management, risk orientation, achievement motivation and attitude towards group action cluster tightly, indicating they move together across respondents as a single underlying construct of internal entrepreneurial competence. Social media exposure, marketing channels and marketing efficiency occupy a distinct region, separated from the core cluster, signalling that marketing and digital dimensions form a separate, secondary axis of effectiveness.

Figure 1. Scree plot showing variance in components**Figure 2.** PCA Biplot

In Table 3 the rotated solution of community engagement, information seeking, risk orientation, attitude towards group action, leadership ability, achievement motivation, fund management and innovativeness load more strongly on Component 1, representing internal entrepreneurial competencies, whereas social media exposure, marketing channels, marketing efficiency load more strongly on Component 2, representing external market interface. Leadership ability recorded the highest communality ($h^2 = 0.863$) and highest weight (7.610), confirming it as the most influential and best-represented construct in the framework, with a mean perceived effectiveness of 0.600 reflecting moderate to high confidence among milletpreneurs. Fund management followed as the second highest weight (7.532) and a high communality (0.850), yet its mean score was comparatively low (0.388), revealing a gap between its recognised importance and respondents' actual financial management capacity. Risk orientation ranked third in weight (7.284, communality = 0.788, mean = 0.509), reflecting a generally favourable

Table 3. Effectiveness indicators with their component variance, communality, weightage, and mean

Indicators	Component Matrix		Rotated Component Matrix		Communality Extraction value (h ²)	Weight of indicators	Mean
	Component		Component				
	1	2	1	2			
<i>Effectiveness indicator</i>							
Community Engagement (COENG)	0.823	0.178	0.494	0.682	0.709	4.885	0.444
Marketing Efficiency (MAREY)	0.762	0.366	0.323	0.780	0.722	3.524	0.412
Information Seeking (INFSE)	0.863	0.027	0.625	0.596	0.762	6.509	0.322
Risk Orientation (RSKOR)	0.825	-0.328	0.833	0.306	0.788	7.284	0.509
Attitude towards Group Action (ATGAN)	0.804	-0.303	0.801	0.311	0.731	6.953	0.471
Leadership Ability (LEDAB)	0.866	-0.341	0.872	0.324	0.863	7.610	0.600
Achievement Motivation (ACHMO)	0.855	-0.228	0.789	0.400	0.779	6.999	0.451
Fund Management (FNDMT)	0.863	-0.320	0.857	0.337	0.850	7.532	0.388
Innovativeness (INNVO)	0.835	0.037	0.597	0.585	0.695	5.669	0.285
Social Media Exposure (SOMEX)	0.683	0.347	0.277	0.714	0.575	3.260	0.042
Marketing Channels (MRCNL)	0.674	0.474	0.186	0.803	0.692	2.405	0.307
Extension Agency Connect (EXAGC)	0.794	0.242	0.430	0.710	0.692	4.277	0.351
Environmental Effectiveness (ENVEF)	0.727	0.072	0.494	0.539	0.532	4.683	0.292

disposition towards calculated risk-taking, consistent with evidence linking risk orientation to entrepreneurial pursuit of innovative ventures (Markowska et al., 2019). Achievement motivation and attitude towards group action followed closely, both exhibiting communalities above 0.73 and moderate mean scores (0.451 and 0.471).

In contrast, social media exposure recorded the lowest mean score (0.042). Despite moderate communality (0.575), pointing towards a severe digital divide rather than measurement weakness. Marketing channels showed both the lowest weight (2.405) and the lowest mean (0.307), suggesting an issue in the marketing channel. Marketing efficiency, although weighted moderately (3.524), had a relatively higher mean (0.412). Community engagement showed a moderate to high distribution (mean= 0.444). Environmental effectiveness recorded the lowest communality (0.532) and a low mean (0.292), suggesting this dimension reflects factors external to individual competence.

Distribution of the respondents based on indicators

The scatter plots (Figure 3a to 3m) represent heterogeneity in individual responses of milletpreneurs under each indicator. Community engagement, information seeking, risk orientation, leadership ability, achievement motivation and innovativeness showed moderate to high, fairly consistent distributions, while fund management displayed a markedly scattered pattern reflecting mixed financial management capacity. Social media exposure, marketing channels and environmental effectiveness clustered towards the lower end of the distribution, confirming these as the weakest dimensions and priority targeted intervention.

The Figure 4 represents the analysis, which reveals a high degree of heterogeneity among respondents with normalised scores generally ranging from 0.100 to 0.850. As illustrated by the multivariate radar chart, there is substantial variance and overlap in key attributes such as community engagement, leadership ability and achievement motivation. While a few individuals exhibit

distinctiveness in specific areas like risk orientation or market efficiency, the overarching trend is a uniform profile across the sample. Instead, the data set demonstrates a complex distribution where most subjects display moderate baseline scores, punctuated by highly individualised strengths. Consequently, this multidimensional variability suggests that the target population operates with high diverse, non-monolithic behavioural and operational profile.

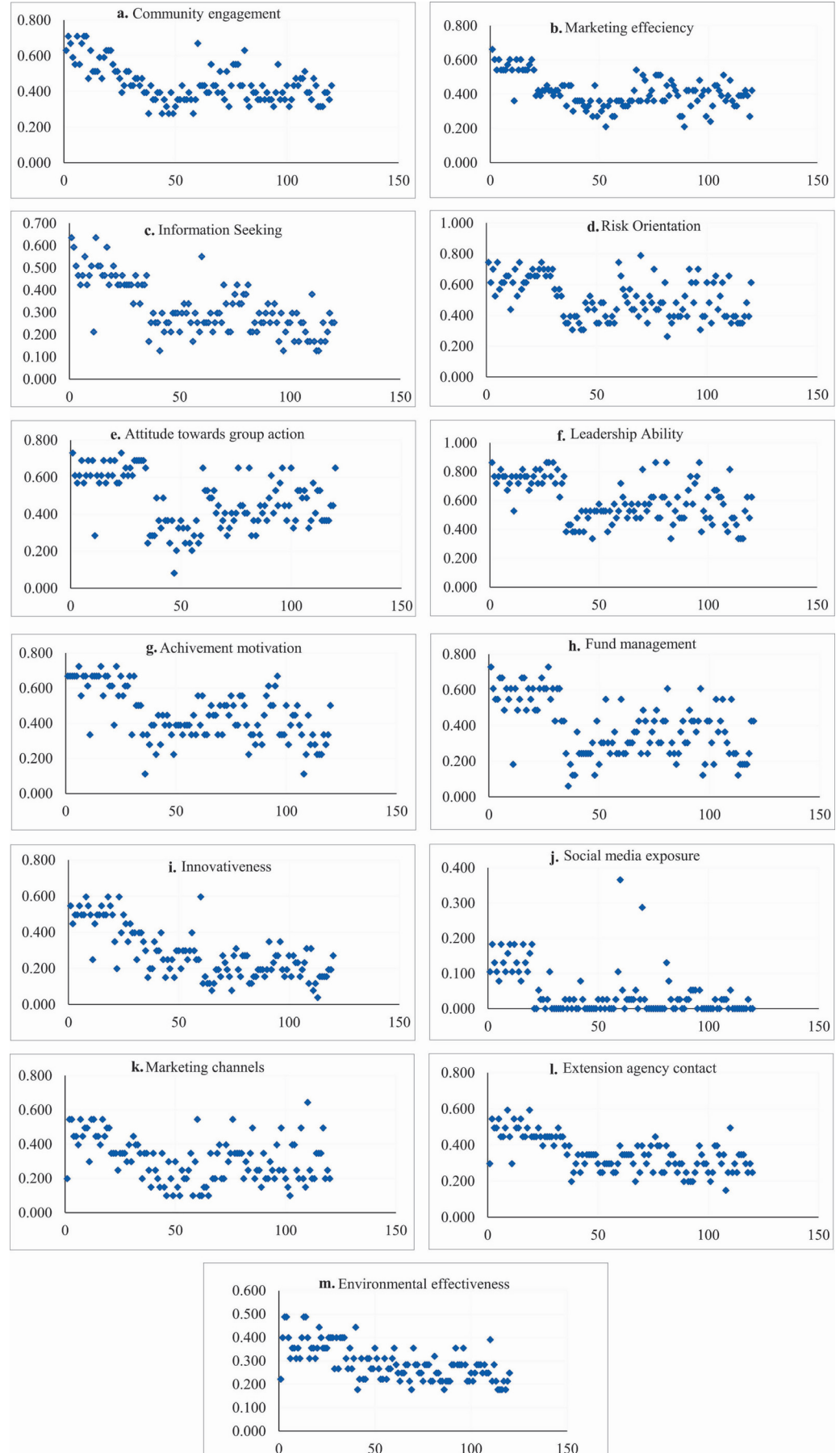
In case of the differential level of perceived overall effectiveness (Figure 5), a majority of the respondents have a moderate level of perception that the community approach is effective in promoting entrepreneurship, while 26.6% have a high perception of the approach.

DISCUSSION

The analysis reveals that there is emerging frameworks in rural entrepreneurship literature and simultaneously challenging view points towards certain assumptions regarding community engagement in milletpreneurship. Unlike a generic descriptive study of community development initiatives, the findings provide an empirically grounded analysis of how diverse entrepreneurial capacity within rural communities either disables or enables the effectiveness of the collective action in the agricultural value chain. The heterogeneity observed in the sample, with 41.7% perceived moderate effectiveness and only 26.6% perceived it as high effectiveness (Figure 5). Similarly, the diversity of the responses can be seen in the scatter plot (Figure 3.a – 3.m), suggesting that community-based approaches can operate as a transformative mechanism. The success depends critically on underlying entrepreneurial capacities within the population.

The findings reframe the relationship between individual entrepreneurial attributes and collective action, diverging from previous conceptualisations that treat community approaches and individual competence as separate. Prior research on community-based rural development (Mhembwe & Dube, 2017; Fortunato & Alter, 2015) has predominantly emphasised institutional and

Figure 3. Distribution of respondents based on the indicators



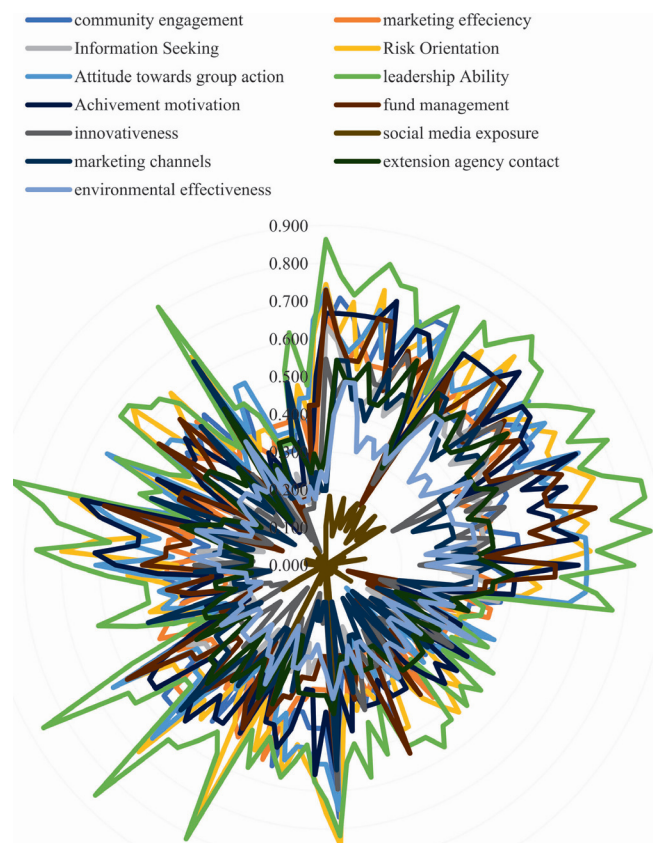


Figure 4. Distribution of effectiveness of the community approach

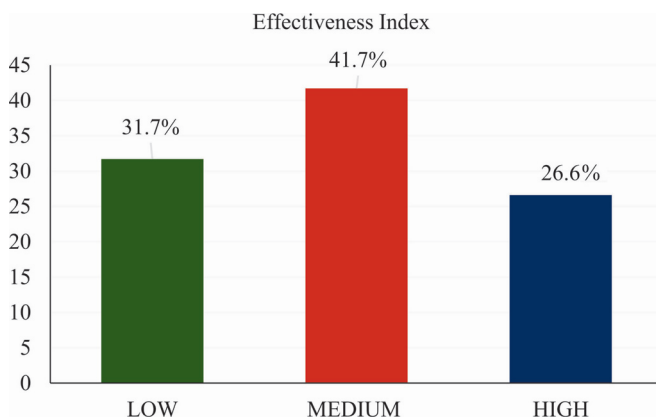


Figure 5. Distribution of the respondents based on the differential level of perceived effectiveness

systematic factors, arguing that the mere existence of cooperative structures or community initiatives drives entrepreneurial outcomes. However, the PCA result demonstrates that 64.1% of the variance in perceived effectiveness is driven by a single integrated dimension comprising individual attributes such as leadership ability (communality=0.863), fund management (communality=0.850), and risk orientation (communality=0.788). This shows that a community's effectiveness is fundamentally driven by individual entrepreneurial competencies (Sinha et al., 2021).

The recent studies on the extension system in India highlight that technological information alone doesn't translate to

entrepreneurial success (Pani et al., 2023; Nain et al., 2024). In contrast to that, the findings demonstrate empirically that the gap between moderate and high effectiveness is not primarily bridged by policy interventions at the institutional level, but rather by investment in developing specific entrepreneurial capacities, particularly financial management and marketing efficiency (mean= 0.388, 0.412, respectively), indicating that despite the community framework, many milletpreneurs lack foundational competencies in financial decision-making and market positioning.

In the case of indicators like community engagement, it is evident that a majority of people have a medium to high level of effectiveness. A parallel study on health and care services also emphasises that community engagement is vital for improving health services by involving citizens (De Weger et al., 2018). This shows that milletpreneurs have a good understanding that a collective approach makes a goal more achievable. It is also found that in the case of marketing efficiency (Figure 3.b), the majority have a high level of responses (mean= 0.412), which signifies that milletpreneurs are getting good returns for their produce/products after selling. It plays a crucial role in boosting industrial development by optimizing the sale of industrial products as well as crop production (Ilyash, 2021; Park et al., 2014). The information seeking also has a medium level of distribution, which shows the milletpreneurs have an interest in being informed. A similar study shows that information seeking is crucial for entrepreneurs to understand market needs (Joshi & Anand, 2018). Risk orientation also plays a crucial role in milletpreneurship, which also has a moderate level of effectiveness. High-risk orientation enables individuals to embrace uncertainty, make calculated decisions, and seize opportunities. A similar finding was observed in a study on nascent entrepreneurs, which emphasised that risk orientation fosters entrepreneurship and encourages the pursuit of innovative ventures (Markowska et al., 2019).

Attitude towards group action is also a contributing factor for millet entrepreneurship promotion (mean=0.471). Fostering collective action accelerates entrepreneurial success by leveraging shared resources and diverse viewpoints to solve complex problems and drive innovation (Gielnik et al., 2013; Flores Anaya et al., 2023). But it can also be interpreted that a diverse viewpoint creates heterogeneity, thus only 26.6% perceived it effective (Figure 5), likely the people who have personal entrepreneurial attributes, rather than 41.7% who perceived it moderately effective, which may represent specific capacity building gaps which are not addressed yet. The moderate level of perception towards leadership ability, which is affecting the regional development and the success of the enterprise. Similarly, for entrepreneurship promotion, respondents have a moderate level of perception towards achievement motivation. Higher achievement motivation drives greater innovation, productivity and overall success by enhancing organizational capabilities and performance (Modak et al., 2018; Tanjung & Musa, 2021).

Fund management shows a quite scattered response, which means milletpreneurs have a quite mixed response towards it. A significant portion of the milletpreneurs perceived adequate financial management capabilities, which is important for entrepreneurship development. People who are well trained, educated are more

efficient in dealing with funds, making investments, take steps for their economic well-being, rather than those who are not. Regions with higher fund management skills might experience better financial outcomes and greater economic stability. In case of innovativeness, a significant number of responses have been recorded where the majority of respondents have a moderate level of perceived effectiveness, which shows milletpreneurs are interested in learning and becoming part of newer practices. Areas with higher levels of innovativeness might experience greater economic growth, innovation, and competitiveness. This can be taken into consideration that innovativeness can be further enhanced by stakeholder convergence (Schut et al., 2015).

In the studied location, milletpreneurs have a lower perception towards social media engagement, which also represents the weakest dimension (mean=0.042, communality=0.575). Regions with lower digital literacy rates and limited internet access often exhibit lower engagement in social media among rural populations. Rural communities frequently face challenges in accessing digital and social media platforms because of poor internet connectivity and difficulties in utilizing the technology. It can also be interpreted that the problem is not just about access to digital technology, but that the community as a whole hasn't grasped that digital marketing is a useful tool for milletpreneurial development. In the case of the marketing channel, milletpreneurs comparatively have a negative perception towards milletpreneurship, as the respondents were still unaware of all possible channels to sell their products or produce, but it is an essential factor as it helps in creating awareness, generating interest, and facilitating sales, ultimately contributing to the success of an entrepreneurial venture.

Engaging frequently with extension agencies is a key factor in entrepreneurial success by providing valuable guidance, resources, and support throughout the business development process. This can include assistance with market research, business planning, financing, and networking opportunities, ultimately increasing the chances of entrepreneurial ventures thriving. A study with a similar context supports that extension contact improves business planning and market access. Environmental effectiveness has one of the lowest perceptions towards effectiveness.

A majority of the respondents (41.7%) perceived the community approach as moderately effective, while only 26.6% viewed it as highly effective. This distribution suggests that many milletpreneurs have not yet been exposed to the full spectrum of benefits this approach offers. However, this gap represents a clear strategic opportunity. Establishing effective linkages through a multidimensional approach strictly focuses on infrastructure development, financial support, capacity building and proper market linkage, can bridge this divide (Gudla et al., 2026). Ultimately, the evidence strongly supports that a well-supported community approach is highly active in building and sustaining local entrepreneurial skills.

It was found that there is pronounced behavioural and socioeconomic heterogeneity observed among respondents, which strongly suggests that uniform one-size-fits-all extension or marketing strategies will likely be ineffective. Instead, the presence of distinct individualized strengths, such as leadership or risk

orientation, points to the necessity for targeted differentiated interventions. Leveraging this specific local capacity rather than assuming a monolithic community profile, policymakers and extension agencies can foster more resilient and adaptive group dynamics. Recognizing this multidimensional diversity is crucial for designing customized capacity-building programmes that align with the actual varied operational realities of the targeted population.

CONCLUSION

The study reveals that community-based milletpreneurship effectiveness is fundamentally driven by individual entrepreneurial capacities rather than institutional structures alone. The 64.1% variance explained by a single integrated dimension comprising leadership ability, management and risk orientation challenges traditional assumptions that treat community approaches and individual competencies separately. The heterogeneous distribution (41.7% moderate, 26.6% high effectiveness perception) demonstrates that one-size-fits-all extension strategies are ineffective. Rather than institutional policy interventions, bridging the moderate-to-high effectiveness gap requires strategic investments in targeted entrepreneurial skill development. The pronounced behavioural and socioeconomic diversity necessitates customized, differentiated capacity-building programs aligned with actual operational realities. Therefore, addressing gaps in social media exposure, marketing channels and fund management through stakeholders' convergence can enhance community resilience. This empirically grounded analysis provides policymakers and extension agencies with evidence to design context-responsive, locally adaptive interventions supporting sustainable milletpreneurship.

DECLARATIONS

Ethics approval and informed consent: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional committee of Siksha 'O' Anusandhan Deemed to be University. Verbal consent was taken before conducting the interview from the respondents. Verbal modality is used to include all the participants with low literacy levels while keeping an equal approach for all participants.

Competing interests: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The authors declare that during the preparation of the work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

Conflict of interest: The authors declare no conflict of interest.

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