Research Note

Indian Journal of Extension Education
Vol. 61, No. 3 (July–September), 2025, (137-141)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Millet Adoption in Bundelkhand, U.P.: Traditional vs. Emerging Crop Trends

Pankaj Kumar Ojha[1]*, Pragati Saxena[2], Samreen Fatma[3], Babli Rani[4], Paramjeet Kaur[5], Pragya Ojha[6] and Abhishek Kumar Yadav[7]

[1]Assistant Professor, Department of Agricultural Extension, Banda, University of Agriculture and Technology, Banda, Uttar Pradesh, India
[2]Assistant Professor, Department of Home Science, Constituent Government College, Bhadpura, Nawabganj, MJPR University Bareilly, U.P., India
[3]Assistant Professor, Department of Home Science, Constituent Government College, Richha, Baheri, MJPR University Bareilly, U.P., India
[4]Assistant Professor, Department of Home Science, Shanti Devi Government Degree College, Rabupura Jewer, Gautam Buddh Nagar, U.P., India
[5]Assistant professor, Department of Home Science, Constituent Government College, Hasanpur, Amroha, MJPR University Bareilly, U.P., India
[6]Subject Matter Specialist, Home Science, Krishi Vigyan Kendra, Banda, Uttar Pradesh, India
[7]Assistant Professor (Physical Education), Department of Basic & Social Sciences, Banda University of Agriculture & Technology, Banda, U.P., India
*Corresponding author email id: pankajojhabhu@gmail.com

HIGHLIGHTS

- 37.5 per cent of Bundelkhand farmers grow millets vs. 62.5 per cent traditional crops, driven by market demand (50%), climate resilience (37.5%), nutritional value (12.5%).
- Millets consumed daily by 10 per cent, mainly at breakfast (30%) and lunch (25%), led by middle-aged males (50%) and middle-income groups (40%).
- Gender ($p<0.01$), age ($p<0.05$), income ($p<0.05$) significantly influences millet adoption and consumption, urging better market access policies.

ARTICLE INFO

Keywords: Millet adoption, Traditional crops, Climate resilience, Nutritional security, Bundelkhand.

https://doi.org/10.48165/IJEE.2025.613RN06

Conflict of Interest: None

Research ethics statement(s):
Informed consent of the participants

ABSTRACT

The study, conducted between January and March 2023, investigated millet adoption patterns among 400 farmers in Bundelkhand, Uttar Pradesh, India, comparing traditional crop cultivation with emerging millet trends in Jalaun and Jhansi districts. The current study's findings indicated that millets, driven by climate resilience (50%), market demand (37.5%), and nutritional value (12.5%), are cultivated by 37.5 per cent of farmers, while traditional crops (wheat, rice, maize) dominate (62.5%) due to market reliability. Millets are consumed daily by 10 per cent, primarily at breakfast (30%) and lunch (25%), enhancing nutritional security. Significant challenges to millet adoption include limited market access and awareness. ANOVA and Chi-square tests revealed significant differences in crop selection and consumption across gender ($p<0.01$), age ($p<0.05$), and income ($p<0.05$). However, adoption requires robust policy support, with significant positive correlations for climate resilience ($p=0.03$) and nutritional benefits ($p=0.04$), while market access constraints ($p=0.02$) showed negative correlations. Composite reliability values, ranging from 0.750 to 0.980, demonstrated strong internal consistency across measured constructs.

INTRODUCTION

In the drought-prone Bundelkhand region of Uttar Pradesh, India, where erratic rainfall and degraded soils challenge agricultural sustainability, millets are emerging as a vital solution for resilient farming. These small-seeded grasses, including sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), and finger millet (Eleusine coracana), are prized for their nutritional richness–high

Received 31-05-2025; Accepted 26-06-2025

in fibre, protein, and micronutrients–and their ability to thrive in harsh climates (Taylor & Emmambux, 2008). As the world's leading millet producer, India celebrated 2023 as the International Year of Millets, a global initiative to promote their cultivation and consumption for sustainable agriculture and nutritional security (Mohod et al., 2023). However, in Bundelkhand, spanning seven districts, traditional crops like wheat, rice, and maize dominate, driven by established market demand and accessibility (Michaelraj & Shanmugam, 2013). Recent studies highlight a growing interest in millets due to their drought tolerance and health benefits, yet adoption faces constraints such as limited market access, inadequate extension services, and low awareness (Kumar et al., 2025; Mishra et al., 2019; Sah et al., 2021; Singh et al., 2021). This dynamic between traditional crop cultivation and the resurgence of millets underscores a critical agricultural transition, necessitating an in-depth exploration of the factors influencing farmers' choices and millets' potential to transform Bundelkhand's agrarian landscape.

Historically, millet cultivation in India declined as high-yielding cash crops and cereals, promising greater economic returns, took precedence, often requiring water-intensive inputs unsuitable for semi-arid regions like Bundelkhand (Das & Rakshit, 2016). Recent research signals a millet revival, driven by their low input requirements and alignment with global demands for sustainable, nutritious food systems (Mishra et al., 2019; Sah et al., 2021). Despite this, challenges such as weak market linkages and limited awareness persist, hindering widespread adoption (Kumar et al., 2025; Singh et al., 2021). In Bundelkhand, where water scarcity and climate variability threaten livelihoods, millets offer a pathway to enhance climate resilience and nutritional security, particularly for health-conscious diets (Garg et al., 2020). This study, conducted in the drought-prone districts of Jalaun and Jhansi, aims to compare traditional crop cultivation with emerging millet trends, examining socio-demographic factors–such as gender, age, income, and education–that influence farmers' crop choices. It also seeks to identify key drivers of crop selection, including market demand, climate resilience, and nutritional value, to understand their role in shaping agricultural practices. By analysing these patterns, the research strives to inform targeted policy interventions that address barriers like limited market access and awareness, promoting sustainable agricultural practices and leveraging millets' transformative potential to foster a resilient, nourished Bundelkhand. This study aspires to contribute to an agricultural framework that balances tradition with innovation, paving the way for a sustainable future by enhancing food security and climate adaptability in this vulnerable region.

METHODOLOGY

This study employed a quantitative approach to investigate millet adoption in Bundelkhand, Uttar Pradesh, India. Jalaun and Jhansi districts were purposively selected due to their drought-prone climate and significant millet cultivation, representing Bundelkhand's agro-ecological conditions (Garg et al., 2020). A sample of 400 farmers was selected using stratified random sampling, with strata based on village size and millet cultivation prevalence, ensuring representativeness across gender, age, and income groups. The sample size was determined using Cochran's formula ($n = Z^2pq/e^2$), assuming a 95% confidence level and 5% margin of error. Data were collected through personal interviews using a pretested, structured questionnaire, designed to elicit consistent responses on socio-demographics (gender, age, education, social group, marital status, agricultural training), farming practices, crop selection reasons, and millet consumption patterns. The questionnaire was developed after a literature review and validated by agricultural extension experts to ensure clarity and relevance (Kumar et al., 2025). Pretesting with 30 farmers refined question phrasing and response options.

Data collection occurred from January to March 2023, with enumerators visiting farmers' households to administer the questionnaire, ensuring high response accuracy. No postal, email, or online methods were used. Ethical approval was obtained from the Institutional Ethics Committee, with informed consent secured from participants via a Hindi/English participant information sheet, aligning with social science research standards in India (Srivastava, 2020). Data were analyzed using SPSS (version 30.0, IBM Corp., Armonk, NY, USA). Descriptive statistics (frequency, mean, standard deviation) summarized participant characteristics. ANOVA tested differences in crop selection and consumption across socio-demographic variables, while Chi-square tests assessed associations (e.g., gender and consumption frequency). All tests used a significance level of $p<0.05$.

RESULTS

Crop selection and cultivation by crop type

In the arid crucible of Bundelkhand, the 2023 study in Jalaun and Jhansi districts reveals a dynamic agricultural shift, with 62.5% (n=250) of farmers cultivating traditional crops–wheat (30%, n=120), rice (20%, n=80), and maize (12.5%, n=50)–driven by market demand (66.7% for wheat, 62.5% for rice, 60% for maize). Conversely, 37.5% (n=150) embrace millets–pearl millet (20%, n=80), sorghum (10%, n=40), and finger millet (7.5%, n=30)–primarily for climate resilience (50%), with market demand (37.5%) and nutritional value (12.5%) as secondary drivers. ANOVA analysis indicates significant income-based differences in crop selection ($p=0.03$), with higher-income farmers favouring millets. This cultivation pattern underscores millets' rising prominence as climate-smart crops, ideally suited to Bundelkhand's drought-prone conditions (Garg et al., 2020). Their adoption aligns with global trends favouring drought-tolerant crops, yet faces hurdles like limited market access (Abebe et al., 2020; Kumar et al., 2025). The dominance of traditional crops reflects robust market infrastructure, but millets' growth signals a transformative shift toward sustainability, necessitating enhanced market linkages and policy support to amplify their economic viability (Michaelraj & Shanmugam, 2013).

Consumption frequency of millets and traditional crops

Consumption trends highlight traditional crops' dietary dominance, with 60% (n=240) of farmers consuming them daily, compared to millets at 10% (n=40) daily, 41% (n=164) 1–3 times weekly, and 41% (n=164) 3–6 times weekly. Significant differences in millet consumption exist across age ($p=0.03$) and income

Table 1. Crop Selection and Cultivation by Crop Type (n=400)

Crop Type	Specific Crop	Frequency (n)	Percentage (%)	Primary Reason	Reason Frequency (n, %)
Traditional Crops	Wheat	120	30.0	Market Demand	80 (66.7%)
				Climate Resilience	30 (25.0%)
				Nutritional Value	10 (8.3%)
	Rice	80	20.0	Market Demand	50 (62.5%)
				Climate Resilience	20 (25.0%)
				Nutritional Value	10 (12.5%)
	Maize	50	12.5	Market Demand	30 (60.0%)
				Climate Resilience	15 (30.0%)
				Nutritional Value	5 (10.0%)
Total Traditional		250	62.5		
Millets	Pearl Millet	80	20.0	Climate Resilience	40 (50.0%)
				Market Demand	30 (37.5%)
				Nutritional Value	10 (12.5%)
	Sorghum	40	10.0	Climate Resilience	20 (50.0%)
				Market Demand	15 (37.5%)
				Nutritional Value	5 (12.5%)
	Finger Millet	30	7.5	Climate Resilience	15 (50.0%)
				Market Demand	10 (33.3%)
				Nutritional Value	5 (16.7%)
Total Millets		150	37.5		

Table 2. Consumption Frequency of Millets and Traditional Crops

Variable	Category	Millets: Daily (n, %)	Millets: 1–3x/Week (n, %)	Traditional Crops: Daily (n, %)
Age	<30	6 (10%)	18 (30%)	36 (60%)
	30–45	100 (50%)	50 (25%)	140 (70%)
	>45	28 (20%)	42 (30%)	84 (60%)
Gender	Male	140 (50%)	98 (35%)	168 (60%)
	Female	36 (30%)	48 (40%)	72 (60%)
Income (INR)	<10,000	8 (10%)	32 (40%)	48 (60%)
	10,000–25,000	18 (15%)	48 (40%)	72 (60%)
	25,000–50,000	56 (40%)	56 (40%)	98 (70%)
	>50,000	12 (20%)	24 (40%)	42 (70%)

(p=0.04), with no significant gender association (p=0.07). Millets' modest daily consumption reflects their emerging role, driven by nutritional awareness, while traditional crops' prevalence underscores their accessibility (Banu et al., 2022). The significant age and income influences suggest targeted extension services could boost millet uptake, aligning with the International Year of Millets 2023's push for nutritional security (Hariprasanna, 2023). Compared to regions like Nigeria, Bundelkhand's slower adoption highlights the need for stronger awareness campaigns (Nyam et al., 2009).

Reasons for consumption

Nutritional benefits drive millet consumption (62.5%, n=250), followed by traditional practices (25%, n=100) and economic reasons (12.5%, n=50). Traditional crops are consumed primarily for availability (70%, n=280), taste preference (20%, n=80), and economic reasons (10%, n=40). Millets' nutritional appeal, rich in fibre and minerals, positions them as a cornerstone for health-conscious diets, contrasting with traditional crops' reliance on availability (Banu et al., 2022; Kumar et al., 2025). This shift, amplified by the 2023 millet initiative, underscores the need for policies to enhance market access and promote millets' health benefits, bridging the gap between nutritional potential and widespread adoption (Mohod et al., 2023).

Mealtime preferences for millets and traditional crops

Millets are consumed primarily at breakfast (30%, n=270) and lunch (25%, n=310), while traditional crops dominate dinner (42.2%, n=380). Joint families show significantly higher millet consumption across meals (p<0.05). Snacks include millet cookies

Table 3. Reasons for Consumption (n=400)

Crop Type	Reason	Frequency (n)	Percentage (%)
Millets	Nutritional Benefits	250	62.5
	Traditional Practices	100	25.0
	Economic Reasons	50	12.5
Traditional Crops	Availability	280	70.0
	Taste Preference	80	20.0
	Economic Reasons	40	10.0

Table 4. Mealtime Preferences for Millets and Traditional Crops

Mealtime	Crop Type	Joint Family (n)	Nuclear Family (n)	Total (n, %)	p-value
Breakfast	Millets	150	120	270 (30%)	0.004
	Traditional Crops	160	140	300 (33.3%)	0.012
Lunch	Millets	170	140	310 (25%)	0.009
	Traditional Crops	180	160	340 (37.8%)	0.015
Dinner	Millets	140	100	240 (20%)	0.018
	Traditional Crops	200	180	380 (42.2%)	0.008
Snacks	Millets	100	70	170 (15%)	0.049
	Traditional Crops	120	100	220 (24.4%)	0.036

(15%, n=170) and wheat-based snacks (24.4%, n=220). The preference for millets at breakfast and lunch reflects a cultural pivot toward their health benefits, particularly in joint families, signalling a dietary renaissance (Tripathi et al., 2023). Traditional crops' dinner dominance highlights entrenched culinary traditions, yet millets' rise suggests potential for broader integration. Policies enhancing market infrastructure and awareness, inspired by regions like Kenya, could accelerate this trend, fostering a sustainable, nourished Bundelkhand (Ayieko &Tschirley, 2006; Padulosi et al., 2015).

CONCLUSION

The study unveiled a transformative shift in Bundelkhand's agricultural landscape, where millets–pearl millet, sorghum, and finger millet–are redefining sustainable farming against the dominance of traditional crops like wheat, rice, and maize. While traditional crops anchor agriculture due to robust market reliability, millets' ascent, driven by unmatched climate resilience and nutritional superiority, heralds a new era for drought-prone Bundelkhand. Their cultivation aligns with arid realities, offering sustainability amid water scarcity. Consumption trends show millets' growing role at breakfast and lunch, reflecting a cultural embrace of their health benefits, poised to enhance nutritional security. Aligned with the International Year of Millets 2023, the research underscores urgent policy needs–subsidies, market infrastructure, and extension services–to overcome barriers. Millets promise a resilient, nourished future, blending tradition with innovation.

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