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Farmers' Perceptions on Millet Cultivation in Hill Farming Systems: A Case Study of Climate-Resilient Food Security Strategies

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Abstract: Millets, known as "nutri-cereals," are small-grained crops celebrated for their resilience, nutritional value, and adaptability to challenging environments. In the hill region of Uttarakhand, millets such as finger millet (ragi), barnyard millet, and foxtail millet thrive due to their low water requirements, short growing seasons, and ability to grow on marginal soils. The study was conducted in the Chamoli district of Uttarakhand, India, utilizing random sampling methods to ensure representation from the farmers. Descriptive analytical tools were employed to analyze data collected through personal interviews using a carefully designed questionnaire. The findings reveal that Finger millet is widely cultivated by 75.5% of farmers, followed by barnyard millet (60%) and amaranth (56.1%), indicating strong farmer preference and adaptation of these crops in hill farming systems. Most farmers conserve seeds from their harvests, especially finger millet (63.3%) and amaranth (54.4%). The study underscores millets' potential as climate-resilient, nutritionally superior crops suitable for hill farming systems in Uttarakhand.

Keywords: Climate-resilient crops • Hill Agriculture • Food Security • Millets • Uttarakhand

INTRODUCTION

Uttarakhand's agricultural sector, spanning 7.5 lakh hectares (13% of its geographical area), faces critical challenges despite its reliance on crops like rice, wheat, maize, and horticulture. Over 85% of farmers are small/marginal (owning <1 hectare), limiting mechanization and profitability. Climate vulnerability exacerbates risks, with 70% of rain-fed agriculture battling erratic rainfall, landslides, and soil erosion, widening cereal yield gaps (40% below the national average). Millets, resilient to harsh climates and poor soils, emerge as a sustainable solution, particularly in erosion-prone hill regions. Addressing these issues requires promoting climate-smart practices, enhancing irrigation, and policy support to bridge productivity gaps and ensure food security. Integrating millets into farming systems could revive traditional resilience, mitigate climate impacts, and support the agrarian economy dominated by vulnerable smallholders (Uttarakhand Agricultural Census, 2021; NITI Aayog, 2022).

Millets Grown in Uttarakhand

(a) Finger Millet (*Eleusine coracana*): Known as *Mandua* or *Ragi*, it is a primary source of sustenance for many hill farmers and is known for its exceptional storage capacity. A staple in the hills, grown in rainfed conditions. Grown in mid-altitude regions (1,000–2,000 meters) under rainfed conditions **(Aribam et al., 2024).** High in calcium and iron, making it a staple for many households (Singh, 2024). It is commonly used to prepare traditional dishes like roti and porridge **(Kumar et al., 2024).**

(b) Barnyard Millet (*Echinochloa crus-galli*): Locally known as *Jhangora*, barnyard millet is widely grown in Uttarakhand. Drought-resistant and thrives in poor soil, maturing in 60–70 days **(Aribam et al., 2024).** Also known for its high fiber content, it adapts well to high altitudes. Grown in temperate zones, it matures quickly (60–70 days) and is ideal for erratic monsoons. High in fiber, making it beneficial for digestive health **(Jalal & Pandey, 2024).**

(c)Foxtail Millet (*Setaria italica*): Foxtail millet (*Kangni* in local dialects) is grown in some parts of Uttarakhand. Known for its resistance to pests and diseases and is suitable for marginal lands. Thrives in poor soil and is drought-tolerant **(Aribam et al., 2024).** A drought-tolerant crop with a short growing season.

(d) Proso Millet (*Panicum miliaceum*): Also known as *Cheena*, this millet is rich in proteins and is an excellent alternative to rice for subsistence farmers in Uttarakhand. Less common but suitable for marginal lands. **(Aribam et al., 2024)**

(e)Kodo Millet (*Paspalum scrobiculatum*): Known as *Kodra*, this millet variety is grown in semi-arid and hilly areas of the state and is highly drought-resistant. Grown in small pockets, it is valued for its resilience. Resistant to pests, it suits higher elevations. **(Aribam et al., 2024).**

Millet cultivation in Uttarakhand is vital for food security and climate resilience, with an average yield of 0.8 tons/hectare influenced by rain-fed systems and hilly terrain. Proso Millet thrives in mid-altitude zones (Tehri, Nainital) due to its drought tolerance and short growth cycle, while Kodo Millet dominates warmer lowlands (Champawat, Udham Singh Nagar) with well-drained soils. Little Millet, though sporadically grown in Dehradun and Haridwar, supports dietary diversity. Finger Millet (Ragi) remains predominant, occupying 47% of the total 31,700 hectares under millet cultivation, producing 170,484 metric tons in 2010–11 (DOA, 2011). Government initiatives like the Millet Mission aim to expand cultivation by 15–20% by 2025, promoting traditional practices such as mixed cropping (e.g., Ragi with pulses) to enhance soil fertility and reduce risks (State Agriculture Dept., 2022). Despite their nutritional benefits and adaptability, challenges like soil erosion, erratic monsoons, and declining traditional practices persist. Sustainable strategies, including crop resilience research, market integration, and community engagement, are critical to strengthening millet's role in climate-smart agriculture and ensuring long-term food security in the region (Meena & Maikhuri, 2024). This study aims to critically assess farmers' perceptions, awareness, and cultivation practices of various millet crops within the hill farming systems of Chamoli District, Uttarakhand, to identify gaps and opportunities that can inform targeted policy interventions to strengthen food security, promote climate-resilient agriculture, and enhance rural livelihoods.

Nutritional Benefits

Countries like the USA, China, and African nations are promoting millet-based diets due to their role in combating malnutrition and improving food security. The UN has also declared 2023 as the *International Year of Millets*, highlighting their global significance.

Table 1: Nutritional Comparison (per 100g)

Nutrient	Finger Millet	Barnyard Millet	Proso Millet	Kodo Millet	Foxtail Millet	Rice	Wheat
Calcium (mg)	344	20	8	35	31	10	41
Iron (mg)	3.9	5.0	2.9	3.6	6.3	0.2	3.5
Fiber (g)	11.5	10.0	8.5	9.0	8.0	0.2	1.2
Protein (g)	7.3	11.0	12.5	9.8	12.0	7.0	13.0
Carbohydrates	72.0	65.0	70.0	66.0	63.0	77.0	72.0

Nutrient	Finger Millet	Barnyard Millet	Proso Millet	Kodo Millet	Foxtail Millet	Rice	Wheat
(g)							
Fat (g)	1.5	2.2	3.1	1.3	4.3	0.8	2.5
Magnesium (mg)	137	150	120	130	110	25	138
Zinc (mg)	2.3	3.0	1.7	2.2	2.4	1.1	4.3
Phosphorus (mg)	283	280	285	290	290	115	357
Potassium (mg)	408	300	250	280	250	115	431
Source	(FAO, 2017; NIN, 2020)	(Longvah et al., 2017)	(Saleh et al.., 2013)	(Devi et al.., 2014)	(Rao et al., 2018)	(USDA, 2023)	(ICAR, 2019)

As presented in Table 1, Finger Millet (Ragi) stands out as the most abundant source of calcium and fiber. Foxtail Millet exhibits the highest iron content among the analyzed grains, while Barnyard Millet provides a well-balanced composition of protein and fiber. In contrast, Rice and Wheat, included for comparative analysis, generally contain lower levels of micronutrients than millet. Globally, the Food and Agriculture Organization (FAO) recognizes millets as "nutri-cereals" due to their high protein, vitamin, and mineral content **(FAO, 2023).** In India, where malnutrition affects 38% of children under five **(NFHS-5, 2021),** millets can address micronutrient deficiencies, earning them the spotlight during the International Year of Millets 2023.

Comparison of other Crops vs. Millets

In the table.2, research indicates that millets outperform traditional staples like rice and wheat in terms of drought tolerance, soil adaptability, and overall climate resilience, making them a strategic alternative for sustainable agriculture in Uttarakhand's hilly terrain. Among various millet varieties, Bajra (Pearl Millet) and Foxtail Millet exhibit the highest protein content, offering superior nutritional benefits, which is crucial for addressing malnutrition in rural communities. Comparative studies also highlight that maize, though requiring less water than rice and wheat, remains less drought-tolerant than millet, making it a relatively less reliable option under changing climatic conditions. Furthermore, Kodo Millet has demonstrated exceptional adaptability to upland dry soils, positioning it as an ideal crop for Uttarakhand's rain-fed and fragmented farmlands. These findings emphasize the need for further agronomic research, policy support, and farmer-centric interventions to integrate millets into mainstream cultivation, ensuring climate-resilient and food-secure agricultural systems.

Table 2: Comparison of other Crops vs. Millets

Parameter	Conventional Crops		Traditionally grown Millet Crops					Source
	Rice	Wheat	Finger Millet	Barnyard Millet	Foxtail Millet	Proso Millet	Kodo Millet	
Water Requirement (L/kg)	2,500–5,000	1,500–4,000	300–500	250–400	200–350	300–450	250–400	ICAR-IIMR, 2023; FAO, 2022
Drought Tolerance	Low	Medium	High	High	High	High	High	NABARD, 2021
Temperature Range (°C)	20–35	12–25	10–40	15–40	15–40	20–40	20–45	Uttarakhand Agri. Dept., 2022

Parameter	Conventional Crops		Traditionally grown Millet Crops					Source
	Rice	Wheat	Finger Millet	Barnyard Millet	Foxtail Millet	Proso Millet	Kodo Millet	
Soil Adaptability	Clayey, waterlogged	Loamy, fertile	Rocky, acidic	Marginal, degraded	Sandy, dry	Poor, alkaline	Upland, dry	FAO, 2021; ICAR, 2023
Growth Duration (days)	120–150	100–120	70–100	75–110	65–90	60–90	90–120	NITI Aayog, 2022
Yield (tons/hectare)	2.5–3.5	3.0–4.0	1.2–1.8	1.0–1.5	1.5–2.0	1.0–1.2	0.8–1.2	FAO, 2022; ICAR-IIMR, 2023
Climate Resilience	Low	Medium	High	High	High	High	High	IPCC, 2023

Research Methodology
Study Area

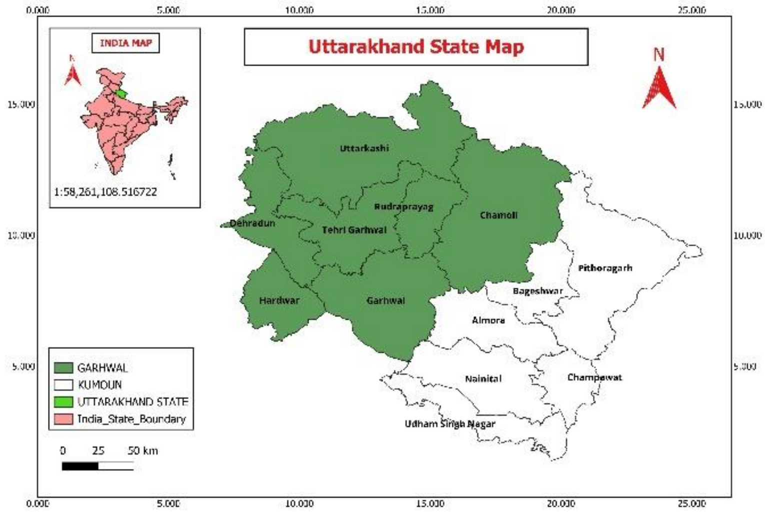

Fig.1: Study Area Map

The present study was undertaken in **Chamoli district**, situated in the **Garhwal region of Uttarakhand**, a hilly state in northern India characterized by its rugged topography, fragile ecology, and small holder- dominated subsistence agriculture. Chamoli lies in the central Himalayas and includes diverse agro-climatic zones ranging from mid-altitudes to high elevations, making it highly vulnerable to the impacts of climate change such as erratic rainfall, declining soil fertility, and shortened growing seasons. Despite these challenges, the region is traditionally known for cultivating hardy, climate-resilient crops such as **millets**, which have gained renewed attention for their nutritional value, low input requirements, and adaptability to marginal environments. Against this backdrop, the present study aimed to assess the potential of millets in enhancing **food security** and **climate resilience** among hill farmers.

Table 3: Research Design

S. No.	Parameter	Details
1	State	Uttarakhand
2	Study Area (District)	Chamoli District, Garhwal Region
3	Latitude & Longitude	30.41°N to 31.27°N latitude, 79.18°E to 80.26°E longitude
4	Altitudinal Range	800 meters to 3,800 meters above sea level
5	Total Administrative Blocks	9 Blocks (as per official administrative division)
6	Block Selected for Study	Joshimath, Dasoli, Gairsain, Karanprayag, Pokhri, Tharali
7	Villages Selected	22
8	Research Type	Descriptive, Exploratory (Perception-based survey)
9	Sampling Technique	Simple Random Sampling & Snowball Sampling
10	Sample Size	180 Farmers
11	Target Population	Millet-growing farmers in selected villages
12	Survey Tools Used	Structured Questionnaire, Personal Interviews
13	Type of Questions	Both Closed-ended and Open-ended
14	Data Type	Primary data (quantitative + qualitative)
15	Statistical Tools Used	Mean Score, TSS, F-Value, Significance, SE(m), SE(d), CV, Correlation
16	Software Used for Analysis	SPSS (Statistical Package for the Social Sciences)

As given in Table 3, a **descriptive survey research design** was adopted to collect both qualitative and quantitative data, primarily reflecting farmers' perceptions, attitudes, and experiences. Data collection was carried out through **structured questionnaires** and **personal interviews**, enabling the researcher to delve into local knowledge systems while maintaining a consistent framework for analysis. The questionnaire comprised a blend of **closed-ended** questions for statistical analysis and **open-ended** questions to capture nuanced perspectives on climate variability, yield performance, market access, income stability, consumption patterns, and institutional support related to millet cultivation. The study engaged a sample of **180 farmers** actively involved in millet farming. Sampling was carried out using two techniques: **simple random sampling** was employed in villages where lists of millet-growing farmers were available, ensuring each farmer had an equal chance of selection; and **snowball sampling** was used where such lists were not accessible, allowing respondents to refer others with similar farming profiles.

The data were analyzed using **SPSS (Statistical Package for the Social Sciences)**, and various statistical tools were employed to interpret the results.

The **significance** of the findings was evaluated using p-values and confidence intervals derived from SPSS outputs. Results were presented in the form of **tables, graphs, and charts**, ensuring a clear and comprehensive understanding of the patterns and relationships observed, as given in Table 4

Table 4: Statistical Tools Employed to Interpret the Results

S. No.	Technique	Purpose	Formula
1	Mean Score	To assess the central tendency	$X= \frac{\sum X}{N}$
2	F-Calculated	ANOVA test to compare group means	$F= \frac{MS\ between}{MS\ Within}$, Where $MS=\frac{SS}{df}$
3	Standard Error of Mean (SE(m))	Estimate the precision of the sample mean	$SE(m) = \frac{s}{\sqrt{n}}$
4	Standard Error of Difference (SE(d))	Compare two means	$SE(d) = \sqrt{SE(m1)^2 - SE(m2)^2}$
5	Coefficient of Variation (C.V.)	Relative variability	$CV= (\sigma/X) \times 100$
6	Correlation Coefficient (r)	Strength of the relationship between variables	$R=\frac{\sum(X-X1)(Y-Y1)}{\sqrt{\sum(X-X1)2\sum(Y-Y1)2}}$

Result

The data reveals significant variations in farmer perceptions, cultivation practices, and market engagement across five millet crops: finger millet, barnyard millet, foxtail millet, proso millet, and amaranth. Below, we synthesize key findings and contextualize them within broader agricultural and socio-economic frameworks.

Cultivation Trends

The results, as presented in Figure 2, revealed that proso millet cultivation has ceased entirely,with 124 farmers (68.9%) reporting discontinuation, likely due to low market demand or agronomic challenges **(Arya *et al.*, 2020).** Foxtail millet also showed declining adoption, with only 44 farmers (24.4%) presently cultivating it, suggesting shifting preferences toward more resilient or profitable crops (**Nithya & Bhavani, 2019**).

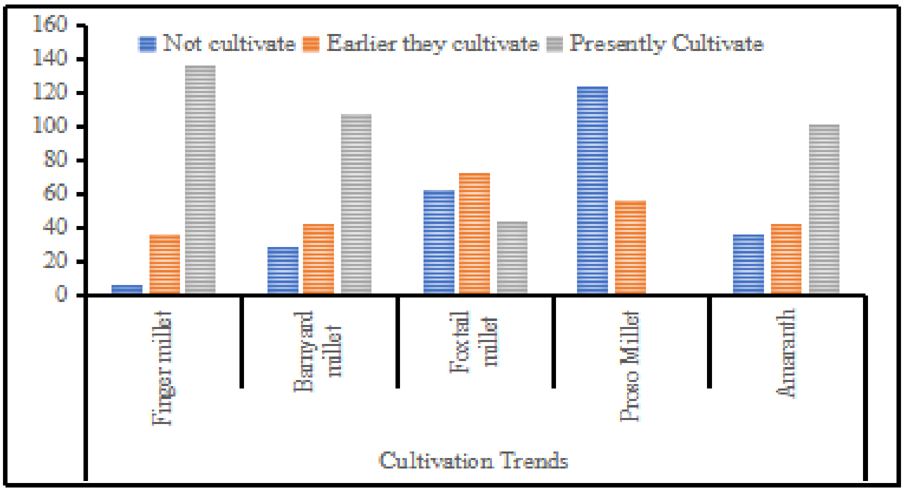

Fig. 2: Cultivation Trends

Awareness of Nutritional Value

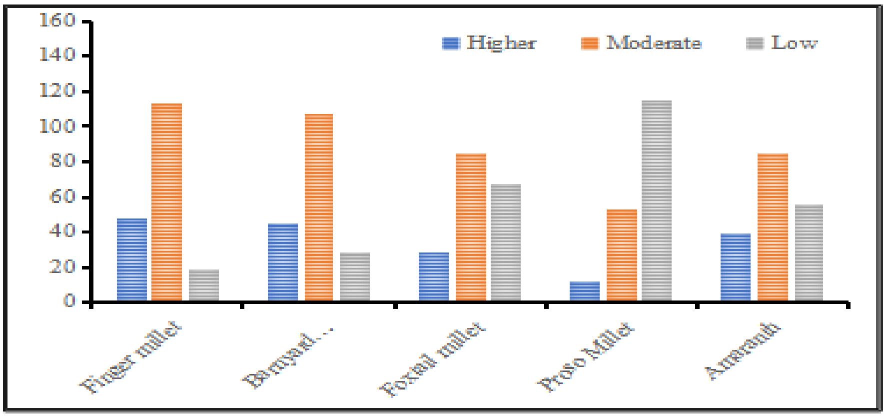

Fig. 3: Awareness of Nutritional Value

Farmers exhibited higher awareness of the nutritional benefits of finger millet (**48, 26.7%** "higher" awareness) and barnyard millet (**45, 25%**), correlating with their cultivation prevalence. Proso millet, however, had the lowest awareness (**12, 6.7%**), which may explain its discontinuation. Amaranth, despite moderate awareness (**39, 21.7%**), maintained strong cultivation rates, possibly due to its dual role as a grain and leafy vegetable (Rai et al., 2021). These trends align with studies linking nutritional literacy to crop retention in smallholder systems (**Kumar *et al., 2018***).

Seed Sourcing and Variety Adoption

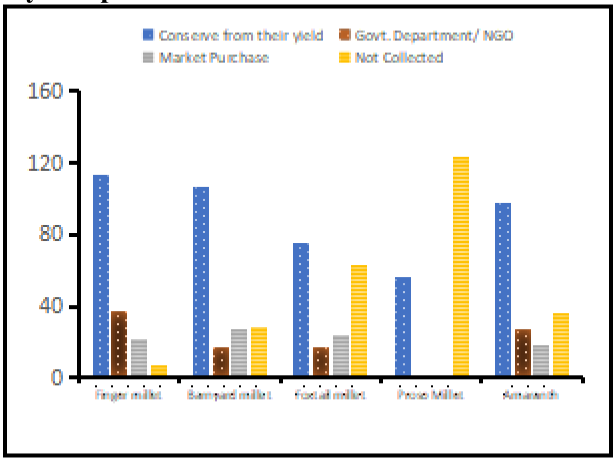

Fig. 4: Seed Sourcing

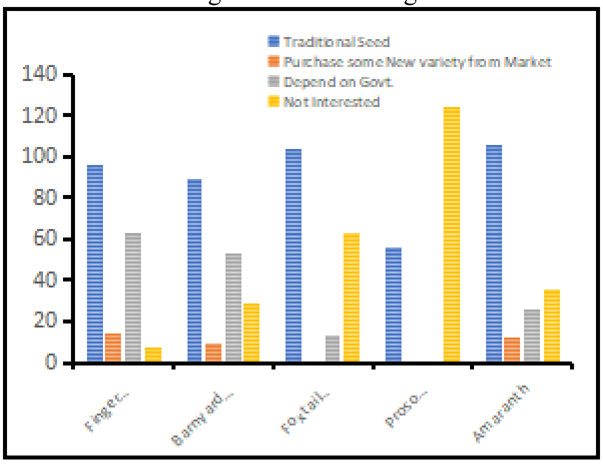

Fig. 5: Seed Sourcing

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Most farmers conserved seeds from their yields, particularly for finger millet (**114, 63.3%**) and amaranth (**98, 54.4%**), reflecting reliance on traditional practices. Proso millet farmers reported no seed collection (**124, 68.9%**), indicating systemic erosion of local seed systems. Government/NGO involvement in seed distribution was minimal except for finger millet (**37, 20.6%**), underscoring institutional gaps in supporting minor millets (Padulosi et al., 2019). New variety adoption was rare, with **96 farmers (53.3%)** using traditional finger millet seeds, suggesting resistance to market-based or institutional innovations

Cultivation Knowledge and Production Satisfaction

Higher cultivation knowledge was reported for finger millet (**32, 17.8%**) and amaranth (**37, 20.6%**), while proso millet had the lowest (**7, 3.9%**). Production satisfaction mirrored these trends: finger millet (**53, 29.4%** satisfied) and amaranth (**57, 31.7%**) outperformed barnyard and foxtail millets, which had higher dissatisfaction rates (**39, 21.7%** and **53, 29.4%**, respectively). Such disparities highlight the role of agronomic familiarity in yield outcomes (Singh & Rengalakshmi, 2020).

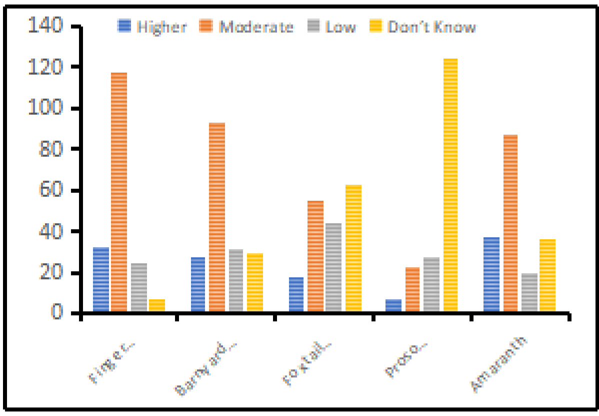

Fig. 6: Cultivation Knowledge

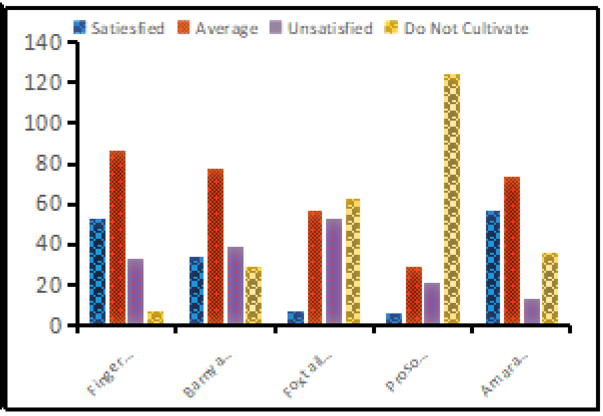

Fig. 7: Production Satisfaction

Marketing Patterns

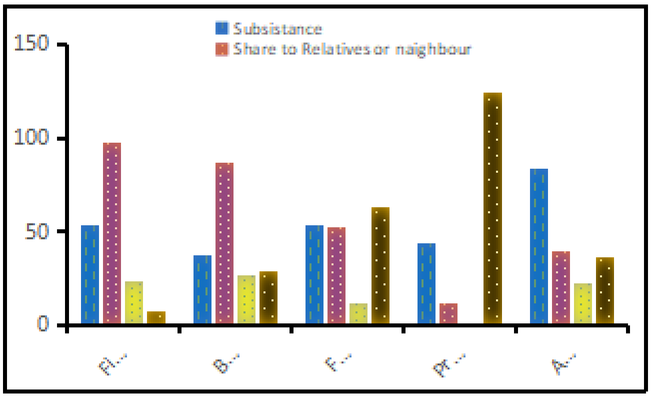

Figure 8: Marketing Patterns

Subsistence farming dominated, with finger millet (**97, 53.9%**) and barnyard millet (**87, 48.3%**) primarily shared within communities. Only **23 farmers (12.8%)** sold finger millet commercially, indicating limited market integration. Proso millet's absence from markets (**0, 0%**) reinforces its declining viability. Amaranth's moderate market sales (**22, 12.2%**) suggest untapped potential for value-chain development (Tripathi et al., 2022).

ANOVA Test for Differences in Farmers' Perceptions of Millet Crops

In calculating the significance of differences of the variables used in determining farmers' perceptions regarding the Millets crops, a one-way ANOVA was performed to examine if the perceptual variables of the respondents could influence their perceptions of Millets crops. The results, as presented in Tables 5 & 6, revealed that there was no statistical significance (0.05) for Awareness about Nutritional Value, Seeds Collected, Production, and Marketing of the Millets crops. A statistical significance (0.05) was, however, associated with Growing, Introduction of New Variety, and Cultivation Knowledge of millet crops.

Discussion

Millet Cultivation findings on millet cultivation patterns, nutritional awareness, seed sourcing, cultivation knowledge, production satisfaction, and marketing among hill farmers, contextualizing these within broader agricultural and socio-economic frameworks. Millet cultivation in Chamoli district shows a clear preference for finger millet, barnyard millet, and amaranth, which are widely grown due to their resilience, adaptability to marginal environments, and integration into traditional hill farming systems (Chaturvedi et al., 2011; Rengalakshmi, 2005, as cited in IDRC, 2013). Finger millet leads in adoption with 75.5% of farmers cultivating it, followed by barnyard millet (60%) and amaranth (56.1%). In contrast, proso millet cultivation has completely ceased, and foxtail millet is also declining, indicating shifting farmer preferences likely influenced by market demand, agronomic challenges, and institutional support gaps. (Chapke & Tonapi, 2019)

Nutritional awareness among farmers correlates with cultivation prevalence. Finger millet and barnyard millet enjoy higher awareness of their nutritional benefits, which supports their continued cultivation (Obilana, 2003; Murugesan et al., 2012, as cited in IDRC, 2013). Proso millet, despite relatively higher nutritional awareness, is abandoned, suggesting that awareness alone does not guarantee adoption; factors such as seed availability, market support, and institutional promotion are critical (Bagdia et al., 2011, as cited in IDRC, 2013). Amaranth maintains moderate awareness but strong cultivation, possibly due to its dual use as grain and leafy vegetable, reflecting the importance of multifunctionality in crop choice.

Seed sourcing practices reveal a strong reliance on traditional seed conservation, especially for finger millet and amaranth, with over half of farmers saving seeds from their own yields (Louwaars, 1994; Cromwell, 1996a, as cited in Karthikeyan, 2017). Proso millet farmers do not conserve seeds, indicating erosion of local seed systems for this crop. Limited government or NGO involvement in seed distribution, except for finger millet, highlights institutional gaps in supporting minor millets (IDRC, 2013). Adoption of new varieties is low, with a majority of farmers using traditional seeds, reflecting resistance to market-based or institutional innovations and emphasizing the need for participatory breeding and extension efforts (Chapke & Tonapi, 2019).

Cultivation knowledge and production satisfaction are higher for finger millet and amaranth, which correspond to better yield outcomes and farmer contentment (Agriculture Journal, 2024). Barnyard and foxtail millets show higher dissatisfaction, underscoring the role of agronomic familiarity and possibly the need for improved cultivation practices and support services. These findings align with existing literature that links farmer knowledge to productivity and satisfaction in smallholder systems (Agriculture Journal, 2024).

Marketing remains predominantly subsistence-oriented, with most finger millet and barnyard millet produced for community sharing rather than commercial sale. Limited market integration is evident, with only a small fraction of farmers selling these millets commercially. Proso millet's absence from markets further confirms its declining viability. Amaranth shows moderate market sales, indicating potential for value-chain development and income diversification if market linkages are strengthened (IDRC, 2013).

ANOVA reveals no significant differences in farmers' perceptions related to nutritional awareness, seed collection, production, and marketing among millet crops. However, significant differences exist in perceptions of growing practices, introduction of new varieties, and cultivation knowledge, highlighting areas where targeted interventions could enhance millet adoption and productivity (Agriculture Journal, 2024).

Table 5: Growing and Awareness about the Nutritional Value of Millet Crops

Indicators	**Crop**	**Not cultivate**	**Earlier they cultivate**	**Presently Cultivate**	**Total Score**	**Mean Score**	**Total Sum of Squares**	946.84
Growing Percentage	Finger millet	7	37	136	489	2.72	**F-Calculated**	2.327
	Barnyard millet	29	43	108	439	2.44	**Significance**	0.046
	Foxtail millet	63	73	44	341	1.89	**SE(m)**	0.075
	Proso Millet	124	56	0	236	1.31	**SE(d)**	0.106
	Amaranth	36	43	101	425	2.36	**C.V.**	67.463
Awareness of Nutritious Value	**Crop**	**Higher**	**Moderate**	**Low**	**Total Score**	**Mean Score**	**Total Sum of Squares**	1,080.55
	Finger millet	48	113	19	331	1.84	**F-Calculated**	2.464
	Barnyard millet	45	107	28	343	1.91	**Significance**	0.044
	Foxtail millet	28	85	67	399	2.22	**SE(m)**	0.08
	Proso Millet	12	53	115	463	2.56	**SE(d)**	0.112
	Amaranth	39	85	56	377	2.09	**C.V.**	73.682

Source: *Field survey, Significance level at 5% probability*

Table 6: Seeds Collected from, Introduction of New Variety and Cultivation Knowledge, Production & Marketing of the Millets crops

Seeds Collected from	**Crop**	**Conserve from their yield**	**Govt. Dept/ NGO**	**Market Purchase**	**Not Collected**	**Total Score**	**Mean Score**	**Total Sum of Squares**	800.88
	Finger millet	114	37	22	7	254	1.41	**F-Calculated**	0.524
	Barnyard millet	107	17	27	29	222	1.23	**Significance**	0.718^{NS}
	Foxtail millet	76	17	24	63	182	1.01	**SE(m)**	0.07
	Proso Millet	56	0	0	124	56	0.31	**SE(d)**	0.099
	Amaranth	98	27	19	36	209	1.16	**C.V.**	62.79

Source: *Field survey, Significance level at 5% probability, NS: Not Significate*

Introduction of New Variety	**Crop**	**Traditional Seed**	**Purchase some New variety from the Market**	**Depend on Govt.**	**Not Interested**	**Total Score**	**Mean Score**	**Total Sum of Squares**	922.44
	Finger millet	96	14	63	7	313	1.73	**F-Calculated**	3.154
	Barnyard millet	89	9	53	29	266	1.47	**Significance**	0.014
	Foxtail millet	104	0	13	63	143	0.79	**SE(m)**	0.072

	Proso Millet	56	0	0	124	56	0.31	**SE(d)**	0.102
	Amaranth	106	12	26	36	208	1.15	**C.V.**	62.394
Cultivation Knowledge	**Crop**	**Higher**	**Moderate**	**Low**	**Don't Know**	**Total Score**	**Mean Score**	**Total Sum of Squares**	978.99
	finger millet	32	117	24	7	338	1.88	**F-Calculated**	6.373
	Barnyard millet	27	93	31	29	306	1.7	**Significance**	0.001
	Foxtail millet	18	55	44	63	260	1.44	**SE(m)**	0.073
	Proso Millet	7	22	27	124	132	0.73	**SE(d)**	0.104
	Amaranth	37	87	20	36	271	1.51	**C.V.**	65.457
Production	**Crop**	**Satisfied**	**Average**	**Unsatisfied**	**Do Not Cultivate**	**Total Score**	**Mean Score**	**Total Sum of Squares**	944.866
	Finger millet	53	87	33	7	326	1.81	**F-Calculated**	1.638
	Barnyard millet	34	78	39	29	306	1.7	**Significance**	0.163 NS
	Foxtail millet	7	57	53	63	208	1.55	**SE(m)**	0.075
	Proso Millet	6	29	21	124	127	0.71	**SE(d)**	0.106
	Amaranth	57	74	13	36	244	1.35	**C.V.**	67.874
Marketing Status	**Crop**	**Subsistence**	**Share to Relatives or neighbor**	**Sell in Market or Govt. Department**	**Do Not Cultivate**	**Total Score**	**Mean Score**	**Total Sum of Squares**	1,104.64
	Finger millet	53	97	23	7	316	1.75	**F-Calculated**	0.72
	Barnyard millet	37	87	27	29	292	1.62	**Significance**	0.579 NS
	Foxtail millet	53	52	12	63	193	1.07	**SE(m)**	0.078
	Proso Millet	44	12	0	124	68	0.38	**SE(d)**	0.11
	Amaranth	83	39	22	36	227	1.26	**C.V.**	68.582

Source: *Field survey, Significance level at 5% probability, NS: Not Significate*

Conclusion

The present study highlights the complex dynamics of millet cultivation in the hill agriculture of Chamoli district, Uttarakhand, under the broader theme of enhancing food security through climate-resilient crops. In conclusion, the survey of 180 respondents regarding the various aspects of millets crops. The findings reveal that Finger millet is widely cultivated by 75.5% of farmers, followed by barnyard millet (60%) and amaranth (56.1%), indicating strong farmer preference and adaptation of these crops in hill farming systems. A majority of farmers conserve seeds from their own harvests, especially for finger millet (63.3%) and amaranth (54.4%). Finding also shows that some crops like Proso millet and foxtail millet cultivation of farmers stopped growing it, pointing to loss of crop diversity and farmer interest, likely due to low market demand and agronomic challenges. ANOVA reveals significant differences exist in perceptions of growing practices, introduction of new varieties, and cultivation knowledge, highlighting areas where targeted interventions could enhance millet adoption and productivity. The study underscores millets' potential as climate-resilient, nutritionally superior crops suitable for Uttarakhand's hilly terrain. It calls for enhanced agronomic research, policy support, institutional engagement, and farmer-centric approaches to revitalize millet cultivation, improve seed systems, boost market integration, and ultimately strengthen food security and rural livelihoods in the region. The findings contribute to the global discourse on millets as strategic crops for sustainable agriculture and nutrition, especially in marginal environments facing climate challenges.

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