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Assessment of the *Amaranthus (Ramdana)* Value Chain and Market Potential in Chhattisgarh and Uttarakhand for Sustainable Value Addition and Nutrition Security

Ambarish Paikaray*, Subhashree Priyadarshini, Ambarish Ghosh

Faculty of Management Studies, The ICFAI University, Raipur, Raipur-Bhilai Road, Kumhari, Durg-490042, Chhattisgarh, India
Centre for Distance and Online Education, Andhra University, Visakhapatnam-530003, Andhra Pradesh, India
*Corresponding Author: ambarish.raipur@gmail.com

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Abstract— *Amaranthus (Amaranthus graecizans and Amaranthus caudatus L.), is a traditional climate-resilient crop grown in the hill areas of Uttarakhand and tribal plains and plateaus of Chhattisgarh. Amaranthus is a very nutritious crop and able to adapt to minimal input rainfed systems . However, it is underutilized and its consumption is mostly seasonal as part of traditional diets. The study focuses on the production, processing and marketing stages of the amaranthus value chain in the key production clusters of the two states. The study utilized a participatory mixed-methods approach including Focus Group Discussions, Key Informant Interviews and secondary data analysis from key stakeholders and institutions. The study identified major restrictions relating to production efficiency, processing facilities and market linkages and also highlights prospects for value addition and increased market integration. Strengthening the amaranthus value chain can boost farmers' income, promote nutrition-sensitive agriculture and build climate-resilient livelihoods in Uttarakhand and Chhattisgarh. Amaranthus is essentially a traditional climate tolerant field crop farmed by hill and tribal populations in hill area of Uttarakhand and Chhattisgarh State.*

Keywords— ***Value chain, Value addition, Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs)***

I. INTRODUCTION

Amaranthus (*Amaranthus graecizans* and *Amaranthus caudatus* L.), commonly known as *Ramdana, Rajgira, Chaulai, and Marsa*, is an important traditional crop cultivated across diverse agro-ecological regions of India, particularly in the states of Uttarakhand and Chhattisgarh. In Uttarakhand, amaranth is predominantly grown in the mid- and high-hill regions, where it has long been integrated into mountain farming systems and household diets, especially during fasting periods, religious festivals, and lean agricultural seasons. In Chhattisgarh, the crop is traditionally cultivated by tribal and smallholder farmers in the plains and plateau regions, where it serves as both a grain and leafy vegetable, contributing to food and nutritional security during periods of scarcity.

Historically, amaranthus has played a role as a staple food in indigenous diets, comparable to its importance in ancient civilizations such as the Aztecs. Its adaptability to marginal lands, tolerance to drought and low-input conditions, and suitability for rainfed agriculture make it a resilient crop for both hill and tribal farming systems. With increasing global recognition of amaranth as a "superfood" due to its superior nutritional profile—characterized by high-quality protein, essential amino acids, minerals, and dietary fiber—the crop holds significant potential for promoting nutrition-sensitive agriculture, livelihood security, and sustainable food systems in both Uttarakhand and Chhattisgarh.

Uttarakhand and Chhattisgarh are ecologically diverse states of India with rich biodiversity and strong dependence on plant-based resources for food and traditional medicine,

particularly among rural and tribal communities (Prasad and Sharma 2018). Millets are climate-resilient food grain crops requiring minimal inputs and are widely used for food, beverages, and fodder (Bhat *et al*. 2024). Traditionally consumed as staple foods in India (Apetrei 2012), millets continue to play an important role in local food systems.

In Uttarakhand, millets such as barnyard millet (*Jhangora*), finger millet (*Mandua*), and amaranthus (*Chaulai/Ramdana*) are traditionally cultivated in hill regions (Raiger et al. 2023). In Chhattisgarh, millets including kodo, little millet, finger millet, and amaranthus are grown mainly in rainfed plains and plateau areas by tribal and smallholder farmers. Across both states, these crops contribute significantly to household nutrition, livelihood security, and climate-resilient agriculture.

Household consumption perspective in Uttarakhand and Chhattisgarh, amaranthus is primarily consumed seasonally and culturally, rather than as a daily staple such as rice or wheat. In Uttarakhand, consumption is largely associated with fasting periods, religious festivals, and special occasions, while in Chhattisgarh it is more closely linked to traditional tribal diets and subsistence food practices. On average, households in these states consume approximately 2–6 kg of amaranth grain per year, with higher consumption observed in hill communities of Uttarakhand and tribal regions of Chhattisgarh. Consumption of amaranthus leaves is more localized and seasonal, depending on home cultivation, wild or semi-domesticated availability, and local market access, and tends to be relatively higher in Chhattisgarh during the kharif season and periods of food scarcity.

Overall, per household consumption of amaranthus in both states remains modest and largely confined to traditional dietary patterns, specific communities, and seasonal availability. Despite its high nutritional value, amaranthus has not transitioned into a regular staple food and continues to play a supplementary role in household diets, as reflected in NSSO (2011) dietary data and subsequent state-level consumption and nutrition assessments.

II. TARGET AREA OF THE STUDY

The study focuses on major Amaranthus-growing regions of Uttarakhand and Chhattisgarh, where the crop is traditionally cultivated under rainfed and low-input systems. In Uttarakhand, the emphasis is on hilly and mid-hill districts, while in Chhattisgarh the focus is on tribal-dominated plains and plateau regions. These areas represent key production clusters where Amaranthus contributes to household nutrition, climate resilience, and livelihood security, and offers scope for value addition and market integration.

Objectives of the Study

1. To assess the Amaranthus value chain in Uttarakhand and Chhattisgarh, covering production, processing, and marketing stages.
2. To identify key constraints, gaps, and opportunities for value addition and improved market linkages.
3. To propose strategic interventions for strengthening the Amaranthus value chain, enhancing farmer income, and promoting value addition and consumption for improved nutritional security in both states.

III. MATERIALS AND METHODS

The present study adopted a participatory, mixed-methods research approach to assess the Amaranthus value chain in selected districts of Uttarakhand and Chhattisgarh. The mixed-methods framework was considered appropriate as it enabled the integration of quantitative and qualitative information for a comprehensive understanding of production, processing, marketing, and consumption dynamics within the Amaranthus sector. Similar participatory and mixed-method approaches have been successfully used in previous Amaranthus value chain and underutilized crop studies.

Study Area and Field Visits

Detailed field visits and stakeholder consultations were conducted in major Amaranthus-growing districts of Uttarakhand, including Almora, Chamoli, Pithoragarh, and Dehradun, and in Chhattisgarh, including Bastar, Kondagaon, Bilaspur, and Raigarh. These districts were purposively selected based on the prevalence of Amaranthus cultivation, traditional consumption practices, market availability, and the presence of local processing or value-addition enterprises. Previous studies have highlighted the importance of these regions for the cultivation and conservation of underutilized crops such as grain amaranth.

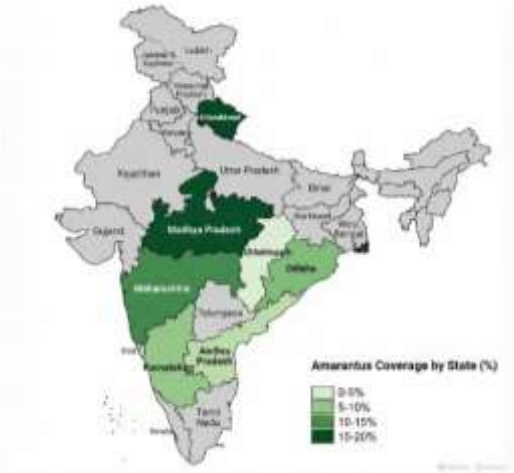
Data Collection

Both primary and secondary data sources were used in the study. Primary data were collected through household surveys, Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), stakeholder consultations, and direct field observations. FGDs were organized with farmers, women's self-help groups, traders, and processors to understand production systems, indigenous knowledge, post-harvest handling, marketing channels, pricing mechanisms, and value-addition opportunities. KIIs were conducted with officials from the Departments of Agriculture and Horticulture, Krishi Vigyan Kendras

(KVKs), extension personnel, local market representatives, researchers, and entrepreneurs engaged in Amaranthus-based enterprises.

The participatory approach adopted in this study was guided by earlier research emphasizing farmer participation, community engagement, and stakeholder-driven assessment in underutilized crop development and value chain studies.

Secondary data were collected from government reports, Agriculture Department records, published literature, research papers, policy documents, and existing Amaranthus-based enterprises operating at state and national levels. Information regarding area, production, productivity, processing technologies, nutritional importance, market trends, and institutional support systems was compiled and reviewed. Previous studies on grain amaranth and underutilized crops were also referred to in order to contextualize the findings and identify research gaps.



Value Chain Analysis

The Amaranthus value chain was analyzed as a sequence of interconnected activities including input supply, cultivation, harvesting, aggregation, storage, transportation, processing, marketing, distribution, and retailing. The study identified and mapped the major value chain actors, namely input suppliers, farmers, traders, processors, wholesalers, retailers, and consumers, along with supporting institutions such as technical agencies, financial institutions, cooperatives, research organizations, and government departments.

The functional linkages among actors, flow of products and information, marketing channels, and value addition practices were examined to identify bottlenecks and opportunities for strengthening the value chain. Earlier studies have emphasized the importance of integrated value chain analysis, stakeholder linkages, market development, and participatory assessment for enhancing the production and utilization of grain amaranth and other neglected crops.

Data Analysis

The collected data were analyzed using descriptive statistics, thematic analysis, and value chain mapping techniques. Quantitative information from surveys was tabulated and summarized using percentages, averages, and frequency distributions, while qualitative data from FGDs and KIIs were analyzed through thematic categorization and content analysis. The integrated analysis enabled the identification of production constraints, market barriers, institutional gaps, and opportunities for value addition, income enhancement, and sustainable livelihood development through the Amaranthus value chain in the study regions.

Table 1: Key Stakeholders for the Value Chain Study

Stakeholder	Parameters	Process of Data Acquisition
Farmers	Production practices, yield, input access, costs, prices, buyer relations	Structured Questionnaire, FGD
Input Suppliers	Seed varieties, fertilizer cost, availability, credit, service support	Structured Questionnaire
Traders/Aggregators	Price negotiation, storage, logistics, frequency of procurement, seasonality	Structured Interview
Processors/Millers	Milling capacity, machine types, losses, packaging, market linkages	Structured Checklist, Open-ended Interview
Retailers/Buyers	Buyer preferences, pricing strategy, branding feedback, shelf placement	Short Survey, Interview

The area under cultivation, production, and productivity of Amaranthus are presented in the table below. Unlike major millets, Amaranthus is cultivated on a relatively smaller scale and largely as a niche crop. However, as per available data from the Directorate of Economics & Statistics, the area and production of Amaranthus in India have shown

stagnation or marginal fluctuations over the last five years, primarily due to its limited commercial cultivation and regional concentration. (Annual Report, 2022-23 DoA & FW)

Despite this, productivity levels of Amaranthus remain relatively stable, supported by its short crop duration, adaptability to marginal lands, and low input requirements. The average annual production of Amaranthus in India is estimated to be modest compared to Finger Millet, but the crop holds strong growth potential owing to rising health consciousness, demand for gluten-free and protein-rich foods, and increasing policy focus on nutri-cereals and climate-resilient crops.

Table 2: Amaranthus Production Area in Major Producing States (India) (Area in '000 Hectares)

State / UT	2020-21	2021-22	2022-23	2023-24	Share of India (%)
Uttarakhand	**72.0**	**74.5**	**76.0**	**78.2**	**19.8**
Madhya Pradesh	64.8	66.0	67.5	69.0	17.5
Maharashtra	58.2	59.6	60.8	61.5	15.6
Odisha	41.5	42.0	42.8	43.5	11.0
Karnataka	39.0	40.2	41.0	42.0	10.6
Andhra Pradesh	32.4	33.0	33.8	34.5	8.7
Chhattisgarh	**18.0**	**18.6**	**19.2**	**20.0**	**5.1**
All India	**326.0**	**333.9**	**341.1**	**348.7**	**100.0**

Source: DES, MoA&FW (2023); State Agriculture Departments; minor millet & pseudo-cereal aggregation.

Cultivation of Amaranthus in both Uttarakhand and Chhattisgarh is largely undertaken by small and marginal farmers under traditional mixed, rainfed, and subsistence farming systems. In Uttarakhand, the crop is predominantly grown on rainfed terraces in hill districts, while in Chhattisgarh it is commonly cultivated as an intercrop or short-duration crop during the kharif and rabi seasons, particularly in tribal and forest-fringe regions. Produce from both states is mainly sold through local haats, weekly shandies, and nearby town markets, providing farmers with supplementary income and simultaneously contributing to household food and nutritional security.

Table 3: Area under Amaranthus Cultivation in Major Districts of Uttarakhand

S. No.	District	Area under cultivation (Ha)			% of total UK (2023–24)
		2021–22	2022–23	2023–24	
1	Uttarkashi	3,450	3,600	3,750	22.8%
2	Chamoli	3,100	3,250	3,400	20.7%
3	Rudraprayag	2,250	2,400	2,550	15.5%
4	Bageshwar	3,700	3,900	4,050	24.6%
5	Tehri Garhwal	2,350	2,500	2,650	16.1%

Source: DES, MoA&FW (2024); State Agriculture Departments

The area under Amaranthus cultivation in Uttarakhand has shown a steady increasing trend during 2021–22 to 2023–24, with districts such as Bageshwar, Uttarkashi, and Chamoli together accounting for a major share of the total cultivated area, reflecting favorable agro-climatic conditions, traditional food habits, and suitability to rainfed farming systems. Similarly, in Chhattisgarh, Amaranthus is gaining importance due to its adaptability to low-input conditions, tolerance to moisture stress, and high nutritional value, making it well-suited to the state's rainfed plains and plateau regions.

With growing consumer demand for nutri-cereals, pseudo-cereals, and health foods, Amaranthus holds strong potential for value addition and market-led expansion in both states. Its integration into local value chains, tribal livelihood initiatives, and nutrition-focused programmes can further enhance farm resilience, dietary diversity, and

income opportunities for small and marginal farmers across diverse agro-ecological regions.

Value Chain mapping

Table 4 : Value of Amaranthus at different stage actors

Actor	Product	Activity	Qty (kg)	Selling Price (₹)	Production / Purchase Cost (₹)	Gross Margin (₹)	Operational Cost (₹)	Net Margin (₹)	Net Profit (%)
Farmer	Amaranthus grain	Production	1	50	35	15	0	15	30.00%
Aggregator / Village Processor	Cleaned & de-husked Amaranthus	Aggregation + Cleaning + De-husking	1	55	48	7	1.5	5.5	10.00%
Wholesaler	Amaranthus grain	Bulk trading	1	62	55	7	1.0	6.0	9.68%
Retailer	Amaranthus grain	Sale to consumers	1	75	62	13	1.0	12.0	16.00%

The table-4 highlights how value and profits are distributed along the Amaranthus value chain across Uttarkashi, Chamoli and Tehri, where production and marketing conditions are broadly similar.

At the farmer level, Amaranthus grain is sold at around ₹50 per kg against a production cost of ₹35 per kg, yielding a net margin of ₹15 per kg and a net profit of 30 percent. This relatively high profitability reflects the low-input nature of Amaranthus cultivation in hill agriculture, with reliance on farm-saved seed, organic manure, and family labour. However, despite a good percentage margin, absolute farm income remains limited due to small landholdings and low marketable surplus.

Value-Added Products from Amaranthus

Value-added products are foods or ingredients developed from raw amaranth grain/flour that have enhanced nutritional, sensory or market value compared to unprocessed grain. Below are common types:

1. **Amaranth Flour Products**

Amaranth grains can be **milled or roasted then milled into flour**, which is used alone or blended with other flours such as wheat:

- **Bread & Baked product** – Bread, cakes, biscuits, cookies using amaranth flour or in blend with wheat flour
- **Pasta & Noodles** – Gluten-free pasta alternatives
- **Chapatis & Flatbreads** – Mixed flour breads with improved protein and mineral content
- **Weaning Foods** – Nutrient-rich flour for infant porridges and complementary foods

Benefits: Higher protein and mineral content than many cereals; suitable for gluten-free diets.

2. Popped Amaranth Snacks

- Popped Grain – Grain heated until it pops (like popcorn) and can be eaten as a snack or mixed with sweeteners
- Energy Bars & Granola – Popped amaranth combined with nuts, seeds, dried fruits

Benefits: Popping enhances texture and makes it a popular snack and breakfast cereal ingredient.

3. **Traditional Indian Value-Added Products**

Many traditional foods can incorporate amaranth flour or grains for better nutrition:

- **Cake with Amaranth Flour** – Where roasted amaranth flour is partially substituted to improve protein and mineral content
- **Besan Burfi (Sweet)** – With popped amaranth flour added for texture and nutrition
- **Coconut Ladoo** – Sweet balls enriched with amaranth flour
- **Cashewnut Burfi** – Nut-based sweet with amaranth added
- **Dosa / Pancakes** – Soaked or fermented amaranth grain incorporated into batter

Nutritional Effects: In these products, adding amaranth increases protein, fibre, iron, calcium and zinc compared to controls while preserving sensory acceptability.

Table 5: SWOT Analysis of the Amaranthus Value Chain

Strengths	Weaknesses
• Low-input, climate-resilient crop suited to hill agriculture and rainfed conditions. • Good nutritional profile (high protein, minerals), aligning with health-food demand. • Reasonable farmer profitability (%) due to low production costs and farm-savedseed. • Existing local knowledge and practices in cultivation and post-harvest handling. • Short crop duration, enabling flexibility and integration into mixed farming systems	• Small landholdings and low marketable surplus limit absolute farm income. • Weak aggregation and collective marketing in Chamoli and Tehri. • Minimal value addition (mostly cleaning/de-husking; little grading, branding, packaging). • Lack of quality standards and price discovery, leading to variable prices. • Limited access to working capital and modern processing equipment at village level
Opportunities	**Threats**
• Growing demand for health and nutri-cereals in urban and institutional markets. • Farmer aggregation through SHGs/CLFs to improve bargaining power and scale. • Cluster-level primary processing, grading, and packaging to capture higher margins. • Branding and niche positioning (organic/natural, hill produce) for price premiums. • Policy alignment with nutri-cereal promotion, climate-resilient agriculture, and livelihoods programs. • Direct market linkages (retail chains, e-commerce, institutional buyers).	• Price volatility and competition from other cereals and substitutes. • Market dependence on intermediaries, especially where collectives are weak. • Quality inconsistency due to traditional storage and lack of standards. • Labour shortages and climate variability affecting timely operations. • Limited consumer awareness in local markets, constraining premium pricing.

4. **Breakfast Cereals & Beverages**

- **Porridge** – Amaranth seeds cooked into hot cereal
- **Breakfast Blends** – Mixed with oats, puffed grains, and seeds
- **Beverages** – Amaranth flour used in nutritious drink blends

These harness the digestibility and nutrient profile of the grain.

5. **Oil and Nutraceutical Derivatives**

- **Amaranth Seed Oil** – Extracted oil with beneficial compounds such as **squalene**
- **Leaf Extracts & Supplements** – Bioactive compounds targeting health benefits (antioxidant, anti-inflammatory)

These are less common food products but are emerging markets in health foods and cosmetics.

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