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Indigenous Traditional Knowledge for Rice Cultivation in Uttarakhand

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Abstract: Rice cultivation in Uttarakhand holds considerable importance in the region's agrarian economy, yet it faces numerous challenges due to the rugged terrain and climatic conditions. The present study reviews the indigenous traditional knowledge (ITK) employed by local farmers to mitigate these challenges and enhance rice yield in the mountainous districts of Uttarakhand. A comprehensive survey was conducted across the hilly districts, focusing on traditional practices related to land preparation, pest control and post-harvest storage techniques. The results highlighted a diverse array of indigenous strategies that have been developed over generations to optimize rice cultivation. These include the use of pre-sprouted seed sowing to enhance germination, deep ploughing techniques for soil aeration and the application of salt for effective white grub management. Additionally, physical deterrents such as scarecrows are utilized to protect crops from wildlife intrusion, particularly wild animals. Post-harvest, farmers employ indigenous storage methods to preserve rice seeds, ensuring seed viability and protection from pests. These techniques include the use of *Kunna* containers, crafted from natural materials and dried bottle gourd vessels, both of which have demonstrated efficacy in seed preservation under local conditions. All the ITK practices enhance sustainability, pest management, reduce herbicide use, enhance soil health and wildlife management it support food security and reduce chemical use. These techniques along with modern system of agriculture make farming eco-friendly and cost effective. The findings of this study highlight the critical role of indigenous knowledge systems in addressing the agricultural constrains and offer valuable insights for promoting sustainable rice cultivation in Uttarakhand.

Keywords: Indigenous Traditional Knowledge • Rice Cultivation • Pest Management • Storage Techniques • Sustainable Agriculture

Introduction

Rice (*Oryza sativa* L.) is an important staple crop supporting the dietary needs of over one third of the global population (Khush, 1997). It is cultivated in most of the countries with China leading global rice production followed by India. India account for approximately 26 per cent of global rice production, consumes approximately 22 per cent of global rice stocks, and contributes around 40 per cent of the world's rice exports .The cultivation of rice spans the entire Indian subcontinent, from the northern highlands to the southern plains, and from the eastern river deltas to the western plateaus. Rice cultivation thrives across various ecosystems and climatic conditions, illustrating its importance in Indian agrarian economy. Many states of India contribute significantly in rice production which includes West Bengal which is the largest producer of rice with 15 per cent of total rice production, Uttar Pradesh is the second-largest producer of rice in India, with around 14 per cent of the total rice production, Punjab (12%), Andhra Pradesh (10%), Tamil Nadu (7%), Bihar (6%) etc (Chaturvedi *et al*. 2024).

In Uttarakhand, rice holds a significant role in the regional diet. A traditional form of rice, red rice, is often prepared with buttermilk, imparting a unique flavor and nutritional profile to the local cuisine. Rice cultivation in this region is shaped by the state's diverse and complex topography. The mountainous terrain of Uttarakhand is characterized by two distinct agro-ecosystems: the "*Shera*" and "*Ukkhad*" systems (known as "*Ukheed*" in the local Garhwali dialect). In the Shera system, rice is grown with a reliable water supply throughout the cultivation cycle, while the *Ukkhad* or *Ukheed* system is dependent on rainfall for irrigation. **Shera** and **Ukkhad** systems differ notably in productivity and sustainability. The **Shera system**, experienced in bottom of the valley having well-irrigated, more productive and fertile land, with higher **efficiency** due to optimal use of inputs like fertilizers and irrgation enhance yield while; **Ukhad system**, located on sloping rainfed uplands, shows **lower productivity** due to poor water retention and limited inputs. However, it is more **sustainable** in the long run, supported by traditional practices like the **Sari system,** which involves mixed cropping and a two-year rotation that preserves soil fertility and biodiversity (Chandra *et al*., 2021). Sera fields is best for yield, Ukhad systems contribute significantly to ecological resilience and agrobiodiversity conservation in the Himalayan region. Despite the region's agricultural potential, rice farmers face numerous challenges, including limited arable land due to the steep terrain, cold climatic conditions, water scarcity, soil erosion from heavy rainfall or snowmelt and inadequate infrastructure (Mehta *et al.,* 2014). Additionally, the prevalence of pests and diseases adds further complications to rice cultivation (Bisht and Kumar, 2024).

Farmers in Uttarakhand, however, have developed adaptive strategies, leveraging Indigenous Traditional Knowledge (ITK) to address these challenges (Anonymous, 2008). ITK refers to the collective knowledge, practices, and cultural beliefs accumulated over generations and utilized in various aspects of traditional life, including agriculture, medicine, spirituality, and natural resource management. Within the context of agriculture, farmers have long relied on indigenous methods to control weeds and manage pest infestations. By relying on local biodiversity, ecological principles, and time-tested experiential knowledge, ITKs contribute significantly to sustainable agriculture. Importantly, they enhance climate resilience by enabling farmers to cope with erratic rainfall, pest outbreaks, and shifting seasonal patterns. As climate change increasingly threatens conventional farming systems, understanding and integrating ITK into modern agricultural frameworks can support more resilient and sustainable food systems. Despite government initiatives promoting the adoption of Integrated Pest Management (IPM) practices, the implementation of such practices remains limited among hill farmers (Chandola *et al.,* 2011).

To further investigate and evaluate these indigenous practices, a study was conducted with the objective of document ting and analyzing the ITK used by farmers in rice cultivation in the rugged terrain of Uttarakhand. The study aimed to explore the rationale behind these traditional practices and the underlying beliefs supporting their continued use. By delving into these indigenous practices and understanding their intrinsic logic, the study aimed to contribute to the augmentation of rice cultivation within the region.

Methodology

A total of four groups was created (two researchers per group) for maximum coverage area and conducting systemic survey across agriculturally less-progressive regions of Uttarakhand to collect data on indigenous traditional knowledge (ITK) related to rice

cultivation and storage practices. Eleven districts namely Almora, Bageshwar, Champawat, Nainital, Pithoragarh, Chamoli, Dehradun, Pauri Garhwal, Rudraprayag, Tehri Garhwal and Uttarkashi were selected for the study. This comprehensive survey was undertaken during the Kharif seasons of 2022 and 2023, targeting key hilly regions within the state.

Total 83 blocks are present in the 11 districts, 3–4 villages per block were chosen based on purposive criteria for in-depth study of ITK. Total of 230 rice farmers, consisting of 3–4 growers from each village, participated in the survey. For collection of data stratified random sampling method were taken according to diverse geographical and agro-ecological zones. Information of traditional knowledge in rice cultivation was collected with the help of semi structured questionnaire (Table 1).

Table 1: Semi structured questionnaire used for collecting information

1	Which type of rice cultivation you are following Ukkhad/ Shera?
2	Which varieties have been used for cultivation?
3	Was there any use of chemical fertilizer and pesticides?
4	Are you aware of disease and insect-pest of rice?
5	Do you know the management practices for disease and insect pest of rice?
6	Do you follow any special storage practices for rice?
7	From where you avail these ITK practices?

Feedback was collected from diverse demographic, including elder farmers and traditional practitioners, offering insights into historical agricultural practices. The primary focus of the survey was to document traditional pest management techniques employed in the region, with an emphasis on their alignment with local climatic conditions. Additionally, detailed discussions were made on cultivation methodologies aimed at improving rice cultivation and ensuring effective long-term storage and preservation. This investigation aimed to understand the integration of indigenous knowledge with sustainable farming practices, while assessing its potential to contribute to contemporary agricultural advancements.

Results and discussion

In the hilly regions of Uttarakhand, rice is cultivated across two distinct seasons: spring and summer. During the spring season, rice is predominantly grown in rain-fed areas, taking advantage of residual soil moisture from the winter months. The broadcasting method is commonly employed for direct seed sowing, with the application of farmyard manure (FYM) at the planting site to facilitate nutrient availability through decomposition. Additionally, approximately 18-20 tons per hectare of compost is incorporated into the soil during ploughing to enhance soil fertility. However, the onset of the rainy season contributes to a significant increase in weed growth, resulting in a heightened demand for manual weeding, which is both labour-intensive and time-consuming which presents a major challenge to maintaining optimal field conditions for rice cultivation during this period.

Summer rice cultivation employs three primary methods: direct seeding (similar to the approach used for spring rice), transplanting and the "*Saindha*" method, which involves the use of pre-sprouted seeds in well-puddled fields. The "*Saindha*" technique encompasses two distinct strategies for raising nurseries: sowing pre-sprouted seeds in puddled beds and sowing pre-soaked seeds in dry, leveled beds. Key advantage of the "*Saindha*" method is the superior weed suppression observed in pre-sprouted seed nurseries, where the rapid establishment of seedlings effectively outcompetes weeds. Fields cultivated using the

"*Saindha*" method demonstrate a yield increase of 30-40% compared to those managed with conventional transplanting or direct seeding techniques (Kediyal and Dimri, 2009). This significant improvement in productivity is likely attributed to the rapid seedling establishment and the elimination of transplant shock, a stress response typically observed when seedlings are uprooted from nursery beds and transplanted into the field (Kediyal and Dimri, 2009). This technique is followed in Tehri and Jakholi block of Rudraprayag district of Uttarakhand (Table. 2).

Table 2. Indigenous Traditional Knowledge followed by different districts of Uttarakhand

District	Nursery and cultivation techniques				Indigenous practice and pest management				Physical injury			Wild management		
	Sain-dha	Kidy-ana	Ukk-had	Shera	Dan-ala	Deep ploug-hing	Com-mon salt	Firing in the field	Kan-dali	Kil-mora	Mules fecus	Bij-uka	Light and sound	Indig-enous dogs
Almora	Not used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Not used	Not used	Used	Used
Bageshwar	Not used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used
Champawat	Not used	Used	Used	Used	Used	Used	Not used	Used	Not used	Not used	Not used	Not used	Used	Used
Nainital	Not used	Used	Used	Used	Used	Used	Used	Used	Not used	Not used	Not used	Not used	Used	Used
Pithoragarh	Not used	Used	Used	Used	Used	Used	Not used	Used	Not used	Not used	Not used	Not used	Used	Used
Chamoli	Not used	Not used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used
Dehradun	Not used	Not used	Used	Used	Used	Used	Not used	Used	Not used	Not used	Not used	Not used	Used	Used
Pauri Garhwal	Not used	Not used	Used	Used	Used	Used	Used	Used	Not used	Not used	Not used	Not used	Used	Used
Rudrapraya g	Used	Not used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used	Used
Tehri Garhwal	Used	Not used	Used	Used	Used	Used	Used	Used	Not used	Not used	Not used	Not used	Used	Used
Uttarkashi	Not used	Not used	Used	Used	Used	Used	Not used	Used	Not used	Not used	Not used	Not used	Used	Used

Indigenous practices adopted at the time of land preparation, sowing and nursery

The soil health is maintained by various ways, some of them are followed by farmers of Kumaon region of Uttarakhand. Farmers have long adherence to a significant agricultural practice known as "*Kidyana*" (Burning of crop residue). This traditional method involves the collection of pine leaves (*Piltu*) from nearby forests, which are then spread over the field along with crop residues. Subsequently, a controlled fire is ignited over this mixture. The purpose behind *Kidyana* extends beyond mere disposal, as it serves as a holistic approach to soil management. By incinerating the crop residues along with pine leaves, farmers effectively mitigate soil-borne pathogens and insect pests, contributing to the overall health of the agricultural ecosystem. The ash generated from the burning process plays a pivotal role in enhancing the yield of rice crops. This nutrient-rich ash acts as a natural fertilizer, imparting essential minerals to the soil. Farmers strategically harvest wheat crops from a specific height, ensuring a substantial amount of residue is available for the *Kidyana* process. Remarkably, this practice is implemented in an alternating yearly cycle, allowing the soil to rejuvenate and maintain its fertility over time. The time-honoured tradition of *Kidyana* stands as a testament to the symbiotic relationship between traditional agricultural practices and sustainable land management in the Kumaon region (Table. 2).

In the hilly districts of Uttarakhand, the method of land preparation for rain-fed rice cultivation (*Ukkhad* or *Ukheed*) follows a well-defined pattern that is relatively

consistent across the region. Approximately 10-15 days after the harvesting of wheat, farmers start ploughing their fields. This timely action is crucial because delaying the ploughing process may lead to excessive drying of the field, making it challenging to undertake necessary interventions for subsequent cropping. The rice fields undergo two rounds of ploughing followed by leveling and clod breaking before the actual sowing takes place. At the time of the third ploughing, they sow rice seeds using the broadcasting method.

In the irrigated rice ecosystems (*Shera*), the approach differs from direct sowing. Instead of direct sowing, nurseries are prepared first. In some areas of Jakholi block of Rudraprayag and Ghansali block of district Tehri Garhwal, nursery is established through two distinct methods: pre-sprouted seed sowing in puddled beds and pre-soaked seed sowing in dry leveled beds. After 30-40 days of nursery preparation, at the time of transplanting, farmers clip the tips of the seedlings to ensure the uniform growth of the crop. Scientifically, this practice is linked to the management practices for stem borer (*Scirpophaga incertulas*). The pest lays its eggs on the tips of leaves of the seedlings. By clipping the tips of seedlings, they avoid the infestation of stem borer (Table. 2).

In rain-fed rice cultivation, once the plants reach the height of 10-15 cm, farmers employ the traditional practice of hoeing to enhance soil aeration and improve water retention. Using a tool called "*Danala*" (Fig. 1). Farmers meticulously remove weeds from their fields while simultaneously performing gap-filling to optimize plant growth. Notably, in the Thathyud block of Tehri-Garhwal, farmers have devised a unique weed management strategy. At the early stage of 4-5 cm rice growth, they utilize "*Patta*," a flat wooden piece, which effectively suppresses weed growth without damaging the rice plants (Table. 3).

Indigenous practices implemented during seedling stage

Fig. 1: Danala used for weeding

Table 3. Traditional storage and pest management practices followed by different districts of Uttarakhand

District	Pest management practices during storage					Indigenous storage practices	
	Walnut	Peach	Timur	Lantana	Camphor	Bottle guard container	Kothar
Almora	Used	Not used	Used	Not used	Not used	Not used	Not used
Bageshwar	Used	Not used	Used	Used	Not used	Not used	Not used
Champawat	Used	Not used	Used	Not used	Not used	Not used	Not used
Nainital	Used	Not used	Used	Used	Not used	Not used	Not used
Pithoragarh	Used	Not used	Not used	Not used	Used	Not used	Not used
Chamoli	Used	Used	Not used	Not used	Not used	Used	Not used
Dehradun	Used	Not used	Not used	Not used	Used	Not used	Used
Pauri Garhwal	Used	Used	Used	Not used	Used	Not used	Not used
Rudraprayag	Used	Used	Used	Not used	Not used	Used	Not used
Tehri Garhwal	Used	Used	Used	Not used	Not used	Not used	Used
Uttarkashi	Used	Not used	Used	Not used	Not used	Not used	Not used

Practices involved in the management of pests

Throughout the cultivation process, rice crops face numerous challenges from pests such as rodents, insects and wild animals which can result in significant economic losses. However, farmers in the hills of Uttarakhand rely on their ITKs to combat these pests (Table. 1).

White grub management

The white grub has emerged as a significant pest affecting field crops in the Western Himalayas, the problem was particularly observed in Dasholi, Joshimath, Karnapryag and Tharali block of Chamoli district. Initially, its destructive impact was confined to specific areas, but over time, it has escalated to the status of a severe pest across the entire hilly region. This pest poses a substantial threat to upland rice, a crucial hill crop, causing damage up to approximately 80% under rain-fed conditions (Garg and Shah, 1983). Among the 31 identified species of white grub beetles in the Western Himalayas, *Anomala dimidiata* (Hope) (Rutelinae: Coleoptera) stands out as the predominant species in the Kumaun hills of Uttarakhand (Vashisth *et al.,* 2015; Pande, 1998). The white grub infestations are notably intense in the terraced slopes of the hills situated between elevations of 1400-2200 m, primarily in rain-fed areas (Srivastava *et al.,* 1985). In response to this challenge, hill farmers in Uttarakhand have adopted specific practices for white grub management (Table. 1).

A. Deep ploughing

The indigenous practice of repeated ploughing has emerged as an effective method for eradicating insect pests and their dormant stages within the soil (Singh *et al.,* 2021). Specifically, in the context of managing the notorious white grub, a customary indigenous technique involves two times of deep ploughing prior to the sowing. This deliberate ploughing serves as a strategic method, which brings the grubs out of the soil. The emerging grubs become vulnerable to natural predators, primarily birds that feast on the exposed pests. Additionally, manual intervention is employed to manually eliminate the grubs.

B. Application of common salt

To manage white grub infestations, a technique involves spreading common salt at a rate of 1 kg per Nali (approximately 200m^2). In hilly regions, farmers utilize salt stones not only for domestic use but also for addressing this issue. The salt stones are finely ground and combined with ash to increase volume. This blend is then dispersed across the field following the initial ploughing, typically conducted after the wheat harvest. Broadcasting usually takes place in the morning, and immediate irrigation of the land is preferred where feasible. This practice is employed in fields exhibiting significant white grub damage (Chandola *et al.,* 2011).

C. Firing the field

After the harvest of wheat crop, hill farmers adopt a practice of burning the field. To facilitate this, they gather pine leaves from the forest and evenly spread them across the field to facilitate drying. Once dried, the pine leaves are set on fire to eliminate the hibernating stage of white grubs.

Management of stem borer

The yellow stem borer poses a threat to deepwater rice as a pest, primarily thriving in aquatic ecosystem, characterized by prolonged flooding. In the hills of Uttarakhand, the prevalence of stem borers poses a significant challenge for farmers. In the Pauri district of the Garhwal region, the problem of stem borer attacks on crops, particularly resulting in chaffy grains, which is locally termed as "*Jhoos Padna*". To address these problem farmers, use the cow urine and sprinkle it across the fields. Additionally, some farmers have found success by incorporating rock salt into their fields (Table. 1). A similar practice is being carried out by the farmers of Tripura for controlling stem borer of paddy crop. They

applied about 30 kg of common salt in one hectare field (Chandola *et al.,* 2011).

Management of rodents

Rodents pose a significant threat to agricultural produce across various stages, including seedling, growth, harvesting, and storage (Rao and Mohan, 1980). India, with its rich ecological diversity, hosts a diverse rodent population, comprising at least 52 genera and 118 species (Ellerman and Roonwal, 1961). These pests inflict substantial damage to standing crops, stored grains, afforestation trees, grass, fodder crops, and other valuable commodities, making them the most destructive vertebrate pests (Table. 1). Specific methods employed by the farmers to control rodent populations are as outlined below:

A. Use of plants causing physical injury

One approach involves placing *Kandali* or *Sisun* (*Urtica dioica*) grass and thorny bushes of the *Kilmora* (*Berberis asiatica* Roxb.) at the entrances of mouse holes which are very common in the hills and apart from pest management they are being used in curing various diseases. *Kilmora* is characterized by its thorny bushes, while *Kandali* or Sisun grass induces irritation upon contact. To deter mouse attacks in the field, farmers place leaves of *kandali* grass and thorny bushes of *Kilmora* at mouse hole entrances. The goal is to cause physical injury to mice as they move through, with the belief that this practice helps mitigate the rat population and reduces the severity of attacks on plants. While scientists may not be entirely convinced of the effectiveness of this method, villagers argue that it serves as a deterrent by causing physical harm to rodents and thus safeguarding their crops.

B. Powdered feces of mules

In hilly regions, "*Khachchar*" (mules) serve as the primary means of transporting goods. Dried feces of them are being collected from the roadside and grinded and then the powdered *Khachchar* feces is strategically placed at the entrances of mouse hole. The strong odor prompts rodents to vacate the area. However, this traditional method has yet not scientifically validated practice.

Practices involved in managing wild animals

Agriculture in the hilly regions of Uttarakhand is characterized by persistent challenges due to the fragmented nature of land holdings and the region's complex topography. Despite these constraints, local farmers continue to cultivate their fields, predominantly utilizing indigenous rice varieties. While these traditional varieties may not offer high yields, they possess significant resistance to pests and diseases, reducing the burden of managing common agricultural problems.

However, in recent years, a new challenge has arisen in the form of wild boars and monkeys, which have become major pests, causing substantial crop losses annually. In response to this growing threat, farmers have increasingly relied on their ancestral knowledge to protect their crops. By drawing on indigenous wisdom, they have developed a range of strategies to mitigate the impact of these animals, employing traditional methods to safeguard their agricultural productivity (Table. 1).

A. Scare-crow or Bijuka

A conventional and widely employed technique for deterring wild animals has been in practice since ancient times. This method involves installing a scarecrow in the agricultural fields to ward off birds and monkeys. The utilization of scarecrows is prevalent across various districts in Uttarakhand, implemented on both small and large scales. Farmers craft these scarecrows using locally available materials. To depict a human head with black hair, an inverted terracotta jar (old pitcher) with a black exterior is positioned atop a vertically erected wooden pole of human height. Alternatively, the head may be fashioned from black fabric. The vertical pole is then linked to a horizontal stick, mimicking arms raised to shoulder height. A wooden frame is draped with an old

brightly colored shirt (*kurta*), creating the illusion of a person engaged in fieldwork.

B. Creation of light and sound

Farmers employ various methods to deter wild animals in crop fields during the night, generating both light and sound. They utilize burning firecrackers to create flashes of light and employ tactics such as bonfires, sounds of empty tins, local drums and shouting to produce noise. The auditory deterrents include drumming, clanging an empty tin, whistling and shouting, all aimed at warding off wild boar and other potentially damaging wild lives.

C. Rearing of indigenous dogs to frighten away

Dogs, particularly the indigenous "*Bhotiya*" breed in Uttarakhand have historically been valued for their roles as loyal companions and protectors of homes and livestock. Farmers rear these dogs relying on their keen senses of smell and hearing to guard crops against wild animals. The dogs' barking serves as both a deterrent and an alert system helping farmers to manage and prevent potential threats from wild animals.

Traditional methods for storage

Fig 2. Kunna used for storage purpose

Storage pests affecting rice belongs to two important orders: Coleoptera (Beetles) and Lepidoptera (Moths). Beetles pose a greater threat as both their larvae and adults can inflict damage on stored materials. In contrast, moths primarily cause harm during their larval stage. Despite the quantitative losses, these pests also compromise the quality of stored grains by introducing contaminants such as dead bodies, shed skins, excrement, and webbing. This contamination leads to undesirable odours, colours and tastes in the stored products. In severe infestation, grains may become unsuitable for consumption. Notably, certain storage insects, such as the rice weevil and moth are known to infest grains even in the field also (Patil *et al.,* 2019). In the remote areas of Uttarakhand, a persistent challenge lies in the scarcity of knowledge concerning agricultural practices and the proper storage of agricultural produce. Farmers in these regions often rely solely on their indigenous knowledge to safeguard their stored products. Embedded within a series of traditional practices, these farmers exhibit a profound understanding of their natural surroundings. Uttarakhand, renowned for its rich diversity of flora and fauna, is home to numerous plants endowed with medicinal, antifungal and insecticidal properties. Examples include Walnut (*Juglans regia*), Peach (*Prunus persica*), Timur (*Zanthoxylum planispinum*), Lantana (*Lantana camara*), Tagar (*Valeriana jatamansi*) and Camphor (*Cinnamomum camphora*). These plants contain alkaloids that serve as natural deterrents against storage pests.

A. Kunna

The storage of rice is a crucial process for safeguarding seeds for the next season and ensuring long-term preservation for food. Indigenous containers known as "*Kunna*" (Fig. 2) are crafted from locally available bamboo sticks and equipped with a sealing lid, serve as larger-sized container for this purpose. Before storage, these containers undergo exposure to sunlight for drying and then a protective coating is applied both inside and outside the container walls. This coating consists of a mixture comprising raw cow dung, cow urine and red soil. The distinctive odour emitted by

this mixture acts as a natural repellent, effectively deterring storage pests and contributing to the preservation of rice for extended periods.

B. Dry bottle gourd container

Fig 3. Bottle gourd kept in side of house for making dry container

Farmers cultivate various indigenous aromatic rice varieties like Hansraaj (cultivated in Chamoli and Rudraprayag) and Dooni basmati (cultivated in Maldevta area of district Dehradun and adjacent areas of Tehri Garhwal) etc, often in smaller areas designated for special occasions. To preserve these unique rice strains, farmers employ a traditional method involving the use of dried bottle gourd containers. This type of container is used in most of the villages of Chamoli and Rudraprayag districts of Uttarakhand. During the raw stage of bottle gourd, a square-shaped cut is made at the top and the inner material is removed using a scraper (Fig. 3). Subsequently, the hollowed gourd undergoes sun drying, transforming it into a rigid container. The farmers then store seeds of aromatic rice within these containers, safeguarding them from insects and pests. The choice of bottle gourd containers is strategic, as the strong aroma of the rice tends to attract insects. The rigid nature of the container acts as a rigid barrier, preventing insects from reaching the stored seeds. This traditional practice not only ensures the preservation of indigenous aromatic rice but also reflects the resourcefulness and sustainable agricultural practices of the local farming communities in Uttarakhand.

C. Kothar

Fig 4: Kothar built inside the home for storage of cereals

Chakrata and Vikasnagar, located in the Dehradun district, serve as the ancestral lands for the Jaunsari Tribal people in Uttarakhand. These communities distinguish themselves by preserving and relying extensively on their indigenous knowledge, setting them apart from other inhabitants of the region. One remarkable aspect of their unique practices involves a distinctive method of storage. In this area, people construct storage structures known as "Kothar" using Deodar (*Cedrus deodara*) tree wood. These Kothars possess a remarkable sturdiness that deters mice from entering. Additionally, the Deodar wood emits a distinct odor that acts as a natural repellent against insect pests. Thus, by using these Kothars, Jaunsari people adeptly store and safeguard rice and other cereals, effectively protecting their harvests from both insect pests and rodents.

Conclusion

The indigenous agricultural practices in Uttarakhand, play a pivotal role in mitigating the challenges faced by farmers in rice cultivation. Through a comprehensive survey, it is evident that traditional methods deeply rooted in local wisdom offer effective solutions to pest management, land preparation, sowing, and storage. These practices, adapted to the region's unique topography and climate, not only demonstrate the resilience of Uttarakhand's farming communities but also highlight the importance of preserving and promoting indigenous

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knowledge for sustainable agriculture. By integrating these traditional practices with modern agricultural advancements, sustainable rice cultivation can be promoted in the region, preserving both agricultural productivity and the cultural heritage of rural communities.

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References

Anonymous (2008) Package of Organic Practices from Uttaranchal for Chilli, Mustard, Potato and Soybean, (FAO) 25/06/08

Bisht AS and Kumar B (2024) Geospatial survey of rice sheath blight in Uttarakhand. Pantnagar Journal of Research. 22(3): 526- 531

Chandola M Rathore S and Kumar B (2011) Indigenous pest management practices prevalent among hill farmers of Uttarakhand. Indian J. Traditional Knowledge. 10(2): 311-315.

Chandra S Chandra D Pandey R Khajuria AK Kumar V and Bhatt P (2020) Sari system: A traditional cropping pattern of the Uttarakhand Himalaya. Microbiological Advancements for Higher Altitude Agro-Ecosystems & Sustainability. 37-53.

Chaturvedi P Nahatakar SB Rajput A (2024) Growth of rice production in India. An International Refereed, Peer Reviewed & Indexed Quarterly Journal for Applied science. 2277-7601

Ellerman JR and Roonwal ML (1961) The Fauna of India-Mammalia. Zoological Survey of India, Calcutta. 483-484 pages.

Garg DK and Shah NK (1983) White grub outbreak on rainfed dryland rice in Uttar Pradesh. International Rice Research Newsletter. 8(4): 16-7.

Kediyal VK and Dimri S (2009) Traditional methods of rice cultivation and SRI in Uttarakhand hills. Asian Agri-History. 13(4): 293-306.

Khush GS (1997) Origin, dispersal, cultivation and variation of rice. Plant Molecular Biology. (35): 25-34.

Mehta PS Ojha SN Negi KS Verma SK Rayal A and Tyagi RK (2014) On-farm status of rice (*Oryza sativa* L.) genetic resources in Garhwal Himalaya of Uttarakhand, India. Genetic Resources and Crop Evolution. (61):1279-94.

Pande DC (1998) Managing Agriculture for Better Tomorrow: The Indian Experience; M. D. Publications Pvt. Ltd.: New Delhi, India. 356 Pages.

Patil NK Adak T Annamalai M Golive P Rath PC and Jena M (2019) Stored Grain Insect Pests of Rice and their Management. NRRI technology bulletin-134 2-7.

Rao AMK and Mohan (1980) Indian field mouse a serious rodent pest problem of agriculture and its control. Pestology. 10(6): 26-29.

Singh R Babu S Avasthe RK Das A Praharaj C Layek J Kumar A Rathore S Kancheti M Kumar SA and Yadav SK (2021) Organic farming in North–East India: Status and strategies. Indian Journal of Agronomy. 66: 163-179.

Srivastava AS Mathur YK Srivastava SK Upadhayay KD (1985) Survey and distribution of white grub beetles in U.P. Pestology. 9:34–36.

Vashisth S Chandel R Verma K Bhatacharya B Pathania M and Kumar V (2015) The Ecology and Control of Potato Whitegrubs of India. Potato Research. 58(2): 147-16