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Tartary Buckwheat Cultivation In Kinnaur District: A Potential Path For Bio-Diversity And Sustainable Development.

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An Abstract

Tartary or bitter buckwheat (*Fagopyrum tataricum*), locally known as Fafra in the Tribal district of Kinnaur in the Himalayan regions of Himachal Pradesh, stands as a unique and resilient crop cultivated in high-altitude regions, particularly above 2100 meters. This research explores the extensive cultivation practices, distribution, and potential of buckwheat in the Indian and the International market. Two species of buckwheat, *Fagopyrum esculentum* (Ogla) and *Fagopyrum tataricum* (Fafra), are cultivated in the Himalayan Mountains of kinnaur region, demonstrating adaptability to diverse climatic conditions.

The cultivation of buckwheat has been a significant aspect of the traditional crop pattern in the Kinnaur District, and it also extends across various districts in Himachal Pradesh, playing a vital and crucial role in the agricultural landscape. Its unique characteristics make it suitable for cultivation in challenging terrains and climates. The research emphasizes the need for increased awareness of Tartary buckwheat's nutritional benefits and health advantages. It also addresses the considerable decline in interest among farmers in recent years (Rana *et al.* 2012)

The present study delves deep into the historical significance and distribution of Tartary buckwheat, highlighting its presence in the local, national and the global context. With its adaptability to extreme temperatures and low soil fertility, Tartary buckwheat emerges as a sustainable crop, providing essential nutrients and catering to the nutritional security of mountainous regions like kinnaur and the other Tribal regions of the state, ensuring the need for the healthy and nutritious staple food for the community. In the Tribal district of Kinnaur, this variety of Millet has been the source of food security and an integral part of the rich tapestry of tribal culture and the peculiar food habit of the community. In Himachal Pradesh, the buckwheat cultivation is concentrated mainly in the specific districts, and with Kinnaur playing a significant role in the farming of this super grain, really needs an extensive research and exhaustive monitoring for the creation of favourable environment for the cultivation the ancient grains.

The research paper also outlines the cultivation guidelines, including optimal planting periods, seed selection, and soil fertility enhancement. The crops medicinal benefits, particularly its phytochemical rut in, are discussed, emphasizing its potential to address health issues such as high blood pressure and diabetes, thyroid, gut related diseases etc. The unique composition of Tartary buckwheat contributes to its various health benefits such as anti-oxidative, anti-cancer, anti-hypertension, anti-diabetic, cholesterol-lowering, and cognition-improving quality which necessitates the resurgence of the old glory of this ancient super food which can bring about a revolution in the mountainous regions of Kinnaur and other parts of the Himalayas. The study also sheds light on the decline in Tartary buckwheat cultivation in recent years, mainly attributed to the shifting

focus of farmers towards horticulture. However, recognizing the nutritional importance of millets, farmers have started once again incorporating buckwheat into their diets, resulting in an increased demand for pseudo-millet flour. To revitalize Tartary buckwheat cultivation in kinnaur and the other parts of Himachal Pradesh, this research advocates for awareness campaigns, scientific interventions, and improvements in cultivation techniques. By enhancing the nutritional content and accessibility of Tartary buckwheat, the research envisions a sustainable and prosperous future for both the farmers and the consumers, contributing to the overall development of the region.

Keywords: - Buckwheat, Fafra and Ogla, adaptability, nutrition, terrains, sustainable crop, food security, millet, community, research, super grain, guidelines, medicinal, composition, cognition, super food, pseudo-millet, cultivation, sustainable prosperity.

Introduction

The Buckwheat (bitter and sweet) has been one of the major staple foods in the traditional kitchens of the tribal communities of the Himalayan region of Kinnaur District. This ancient super-grain has been an integral part of all occasions of ceremonies, functions, religious events, festivals, and rituals which constitute the rich cultural heritage of the simple, innocent and hardworking people who had been living in a harmonious relationship with the Mother Nature. The nutritious, medicinal, and gluten free super food has been a significant aspect of the bio-diversity and sustainable development in the eco-system of this tribal community. However, with the advent of modern civilisation along with the radical changes in the farming patterns, which resulted in the excessive plantation of the cash crop apple in recent years, a considerable decrease has been recorded in the cultivation of the pseudo millet Buckwheat as the land holdings in these challenging terrains and climate are limited because of the mountainous nature of the sub-tropical geographical landscape. Cultivated in the rugged terrain of Kinnaur, Himachal Pradesh, Tartary Buckwheat, or Fafra, emerges as a unique and resilient crop thriving at altitudes exceeding 2100 meters. This paper ventures into an exploration of the extensive cultivation practices, distribution dynamics, and the immense potential of this extraordinary grain in both Indian and international markets. Fafra, a local variant of bitter buckwheat (Fagopyrum tataricum), has been an integral part of the traditional crop pattern in Kinnaur, echoing its significance across various districts in Himachal Pradesh. Its distinctive attributes make it well-suited for cultivation in challenging terrains and climates, positioning it as a beacon of sustainable agricultural practices. However, recent years have witnessed a decline in its cultivation, with farmers shifting focus towards horticulture. This study delves deep into the historical significance and global distribution of Tartary buckwheat, emphasizing its adaptability to extreme temperatures and low soil fertility. It unravels the potential of Fafra as a sustainable crop, providing essential nutrients and catering to the nutritional security of mountainous regions, especially in the Tribal district of Kinnaur. The research accentuates the need for heightened awareness regarding the nutritional benefits of Tartary buckwheat and addresses the concerning decline in interest among farmers. Beyond its agricultural significance, the paper explores the medicinal benefits of Tartary buckwheat, particularly its phytochemical rutin. With qualities ranging from anti-oxidative and anti-cancer properties to aiding in issues like high blood pressure and diabetes, the unique composition of Fafra positions it as more than just a crop—it becomes a potential solution for health-related challenges. The cultivation guidelines outlined in this paper encompass optimal planting periods, seed selection, and soil fertility enhancement. It underscores the need for a revival in Tartary buckwheat cultivation, advocating for awareness campaigns, scientific interventions, and improvements in cultivation techniques. The decline witnessed in recent years is attributed to the shifting focus of farmers towards horticulture. However, recognizing the nutritional importance of millets, including Tartary buckwheat, there is resurgence in interest, resulting in an increased demand for pseudo-millet flour. As we navigate through the unique characteristics, geographical distribution, and medicinal virtues of Tartary buckwheat, this research sets the stage for a comprehensive exploration of its potential in revitalizing agricultural landscapes. The paper envisions a future where heightened awareness and scientific advancements converge to usher in a sustainable and prosperous era for both the farmers of Kinnaur and the consumers they serve. Buckwheat cultivation, once a cornerstone of traditional practices, can be rejuvenated through collective efforts, contributing not only to bio-diversity conservation but also to the holistic development of the region.

Buckwheat Cultivation driven and inspired holistic Development.

The Buckwheat (Fafra and Ogla) has been a significant crop in the hilly regions, cultivated at an altitude of over 2000 meters above sea level for seeds and green leaves. In India, both the common buckwheat and Tartary buckwheat are grown in different levels of altitude, common buckwheat in lower altitudes up to 1000 m and the other in higher altitudes >2500 m2. (Nalin Kumar and Singh, 2020). It is a unique crop that can be successfully grown from the high Himalayas to 4500 meters. In the mountainous regions of the Himalayas, two species are cultivated: *Fagopyrum tataricum*, known as Tartary Buckwheat, Green Buckwheat, or Bitter Buckwheat, and Fafra, known as Brass in the Kinnaur district. In Himachal Pradesh, Fafra is known as Brass in the Kinnaur district. Fafra is a pseudo-cereal belonging to the Polygonaceous family and the genus *Fagopyrum*. It is an agricultural food plant. In India, this crop is grown from the west in Jammu and Kashmir to the east in Arunachal Pradesh. It is cultivated in the high-altitude regions of Uttarakhand, Jammu and Kashmir, and Himachal Pradesh because the climate in these areas is conducive to Fafra cultivation. The hilly regions of Himachal Pradesh are highly suitable for the production of various agro-climatic crops related to small millets such as amaranths, Buckwheat, and chenopods. According to the biology of Buckwheat, two species of Buckwheat are produced globally as food substances. Fafra, a grassy annual plant, is taller and larger than common buckwheat (Ogla), with narrow and sharply pointed leaves. The flowers are also similar, adorned with unique clean green spikes. This species has a solitary nutritional diet, and the chromosomal number is 2n=16. Tartary buckwheat or Fafra is grown at an altitude of 2000 to 4000 meters in the Himalayas. It is an excellent source of nutrition, including protein, carbohydrates, fibre, essential amino acids, and minerals. Its grain is commonly used as human food in the form of flour. In Kinnuar, the flour of Fafra is used to prepare traditional dishes such as Hoth (Chilta), Doo, Roti, and Brass Kadd (Fafra vegetable). The dried green leaves are used to prepare Brass Kaan in winters. It is a leafy vegetable crop produced in various regions of the Indian subcontinent. It is also suitable for re-cultivating low-productivity land, as it grows rapidly on such soil and produces a vast green manure crop in a short period. The whole grain can be used in poultry feed mixtures. It is rich in middle protein and is therefore useful as livestock feed. Fafra is also grown as a cover crop to improve soil fertility and prevent erosion.

Brief description and nature of Buckwheat, fafra (Pseudo millet)

Tartary buckwheat is one of the various ancient crops grown in Asia, primarily produced in India, China, Nepal, Canada, North Korea, Bhutan, Eastern Russia, Mongolia, and Japan. However, there has been a decline in buckwheat production in the first half of the 20th century. The global average buckwheat production was 2.9 million tons in 2018, showing a decrease compared to the previous three years (Anonymous, 2018). Buckwheat is well-suited for extreme temperature, low soil fertility, and various climatic conditions, making it a resilient crop. Distinguishing growth traits exist between Common and Tartary buckwheat (Kasajima *et al*., 2019). Notably, Tartary buckwheat exhibits resistance to cold weather, attributed to its epigenetic regulation through DNA methylation (Song *et al*., 2020). It is annually cultivated in the hilly regions of India as a pseudo-cereal and among minor grains. Pseudo-cereals are not true cereals; in botany, true cereals are monocotyledonous plants, while pseudo-cereals are dicotyledonous, producing both edible fruits and seeds. Other pseudo-cereals include amaranth (rajgira / cholai) and quinoa.

Geographical Information and the Botanical nature of Buckwheat:

Common Names:	Fafra, Brass, Tartari Buckwheat, Buckwheat
Distribution:	Shimla, Kinnaur, Kullu, Mandi, Kangra (Bhangal region), Lahaul Spiti, and Chamba districts of the state.
Origin:	Southeast Asia
Altitude:	2000-4000 meters
Growing Season:	April-July (High-altitude regions) and July-October (Lower-altitude regions)
Unique Importance:	Fafra contains Phyto-chemical rutin, which enhances the strength of veins/nerves and regulates cholesterol levels. Therefore, it is an ideal food substance for individuals with hypertension and diabetes.

Belonging to the polygonaceous family and *Fagopyrum* genus, buckwheat thrives in the current climate change scenario and the increasing population in mountainous regions, catering to rising food demands. It grows at high altitudes, developing and producing within three to four months, making it the most suitable crop in these areas. Due to its adaptability to low rainfall and poor soil conditions in rocky terrains, it is considered a sustainable true grain for these regions, providing a crucial source of livelihood for rural populations. Buckwheat cultivation is acknowledged to be suitable for high mountainous regions, with acceptance for planting typically from June to September. Being gluten-free, buckwheat is used in various food products, and its seeds contribute to the nutritional content of these items. Buckwheat is a type of millet used as a food source, rich in essential nutrients such as protein, carbohydrates, fiber, potassium, phosphorus, magnesium, calcium, and iron. It is a high-energy food providing energy during physical exertion.

Distribution of crop pattern in Kinnaur and other parts of Himachal Pradesh.

In Himachal Pradesh, the cultivation of buckwheat (fafra) is practiced in the districts of Kinnaur, Shimla, Kullu, Mandi, Kangra (Bhangaal region), Lahaul-Spiti, and Chamba. Buckwheat is the primary crop produced in these regions. Besides Himachal Pradesh, another variety grown in Uttarakhand is also cultivated in Himachal Pradesh. Historically, domestic cultivation of buckwheat was prevalent in East Asia, and it is also produced in Europe and North America (Chen*et al*., 2018). While it was relatively unknown in the West, today it is common in the Himalayan region and is found in other regions of South-western China, such as Sichuan Province. In the Indian state of Himachal Pradesh, buckwheat, also known as Tartary buckwheat, is grown in the districts of Shimla, Kinnaur, Kullu, Mandi, Kangra (Bhangaal region), Lahaul-Spiti, and Chamba. Due to its adaptability to moderate climates, Himachal Pradesh can play a significant role in the production of this crop. The upper hilly areas of Kinnaur district, including Chitkul in the Sangla Valley, Rakchham, Sangla, Kamru, and Batseri, contribute significantly to buckwheat production. Buckwheat is also grown in other regions of Kinnaur, excluding the lower and upper dry cold regions. These areas yield an advanced crop of buckwheat, which could be used for maximum nutritional content and nutraceutical security.

Yield and prospects.

The buckwheat species Fafra has a higher production yield compared to Ogla. Buckwheat seeds are rich in various nutrients. Farmers can achieve a production of two to two and a half quintals per bigha or ten to twelve quintals per acre through buckwheat cultivation. Buckwheat cultivation has higher productivity compared to Ogla, and the presence of birds in the crop is minimal due to the bitterness in the seeds. Suitable fertilizers, water, and climate are essential for obtaining good and high yields.

Cultivation practices Kinnaur District and other parts of Himachal Pradesh.

The cultivation of buckwheat takes place from April to July in higher altitude areas and from July to October in lower altitude areas. Before initiating buckwheat cultivation, it is essential to carefully select seeds that yield optimal production in your region. Sow the seeds at a rate of 12.5 kilograms per acre or 60 kilograms per acre, or 1.5 quintals per hectare. Before sowing, use organic fertilizers such as cow dung or compost along with other available nutrients to enhance soil fertility. Buckwheat is typically grown in regions with a cool to moderate climate. It is sensitive to temperature and tends to thrive in areas with higher humidity, especially when moisture is scarce. Fruit drying and reduced production occur when temperatures rise above 30°C. Buckwheat may suffer significant damage from late May frost or early September snowfall. Buckwheat is a robust plant suitable for small climate zones and less fertile soils. It can withstand both hot and cold temperatures, showing resilience particularly in comparison to Oglala. Cultivation on recently cleared land, following deep ploughing, harrowing, and planking, prepares the field for successful germination and even development of the crop. Plant the seeds at a depth of 3 to 5 centimetres, maintaining row-to-row spacing of 30-45 centimetres and plant-to-plant spacing of 10-15 centimetres, depending on the variety. After 15-20 days of sowing, thinning can begin to reduce the number of plants and facilitate proper spacing. The crop generally

germinates within 4-5 days. Regular activities such as irrigation, pest control, and leaf picking before flowering are crucial. Important tasks include weeding and thinning, which should be done 20-25 days after germination. If required, weeding and thinning can be repeated 10-15 days later. Irrigation is crucial for the structural development of the crop. Regular watering, about 5-6 times from sowing to harvesting with intervals of 15-20 days, is recommended. Although buckwheat is relatively resistant to pests and diseases, appropriate measures should be taken if any infestation occurs. Harvesting is typically done when the seeds turn dark or black, or when pressing the seeds results in a flour-like texture and the leaves begin to turn yellow. After harvesting, the crop is left in the field to dry for 4-5 days, and then the seeds are separated from the chaff by threshing. The seeds are further sieved and dried in the sun for a day before storing in jute bags. Buckwheat cultivation generally yields more in comparison to Ogla.

Medicinal and nutritional Benefits

Buckwheat, known for its health benefits, contains a phytochemical called rutin, which enhances the strength and flexibility of blood vessels and nerves. It also helps regulate blood cholesterol levels. Therefore, buckwheat is an ideal dietary option for individuals with high blood pressure and diabetes. Compared to common buckwheat (Oglala), buckwheat has a higher bitterness and a greater quantity of rutin. Buckwheat also contains other vital components such as flavonoids, phenolic acids, hydroxyl benzyl amine, and quercetins. Its nutritional value surpasses that of common buckwheat. Buckwheat is rich in essential nutrients and possesses remarkable medicinal properties. It serves as an antioxidant, aiding in the prevention and treatment of conditions such as AIDS, cancer, heart diseases, and neurological disorders. It helps reduce blood pressure, blood fat, and blood sugar levels. Additionally, it facilitates toxin removal and weight loss. Thirteen tartary buckwheat varieties were sampled at the Mountain Agriculture Research and Extension Centre in Sangla District, Kinnaur. Analysis revealed variations in magnesium (194.5–216.5 mg/100g), phosphorus (346.6–375.2 mg/100g), calcium (49.2–57.6 mg/100g), zinc (2.6–3.2 mg/100g), and iron (3.5–4.2 mg/100g). Soluble protein content ranged from 9.8 to 11.3%, with further fractionation into albumins (4.5–5.4%), globulins (0.7–1.2%), glutelins (2.1–2.5%), and prolamins (1.5–2.0%) based on solubility in different solvents (Thakur *et al*., 2016). Both varieties of buckwheat have higher concentrations of trace elements. The flour is rich in vitamins B1, B2, and B6. It contains unsaturated fatty acids (oleic acid, linoleic acid, and gamma-linolenic acid) crucial for the formation of cell membranes and prostaglandins, thromboxanes, and leukotrienes.

Table 1 Comparison of nutritive value (%) of buckwheat with other cereals and millet in India:

Source	Tartary Buckwheat	Common Buckwheat	Ragi	Wheat
Energy	328	343	321	322
Carbohydrates	74.3	71.5	66.8	64.7
Protein	10.3	13.3	7.2	10.6
Lipids	2.5	3.4	1.9	1.5
Dietary Fibre	6.3	10	11.2	11.2
Ash	1.8	2.1	2	1.4
Moisture	10.2	9.8	10.9	10.6

Buckwheat stands out for its rich nutritional profile, surpassing many other cereals with its abundance of macronutrients, micronutrients, and bioactive compounds, as highlighted in the study by Rauf *et al*. (2020). A detailed comparison of the nutritive value of buckwheat with commonly consumed crops in Kinnaur, Himachal Pradesh is provided in Table 1, as outlined by Nalinkumar and Singh in 2020.Buckwheat plants produce tender leaves that are used in making green chutneys and vegetable dishes. Additionally, buckwheat is used as a valuable forage crop (Babu et al., 2020)

Potential of Buckwheat Cultivation in Kinnaur District.

Cultivating buckwheat could be a thriving industry for the overall development of in this tribal district, especially in high-altitude regions. Buckwheat proves to be an excellent crop for such areas as it requires less time to grow and is resilient to environmental stress. It thrives well in regions with less fertile soil and limited water availability. Moreover, its cultivation, including fruiting and seed preparation, is relatively straightforward, ensuring farmers a profitable venture. Buckwheat cultivation could emerge as a promising option for farmers in this hard and difficult terrain who are seeking progress. Its utilization extends beyond just food; it is also used for medicinal purposes, making it a marketable product. The unique qualities and marine nutrition of buckwheat make it a favourable choice. While buckwheat cultivation has been a good source of income for farmers and mountainous regions, recent years have seen a decline due to decreased interest among farmers. Farmers are gradually shifting from traditional agriculture to horticulture, such as the production of apples and other fruits, reducing the focus on buckwheat cultivation.

Bio-Diversity and Sustainable Development; a way home.

There has been a perceptible awareness among the community and the traditional farmers for immediate need for the adoption of crop pattern and the horticultural and agricultural practices which accommodates and promotes bio-diversity and sustainable farming to ensure the rich, traditional and inherent biodiversity the sustainability which had been the hallmark of this tribal area. In recent years, recognizing the nutritional importance of millets, farmers have started incorporating pseudo-millets like buckwheat into their diets. The demand for pseudo-millet flour has increased, providing farmers with better returns. Buckwheat is a less-explored crop in Himachal Pradesh due to limited awareness of its nutritional and health benefits. The lack of promotion and awareness has led to reduced demand and production of buckwheat in India. To enhance its production and use, there is a need for awareness campaigns highlighting its nutritional benefits. Understanding the specific nutritional profile of buckwheat, including protein, dietary fibre, vitamins, minerals, and bioactive compounds, is crucial. It is essential to encourage scientific interventions, research on cultivation methods, improve crop management techniques, and enhance the nutritional content of buckwheat. By implementing these measures, the availability and accessibility of buckwheat can be increased, contributing to the betterment of the lives of those involved in its cultivation.

Conclusion

The research paper concludes by envisioning a sustainable and prosperous future for both farmers and consumers through enhanced nutritional content and accessibility of Tartary buckwheat. The keywords highlight the importance of buckwheat, its adaptability, nutritional value, and the need for sustainable cultivation practices. The potential of buckwheat cultivation in this tribal region is seen as a promising avenue for overall development, especially in high-altitude regions. The post COVID period however, has drastically changed the scenario of farming practices in the region and there is a strong wave of recognition of the nutritional and cultural importance of millets and pseudo millets, farmers have started once again incorporating buckwheat into their food patterns , resulting in the incremental change in the crop patterns which would be instrumental in creating the ideal environment for the much needed bio-diversity and sustainable development in the field agriculture and horticulture in particular and for the well being of the community in general. The paper underscores the importance of increasing awareness, conducting scientific research, and implementing improved cultivation methods to ensure the continued growth and utilization of this ancient super food.

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