

Socio-Economic Impact of Modernizing Apple Preservation in the High-Altitude Cold Desert.

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INTRODUCTION

In Himachal Pradesh, the apple has solidified its status as the premier temperate fruit and a vital economic lifeline. However, the last decade has witnessed a dramatic climatic shift, characterized by rising average temperatures and reduced precipitation, leading to the rapid melting of glaciers and a remapping of the state's traditional vegetation zones. Paradoxically, this climate crisis has birthed a "miracle" in the cold dry temperate region of the Spiti Valley (\$2400\$–\$6517\$ m). In an area where commercial apple farming was largely unknown a decade ago, the warming trend has created a new cultivation zone, resulting in a 2% shift in land use toward orchards and a corresponding 10% boost in local income. While traditional apple-growing regions in lower Himachal face declining yields due to a lack of essential winter "chilling hours," the harsh, high-altitude climate of Spiti ensures the necessary dormancy and disease prevention. Furthermore, the extreme cold produces fruit with an extended shelf life, making it ideal for international export markets. Despite these regional successes, the state faces a broader challenge: while the total area under cultivation grew from 97,438 ha in 2008–09 to 114,650 ha by 2021–22, overall productivity and export quality have remained stagnant or declined. To secure the future of this sector, In Spiti, the high profitability of apples is encouraging young people to stay or return to their villages to manage family orchards. Women are the backbone of Spiti's agriculture through Self-Help Groups (SHGs), they are now leading the value-addition sector—processing Grade-B apples into cider, vinegar, and the famous Apple Barfi, apple slices, apple jam, apple powder which provides them with independent financial standing. It is now imperative to integrate modern technologies and ensuring the long-term economic stability of the rural farming community.

Role of Self-Help Group- In the cold desert of Spiti Valley

In the high-altitude cold desert of the Spiti Valley, Self-Help Groups (SHGs) led by local women have emerged as the vital bridge between age-old survival traditions and the modern commercial economy. While households historically relied on the simple sun-drying of apples to create (dried rings) for winter sustenance, these groups have now revolutionized the local food landscape under the expert guidance of the National Rural Livelihood Mission (NRLM) and the Krishi Vigyan Kendra (KVK) in Tabo. By pooling their resources to invest in advanced solar dryers and mechanical pulpers, SHGs are able to preserve the rich nutritional profile of high-altitude fruit while significantly extending its shelf life for national markets. This transition is characterized by a "waste-to-wealth" philosophy, where "Grade-B"

apples—previously considered unmarketable—are converted into premium juices and Apple Cider Vinegar, effectively turning potential losses into significant profit margins. The modernization of tradition is most evident in the creation of Apple Barfi, a preservative-free, slow-cooked delicacy that has evolved from a basic dried snack into a branded, high-demand product fetching premium prices at urban Him-Ira fairs. By ensuring these products meet strict FSSAI standards, SHGs have successfully bypassed local middlemen through collective bargaining, enabling remote desert goods to reach online platforms and specialty shops across India. Ultimately, this shift has provided Spitian women with profound socio-economic agency, elevating what was once a routine household chore into a sophisticated enterprise that allows for reinvestment in higher education and modern, solar-heated housing for the community.

Table 1: Nutritional Profile (Per 100g)

Nutrient	Amount (per 100g)	% Daily Value (DV)
Calories	52 kcal	3%
Total Carbohydrates	13.8g	5%
Dietary Fibre	2.4g	9%
Sugars	10.4g	—
Vitamin C	4.6mg	5%
Potassium	107mg	2%
Vitamin K	2.2µg	2%

The traditional food products of apple and preservation techniques unique to these cold desert areas:

In the high-altitude "Cold Deserts" of the Himalayas—specifically regions like Ladakh,

Lahaul & Spiti, and Kinnaur—the apple is more than just a fruit; it's a lifeline. Short growing seasons and harsh winters have led these communities to develop ingenious traditional methods for preserving apples.

Table2: The Value-Added Advantage of fresh spiti apple and value added product

Product	Fresh Spiti Apple	Value-Added Product
Duration	Lasts 4–5 months	Lasts 12–18 months
Market Range	Limited by transport	Shipped globally with ease
Sugar/Additives	Natural	Still 100% Natural
Economic Impact	Harvest-dependent	Year-round income for farmers

1. Sun-Dried Apple Slices (Shunghu / Thamo):

In regions with zero humidity and intense solar radiation, sun-drying is the primary preservation method. Apples are peeled, cored, and sliced into rings or wedges. They are spread on rooftops or

hung on strings in the sun. A leathery, sweet, and chewy snack that lasts the entire winter. These are often eaten plain or rehydrated in traditional stews.

Table 3: Comparison of Traditional and Modern Apple Drying Methods

Feature	Traditional Method	Modern Dehydration
Process	Sun-drying on rooftops or in open courtyards.	Use of solar dryers or convective installations.
Appearance	Lightly browned, chewy, and rustic.	Uniform, crisp "apple chips."
Nutrients	Retains high fiber and potassium.	Optimized to preserve Vitamin C and A.

2. Apple Chutneys and Relishes: Traditional households often create a "crushed" apple preserve using wild herbs, Grated apples mixed with wild mint, garlic, and local chilies. These are fermented slightly in earthenware pots to develop a tangy profile, served alongside *thukpa* (noodle soup) or *khambir* (local sourdough bread).

3. Apple-Infused Beverages: apples are a later introduction compared to barley, they have integrated into the local beverage culture. Slices of dried apple are boiled with cinnamon and mountain herbs to create a naturally sweet, warming tea. Local Spirits (Chhang/Arak variations): In some pockets of Himachal's cold deserts, apples are fermented along with barley to create a potent local liquor or cider-like brew used during festivals.

4. Apple cider: Apples (often the smaller "Grade II" or "Pitthoo" apples) are chopped and boiled in a large vessel with a small amount of water and sometimes a stick of local cinnamon. Once soft, the mash is placed in a clean muslin or jute cloth and squeezed by hand over a wooden bucket to extract thick, golden, cloudy nectar. This juice is rarely consumed "fresh" in large quantities; it is often used as a base for Apple Tea or slightly fermented to create a mild Apple Cider.

5. Apple Jam: Traditional apple jam, start by peeling, coring, and finely chopping about one kilogram of sweet, firm apples. Place the pieces in a heavy-bottomed pot with a cup of water and a cinnamon stick, simmering over medium heat until the fruit becomes soft and mashable. Once the apples have reached a pulpy consistency, stir in approximately 600 grams of sugar and keep the mixture at a steady boil, stirring frequently to prevent the bottom from scorching as the water

evaporates. As the jam thickens and turns a deep golden hue—usually after 20 to 30 minutes—add two tablespoons of lemon juice to help it set and provide a hint of brightness.

CONCLUSION

The emergence of the Spiti Valley as a premier apple-growing hub represents a rare "silver lining" in the global climate narrative. While rising temperatures have challenged lower altitudes, they have unlocked a new frontier for high-quality, high-Brix apples in the cold desert. This transition is not merely agricultural; it is a profound social and economic evolution. By bridging the gap between Indigenous Technical Knowledge (ITK)—such as *Shunghu* and earthenware fermentation—and modern value-addition technologies, the community has secured its financial future. The role of Self-Help Groups (SHGs) has been transformative, moving the valley away from a dependence on raw harvest sales toward a sophisticated "waste-to-wealth" model. Grade-B apples, once a loss, are now the foundation of a thriving cottage industry producing Apple Barfi, cider, and jams that meet national standards. Ultimately, the commercialization of Spiti's apples ensures that the youth and women of the valley have a sustainable reason to remain in their ancestral homes. As these products move from mountain rooftops to global online platforms, Spiti stands as a model of how traditional wisdom, when supported by modern technology and collective bargaining, can turn a harsh environment into a land of opportunity.