Chapter 19

Transhumance in the High-Tarentaise, Alps, France

Going and coming back to the alpine meadows[16]

René POCCARD-CHAPUIS[1] & Jean-François TOURRAND[2]

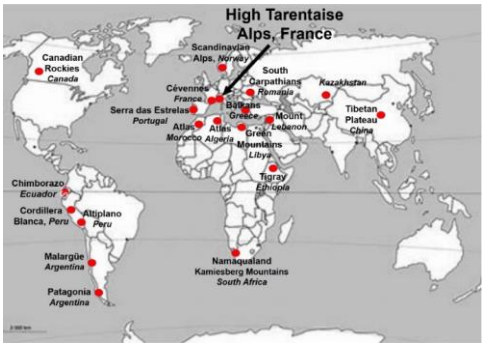
[1] Geographer, Cirad, Montpellier & Peisey, Savoie, Alps, France, rene.poccard@cirad.fr

[2] DVM/Dr Vet. Med. and Animal Sc., TLS, retired Cirad & MAAF, Montpellier, France, tourrand@aol.com

Abstract

Over the past half-century, the Upper Tarentaise region has evolved into one of the largest ski areas in the world. Previously, it was a mountainous region primarily dedicated to livestock farming, specializing in the production of Beaufort and Tomme cheeses, made from the milk of Tarine cows, a breed particularly well-suited to the regional environment. Due to its geomorphological origins, Upper Tarentaise is characterized by a complex network of glacial valleys, bordered by hanging valleys and overlooked by high-altitude watersheds, segmented by rocky outcrops and thresholds. This unique topography has given rise to a system of vertical transhumance, where herds move between high-altitude alpine meadows (above 1,500–2,000 meters) in summer and the valley floors and slopes (between 800 and 1,500 meters) in spring and autumn. Most villages are also located in these lower areas. During winter, the herds remain in barns, fed with harvested hay. The transformation of Upper Tarentaise is driven by economic development, demographic growth, and urban expansion associated with winter tourism. These changes impact grazing areas, landscapes, and local society, which now benefits from new tourism opportunities. This transition affects the local economy, the region's future prospects, and the environment, all within the framework of innovative national and European public policies and evolving social and cultural constraints.

Key-words: Alpine meadows, Herd management changes, High valley pastures, Winter tourism



[16] Photo credits: the authors

Introduction

The Tarentaise Valley is an intra-alpine valley located in the Savoie department of France, bordering Italy and Switzerland (Map 1). It stretches from the source of the Isère River near the Val d'Isère ski resort to the town of Albertville. The Upper Tarentaise is situated upstream from the town of Moûtiers. As a glacial valley, it is deeply incised and exceptionally narrow in some areas. The valley is bordered to the north by the Beaufortain and Mont-Blanc massifs and to the south by the Vanoise and Lauzière massifs.

Originally an agricultural and industrial region, the Tarentaise Valley turned to summer and thermal tourism in the latter half of the 19th century, before shifting towards winter sports in the 20th century, ultimately becoming one of the largest ski areas in the world.

Map 1. The Tarentaise located along the Isère River in the French Alps at the border of Italy and Switzerland

A quick gastronomic glance is enough to reveal that the Northern Alps are a traditional stronghold of livestock farming, as evidenced by the diversity and quality of their cheeses. However, upon closer examination, one discovers that this culinary richness is born at high altitudes. It is in the heights of the various mountain ranges that livestock farming and pastures are primarily concentrated. By contrast, the valley floors have followed a classic trajectory since the 19th century, transitioning from mining and industrial activities to urban services and transport. Agriculture does exist in these valleys, but it is more focused on crops such as corn, grapes, apples, and walnuts.

In the remote high valleys of the Northern Alps, alpine pastures and livestock were long the primary resources for mountain communities. Then, in the 1960s, skiing emerged—the "white gold" revolution—ushering in a winter sports economy that transformed the Alpine territories. A new Alpine geography has since been shaped by investments, demographic shifts, and the growing impacts of climate change.

Among the various mountain ranges of the Northern Alps, the Upper Tarentaise is emblematic of the coexistence of two models: pastoralism and tourism. Livestock farming has ancient roots here, with records dating back to Roman administrators. It gained further recognition in the late 1960s with the establishment of the Beaufort cheese Appellation d'Origine Contrôlée (AOC), celebrated as the "Prince of Gruyères." At the same time, the creation of the Vanoise National Park in 1963, France's oldest national park, laid the groundwork for future summer tourism development.

Winter tourism, on the other hand, began in Val d'Isère in the 1930s and experienced a meteoric rise. Today, Upper Tarentaise boasts the highest concentration of ski resorts in the world. Yet, these high-altitude resorts now face a severe threat from the dramatic effects of climate change.

How can a pastoral tradition—no matter how ancient and respected—continue to thrive in a mountainous region so intensely focused on tourism and so profoundly affected by the climate crisis?

I. Complex pastoral resource due to specific mountain landscape

1. A maze of high-altitude valleys and small high mountain basins

In the heart of the Northern Alps in France, the Isère River originates and flows, serving as one of the main tributaries of the Rhône (Photo 1). Over its first fifty kilometers, the main valley is bordered by numerous perched valleys, which are themselves overlooked by multiple high-altitude basins, compartmentalized by rocky bars and natural barriers (Photos 2 & 3). This intricate landscape defines a distinct and well-delineated territory: the Upper Tarentaise.

A geological perspective is essential for understanding how the Upper Tarentaise's forage systems function. Within the inner Alpine massifs, the rocks originate from the deep layers of the Earth's crust. Transformed by intense heat and tectonic pressure, these rocks were uplifted to high altitudes, fractured, displaced, and rearranged through a complex network of geological faults. Over time, these diverse rock formations were further sculpted and shaped by the glaciers of the Quaternary period.

This complex morphogenesis gave rise to the region's tiered valleys and basins, creating a remarkable diversity of soils, slopes, and landforms that significantly influence local vegetation. This stands in sharp contrast to the more orderly landscapes of other Alpine massifs.

Altitude gradients are another crucial factor. They range from a base level of 815 meters above sea level in Bourg-Saint-Maurice to a peak elevation of 3,855 meters at the summit of La Grande Casse. Vegetation types are distributed across an elevation range of over 2,000 meters, exhibiting clear stratification due to variations in atmospheric oxygen, precipitation, temperature, and solar radiation.

Photo 1. The Source of the Isère River in the Upper Tarentaise: At an altitude of 2,700 meters, the alpine meadow reaches its peak development in early August. Biomass varies significantly depending on sunlight exposure, slope, and soil type. These high-altitude pastures, situated above the rocky cliffs overlooking the village of Val d'Isère, are traversed by skiers in winter, as evidenced by the numerous ski lifts of Espace Killy, one of the largest ski areas in the world.

Photo 2. Vertical Gradient Between Alpine Meadows and Valley Pastures: This alpine meadow extends from an altitude of 2,600 meters in the foreground down to 1,900 meters below. During the summer season, herders move from chalet to chalet, following the growth of grass to graze their herds. At lower elevations, around 1,600 meters, it is haymaking season in the valley pastures, visible here in the background.

Photo 3. High Valley, Perched Valleys, and Small High Watersheds: The bottom of this high valley in the Upper Tarentaise is flat, as is typical of all glacial valleys. This is not the case for the perched valleys and small high basins. Above, layers of rocks of varying types are stacked, as indicated by their diverse colours. This compartmentalized and contrasting relief significantly influences forage management and herd mobility.

The vegetation of the Upper Tarentaise benefits from abundant rainfall. Exposed to westerly atmospheric flows, the region fully receives Atlantic moisture. Unlike the more southern Alpine massifs, the Upper Tarentaise is not shielded by the Massif Central and is therefore largely unaffected by Mediterranean influences. As a result, its precipitation regime is both plentiful and relatively well-distributed throughout the year, in contrast to the Swiss, Italian, German, and Austrian Alps, where the continental influence is more pronounced.

These climatic conditions are significantly shaped by seasonal variations, driven not only by solar inclination but also by shifting regional air masses. Depending on the season, the Upper Tarentaise may be influenced by Siberian, North Atlantic, Saharan, tropical-Atlantic, or Mediterranean air currents.

This unique geography imposes a complex forage management system on local livestock farmers, who must account for a wide range of factors, both structural and unpredictable. Geological and topographical diversity, seasonality, meteorological variations, sun exposure, vegetation stratification, soil composition, and drainage conditions all combine to create a complex equation for forage production in the Upper Tarentaise.

2. The pastoral resources in High-Tarentaise

In many pastoral farming regions, livestock must move throughout the seasons to access available forage resources, completing their annual feeding cycle by shifting from one area to another.

This is also true in the Upper Tarentaise. However, due to the constraints of rugged terrain and dense forests, the grazing circuit cannot extend over a vast perimeter. Instead, livestock mobility is structured by altitude, resulting in a tiered transhumance system where the primary movement axis of the herds is vertical.

Transhumance in the Upper Tarentaise revolves around two main types of grazing areas: high-altitude pastures and valley meadows. Located at different elevations, these two zones were cleared during Antiquity and the Middle Ages. Over time, pastures gradually replaced high-altitude shrub formations, which have only persisted in less accessible areas such as rocky slopes, steep escarpments, and shaded hillsides. Meanwhile, meadows developed at lower elevations through the clearing of deciduous and coniferous forests.

a. The alpine meadows or high pastures

These alpine meadows, or seasonal grass pastures, are key to the renowned quality of dairy products from the Upper Tarentaise, thanks to their rich floral diversity, which imparts distinctive organoleptic qualities to the cows' milk.

Often referred to as "alpine lawns" due to their low-growing, dense, and uniform structure, these grasslands blanket the slopes and high-altitude valleys between 1,800 and 2,800 meters. Their annual vegetative cycle spans from May to October, beginning with the snowmelt and ending with the return of winter. Beyond this seasonal rhythm, vegetation growth is influenced by sun exposure (with south-facing slopes being earlier and more productive), as well as by altitude, humidity, and soil fertility. Weather conditions also play a critical role, with potential snowfall throughout the season and significant variations in rainfall and temperature.

The shepherd’s skill lies in adapting to these ever-changing conditions, ensuring that livestock graze on the best possible grass throughout the season. Meanwhile, the cheesemaker’s craft involves fine-tuning the cheese-making process daily, adjusting to the pasture’s characteristics to maintain high quality and minimize losses—all despite the absence of modern cold storage.

b. The pastures of the valley

Between 800 and 1,800 meters in elevation, south-, east-, and west-facing slopes, along with plateaus and valley floors, host lush valley pastures. Less exposed to the harsh conditions of high altitudes, these grasslands produce significantly more forage biomass than alpine meadows and sustain a longer growing season, from April to November.

These pastures are grazed in spring and autumn, while two hay-cutting cycles occur during the summer season. The harvested hay is then stored on farms to feed livestock throughout the winter months.

II. The evolution of pastoral system over time

1. The traditional mobility of the herds

Until the 1970s, each family in the Upper Tarentaise valleys maintained its own small herd, typically consisting of 10 to 20 cows, most of which belonged to the Tarine breed (Photo 4). Sometimes referred to as "Tarentaise," the Tarine breed is known for its balanced dairy and meat production capabilities, but above all, for its size and agility, which are perfectly suited to the rugged terrain and altitude constraints of the region.

In spring, as the snow begins to melt, the lowest pastures—particularly those with southern exposure—are the first to emerge. This marks the beginning of the grass growth season, prompting the herds to leave the barns for the first pastures. By May, the valley pastures are fully covered in fresh grass, and the cows are grouped into collective herds of 100 to 150 head, led by a herder. The herder, assisted by a team of around ten people, guides the herd through a grazing cycle lasting four to six months. This journey begins with the "montagnette," the highest valley pastures, before continuing to the expansive alpine meadows.

With two milkings per day, the fresh milk is immediately transformed into Beaufort cheese (Photo 5), the primary economic product of farming in the Upper Tarentaise. At the end of the grazing season, after the Beaufort has been produced in the alpine meadows, the herds descend back to the valley, returning to the "montagnette" they left in spring for autumn grazing. The annual cycle concludes in the lower-altitude meadows, where the cows are reunited with their owners.

Forage management in this region follows a vertical gradient, extending from valley floors to alpine summits. A key and symbolic moment in this seasonal cycle is the "enmontagnée"—the ascent to the mountain pastures—at the end of June. During this ascent, the herder's team, along with the herd, moves to high-altitude chalets that are only accessible during the summer. They will not return to the valley until the end of September, during the "démontagnée"—the descent from the mountain pastures.

This system of mobility serves several purposes. First, it maximizes the use of high-altitude forage resources while supporting a summer cheese-making process adapted to the isolation of the alpine meadows. This process produces cooked, pressed cheeses in 50-kilogram wheels, which are then aged locally. Additionally, it frees the families who own the cattle from the daily tasks of animal husbandry, allowing them to focus on hay production for winter and staple crops (such as potatoes and rye).

Families retrieve their cows in autumn when milk production declines. The winter milk, which is less abundant, less rich, and less flavourful, is traditionally used to produce a smaller, lower-value cheese known as "tomme." However, starting in the 1950s, an innovation emerged—the "winter Beaufort." This development led to the creation of the "Fruit Commun," a cooperative system in which families pooled their winter milk, hired a cheesemaker, and produced a higher-value cheese compared to the traditional tomme.

Photo 4. The Tarine (Tarentaise) Cow and the Alpine Meadow: A symbol of the Tarentaise region, the Tarine cow is small in size, providing it with exceptional agility for grazing on steep slopes, even those that can become slippery after snowfall. Here, at the end of August, at an altitude of 2,000 meters, the alpine meadow is still in full bloom, which imparts a distinct flavour to the milk of the Tarine cows.

Photo 5. Milking in the Alpine Meadow: The milking system is mobile, allowing it to be positioned as close as possible to the grazing areas. This setup optimizes herd mobility, making the best use of available forage resources based on current conditions. A mobile electric fence is visible in the foreground, used to define the daily grazing area.

In addition to Beaufort, other co-products are also produced in the alpine meadows, including cream, butter, and sérac (a cheese made from buttermilk). The whey is used to fatten young pigs, which are slaughtered in the autumn. The pastures also support sheep flocks, which add value to these resources through the production of wool and meat in areas that are inaccessible to cattle due to distance, altitude, steep slopes, and rocky terrain.

2. Nitrogen in the pasture or disruptions in the forage system

The structure of this vertical mobility system has persisted to this day, but its functioning has undergone profound changes in recent decades. As in the rest of France, mechanization has facilitated transportation and various stages of production, such as stirring, skimming, and churning butter. Electricity and gas have replaced dry wood and manual labour, while industrially produced tools have supplanted handmade instruments.

However, it is primarily the concentration of herds and lands into the hands of a few farming families that has transformed forage systems. Despite the success of the 'Fruit common' system, the rise of tourism from the 1970s onward led most families to gradually abandon their small herds.

A few families, however, made the opposite choice: they consolidated herds and meadows, initiating a new production model. Herds are now gathered not only in summer but also in winter, within the same farms. New types of barns have been built, where, for the sake of labour productivity, solid and liquid manure are mixed and stored in slurry pits. The large quantities accumulated during the winter are then spread on the meadows in spring.

These substantial inputs of nitrogen, phosphates, and potassium alter soil functioning, disrupt the floral composition of plant communities, and ultimately affect milk quality (Photo 6). With the increasing number of cattle, the volume

of slurry also rises, and due to limited available space, spreading gradually extends to alpine pastures, where the agronomic and ecological impacts are even more pronounced. Beyond disrupting flora, water pollution from eutrophication can occur in catchment areas, affecting rivers and groundwater.

A direct consequence of the growing herds is an increased demand for forage, which local production can only partially meet, even when boosted by organic nitrogen inputs and other chemical fertilizers. Imports of hay from Crau (a region located 300-400 km to the south) have increased, along with imports of alfalfa pellets.

These external inputs further exacerbate imbalances between soils and plants in the meadows and alpine pastures where slurry is spread. This trend is reinforced by the valorisation of milk produced at altitude, which encourages farmers to enhance the productivity of alpine meadows, extending the grazing period beyond the traditional 100 days.

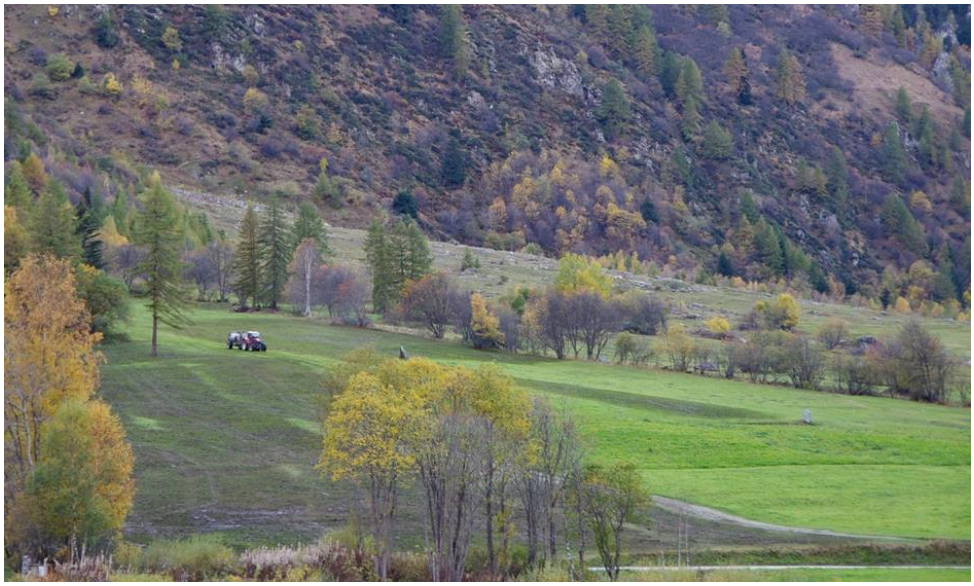


Photo 6. Spreading Slurry and Manure: Before winter begins, slurry and manure pits must be emptied, resulting in their application across valley pastures and alpine meadows, typically in autumn before the first snow. While this practice boosts forage production, it negatively impacts floral diversity and the sensory qualities of milk. Additionally, it can cause water pollution and generate unpleasant odors.

In response to this trend over recent decades, regulations—such as the AOP Beaufort standards and European directives—have evolved to mitigate the impact on plant diversity and cheese quality. Additionally, collective efforts have been strengthened through the "Fruit common" system and maturation cooperatives.

These initiatives provide better control over production processes, from land management to marketing at tourist sites, ensuring the continued profitability of traditional herd and pasture management.

III. Changes and perspectives: coming back to the mountain pasture?

Climate change is reshaping the forage resources of High-Tarentaise, just as it is across the Northern Alps. Winter tourism now faces the challenge of declining snowfall, leading to increased reliance on artificial snow, which introduces new competition for water resources. At the same time, rising risks of drought place additional pressure on forage, especially where livestock numbers have grown.

However, it is tourism—more than any other factor—that has driven change in High-Tarentaise. For decades, tourism has attracted young people, expanded buildable land, and dramatically increased property values due to demand from tourists and developers. This influx of wealth has transformed the local economy, replacing livestock farming with a thriving service sector built around businesses, real estate, and ski-related jobs. The region has urbanized rapidly, despite some regulatory constraints from the Vanoise National Park.

Yet tourism's impact on agriculture is not entirely negative. The millions of tourists who visit annually provide a steady market for local products, especially the renowned Beaufort cheese, supporting high prices regardless of product quality. Livestock farming, once in decline, has been revalued as cultural heritage—sometimes even achieving a folklore status. It contributes to the region's iconic landscapes, a critical asset for tourism. As a result, the activity has regained appeal among young people, who are returning to shepherding and cheesemaking. This resurgence is supported by strong product value, family real estate income, a dynamic job market (including opportunities for dual occupations), and regulatory measures that encourage a return to mountain life.

However, tensions persist over land use. Agricultural lands, particularly valley meadows with prime southern exposure, are being converted to buildable plots (Photo 7 & 8). The expansion of ski slopes, often involving extensive earthmoving, alters soil composition and degrades pasture diversity, impacting forage quality.

Livestock farming also presents challenges for tourism. Manure spreading produces unpleasant odours and can contaminate watercourses, conflicting with tourist expectations. Large "Patou" dogs, while essential for protecting herds from wolves, can pose risks to summer hikers. Off-road vehicles—bicycles, motorcycles, and quads—preferred by some tourists, damage pastures and trails. Hikers' dogs, uncontrolled, threaten herds and local wildlife. Beyond forage management and livestock farming, tourism's rapid growth has disrupted many foundational aspects of High-Tarentaise.

Altitude, once a barrier and defining feature, has been conquered. It is now accessible to tourists year-round, crossed by skiers and hikers, connected by roads, dotted with comfortable housing, and governed by strict regulations on flora and fauna. Larger, more productive herds graze these mountain spaces, which have become normalized, no longer demanding the same resilience and skills.

The region's population has also transformed. After two generations of intense migration, a diverse, multicultural community has emerged. Once isolated and even marginalized, mountain residents now embody values of progress, sustainability, and quality of life that were once seen as urban. These human resources have redefined the region's identity, transforming traditions to align with new values. Tourism—once the primary threat to traditional life—now helps preserve and celebrate it, highlighting the complex balance between tourism and livestock farming in High-Tarentaise.

Despite being impacted by significant territorial changes, the forage system of High-Tarentaise has become a driver of change itself, thanks to its economic significance, its deep connection to the landscape, and the iconic value of its products. Yet, in High-Tarentaise, the allure of "white gold" (snow) continues to dominate. Investments keep pouring

in to enhance and internationalize tourism offerings, leveraging the region's environmental and logistical advantages to position it as a leader in addressing the risks of climate change.

Balancing these two key activities—agriculture and tourism—within the region is a complex task, overseen by multiple public institutions. These organizations face challenges such as navigating complex administrative structures, managing the difficult consolidation of small municipalities as encouraged by the state, and addressing uncertainties in overseeing the peripheral areas of the Vanoise National Park.

Photo 7. Grazed Landscapes and Tourist Areas: In High-Tarentaise, pastures serve as expansion zones for tourism, accommodating ski slopes, golf courses, and residential developments, as shown here in Arc 1800. In the background lies the Tarentaise Valley near Bourg-Saint-Maurice, flanked by numerous perched valleys, with high-altitude pasturelands rising above.

Photo 8. Haymaking in Valley Pastures During Summer: While herds graze in the alpine meadows, two hay-cutting cycles take place in the valley pastures each summer, following spring grazing. These pastures are essential for ensuring farms' forage self-sufficiency during the harsh winter months. However, they are increasingly threatened by the expansion of buildable land, as shown by the campsite on the left and the tourist residence on the right. This pressure drives the push for higher pasture productivity, altering plant diversity and ultimately diminishing both product quality and landscape beauty.

Conclusion

Situated at the foot of Mont Blanc, where France, Italy, and Switzerland meet, High-Tarentaise has long been a region of strategic importance. Over the past half-century, it has experienced profound economic, social, cultural, and political changes driven by the growth of winter tourism. Despite the evolution of some pastoral practices, High-Tarentaise remains a region rooted in livestock farming, with transhumance at its core, making use of diverse high-altitude grazing areas.

However, the region now grapples with two major challenges. On one hand, urban and peri-urban expansion encroaches on grazing lands, altering traditional land use. On the other, evolving livestock farming practices are causing irreversible environmental impacts. A range of public policies at local, national, and European levels aims to address these challenges, seeking a balance between conservation, development, and sustainability.

Although the outcomes do not always align with local stakeholders' expectations, these policies offer coherent alternatives for managing mountain territories—both in the Alps and beyond.

References

Bocquet, A. 1997. *Archéologie et peuplement des Alpes françaises du nord* », *Anthropologie*, no tome 101, fascicule 2, 1997, p. 361-381

Bozon, P. 1986. Maurienne et Tarentaise : Les Destinées des Hautes Vallées De Savoie, *Ed. Cahiers de l'Alpe*, Grenoble, France, 259p

Onde, H. 1941. *L'occupation humaine en Maurienne et en Tarentaise. Rev. Géog. Alpine,* vol. 9, no 2, 1941, p. 223-264.

Penna, J.L. 1997. La Tarentaise d'antan. *2ième Ed. Montmélian, Imp. Seilc*, Aubenas, France, 195p.

Rando-Evasion, 2013. Le Grand tour de la Tarentaise, *Ed. Glénat*, 144p.

Wikipedia, Vallée de la Tarentaise — Wikipédia

Wikipedia, https://fr.wikipedia.org/wiki/Beaufort_(fromage)

Wikipedia, Tomme de Savoie — Wikipédia