FOLLOWING THE THREAD OF YAK

IFAD
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Following the Thread of Yak is the first publication exclusively focusing on yak wool production and its commercialization, although incorporating a broader scope aimed at combining the technical report and the socioenvironmental narrative attached to the High Asia region and its indigenous communities, native growers of yak fibre.

Following the Thread of Yak is an IFAD contribution to the welfare of the traditional pastoral and agropastoral communities living in this harsh high-altitude ecosystem and the future economic development of the pastoral products originating in this crucial biocultural region and from these eco-friendly practices.

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Kyrgyz young shepherd with baby yak in the Alai valley of Kyrgyzstan
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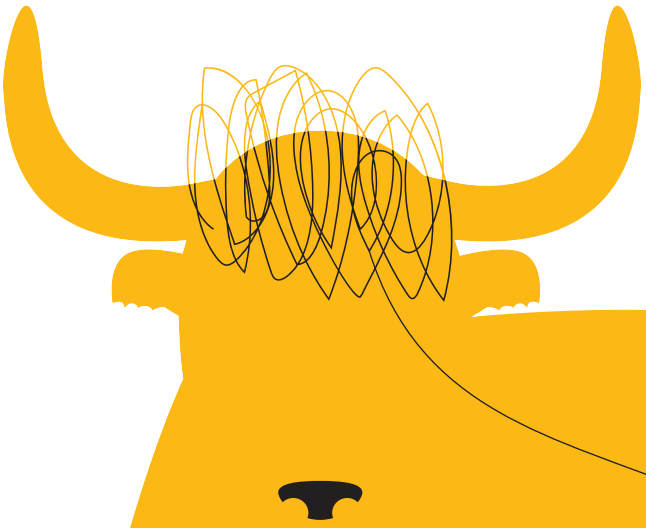

FOLLOWING THE THREAD OF YAK

A holistic study and technical report on the yak wool industry

Author:
Santiago J. Carralero Benítez

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Abbreviations

AKF	Aga Khan Foundation
AVSF	Agronomes et Vétérinaires Sans Frontières
CAAD	Cooperative Ar Arvijin Delgerekh
ESVCA	Ecosystem service value chain analysis
FAO	Food and Agriculture Organization of the United Nations
GBAO	Kuhistani Badakhshan Autonomous Region
GIZ	Gesellschaft für Internationale Zusammenarbeit
ICAR	International Committee for Animal Recording
ICIMOD	International Centre for Integrated Mountain Development
IWTO	International Wool Textile Organisation
META	Murghab EcoTourism Association
MNFPUG	Mongolian National Federation of Pasture User Groups
NIRJAFT	National Institute of Research on Jute and Allied Fibre Technology
NRCY	National Research Centre on Yak
RWS	Responsible Wool Standard
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
TAR	Tibetan Autonomous Region
UDAW	Universal Declaration on Animal Welfare
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
WYHA	World Yak Herders Association

Foreword

The yak is a long-haired species of Bovidae living throughout high-altitude areas that began to be domesticated approximately 10,000 years ago. Even though the yak originates from the Tibetan Plateau, it has spread among the Greater Central Asia uplands. These animals not only are intrinsically interrelated with the territory that they live in and its traditions, but also provide humans with essential services to successfully survive in such challenging environments.

People living in high-altitude ecosystems have to deal with geographic remoteness and extreme climatic conditions, in addition to social marginalization, especially in relation to urban areas. During the last two centuries, yak herders went from being regionally prominent to becoming nationally marginal. At the same time, mountain areas started being conceived as massive "natural resource supply providers", with fresh water being the most valuable product.

The many qualities of yak have attracted the attention of researchers, scientists and business investors. The first research group on yak was established in 1978 in China, whereas the first International Conference on Yak was celebrated in Lanzhou in 1994, supported by the Food and Agriculture Organization of the United Nations (FAO), the International Centre for Integrated Mountain Development and the International Livestock Research Institute. Since then, the International Yak Information Center Conference, the major event at the global level on yak-related issues, has been hosted at Lanzhou.

In 2018, during the Sixth International Yak Information Conference (Qinghai, China), representatives of yak-herding communities from China, Mongolia and Nepal stressed the need to create an association to properly discuss and address the special conditions characterizing high-altitude ecosystems. The project of a World Yak Herders Association was patronized by FAO, with a crucial role for the YURTA Association, founded in 2012 by Santiago Carralero, the author of this report. IFAD showed its interest in supporting the High Asia region's rural communities through the yak fibre sector during the last Pastoralism Knowledge Hub Partners' Meeting in November 2018 (Rome).

McGregor, in a 2018 publication, highlighted how information on rare animal fibres, such as mohair or yak fibre, is scattered in scientific journals, conference proceedings and books. He also affirmed that in recent years more research on these fibres has been conducted in China and South America, but the articles have not been translated from Chinese or Spanish and are also difficult to locate.

Even though this publication had to face this challenge, it represents the first global review focusing on the yak hair industry and it aims to build the knowledge basis required to develop projects with long-term and eco-social benefits. Consequently, a project proposal is briefly illustrated at the end of the publication.

Introduction

This publication is intended to merge economic, anthropological, socioenvironmental and historical knowledge of yak-herding societies. It has been conceived to be a document of interest for natural and social researchers, technicians, textile processors, private investors, public institution representatives and the general public. This study aims to fill the gap present in the literature on yak wool production. The report will widen knowledge on yak-herding production and the livelihoods of related communities, now living in marginalized areas. The yak wool industry will then be considered at the policy level, as interventions and policies need to better address producers' needs and enhance their involvement in the value chain. In the first part of the publication the territory of High Asia and its uniqueness will be explored, explaining why its topography has strongly impacted the human geography of those areas, where different ethnic groups have to face economic, sociocultural and political marginalization, especially in terms of development and self-management. Second, the yak and its fibres, as well as the other derived products, will be analysed to provide greater knowledge of this unique animal and its services to the whole community. Finally, the yak-derived product markets will be explained and a variety of examples of yak wool industry initiatives, together with some selected cases of other types of animal fibre, will be reported to better define the current market situation and future opportunities.

Among the objectives of the report is that of outlining the best way to set up businesses based on yak hair-derived industries, with the practical conclusions at the end of this study having this specific purpose, in the form of a potential project.

This study underlines the importance of setting up an innovative industry of yak products based on ecological production and alliances with cashmere, sheep wool, mohair and alpaca wool industries. By diversifying products and experimenting with textiles composed of blends of different animal fibres, the challenges become more surmountable. Undoubtedly, the situation of the herders would improve by increasing the profit derived from yak wool commercialization, with external retailers still obtaining an attractive margin of benefits. For those rural communities wishing to obtain higher profits from yak hair, the major challenge is satisfying a competitive market despite the communities' limited capacity for commercialization with regard to quality, price and bargaining power (Bonfoh et al., 2016).

To be competitive and stand out from cashmere and sheep wool industries, yak herders need to collaborate with each other in the form of cooperatives and associations. They also have to stress the further added value provided by the environmental services and the particular benefits inherent to yak pastoralism. For example, the mobile pastoralism of yak means that they can make use of extensive territories where life conditions are truly adverse and there are no other options for generating livelihoods.

This study focuses on measures to increase the income of native livestock keepers, without altering socioenvironmental conditions. It also aims to promote an inclusive type of development that goes beyond the political will and interest in the region and its resources, by focusing on its inhabitants and their animal husbandry and social practices.

THE YAK AND THE HIGH ASIA REGION

CHAPTER 1

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The High Asia region

The geographic and environmental relevance

High-altitude pastoralism takes place in a biome named alpine tundra, with climatic conditions that are similar to those in the Arctic but at lower latitudes. The alpine tundra biome is located throughout the world at altitudes where trees cannot grow, with the central area of Asia being the greatest example of alpine tundra (see Box 2). It is the area where the largest fluvial run-off, at 8,000 km³ per year (18 per cent of the global water run-off), is recorded and where almost 17 per cent of the glaciers and ice caps on Earth are found (Viviroli et al., 2003; WGMS/UNEP, 2008). Considering that only 0.3 per cent of all water resources on our planet are freshwater, the relevance of the High Asia region increases, as its fluvial network provides benefits to nearly half of the world's population (see Box 1; Mountain Partnership, 2014).

The High Asia region can be categorized by:

1. A minimum altitude of between 2,000 and 2,400 m, with a maximum altitude of 8,000 m.
2. A particular climate characterized by very short mild summers and very long and cold winters.
3. A great concentration of high mountain ranges converted into massive water storage reservoirs.
4. A tundra-type ecosystem and biome called alpine tundra.
5. A high altitude where oxygen scarcity is potentially dangerous for humans.

The human dimension

Currently, about 140 million people reside at altitudes over 2,500 m, mainly in South America, Asia and Africa (Moore et al., 1998). Beyond big cities such as Lhasa, La Paz, Quito and Bogota, most of this population lives scattered in small towns, villages and hamlets, thus suffering the traditional social and political marginalization and isolation from the urban centres. In these remote and adverse socioenvironmental conditions, these communities have produced local goods for millennia as part of their cultural, biological and gastronomic heritage (Pflimlin et al., 2006). However, the correlation between high-mountain areas and marginalization is not always the rule, as shown by observations of contemporary Switzerland.

Although, according to the United Nations, "the benefits derived from mountain regions are essential for sustainable development" (United Nations, 2012), the present reality is that, except in the European Alps, high-mountain communities have been subjected to severe marginalization in terms of lack of interest and investment, despite their crucial role in providing water resources to the human population (United Nations, 2013).

Pastoralism can play a key role in the rural development of these areas; indeed, it contributes up to 50 per cent of the total income of pastoral and agropastoral families, which translates into more than 50 per cent of the total gross production value of agriculture (Tulachan et al., 2000). According to Dr Kreutzmann's (2012) masterly definition, "High Asia is a particular biocultural space up to 2,500 m, altitudinal belt where pastoralists have played an important role in shaping relationships, connecting regions, exchanging goods and valuable information".

Several experts have unanimously affirmed that "where livestock mobility and institutions for communal governance are found, rangeland degradation is scarce", and, concerning pastoralists, that they provide "valuable ecosystem services in a wide range of landscapes such as maintaining high levels of biodiversity, increasing vegetation soil cover, reducing erosion, preventing wildfires, maintaining infrastructures, dispersing seeds, allocating nutrients, and defragmenting landscapes" (Herrera et al., 2014). In fact, pastoralism supports several hundred million households in marginal, less productive lands, and pastoralists themselves are able to produce food where farmers cannot (Pastoralism Knowledge Hub, 2016). Moreover, mobile pastoralists weave a sort of human network that provides social cohesion in vast empty areas that might otherwise be a propitious breeding ground for banditry, misrule, power struggles or terrorism. However, as in any network, threads composing the net need to be well tightened to operate efficiently.

The political turmoil occurring during the last few centuries in the heart of Asia exacerbated the social marginalization of these areas, particularly with regard to the rural population and production. During the nineteenth century, the economic colonization and subsequent territorial domination by the British East India Company over the south and by Tsarist Russia in the north turned the High Asia region into a strategic chessboard. Permanent border tension developed throughout this area and, in South Asia, it caused armed clashes, namely, the Gurkha Wars and the Opium Wars; this period is known in the Central Asia region as the "Great Game". Once the European colonial powers had been halted, territorial domination was pursued by India, China and the Russian Federation.

The collapse of the Soviet regime had repercussions for Inner and Central Asia. In China, the adoption of post-socialist programmes led to certain misconceptions related to the causes of overgrazing and the adverse consequences that mobility might have in the Chinese uplands. Moreover, in both China and India overpopulation triggered an internal process of socio-economic colonization from the lowlands upwards, and militarization of the border areas steadily increased in response to the expansion processes. Only in some areas did traditional pastoralism survive as before, safeguarded in old remote kingdoms such as Wakhan (Afghanistan), Bhutan or some parts of Nepal.

BOX 1 **High Asia and its fluvial system**

Rivers	Length (km)	Basin (km²)	Discharge (m³/s)
Irtysh-Ob	5,410 – world's seventh longest river	2.97 million	12,480
Yenisei-Angara-Selenge	5,539 – fifth longest river	2.56 million	19,800
Lena	4,292 – eleventh longest river	2.49 million	12,100
Syr Darya	2,212	402,760	1,180
Amu Darya	2,540	534,739	2,525
Indus	3,610	1.17 million	6,600
Brahmaputra-Ganges	2,510	712,035-1,086,000	19,800-30,770
Salween	2,400	320,000	10,000
Mekong	4,350	795,000	16,000
Yangtze	6,300 – third longest river	1.8 million	30,166
Huang He	5,464 – sixth longest river	752,000	2,571

BOX 2 **High Asia and its mountain system**

Mountain system	Country	General altitude (m)	Highest altitude (m)
Sayan	Russian Federation, Mongolia	2,000-2,700	Mönkh Saridag: 3,491
Khangai	Mongolia	2,500-3,000	Otgontenger: 4,031
Altai	Russian Federation, Kazakhstan, China	2,700 (average)	Belukha: 4,506
Tian Shan	China, Kyrgyzstan Kazakhstan	5,000 (average)	Jengish Chokusu: 7,439
Pamir	Kyrgyzstan, Tajikistan, Afghanistan	4,000 (average)	Ismoil Somoni: 7,495
Hindu Kush	Afghanistan, Pakistan	4,500 (average)	Tirich Mir: 7,690
Karakoram	Pakistan, China	6,500 (average)	Chogori: 8,611 (K2)
Kunlun	China	5,500-6,000	Kongur: 7,167
Qilian	China	4,000-5,000	Qaidam: 5,808
Tibetan Plateau	China, India	4,500	Namtso Lake: 4,718
Hengduan	China, Myanmar	4,500	Gongga: 7,556
Himalayas	India, Nepal, Bhutan, China	6,100	Sagarmatha (Everest): 8,848

The yak

Origins of the yak

It is largely assumed that yak and cattle diverged naturally into two different species approximately 4.9 million years ago (Qiu et al., 2012). Both animal species were mixed through human-induced hybridization processes more than 1,500 years ago (Medugorac et al., 2017). The origins of the yak as a herding animal can be traced back to the domestication of the wild yak in northern Tibet almost 4,000 years ago (Wiener et al., 2003).

Currently, there is no scientific consensus over whether yak domestication took place on the Tibetan Plateau or on its lower margins, or the way that this domestication happened. What has always been clear is that humans began to follow and hunt wild yak for food, fuel and warm clothing, thus obtaining a higher energy diet and better means to cope with the cold, such as through the use of yak dung and yak hair.

Distribution, hybridization and current population

The yak spread outside its original range and had to adapt to different eco-cultural variants of high-mountain pastoralism (see Box 3 and 4). In the Russian Federation republics of Altai, Tuva and Buryatia, as well as in Mongolia, yak were introduced to ancient pastoral complexes in the Khangai and Altai-Sayan mountain ranges. Among some areas of the Himalayas and Karakoram, yak were embedded in pre-existing agropastoral complexes and their exploitation was subject to the cultural restrictions of Hinduism and Buddhism.

Moreover, the yak has also been subjected to a hybridization process, which began by crossing female yak with local male taurine (*Bos taurus*) or indicine (*B. indicus*) cattle. This practice has been common among mid-mountain agropastoral communities "since 1100 BCE, and it intensified in the mid-1900s to explore the heterosis in milk and meat performance" (Jianlin, 2014). The genetic phenomena of heterosis also made these hybrids physically stronger than cattle and yak (Wiener et al., 2003). Generically called "yakows", or *dzo* and *dzomos* in the Tibetan context, *pien niu* by the Chinese, *khainag* in Mongolia and *chauris* in Nepal, today they occupy an intermediate position between the tundra alpine and the foothill areas.

Providing an exact calculation of the total yak population is challenging, as statistics vary according to the source and because sometimes the yak is included in the generic category of cattle. However, some research studies have affirmed that in both Central Tibet and Nepal, the average number of yak per household was 55 during the decade 1990-2000 (Goldstein and Beall, 1990). These data make it possible to estimate an approximate total number of 250,000 households engaged in yak husbandry; given that a pastoral household would include at least four family members, a figure of approximately 1 million yak pastoralists has been estimated.

Yak pastoralism and its characteristics

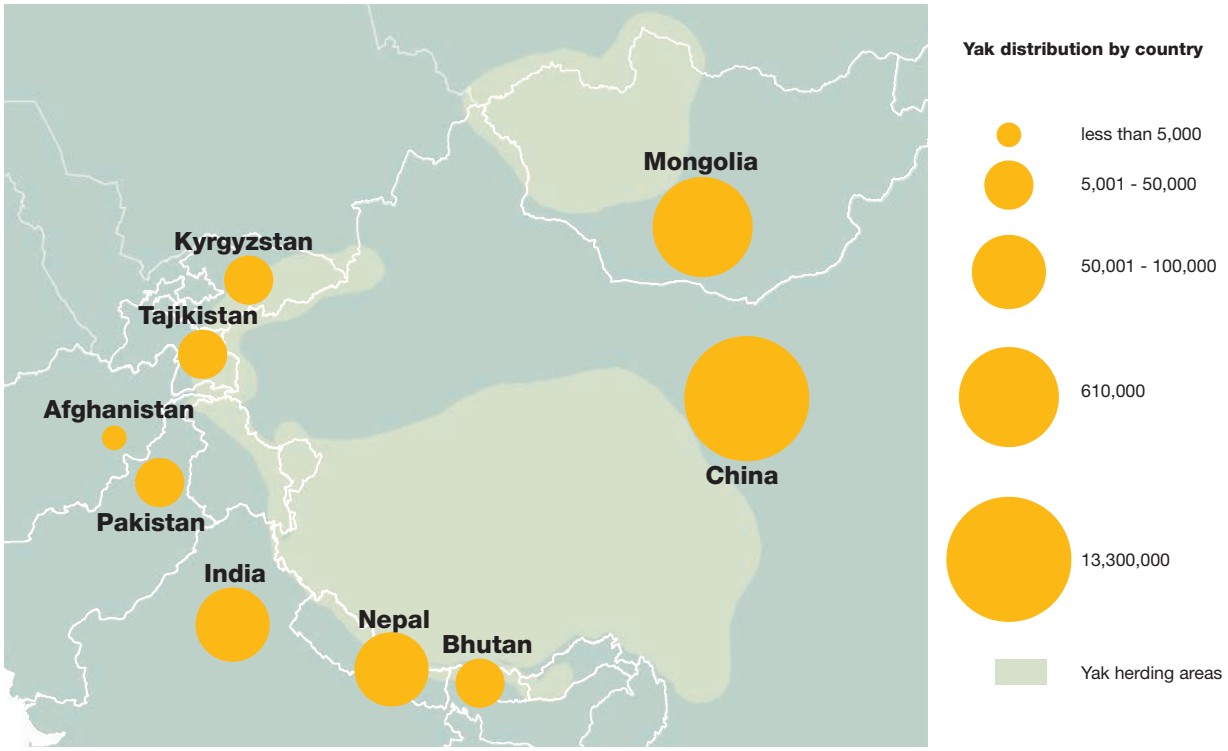
Yak (*Bos grunniens*) in High Asia and alpaca (*Vicugna pacos*) in the Andean region are known to upregulate a fetal β-like globin gene (Storz and Moriyama, 2008), which enables them to thrive in the most extreme uplands. Moreover, the robust physiology of yak – their larger lungs and heart than those of cattle found at lower altitudes – makes them perfectly adapted to live at high altitudes (Jest, 1978). Further adaptations to the cold include a thick layer of subcutaneous fat and an almost complete lack of functional sweat glands (Wiener et al., 2003).

BOX 3 **Yak population and distribution (comparative table of yak population figures and other livestock)**

Country	Number of yak (year)	Distribution	Number of households (approx.)	Number of other livestock (2017)
China	13,300,000 (2000)	3,700,000 (Qinghai); 3,900,000 (Tibetan Autonomous Region); 4,100,000 (Sichuan)	400,000	Sheep: 161,351,017; goats: 139,916,096
Mongolia	610,000 (2017)	125,000 (Khövsgül); 150,000 (Altai); 250,000 (Khangai)	20,300	Sheep: 30,109,888; goats: 27,346,707
India	77,000 (2012)	70% (Ladakh); 18% (Arunachal); 7% (Sikkim)	2,200	Sheep: 63,068,632; goats: 133,347,926
Nepal	65,000 (2013)	12,000 (Solukhumbu); 12,700 (Humla); 7,500 (Dolpo)	1,860	Sheep: 801,975; goats: 11,165,099
Bhutan	39,543 (2013)	11,000 (Thimphu); 7,150 (Trashigang); 5,800 each (Haa, Gasa)	1,250	Sheep: 10,444; goats: 42,689
Kyrgyzstan	57,000 (1990); 17,000 (2010)	70% (Naryn, Issyk Kul); 20% (Osh)	566	Sheep: 5,257,732; goats: 820,043
Tajikistan	14,300	14,000 (Eastern Pamirs)	480	Sheep: 3,635,763; goats: 1,945,733
Afghanistan	4,600	4,600 (Pamir)	100	Sheep: 13,866,000; goats: 7,598,000
Pakistan	45,000	35,430 (Gilgit-Baltistan); 7,870 (Chitral)	400	Sheep: 30,100,000; goats: 72,200,000

Sources: FAOSTAT, 2017; WWF, Livestock Census Department.

BOX 4 **Yak distribution per country**



In such a harsh environment, yak have always competed for pastures with other grazing animals, whether domesticated or wild; yak pastoralism has never been the only survival strategy in this too unpredictable sociogeographic environment. Indeed, different activities have been put in place, such as wild harvesting, hunting, bartering and long-distance trading. The bulk of the Asian upland pastoral system is formed of yak, cashmere goats and sheep (Ekvall, 1968); wild species are also present, such as wild sheep (Argali or Marco Polo), bharal, alpine musk deer, Himalayan gorals, kiangs and several types of antelope.

In a still very relevant publication, Khazanov et al., in 1994, distinguished three different pastoral areas in relation to the presence of yak. First, the core zone is the Tibetan Plateau and the adjacent Himalaya-Karakoram mountain strip, where the yak is strongly dominant. Second, a minor core area, where the yak is inferior in number but still essential, is the Eastern Pamirs. Third, in the northern zone (Mongolia and the Russian Federation), yak are reared in a certain proportion together with other grazers such as cows, horses and sheep. The current nature and reach of mobility in these three subregions, from pure full-time nomadism to ranching systems and widespread seasonal transhumance, have been mostly influenced by historical-political events. For instance, the Soviet regime withdrawal marked the general adoption of cooperative systems in Mongolia, Central Asia and China.

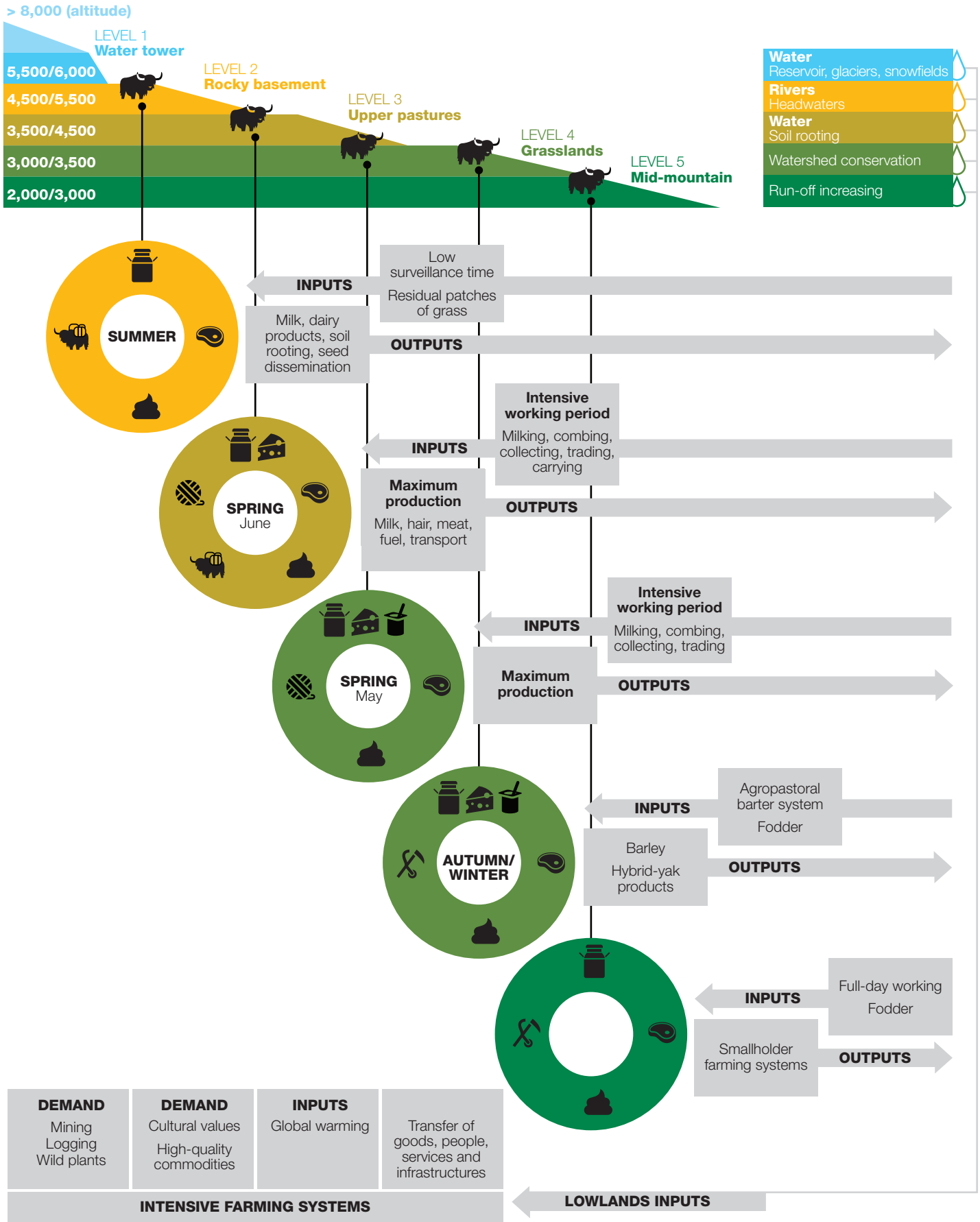
The yak has succeeded in establishing a kind of pastoral uniqueness that is globally identifiable because of its capacity to perform multiple functions as food, as a supplier of fibre and combustibles, as a means of transport and as a draught animal. Yak are more environmentally friendly than other grazing animals, as when they eat they cut the grass without plucking it and then rapidly move in search of better pastures, thus encouraging grass regeneration. They are also independent animals and do not need to be reared all of the time, thus allowing pastoral households to carry out complementary activities for economic advancement, such us trading, craft production, community-based tourism, environmental protection and education. Finally, yak are draught animals: they can transport goods and equipment and even assist human victims in cases of emergency (earthquakes, landslides, etc.). All of these benefits, both for humans and for the environment, should be taken into consideration before concluding that yak pastoralism is a low-productive economic system.

Yak-derived products and services

Free service commodities: yak dung

Yak dung was probably the first natural resource extracted by primitive human colonizers on the Tibetan Plateau, which enabled the autonomy of pastoral systems for centuries by providing a recyclable natural combustible in a predominantly cold environment. According to different research studies, the yak produces three to four times its weight in dung every year (Rhode et al., 2007) and its manure has a higher energy content than dung from other herbivores. Yak dung not only is a suitable combustible for cooking and heating, but also can be used for the construction of walls and windbreaks. Finally, as discussed earlier, the primary environmental service directly provided by yak is grass regeneration; indeed, the recovery of ingested seeds from yak (28.1 per cent) is significantly higher than from sheep (9.4 per cent). In addition, seeds contained in yak dung have a high capacity for germination and survival from digestion (Yu et al., 2012).

BOX 5 **Annual productive scheme of yak pastoralism in High Asia**



Source: author.

Pastoral products and services: agriculture, transport and dairy products

In Tibet, yak have been historically referred to using the term *nor* (wealth) (Barfield, 1993); the more yak a family had, the more prosperous they were. As discussed earlier, non-tangible added value mostly concerned transportation, ploughing and loading, however, yak can also have entertainment functions, such as the yak polo game exhibitions at some yak festivals in Khatgal, Sary Mogol (Kyrgyzstan) and Chitral (Pakistan).

Yak milk and its derived dairy products make the most valuable contribution to feeding high-mountain communities; today, milk is also consumed in China after the China Nutrition Society affirmed that yak milk contains 18 types of amino acids, including eight essential amino acids that humans cannot synthesize (Li et al., 2011). The proportion of amino acids, calcium and vitamin A is up to 15 per cent higher in yak milk than in cow's milk. In addition, the China Nutrition Society has claimed that yak milk not only improves immunity and bone density but also plays an essential role in strengthening muscle tissue.

The benefits of yak milk have been confirmed by recent research studies. Or-Rashid et al. (2008) reported that yak cheese has a lower overall fat content than cheese made from cow's milk, while at the same time containing much higher levels of heart-healthy "good fats" such as conjugated linoleic acid and omega-3 fatty acids (almost four times higher). For all of the aforementioned reasons, yak-derived products are becoming more and more in demand.

Final products: meat, hide, horn and carcass

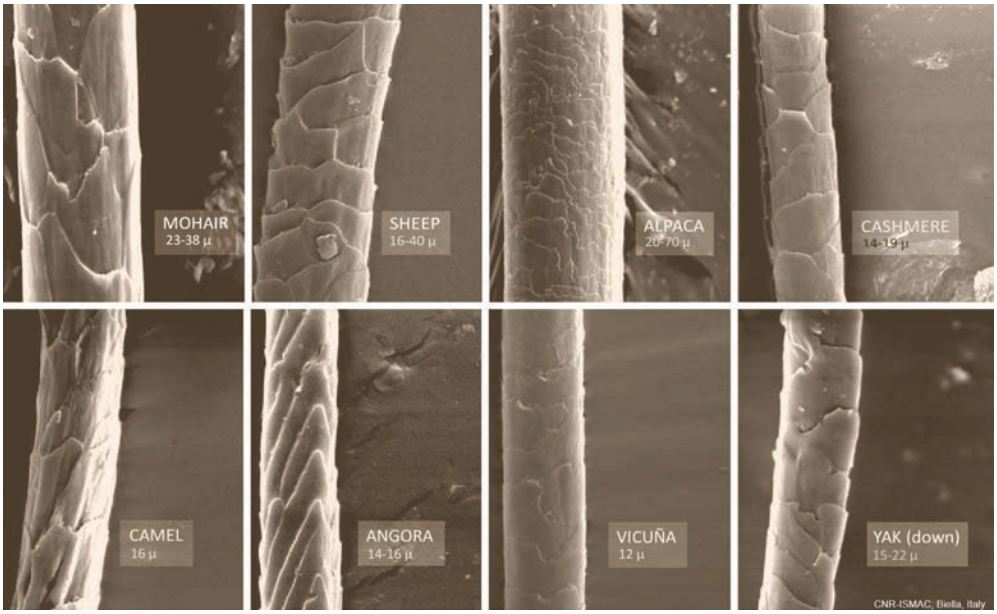
In some countries, yak products are challenged by cultural constraints. For instance, in India and Nepal, yak meat is subject to governmental limitations because of prescriptions on overall cattle consumption. These two countries, together with Bhutan and China, also face restrictions because of Buddhist thinking on the slaughtering of animals; this resulted in the Hui Muslim community serving as the butchers and middlemen in the Tibetan value chain of yak meat and offal, especially in China, thus truly enhancing their prosperity. Indeed, Tibetans used to sell their yak directly to the Huis; the Huis would pay them in cash, slaughter the yak and sell the meat in the meat markets.

As with milk, yak meat is a highly valued product; it is rich in amino acids and proteins and low in saturated fats, cholesterol and triglycerides (Yin, R., et al., 2009). In addition, yak hybrid meat has the same characteristics as pure yak meat. Yak hides are used to make boots in Mongolia and wallets in China, and the United Nations Industrial Development Organization (UNIDO, 2010) has also reported that yak leather is expected to become increasingly important for the international market.

BOX 6 **Main characteristics of basic yak-derived products**

Lifespan: 20-25 years	Properties	Products	Benefits
DUNG	13,8457 MJ/kg of heat energy Total recovery of ingested seeds: 28.1%	• Organic fuels • Natural fertilizers • Biogas • Thermal insulators used to line the walls	• Seed dispersion • Grass restoration • Forest conservation
MEAT	Energy: 154 MJ/110 g Protein: 24.7 g/110 g Fat: 6.10 g/110 g	• Air-dried and fresh yak meat • Viscera, offal and hooves • Processed meat	Very low in cholesterol, saturated fats and calories. Yak meat is also high in protein, zinc, niacin and B vitamins.
MILK	Solids: 16.9-17.7% Protein: 4.9-5.3% Fat: 5.5-7.2% Lactose: 4.5-5.0% Minerals: 0.9%	• Cheese • Butter • Urum • Raw milk • Yoghurt	Yak milk fat is richer in polyunsaturated fatty acids, protein, casein and fat than cow's milk. Yak milk improves immunity and bone density, controls diabetes and plays an important role in muscle tissue.
FIBRES AND WOOL	Three different types of fibre: • Coarse: size range 50-90 µm, forming the outer coat of long hair that characterizes the appearance of the yak • Mid-type: with a diameter between 20 and 50 µm • Wool (down) fibre: the finest fibre (16-20 µm)	• Ropes and tents • Bags, rugs and slings • Outdoor clothing • Luxury clothing	• Warmth: in woollen garments, air pockets are created between the fibres that reduce the rate of heat transfer • Softness: the diameter of the down fibre of yak ranges from 16 to 20 µm, making its softness comparable to that of cashmere • Breathability: wool can absorb over 30% moisture

BOX 7 **Comparative microphotographs of the surface cuticle scales of animal fibres**



Micrographies (scale: 1 x 1250)
International Year of Natural Fibres/Institute of Macromolecular Studies, Biella, Italy

YAK WOOL: AN INTRODUCTION

CHAPTER 2

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Characteristics, properties and applications

Characteristics

Yak wool is a unique natural product with exceptional characteristics. The natural raw yak fur consists of a mixture of long coarse hairs, which form an outer coat and resist rain, wind and snow and whose fibre diameter exceeds 50 µm, plus an inner coat of finer fibres, which provides warmth and insulation and protects the animals even when the outside temperature falls to -40° C or lower. In order to obtain the finer wool from the raw fur, the harvested fibre has to be dehaired to separate the coarse hair from the fine wool. There is a mixture of longer coarser hairs and finer shorter fibres across the body of the yak. The physical properties of the fibres also vary with the age and size of the yak.

Hairs contain a medulla, which is essentially a central canal of cells filled with air. Fibres with a medulla are called medullated fibres and are stiff and difficult to process and cause many faults in textiles designed for wearing. However, long hairs provide excellent material for specific uses such as ropes and strong woven goods.

The softer finer fibres used to produce yak wool (sometimes called yak down) usually grow in the autumn; these are shed or moulted in late spring, when they are plucked or combed from the animals. Yak wool is harvested only once a year. Because almost all yak wool production is kept in the hands of indigenous female weavers and pastoralists, who collect the raw material, its promotion and development could positively impact on rural people, especially with regard to women's empowerment. The yak wool industry could indeed be an example of an important business that is managed by indigenous women and has an international projection.

Properties and dehairing

The most important textile properties of yak fibres are the mean fibre diameter, the fibre length and the fibre colour. Other important properties are the softness, which is related to the fibre curvature (fibre crimp), the presence of impurities in the raw fibre and fibre strength. In order to obtain the finer softer fibres, the raw yak fibres are washed to remove soil and are then "dehaired". Traditionally, fibres were dehaired by hand, which is a slow, laborious activity. Modern dehairing is a special industrial process that separates the finer valuable fibres from the coarser hairs. Obtaining a perfect separation is difficult, as there is an almost continuous range of fibre diameters, medullations and fibre lengths in yak fibres. Dehairing consists of many processing operations to remove the hairs, but the processes break some of the fibres and so the average fibre length is reduced. Dehairing efficiency is reduced by medullated fibres, impurities in the raw fibre, such as vegetable matter, felting of the fibres and very long hairs (McGregor, 2018). Dehairing is an expensive processing step, and knowledge is often viewed as industrial intellectual property. Efforts are needed to improve the efficiency of the yak-dehairing process, and information about the dehairing of other fibres is essential to improve product quality (McGregor and Butler, 2008a). Excessive dehairing results in a shorter fibre length of the product, which detracts from the subsequent spinning performance and the wear properties of the final textile materials.

To obtain the highest quality fine yak wool, the cleanest raw fibre from young yak is processed. "Baby" yak fibre has a diameter of less than 20 µm and is as soft as cashmere, with a similar fibre curvature (crimp) (McGregor, 2014). Yak fibre comes in a range of natural colours, including black, brown and white. White fibre is preferred, as it can be dyed to a greater range of colours. Dark-coloured yak fibre is often bleached to obtain yak wool that is more suitable for dyeing to other colours (McGregor, 2012).

Among the most publicized properties of yak wool are its softness, warmth and breathability, as well as its itch-free and antibacterial nature; indeed, it is a hypoallergenic and antistatic material, keeping moisture away from the skin. In addition, yak wool has a long durability and protects from ultraviolet rays; additional benefits include the fact that it is easy to care for in cold temperatures and its fast-drying property.

Characteristics of yak wool that can determine its authenticity include the following: (i) the geographic origin of the raw fibre; (ii) the presence of hairs showing a medulla in the centre of the fibre shaft (Nagal, 2006); (iii) the oval or elliptical cross-section of the fibres; (iv) the generally deeply pigmented fibres; and (v) the surface cells of the fibres (cuticle scales) with smooth overlapping edges that encircle the whole fibre (Piotrowski and Carus, 2010). Many of these fibre properties are similar to those of other rare animal fibres, although they differ from those of sheep wool (Tucker et al., 1988). Examining fibre cuticle scales is expensive and time-consuming; the cuticle scale properties of animal fibres also vary with fibre diameter, the nutrition of the animals and other factors.

BOX 8 **Yak fibre types and their properties**

Fibre types			
	Wool fibre	**Mid-type hair**	**Coarse hair**
Fibre diameter	Short, unmedullated fibres of less than 25 µm in diameter that have crimps	Diameter between 25 µm and 50 µm. These hairs have a few large crimps. Some of the fibres have a latticed medulla	Diameter exceeds 50 µm. The hairs have no crimps and are long
Proportions of different types of fibres on different parts of the yak body (%)			
Position			
Shoulder	19.5	17.7	62.8
Back	21.1	15.0	63.9
Rump	20.4	18.9	60.7
Belly	63.6	29.5	6.9
Foreleg	60.3	33.9	5.7

Fibre classification and characteristics for commercial use		
Characteristic	**Wool**	**Coarse**
UPF protection	One 40th of UV rays (high protection)	
Spinning process	Manual/mechanized	Manual
Moisture regain	15.6% up to 16.5% after souring and bleaching	
Moisture retention (%)	7.4-7.7 (76-85% air humidity)	11.3-12.3 (76-85% air humidity)
Bacterial retention	Antibacterial, antimicrobial capacity	
Breathability	High breathability capacity (the higher the absorption value the better the textile is at adapting to humidity-level changes)	
Odour	High odour resistance	
Dyeing	Only possible for white or light colours	
Insulation	High degree of heat insulation	
Strength (g)	9.8 (dry)-6.9 (moist): breaking load	32.8 (dry)-25.1 (moist): breaking load

UPF, ultraviolet protection factor
Source: FAO, 2003, The yak: second edition.

Felting

Felting is a unique property of animal fibres, which can be used for the production of textiles. Felting occurs when fibres move relative to each other and become locked into position by the orientation of the cuticle scales and the entanglement of the fibres related to the fibre crimp. Yak wool can be felted in pure form or following blending with other fibres such as cashmere and sheep wool. Finer and softer fibres tend to produce denser felts than coarser and less compressible fibres (McGregor and Schlink, 2014).

Colours

Wild yak tend to have black hair whereas most of the domestic yak have a dark mixed aspect, predominantly black-brown faceted and sometimes with white patches. White hair is the most popular, as it can be dyed; however, just 10 per cent of yak have white hair (Petrie, 1995). In Mongolia, the approximate proportions of the more frequently found colours are 68.5 per cent black/dark brown, 16.9 per cent brown, 8.9 per cent blue/light blue and 5.7 per cent white (Gongor et al., 2017).

BOX 9 **Different colours and qualities of yak hair according to age and area of the High Asia region**

BOX 10 **Traditional and new applications of yak coarse hair**


Modern design of handbag


Black tent in Kham (Sichuan, China)


Carpet from Dolpo (Nepal)

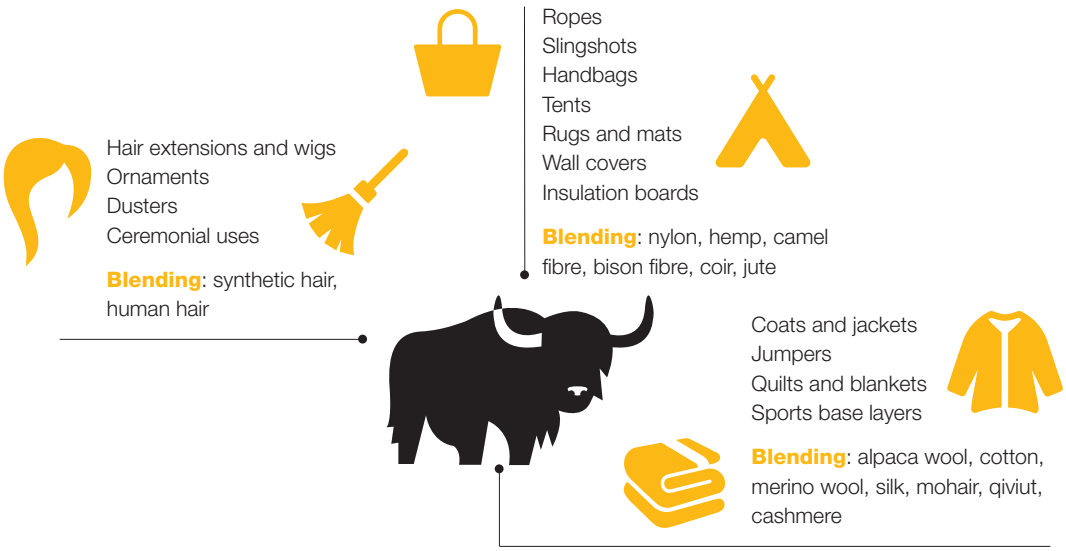

Small rugs for dowry made in Nepal

Applications

In practice, there are three specific types of fibre harvested from yak: coarse hair, yak wool and tail hairs.

Traditionally, the coarse long yak hair is commonly used to make ropes, tents, bags, rugs, slings, clothing, sacks and caps. Currently, yak tail hair is becoming popular within the wig industry and is appreciated by African-American customers. For centuries, yak wool has been used for the production of quality textiles, in competition with sheep wool and other textile products. Yak wool is also blended with sheep wool, cashmere, camel fibre, silk and cotton. Some of the companies that specialize in yak wool textiles and yarns are CYAK, Jinst Murun, Khunu, Kora, mYak, Norlha, Peak to Plateau, Reywa, Rocking Yak, Shokay, Tengri and Uujin. Some of these companies are discussed further later in this report (Chapter 4.2).

BOX 11 **Summary of current and potential uses of yak fibres**



Current yak wool industry in High Asia: an overview

Less developed areas

In the Hindu Kush Himalayan region and Central Asia, the yak population has suffered a severe decline during recent decades. This is one of the reasons for the underdevelopment of the yak product industry in these areas. Yak populations need to increase and related industries have to be enhanced to reduce the poverty rates of the communities living there.

The Hindu Kush Himalayan region

The Hindu Kush Himalayan region extends 3,500 km over eight countries from Afghanistan in the west to Myanmar in the east. It is the source of ten large Asian river systems and provides water, ecosystem services and the basis for livelihoods to a population of around 240 million people in the region. Its enormous altitudinal range and subsequent climatic variability produce an agropastoral biodiversity hotspot, with only some areas, such as Ladakh, Dolpo, Mustang and Muguthang, retaining the typical alpine arid conditions of the central Tibetan Plateau.

It has been estimated that there are about 185,000 yak, owned by 5,600 households, scattered over 1.65 million square kilometres (Yurta Association, 2016). According to Wu Ning et al. (2016), the closure of political borders and the establishment of protected areas over the past decades have greatly hampered yak mobility and weakened the adaptive capacities of yak-raising communities. Indeed, in the yak-raising areas of the Hindu Kush Himalayan region adjoining China, the yak population is thought to be suffering from inbreeding because of the lack of availability of new yak germplasm from the original yak area, the Tibetan Plateau, thus lowering the rates of survival and yak performance. Moreover, in the 1980s, an agreement banning the transborder use of pastureland was implemented and the previously accessible high mountains across the borders could no longer be used as pasture, thus leading to overgrazing in the lower altitude rangelands. Wu Ning et al. (2016) reported that a further cause of shortage of the pure yak bulls needed for genetic improvement was the closing of the borders between China and Bhutan and between China and India after the 1960s.

Currently, the Hindu Kush Himalayan region includes the following yak-herding areas:

- **Ladakh (India)**, with an average altitude of more than 3,500 m, has a high concentration of yak. The Changtang Plateau of Ladakh is the homeland of pashmina goats, a variety of cashmere goat introduced into the market by the Kashmiri people. This cashmere has a current market value of ₹2,000 per kilogram, far more than the value of yak wool, which is only ₹250 per kilogram (WYHA project, 2016). In this area, yak wool is used locally for clothing, although some yak wool is sold in Himachal Pradesh, where local artisans use it to make Kullu garments.
- **Northern Sikkim (India)** produces the typical coarse yak hair goods, such as carpets, doormats and slingshots. Yak wool is also used to make garments such as mufflers, sweaters and blankets, as well as high-quality caps, by blending yak wool with the fine fibre from the Angora rabbit.
- **Arunachal Pradesh (India)** is the homeland of the Brokpa people, the pastoral branch of the majority Monpa community. The National Research Centre on Yak (NRCY), set up in Dirang, is the only institution in the world devoted to yak research, with a strong focus on genetic issues. The NRCY carried out a promising programme in which a young group of yak herders were trained to make winter garments by combining yak wool and jute. This project aims to

Yak-herding areas in the Hindu Kush Himalayan region

foster economic growth, as well as provide entrepreneurship opportunities to local youth (International Committee for Animal Recording [ICAR]-National Institute of Research on Jute and Allied Fibre Technology [NIRJAFT]).

- **Bhutan** is recognized as having three distinct yak-breeding systems. Pure line breeding is practised in the western region, whereas, in the central and eastern regions, crossing with cattle is quite common (Winter and Tshewang, 1989). Finally, in central Bhutan, hybrids are backcrossed to yak, whereas in the east they are mainly backcrossed to cattle. Herders frequently exchange their breeding bull with that of neighbouring farmers to reduce inbreeding in the herd.
- **Nepal** is considered a chaotic market in the yak wool industry. As it mostly depends on tourism, yak wool items have a marginal role and are used as souvenirs for tourists. In spite of government efforts (with Asian Development Bank support) to enhance the socioecological resilience to climate change of rural mountain populations, by assisting mountain farmers to downstream businesses (HIMALI Project), yak wool is not yet considered a serious industry in Nepal.
- **Pakistan** has provided very little information on yak wool initiatives. Its most distinctive production comes from the Gilgit-Baltistan and Chitral areas, where local groups use yak hair to make carpets named *pullos*, famous for lasting for more than 200 years.

Yak used for carrying goods in Nepal

Yak-herding areas in Central Asia

Central Asia

Accounting for almost 1.65 million square kilometres, approximately 226,000 yak and an estimated 1,150 yak-herding households, the high-mountain areas of Central Asia still suffer from the consequences of communism's withdrawal. The Soviet Union's collapse resulted in yak having a marginal role as mere meat providers, being kept in a semi-wild state on high pastures (Yurta Association, 2016). This lack of interest in the yak population contributed to yak being included under the broader category of cattle, for both statistics and market prices.

- **Kyrgyzstan**, because of a loss of almost 30,000 yak over 20 years, currently has a lower yak population than those of other livestock such as horses (80,000), cows (1 million), sheep (3.4 million) and goats (2.1 million). Because grazing animals use only 64 per cent of the total usable natural fodder land in Kyrgyzstan, there is considerable potential for the development of the yak population and related industries (Asylbekov et al., 2002). Although the favourite fibres of Kyrgyz herders are cashmere and sheep wool, in the Chon-Alay Valley, yak herders have begun developing alternative strategies for yak hair production. Yak promotion in Kyrgyzstan has also been prompted by a World Wide Fund for Nature project named Promoting Sustainable Livelihoods, to highlight the need for local communities to diversify and for better marketing of yak-derived products.
- In **Tajik Pamir**, yak are almost the exclusive livestock inhabitants of the Murghab district of the Gorno-Badakhshan Autonomous Region (GBAO). A remarkable initiative on yak production was the establishment of the Zhengi Baba yak milk producers' cooperative in 2013, which represents the country's first commercial producer of dairy products from yak milk and Murghab's first processing company of any kind. The Food and Agriculture Organization of the United Nations (FAO) supported this initiative to link yak herders in remote areas to markets in the capital by advancing yak product value chains, which was the project's main objective. A further initiative has been developed by META (Murghab EcoTourism Association), which wanted to support women in remote communities and encourage them to produce attractive items for the seasonal tourism market. However, the yak population is quite small (13,500), especially compared with the sheep and goat populations, which number almost 3.8 million, and sheep wool and cashmere are preferred to yak wool because the former are considered more profitable for herders, thus pushing them to keep increasing the number of goats rather than yak.

Yak-herding areas in Mongolia and southern Siberia

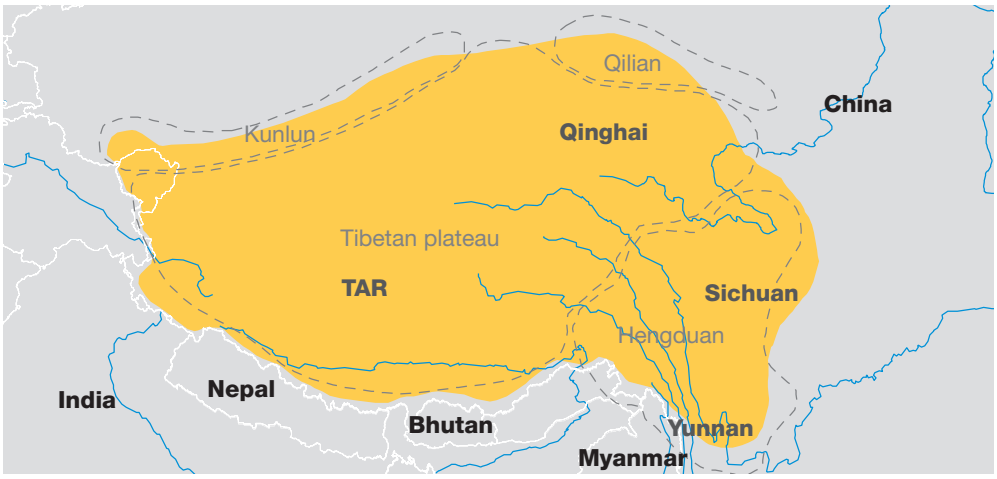
- In **Afghan Pamir**, the yak has been historically recognized as the animal that is best adapted to its extreme environment and the only one that is able to find food under the snow in the long and harsh winter season (Bliss, 2006). As in the neighbouring Hunza region of Pakistan, cross breeding is not practised. Adult yak produce up to 1,400 g of hair and 500 g of wool fibre per year (Rasool et al., 2002). Here, yak hair is used for making tents, sacks and ropes, whereas tails are utilized as dusters. The only commercialized fibres in Afghanistan are sheep wool and cashmere, collected and marketed worldwide through a few dealers in Herat (Thieme, 2006).

Developing areas

- In the **Russian Federation**, yak are found only in southern Siberia, especially among the republics of Altai, Tuva and Buryatia. Commonly called salyk, yak are mainly used in the Russian Federation as a source of milk and meat; only occasionally do some households collect yak hair, to obtain a supplementary income. According to a recent study, the yak population in the Russian Federation is estimated to be around 20,000 yaks plus almost 40,000 hybrid yaks (FAO, 2016).
- **Mongolia** has, together with China, a crucial role in yak hair production, thanks to the technical and financial support provided by international institutions such as Agronomes et Vétérinaires Sans Frontières (AVSF) and the Swiss Agency for Development and Cooperation (SDC). This has resulted in several Mongolian brands being developed that specialize in yak wool garments. It has also fostered the inclusion of yak wool products within the cashmere collections of well-known Mongolian textile companies such as Bodio. The yak-herding area in Mongolia encompasses approximately 1 million square kilometres; recent statistics assessed the total yak population at 820,000, thus implying that around 21,000 households are involved in yak-herding practices.

  Three Mongolian yak-herding areas are particularly important for the yak industry:

  - **Khövsgül aimag**, with over 120,000 yak, supplied national processing companies with 1.5 tonnes of yak hair in 2016 and 3 tons in 2017, thanks to an intensive training programme offered by the Pasture User Groups



Yak-herding areas in China

Association, an NGO facilitating business linkages between yak herders and urban-based companies.

- **Arkhangai aimag**, with 270,000 yak, is characterized as having the highest lands of the Khangai Mountains. As the herders of this area greatly depend on yak, they want to improve the yak breed so that it is able to live longer and is capable of living at lower altitudes (Fijn, 2011). As the market price of yak products is low (₮6,000 per 1 kg of yak hair, 2017), herders are not keen to increase the number of yak in comparison with cashmere goats. However, yak hair production is rapidly attracting the attention of foreign investment.
- **Khovd aimag**, in the Altai Mountains, is famous for its yak population and business-related initiatives. Traditional key areas with the highest number of yak are Must, Munkhkhairkhan, Tsetseg and Duut (Goldstein and Beall, 1994), accounting for around 150,000 yak. Some local cooperatives, such as Altain Uulsiin Orgil cooperative, produce yak wool, sheep wool and cashmere to supply national processing companies and factories producing yarns and end products for both domestic and export markets.

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- **China**'s internal market already represents a huge share of the global market, especially considering the recent rise of a middle class wishing to access luxury services and items. However, the environmental challenge that might arise from too-intensive production needs to be considered. International investors, interested in Tibetan yak wool, found in the freely accessible Qinghai and Sichuan provinces a good playground to establish their supply centres. In addition, in these provinces, the pastures are more productive because of the monsoon, thus benefiting the quality of the yak hair. Qinghai province was selected to supply different business textile companies, such as Kora, Khunu and Shokay, whereas Sichuan provides the Italian mYak company with yak hair. Among the leading Chinese companies offering both yak wool and coarse hair in Xining, it is worth mentioning Qing Hai Xue Zhou San Rong Group,

established in 1989, which has become one of the biggest textile enterprises in China and a leader in yak wool dehairing production, garment design and technology development.

- The **Tibetan Autonomous Region (TAR)** combines nomadic and semi-nomadic pastoralism at very high altitudes (5,000 metres above sea level on average). Nakchu and Chamdo, in the eastern part of TAR, have the highest proportion of yak. Although the Kalimpong-Lhasa yak wool trade retained its vigour during the 1930s and 1940s, it drastically declined during the Indo-China war in 1962 (Harris, 2008). Currently, yak meat and milk consumption prevail over yak hair.

  The case of Yak Norbu illustrates well the opportunities that yak wool can offer in terms of employment and empowerment. TIBET.CN news (24 December 2018) reported that "the secretary of Siji Jixiang Village, which produces high-quality wool fabric for Yak Norbu, said that as a relocation village, it has been difficult for local women to earn money and increase their incomes". The high-end fashion brand Yak Norbu represents an opportunity to generate rural employment for the Chushur county people of the Lhasa River while supporting the integration of traditional culture with modern aesthetics. The products have reached international markets and were shown during the 2019 New York Spring and Summer Fashion Week.
- **Sichuan** and **Yunnan**, even though they represent a propitious scenario for yak wool initiatives because of the elevated number of yak, have a more complex social landscape than Qinghai or Gansu. Among the local-level initiatives that have been implemented is the Dancing Yak, which uses coarse yak hair combined with felt and other materials to make original bags and other designs. A further initiative, called the Rocking Yak, takes place in the highlands of Yunnan, where yak and yak hybrids share the pasturelands. This project specializes in producing yarn from yak wool and in the minor production of small garments. In some parts of northern Sichuan, especially Ruoergai and Hongyuan, the grasslands have an almost untapped potential for future projects on yak wool development. These areas have some of the largest concentrations of yak in the world, products would easily be transportable by road or by plane and, in addition, yak cooperatives are already working there on yak milk production. These networks of people and services could also be used for yak wool collection.
- **Qinghai** and **Gansu** are, from a political point of view, more stable provinces than TAR and Sichuan, therefore providing a favourable framework for establishing yak industries. Moreover, new local airports have been inaugurated and the road network is improving very fast. However, the livestock development of Qinghai has decreased because of a severe desertification process caused by overgrazing, thus leading to the establishment of an extensive protected area, the Three-River Source National Nature Reserve.
- In **Xinjiang**, there are no relevant initiatives on yak wool development. The yak was introduced here from Tibet in the early 1920s, after a long selective breeding process carried out by local Mongolian herdsmen. In this province, mature male yak currently provide up to 3 kg of wool annually (Abudula et al., 2000).

Initiatives, projects and institutions by geographic area

Himalaya-Karakoram area

- Development of Yak at High Altitude Areas of Pakistan (Livestock and Dairy Development Board regional office, Gilgit-Baltistan).
- Dungkharpa Welfare Association (Dirang, India).
- HIMALI Programme (Nepalese Government).
- Himalica (European Union, International Centre for Integrated Mountain Development [ICIMOD], and the Aga Khan Rural Support Programme, 2012-2018).
- Hindukush Yaks Association Chitral (2018).
- KAL, German initiative on yak, sheep and cashmere wool.
- "Income Generation in the Western Himalayas" (The Ladakh Ecological Development Group).
- NRCY, Dirang.
- PANOS Oral Testimony (Shimshal, 2010).
- Project Laksal – "Looms of Ladakh".
- Project on jute–yak wool mixed fibre (ICAR-NIRJAFT).
- "Save the Yak" Expedition (Mahindra, Himalayan explorers).
- World Yak Herders Association (WYHA) (YURTA, FAO).
- Yak Herders Association of Nubra Valley (2018).

Central Asia

- Agency for Technical Cooperation and Development-META: Yak House (Murghab).
- Aga Khan Foundation (AKF) project for Tourism Promotion (2010).
- WYHA (YURTA, FAO).
- Zhengi Baba yak milk project (FAO).

Inner Asia

- WYHA (YURTA, FAO).
- Institutions: AVSF, SDC (Green Gold project), Mongolian Yak Society, Mercy Corps.
- Specialized companies: Tengri, Jinst Murun, Uujin, Bodio, Goyo, Sarlag, Ula + Lia.
- Mongolian Wool and Cashmere Association.
- Mongolia Pasture Users Groups Association.
- Cooperative Ar Arvijin Delgerekh (CAAD).
- Cooperatives Erkhel Khurd and Altain Uulsiin Orgil.
- MoPA Association.

China

- Norlha (Ritoma, Gansu).
- Shokay (Shangai).
- Qing Hai Xue Zhou San Rong Group (Xining, Qinghai).
- Yak Norbu (Chushur, TAR).
- Rocking Yak (Shangri-La, Yunnan).
- Dancing Yak (Chengdu, Sichuan).
- Yak museum (Lhasa, TAR).

PROVIDING ENABLING FRAMEWORKS

CHAPTER 3

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Investing in mountain regions: why and how

Living in mountainous regions has never been simple. Inaccessibility, fragility, marginality, diversity, biological niches and human adaptation mechanisms characterize these areas (Jodha, 1995). However, the mountain ecosystem is of paramount importance, as it covers a non-negligible 25 per cent of the world's land surface and supports 12 per cent of the world's population and provides benefits to at least 50 per cent (Mountain Partnership, 2014; R. Chand and Leimbruger, 2016). These benefits were recognized by Agenda 21 during the Earth Summit in 1992, where Chapter 13 of the Agenda affirmed that "there is widespread poverty among mountain inhabitants and loss of indigenous knowledge. Hence, the proper management of mountain resources and socio-economic development of the people deserves immediate action". The 2012 Rio Declaration, referring to mountain areas, also confirmed that "continued effort will be required to address poverty, food security and nutrition, social exclusion and environmental degradation in these areas" (United Nations, 2012).

In the nineteenth century, Swiss politicians realized that investments in mountain areas were necessary to ensure the country's overall development and social cohesion (FAO, 2011). Indeed, today, the European Alps are one of the few mountain areas that are highly developed and embedded in one of the most developed economies in the world.

Together with the Arctic, High Asia is described as "the most environmentally strategic area in the world" (Sinha, 2017); even though the Himalayas are among the most deprived areas in social terms, they are also one of the most productive in terms of biocultural diversity.

Detecting imbalances in the development of mountain areas is of crucial importance and, for this reason, the United Nations Development Programme (UNDP) has proposed two major indicators to measure human development: the Human Development Index and the Human Poverty Index. By applying these indexes in High Asia, imbalances are found at the supra-regional, national and intra-national levels. The Gender Development Index offers additional information on women's involvement, life expectancy and education (Kreutzmann, 2001). Kreutzmann (2001), who for more than 25 years conducted research on issues of resource use and the development of mountain regions, has suggested that three additional strategies should be added to the previously cited indexes, at least in High Asia, namely, "(i) territorial appropriation, settlement strategies, and population change; (entrepreneurship and livelihood strategies, (iii) resource management and energy supply". Working with yak-herding communities and improving their livelihood is a crucial step in rebalancing the unevenness in High Asia, providing economic, environmental and sociocultural benefits and contributing to political stabilization.

As discussed in this report, social, political and historical circumstances have favoured the development of some pastoral areas at the expense of others; this is why, today, some prosperous communities of highlanders may be located close to seriously deprived communities.

This study aims to highlight the importance for policymakers of correcting the unevenness inherited from the past before implementing new policies. From the opposite side, pastoralists and agropastoralists need to be organized at their own local level and at the level of regional associations in order to be able to influence the international arena while expressing their needs to governments and institutions.

Institutional framework for the marketing of animal fibres

Sheep wool has been, by far, the most prominent animal fibre industry in history (Dellal et al., 2013). Already in medieval Europe, sheep wool was a competitive market for the leading emerging economies, namely, England, Flanders, Italy and Spain. The Castilian Mesta was the first association of wool producers at the national level, which was followed by the Clothworkers' Company, established in England in 1532. The colonial and economic expansion of European states in the seventeenth and eighteenth centuries provided transnational supply routes for wool, mohair, alpaca, silk and cashmere. The first attempt to coordinate information and marketing for wool-producing nations was the foundation of the International Wool Secretariat in 1937. Unfortunately, the initiative caused discontent with marketing and trademarks and it was therefore abandoned (McGregor, 2012); similar reasons led to the dissolution of the International Mohair Association (Hunter, 2012). Currently, the International Wool Textile Organisation (IWTO) and the International Alpaca Association are the only two international bodies concerned with the standardization of testing, trading and labelling for wool and other animal fibres so that producers, selling agents and traders use the same terminology and definitions. The IWTO members include "wool growers, traders, primary processors, spinners, weavers, garment makers and retailers of wool and allied fibres, as well as organizations related to wool products" (Roche, 1995). The Cashmere and Camel Hair Manufacturers Institute must also be mentioned, as it also deals with labelling and content verification for cashmere textiles and promotes inspiring initiatives such as the Australian Superfine Wool Growers Association and the South African Mohair Growers' Association.

FAO organized an Intergovernmental Group on Jute, Kenaf and Allied Fibres (Rome, 2004), declaring 2009 the International Year of Natural Fibres, to raise the profile of natural fibres (plant- and animal-derived fibres), thereby strengthening demand, promoting efficient and sustainable industries and contributing to the improved welfare of fibre-producing farmers. The 2009 International Year of Natural Fibres, together with the 2012 declaration, "The Future We Want" (UNCSD, 2012), set up a global and formal framework for economic advancement in mountain areas with regard to animal fibre-derived industries. It implicitly recognizes the right of the indigenous producers to own co-managed enterprises, and advises governments and cooperation agencies on adopting solutions aiming at increasing their financial returns.

The role of FAO

FAO has been addressing yak-related issues since the end of the twentieth century. Through the mediation of its Pastoralism Knowledge Hub, FAO set up an umbrella organization named the World Yak Herders Association to represent the yak herders of High Asia. Through multilevel dialogue (institutional, informal and representational), the project has been able to determine the global and regional limitations on adequate and sustainable development among indigenous communities living at high altitude and depending on the yak for their livelihoods. Indeed, during the community dialogues promoted by FAO to set up the WYHA, one of the main topics discussed by herders concerned access to a variety of services and opportunities, such as markets, education, health, training and technology.

Consequently, the promotion of yak products was one of the major issues discussed; agropastoral communities requested the development of the yak wool sector and assistance to overcome their main limitations, namely, lack of financial support, training, information and machinery. The participating herders agreed that the establishment of the WYHA was the right solution for overcoming these limitations and strengthening rural voices from

High Asia in their demand for more investment and attention from institutions. After the initial phase (December 2017), the WYHA project was integrated as part of the preparatory activities of the Sixth International Conference on Yak held in Xining (August 2018), an event firmly devoted to the yak industry. The union of all of the yak-herding communities on a common platform was seen as a way to facilitate knowledge and technology exchange and promote dialogue with investors and governments, as well as a means to enhance market access for the different yak products with redefinition of the value chain. Inspired by the success of the Association of World Reindeer Herders, the WYHA project still needs to be consolidated. It requires continued efforts from all of the stakeholders involved, both in the previous phases of its development and in its facilitation, namely, FAO, AKF, ICIMOD, regional and local governments and organizations of pasture users, etc. In Xining, the Mongolian National Federation of Pasture User Groups (MNFPUG) expressed the wish to host the headquarters of WYHA in Mongolia, keeping regional delegations in Central Asia, China and the Hindu Kush Himalayan region. The WYHA label should be used as a symbol of the environmental quality of the products, while also reminding people about the shared cultural identity. Further development of the yak wool industry is possible and may be achieved through decisive indigenous participation in project management or in the value chain.

The role of IFAD

IFAD already works with rural communities living at high altitude. During 2006-2016, IFAD worked in the Bolivian Altiplano through the Proyecto VALE project, which was targeted at increasing the income of 9,000 people from camelid farming through the implementation of better management practices and the creation of value-added products from meat, fibre and hides (IFAD Supervision Mission Report, 2013).

IFAD has also worked in the Central Asia-adjacent mid-mountain areas, where pastoralism is a crucial means of livelihood. Indeed, in Kyrgyzstan, the Livestock and Market Development Programmes I and II (between 2013 and 2018) and the Access to Market project (to be completed by 2022) have been implemented and are respectively designed to enhance "community-based pasture management, livestock health, production services, and market and value-chain initiatives" (IFAD, 2013) and to develop "capacity for sustainable, efficient livestock production, processing and marketing enhanced" (IFAD, 2018a). In Tajikistan, two IFAD grants have successfully supported the development of women-led cashgora yarn-spinning businesses and export-oriented value chains to ultimately generate higher incomes for producers and women processors. The programme was first implemented in partnership with the International Center for Agricultural Research in the Dry Areas (2009-2013) in Iran, Kyrgyzstan and Tajikistan and, successively, a second phase was carried out in collaboration with AKF (2013-2017) in Afghanistan, Kyrgyzstan and Tajikistan (IFAD, 2018b).

Animal welfare

The institutional framework should also include guidelines and policies for the protection of animal welfare and health, thus going a step further than the mere analysis of the market and related cost-effectiveness. Although the most respected brands using luxury animal fibres recognize the need to guarantee animal rights, general legislation on registered labels for the rights of animals used for industrial purposes is still missing. A group of animal welfare organizations has proposed the Universal Declaration on Animal Welfare (UDAW) as "an inter-governmental agreement to recognise that animals are sentient, to prevent cruelty and reduce suffering, and to promote standards on our welfare". The UDAW provides a non-binding set of principles that acknowledge the importance of the sentience of animals

and human responsibilities towards them. In a foreseeable future global framework of increasing animal protection, yak wool, animal-friendly industries could have a leading role, especially if they ensure that indigenous communities have greater control over the commercial chain. Indeed, yak are usually well treated in those places where they are kept by their indigenous keepers; for instance, in the Sagarmatha National Park, where yak are used for transporting purposes, there are stipulated weights and working hours that cannot be exceeded.

Why invest in the yak wool economy?

In Asia, even though reindeer, Bactrian camels and yak provide their services and products under adverse conditions, they receive little attention and investment from policymakers, donors, researchers, etc., compared with the "big five": pigs, cattle, sheep, goats and chickens (LPP, Life Network, IUCN–WISP, FAO, 2010).

The production of natural fibres (both animal- and plant-derived) is expected to reach up to 40 million tons per year by the middle of the twenty-first century, with an increase in cotton production of up to 26-30 million tons per year (Kozlowksi and Mackiewicz-Talarczyk, 2012). Meanwhile, the sheep wool production industry has declined because of the low profitability in major producing countries such as Australia, where there are more economical alternative enterprises for farmers. Similarly, mohair production has declined substantially since the 1970s in the major producing countries of South Africa, Turkey and the United States (Hunter, 2012). In some countries the processing sector has been unable to maintain its processing capacity and finance the purchase of raw material from farmers (FAO, EBRD, 2006). Considering all of this, it is clear that there is an opportunity for alternative animal fibres to be utilized more.

For its part, yak production is truly profitable because of the low costs in terms of both money invested and time devoted and because of the high prices obtained for its three primary yields: meat, milk and wool; production could be even more profitable if the high quality and high ecological added value of the products are included. There are more than 3 million hectares of high-altitude open pasturelands under severe conditions that would be ideal for yak and the expansion of yak husbandry in marginal areas (Carralero, 2017).

A challenge is represented by the lack of interest of younger generations in working in rural areas; they prefer tourism-related jobs. However, yak husbandry can play a crucial role in reducing the risks that households face when relying on only one income source. Pastoralists rarely rely on a single product or activity, such as herding, in order to minimize the risks inherent in their hazardous environments. By combining different uses of their animals with compatible economic strategies, pastoralists obtain more benefits from alternative uses of resources in marginal areas where farming is less suitable (Dong et al., 2016). Further activities usually include hunting and military services (Central Asia, Tibet and Mongolia), mountain tourism (Ladakh, Nepal and Pakistan) and harvesting of caterpillar fungus and medicinal plants (Bhutan, Tibet).

After the earthquake in Nepal in April 2015, villagers realized that yak and yak hybrid farming had to be a central pillar in the valley's economy in order to reduce the heavy dependency on mountain tourism. Yak husbandry, together with agriculture and tourism, provides young people with the economic means to stay and make a living in the high-mountain ecosystem. However, in order to convince new generations to stay, integrated programmes at the regional level need to be developed. Broad institutional coverage is therefore required, which should result from collaboration among United Nations

agencies (UNDP, United Nations Environmental Programme, IFAD, FAO, United Nations Educational, Scientific and Cultural Organization and UNIDO), interregional organizations (AKF, ICIMOD, the South Asian Association for Regional Cooperation (SAARC), NGOs and national governments involved. The integrated programmes on yak husbandry should promote the sustainable and full utilization of yak-derived services, as well as the improvement of animal welfare levels, as part of their total output.

Inspirational pro/con examples of animal fibre production

The natural fibre market is dominated by cotton and sheep wool. With more than 1 million tons produced per year, sheep wool is the most important animal-based natural fibre, representing 95 per cent of all animal fibre, with alpaca hair, angora rabbit hair, camel hair, cashmere, guanaco hair, llama hair, mohair, vicuña hair and yak hair making up the remaining 5 per cent (Textile Exchange, 2018). Nevertheless, other added value and the quality of products are becoming more and more important, thus affecting both prices and demand, as shown in the following examples.

BOX 12 **Inspirational initiatives on animal fibre development**

Current trends and innovations in sheep wool production (1): Europe

The European Parliament established the label "Mountain Product" in 2012 to make producers in less favoured areas more competitive (Battaglini et al., 2015). Related initiatives, such as the Responsible Wool Standard (RWS), rapidly expanded: "RWS qualifications increased from 7 in 2016 to 235 in 2017" (Textile Exchange, 2018). Through RWS qualification, not only are animal welfare and best environmental practices put in place in producing the products, but also organic wool is produced only from sheep fed with a pasture-only diet.

The Ortovox experience, in partnership with Swisswool, deserves to be mentioned. "Founded in 1980 in Munich, Ortovox has stood for a sophisticated protection and comfort system for the mountains, characterized by the responsible treatment of people and nature, as pioneers in the avalanche safety field. After more than two years of talks with wool farmers, suppliers and producers, in 2017 Ortovox initiated the Ortovox Wool Promise (OWP), based upon the Responsible Wool Standard (RWS)" (Ortovox, 2018).

Current trends and innovations in sheep wool supply chain (2): New Zealand

The Merino breed originated in Spain around the twelfth century and was then exported to Australia in 1797 and later from Australia to New Zealand. In Australia, a breed improvement process led to the modern Merino, which now produces the finest and softest type of wool.

Founded in 1995, a company named Icebreaker developed a supply chain in order to produce high-value underwear, mid-layers, outerwear, socks and accessories using sheep wool. Currently, Icebreaker supplies more than 2,500 stores in 45 countries, with global sales of around NZ 225 million (2018). Icebreaker Merino fabric is certified to Oeko-Tex Standard 100 class 1[1] and its factories meet ISO 14001 environmental standards. In addition, Icebreaker pioneered long-term contracts that pay a significant price premium to selected New Zealand sheep farmers, mostly from the alpine region. In return, contracted growers agree to meet Icebreaker's strict conditions on socioenvironmental issues and animal welfare.

Camelid fibre supply chain in the Andean region of South America (1): alpaca fibre

Peru accounts for 87 per cent of the total alpaca population. According to the Consejo Nacional de Camélidos Sudamericanos, within the Peruvian alpaca wool value chain there are the following actors: alpaca keepers, trading intermediaries, the processing industry, artisans, the government and NGOs. In total, 90 per cent of producers are considered small producers organized in rural communities or cooperatives, who own 10-150 alpaca each (Schmid, 2006).

Crafters are mainly women who carry out one or several processes, from producing yarn to knitting clothes. The raw material collected from the *alpaqueros* is stored in provincial capitals to be transported later to Arequipa, where three big enterprises carry out the fibre processing, namely, Michell, Prosur and Grupo Inca. These companies operate internationally and process 80-90 per cent of the alpaca fibres produced in Peru, as well as 70-75 per cent of the alpaca fibres produced in the world (Schmid, 2006).

1. For further information see www.oeko-tex.com/en/our-standards/standard-100-by-oeko-tex

Camelid fibre initiatives in the Andean region of South America (2): vicuña fibre

The vicuña is one of the world's most prized sources of animal fibre because of the scarcity of the fibre and its very fine fibre diameter of about 13 µm. Paradoxically, vicuña fibre is harvested by extremely vulnerable and low-income communities. In Peru, until 2004 there was one trading channel, through the National Vicuña Society, which secured verification that the fibre was from non-poached animals. However, in 2004 the National Vicuña Society disintegrated and, at present, communities can negotiate individually with intermediaries or textile companies. Vicuña fibre, like yak fibre, lacks a formal market; indeed, in the past 10 years, prices paid for raw fibre have ranged from US$250 per kilogram to US$940 per kilogram. The highest prices have been obtained not by local communities negotiating by themselves, but rather by governmental agencies (e.g. the National Agricultural Technology Institute in Argentina after 2004) or by local cooperatives strongly supported by governments (e.g. Chile). Vicuña fibre needs to be dehaired and the final yield is about 65 per cent of the raw fibre. Various trademarks have been developed for vicuña (McGregor, 2012). "Most of the fibre from Peru is sold to the International Vicuña Consortium (IVC), a holding company led by the Italian firm Loro Piana (2008). The revenues obtained from the transformation of raw material in Italy are very high. Assuming the market prices paid to rural communities in 2007 (i.e. USD380/kg), the cost in raw material for a vicuña scarf that is sold for USD$1975 [sic] is, at most, USD$95. Accordingly, producers get < 4.8% of the price paid for the final product" (Lichtenstein, 2010).

The qiviut fibre industry from musk ox in North America

Qiviut is the inner wool of the coat of the musk ox, which grows beneath the longer outer coarse hair. The musk ox sheds this layer of wool each spring and qiviut is plucked from the coat during this moult, in a similar manner to how yak wool and camel fibre are harvested. Qiviut fibre length is about 3.5-7 cm, with a mean fibre diameter from 15 to 18 µm. Qiviut has a softness similar to that of cashmere (McGregor, 2014). An adult musk ox can produce between 2 and 3 kg of fibre each year. Through a craft mill system, the qiviut is processed using the following stages: (1) scouring, (2) picking, (3) dehairing, (4) carding, (5) drawing, (6) spinning, (7) plying and (8) steaming. The largest barrier to fibre processing is the cost of the equipment. One knitting cooperative, the Musk Ox Producers' Co-operative, is based in Anchorage, Alaska. It was formed in the late 1960s by indigenous women and is currently still owned by almost 200 native Alaskan people.

The mohair industry in South Africa

South Africa was the first producer of mohair, the highly desired fibre from the Angora goat. Its name derives from Ankara, the region in Turkey where the Angora goat originated. The export of goats from Turkey began after 1838 and henceforth Angora goats began being imported by South Africa and the United States. Currently, 55 per cent of mohair is produced in South Africa, which is now the world's biggest mohair manufacturer, with an average annual production of about 2.23 million kilograms (2018). In 2014, most mohair was exported to China (32 per cent), followed by Italy (31 per cent) and the UK (14 per cent). Other alternative markets are in Japan and India (Directorate Marketing, 2015). The South African Mohair Growers' Association supports and lobbies the Angora goat farmers, whereas Mohair South Africa seeks to advance the mohair industry through international partnerships and alliances to enhance the production and consumption of mohair products. However, as there is still a lot of criticism about animal cruelty related to the mohair industry, especially in South Africa, over 340 top retailers have banned mohair goods (PETA, 2018).

The pashmina-cashmere industry in the Ladakh Changtang of India

Pashmina is drawn from Changra goats found in the Ladakh region of Kashmir state and a part of the Tibetan peninsula, more than 4,000 metres above sea level. The peninsula is often called the "Roof of the World". Kashmiri craftsmen have relied on Changra goats for generations to make the renowned pashmina shawl, which is woven by hand and often embellished with fine embroidery. Currently, because of the limited pastures available, the goats are suffering from inadequate nutrition and, because of the link between starvation, the body reserves of goats and hypothermia (McGregor and Butler, 2008b), an increasing number of goats are dying and Changpa families are being forced to migrate from rural areas to cities and sell their livestock. Any threat to pashmina production is a threat to the livelihoods of about 300,000 people in the Jammu and Kashmir state of India who depend on pashmina directly or indirectly.

Currently, different voices are warning about the adverse consequences of overgrazing in the current climate scenario. This problem is mainly experienced in Mongolia, where grasslands are suffering from land degradation because of overgrazing and climate change. The reliance on cashmere in this country is a market-driven phenomenon that first gained momentum after the collapse of communism in 1991. Indeed, as explained by Pearly Jacob (2012), after being cut off from milk and meat buyers in the former Soviet Union, the herders turned to raising cashmere as one of the only profitable activities available. Without collective farms to manage the animals, individuals began keeping larger flocks, causing the goat population to swell from 5 million in 1990 to almost 20 million by 2009, according to government statistics. Moreover, volatile international cashmere prices have pushed many herders to keep larger flocks as a hedge against falling prices. Changing weather patterns are also prompting herders to keep larger flocks, as affirmed by Robert Schoellhammer, a country director of the Asian Development Bank, so that they can increase their income to cope with risks related to climate change. Finally, the Mongolian Government is massively subsidizing employment in the herding sector to alleviate unemployment problems in urban areas, even though this has a negative impact on the land (USAID, 2005). To cope with this situation, international organizations such as AVSF are promoting sustainable cashmere production instead of limiting the number of cashmere goats. The animals are not the problem; instead, a high level of deregulation combined with climate change and poor management practices are the causes of desertification.

The Paris-based Kering international group, which includes well-known luxury brands such as Gucci, Yves Saint Laurent and Balenciaga, is dependent on cashmere for its products. After publishing its 2016 sustainability report, Kering announced its new programme in alignment with the United Nations Sustainable Development Goals (SDGs). Kering also recognized the need to invest more resources in finding new textiles (Crowley et al., 2016) to avoid the so-called "cashmere catastrophe".

BOX 13 Overgrazing desertification cycle

BOX 14 Differences in animal fibres around the world

Animal fibre	Origin/status	Local use	Later development	Risks	Marketing
Alpaca wool	Andean Altiplano; domesticated	Used since the Inca Empire as a symbol of status	Australia, United States	Monopolized by three firms	Europe, Australia
Cashmere	Himalayas, Tibet; domesticated	Used by herders for the inner fleece of winter coats	Mongolia, Iran	Overgrazing in China	China, Italy and Europe
Mohair	Himalayas, Central Asia; domesticated	Used since 16th century	Turkey, South Africa, Australia, United States	Easily replaced by man-made fibre	Europe, China, Japan
Qiviut	Greenland, Arctic; wild	Musk ox was used only for meat	Alaska, Canada	Spreading of diseases out of the free polar domain	North America
Merino wool	Spain; domesticated	Used since 12th century	Australia, New Zealand	Animal welfare; China processes 80% of the raw wool	Europe, Australia, global
Vicuña wool	Andean region; wild	Reserved in the Inca empire for royalty	Ecuador	Monopoly by the Peru government – Loro Piana	Italy (and then to Europe)
Yak wool	Tibet; semi-domesticated	See Box 10 and Box 11	Mongolia, Central Asia, Himalaya, Karakoram	Excessive fragmentation and intermediation escalation	Europe, Asia, North America

THE CURRENT YAK WOOL MARKET

CHAPTER 4

The origins of yak hair trading

Yak fibre was originally harvested to create household goods, mostly tents; indeed, black tents served as mobile housing for many years. Today, because of new settlement policies and the reluctance of the younger generations to follow the hard life of herding, black tents are disappearing from the uplands (Manderscheid, 2001).

The use of yak hair in textiles has a long tradition in China. The earliest historical records belong to *Erya*, the oldest surviving Chinese dictionary known (compiled around the third century BC), which mentioned a fabric called *Mao Ji*, a textile made of yak hair. Reference can also be found in the "Book of Wei", which narrates that the Tibetan ancestors lived in tents covered with fabrics woven from yak tail hair. From reviewing the literature it is clear that, until recently, the use of yak hair was traditionally restricted to the domestic sphere, with very little commercial value, and mainly for ropes and tents.

The animal fibre market has generated well-known trading routes. The most extensive and famous was the Silk Road, a network of trade routes that connected East and South-East Asia with Persia, the Arabian Peninsula, East Africa and Southern Europe. Trading between the Tibetan Plateau and the Indian subcontinent was very common; at the regional level, the so-called Wool Road connected the plains of Punjab in India to Tibet, Central Asia and China. By the mid-twentieth century, Kalimpong had become one of the most important towns in the region for the exchange of commodities; in particular, it was the main centre for the sorting and processing of Tibetan wool. The wool was brought to Lhasa from Ngari or Changtang by nomads or middlemen, where it would then be baled for transport and loaded onto mule caravans (led almost exclusively by Tibetan or Newar men). The caravans would make the month-long journey in stages to Kalimpong, where the wool would be weighed, sorted and stored in large *godowns* (warehouses) for transport to the port of Calcutta. However, after the Chinese occupied Tibet in 1950, the trade in wool began to slow, with a further decline caused by the 1962 Sino-Indian War. Sino-Indian trade negotiations were renewed in the 1990s and early 2000s after the growth of China and India as major economic powers (Chettri, 2018).

Newar traders in Lhasa (1903).

Yak wool global market and some leading initiatives

Several European firms began considering yak wool as an alternative able to compete with the prevalent luxury fibres. The use of yak wool in the fashion industry began in the mid-twentieth century through Lyle & Scott, a well-known, exclusive Scottish brand initially devoted to golfing knitwear. According to Carolyn Massey, head of design for Lyle & Scott, the yarn obtained from the "high-altitude" alpaca and yak is "natural and incredibly flexible, more than many technical yarns". Brands such as Louis Vuitton, Eileen Fisher and Vince began combining yak wool with merino wool, inaugurating a series of yak wool blending experiments that later also included fibres such as alpaca wool, cashmere, cotton and silk.

In northern Italy, Paola Vanzo, founder of mYak, collaborated with Himalayan yak herders in the design and supply of 100 per cent baby yak wool and introduced the concept of "socially responsible and ethically produced" for accessories and products that respect traditional cultures and are made in collaboration with local communities (Laskhmanan et al., 2016).

Sensitive and pastoralist-inclusive approaches to high-quality yak wool production have recently been put into practice through several projects and initiatives. The following contemporary examples of yak wool business initiatives offer an overview of the possible types of production and value chain systems, as well as the location and operation areas of such initiatives. All are introduced by their main protagonists through website quotes or biographies.

CYAK

"More than ten years ago, Mr Tsultrim, a Tibetan doctor from Yushu, started a social welfare enterprise to provide local farmers, herdsmen and their families with entrepreneurship trainings. In 2012, Tsultrim met Mrs Mangxie, a Chinese self-taught textile artist. In 2014 they established the CYAK Handicraft brand which started serving customers also from outside Qinghai, China. CYAK directly purchases yak wool from herdsmen in Yushu prefecture during spring, which is later treated by skillful women, living around Xining city, to produce garments. By sub-contracting the production to these women, CYAK enables the formation of small businesses to improve the lives of vulnerable women, and by using manual machines it promotes a low carbon emission production."

(Selectively extracted from www.cyak.net)

Catherine Allié

KAL

"Catherine Allié travelled throughout northern India to find home-based weavers who keep following their tradition and using natural fibres. She founded KAL, a community of farmers, spinners, weavers, nomads, designers, knitters and culture lovers who want to create meaningful products with the commitment of using exclusively hand-spun and hand-woven. In Ladakh, a whole community is part of this team: the nomads of Changtang, in the High Himalayas. Some of them are still herders and provide KAL with the requested wool, while others left the nomadic life and settled close to the city of Leh in Ladakh, now hand spinning woollen yarn following the traditional method as well as weaving the typical nomadic carpets."

(Selectively extracted from www.wearekal.com)

Julian Wilson

Khunu

"Since those early days, we've seen a growing acceptance of yak at the premium end of the textile industry, meaning fair prices for the fibre can be sustained. Each year our network of small, high-quality manufacturing partners in China, Italy and the United Kingdom help us make incremental improvements to products as we learn more about the fibres we're working with. We invest two per cent of our revenues back into the communities we work with, especially to support entrepreneurial Tibetans. Our partnership with iYak, in Qinghai, has created jobs, new skills and helped herders maintaining their traditional ways of life."

(Selectively extracted from www.khunu.com)

Kora

"Michael Kleinwort spent two years refining his vision to create a social company, named Kora, producing the world's best technical base layers, working with the finest yarn spinners and fabric mills to transform the raw yak wool into Hima-Layer™ Original 230. The results were even better than expected, not only because it was incredibly soft, light and odour-resistant, but lab tests have shown the fabric to be even warmer and more breathable than merino wool. Kora officially launched its first products in 2013 and since then new fabrics and garments suitable for the outdoor adventures have been created. Our mission is still the same: 'Use the science of nature to support athletic performance in extreme environments; bring positive change to the communities that provide our wool; make the highest performance products on fair trade principles – and never compromise on quality and integrity'."

(Selectively extracted from www.kora.net)

Rocking Yak

"Every two weeks, we fill my truck with 25 to 30 bags of cleaned and carded yak down fibre to be delivered to the Tibetan women living in rural villages. The spinning is carried out in their homes during the winter months using a drop spindle, which creates a yarn that is unique in its inconsistent 'thick and thin' pattern, something that is characteristic of hand-spun yarns. This project allows them to stay with their families and live their traditional Tibetan lifestyle without moving to bigger towns for work. When the spinning is done, the yarn is collected, checked, washed, and rolled into balls by hand."

(Selectively extracted from www.rockingyak.com)

United Yak Brands of Mongolia

Mongolia represents the most integrated case in the development of the yak wool industry at the national–regional level and with an international projection. As the country with the second-largest yak population, Mongolia not only provides the domestic market with sufficient yak wool, but also exports products to Western European and Russian Federation markets through privately owned initiatives such as Tengri or MCashmere, or directly from yak-herding cooperatives supported by international agencies.

The two main international actors promoting the yak wool industry in Mongolia are AVSF and SDC, the latter mostly through the Green Gold project. The success of the yak wool industry in Mongolia is the result of the cooperative spirit among the three key sectors – producers, intermediaries and facilitators – and urban-based companies. As a result of this inter-cooperative impulse, yak wool-processing factories in Mongolia agreed to establish a joint label: the United Yak Brands of Mongolia.

Muji

Muji was the first retail business in Asia approved as a Business Call to Action initiative. Muji is known for providing simple, innovative and elegant products, which comes from the Japanese notion of *Kanso* that brings a sense of calm into everyday life, as well as its minimalist design, its emphasis on recycling, its avoidance of waste and its "no logo" or "no brand" policy. In 2012, Muji announced the development of a plant in Cambodia to promote eco-friendly dyeing. In 2017, Muji presented the ReMuji and Yak collections, inspired by its concern for the environment. The latter, launched in autumn/winter 2017, was presented as a line of basic clothing items for women and men using yak wool blended with sheep wool and nylon in different proportions, in a palette of natural colours.

Other initiatives

In China:

"Qing Hai Xue Zhou San Rong Group was established in 1989. The group has become one of the biggest textile enterprises in Qinghai Province, as well as in China, and the biggest production base for yak wool dehairing, yak wool garment design, and yak wool technology development. It has also become a diversified management group involved in materials purchasing, woollen and worsted production, and domestic and overseas sales." (Extracted from www. xuezhousanrong.en.ecplaza.net.)

"Reywa Fibres is a small family-run business with roots that run deep in the Tibetan Plateau of China. Reywa Fibres 100% Tibetan yak down yarns are made from fibre hand-harvested by Tibetan nomads. Reywa Fibres Bloom is a blend of ultra-soft Tibetan yak down and the finest Chinese silk."
(Extracted from www.reywafibres.com.)

In the Russian Federation:

"The company MCashmere is the only Russian producer of yarn from yak hair, camel hair and cashmere. MCashmere produces its own yarn under the brand Sarlag, a high-quality natural yarn carefully selected by our specialists in Mongolia. Our yarn is not subjected to any chemical treatment, so it is ideal for children's clothes and for people with allergies. It is a luxury product for true lovers of knitwear, produced using only the best equipment and advanced technologies. As yak hair cannot be coloured without losing its quality, Sarlag yarn is represented only in natural colours."
(Extracted from www.sarlag.ru.)

BOX 15 **United Yak Brands of Mongolia and the Yak Festival**

United Yak Brands of Mongolia (UYBM) aims to enhance the reputation of Mongolian yak wool products in the international market and to collaborate with herders and their cooperatives in order to increase revenues by improving quality and yield. UYBM also wants to create an encompassing value chain with traceability from the area of origin to the final exquisite product and to promote cooperation with international buyers interested in yak wool. Seven companies have joined the UYBM initiative, namely Altai Cashmere, Bodio, Jinst Murun (JM), Mongol Textile, Sor Cashmere, Snowfields and Uujin.

The The JM Company, based in Murun, collaborates with yak herders from Khovd, Arkhangai and Bayankhongor aimag to purchase extra amounts of raw yak fibre and make 100 per cent natural JM brand yak wool garments for national and international markets. In addition, it has organized the Mongol Yak Festival for the last three years. The festival's main aim was to raise awareness among herder families on the importance of improving the quality of primary raw materials and facilitating better collaboration between yak herders, cooperatives and domestic processing companies for sustainable value-chain development.

Current status of the yak wool value chain: the value of the links

Raw material marketing and prices

Unlike for sheep wool in the larger producing countries, there are no regulatory institutions or frameworks to ensure consistent prices for yak wool. Consequently, prices fluctuate widely, not only from place to place but also, and at the same time, depending on the different wool quality, type and use. Ultimately, yak wool prices are negotiated directly between producers and companies or by intermediaries.

Verifying the authenticity of the products is a crucial step in selling them in international markets. Local verification is required and there are many schemes around the world that provide brands, logos or trademarks to satisfy consumer or retailer sentiments. For the many examples provided later in this report, it is the reputation of the processor and their management of the supply chain that provides the authenticity for the products. It is hoped that, in the future, the community of yak wool producers are able to coordinate within a common interest organization, such as WYHA, which could issue a unified "label" or certificate of quality.

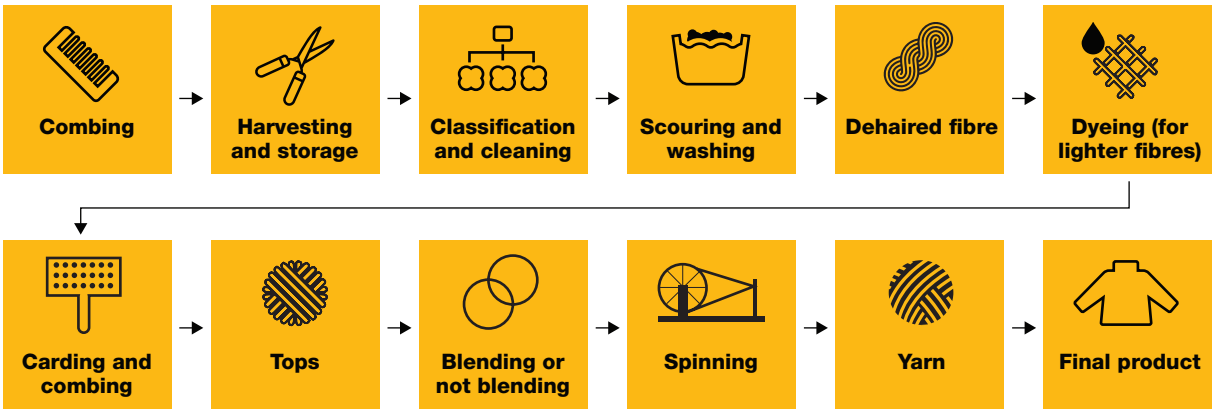
Raw fibre processing

For centuries, yak fibre has been traditionally spun by hand, mostly by women, through the use of drop spindles, resulting in yarn with a higher lanolin composition than yarns produced by commercial processors.

However, the general pattern of the development of the yak wool industry does not follow a community-based artisanal model. In the Chinese province of Qinghai, yak are carefully combed each spring and the collected fibre is then stored and sent to the collection centres, where it is sold and later transformed into spun-fibre material. At the collection centres, once classified by colour, the fibre is beaten (willowed) to remove loose dirt and soil content before being washed (scouring). The next phase is called dehairing, which consists of physically separating, using special machines, the coarse hairs forming the outer coat of the animal from the finer softer yak wool. The machine-processed dehaired wool is then ready to be used in the manufacturing industry, treated under categories such as "baby yak down", "premium yak down", "soft down" or just "down".

Once the yak fibre has been further processed, it can be offered as yak wool tops, or can be spun using different types of machinery to produce a variety of yarns.

BOX 16 **The yak wool industrial processing value chain**



Depending on whether an artisanal or an industrialized type of production is used, the product will have different practical and aesthetic characteristics. The industry model used will alter the eco-social impact. The incorporation of mechanization does not necessarily result in an urban-based modern factory scheme; rural families can own manually operated machines as part of a community-based high-quality firm.

Blending experiences

Blending fibres during textile production is a common practice, with many potential benefits. Blending can reduce the cost of the final product while exploiting the positive market perceptions associated with a luxury fibre content. Blending longer fibres with shorter fibres can make the blend easier to process than processing only shorter fibres. Some blends improve the knittability of the fibres as the quality of the yarn is improved and the yarn is stronger. Blending can improve the yarn's evenness, providing improved aesthetic qualities, such as look, touch and appeal, and improved wearing qualities of the final textile product.

Yak and other animal fibre blends

In analysing yak wool-blending opportunities, priority should be given to those that can be produced in the geographic contexts where yak are found or adjacent ones. The usual blend is made of yak wool with sheep wool or cashmere, the two main animal fibres produced in High Asia. Sheep wool is generally easier to process than rare animal fibres such as yak wool and cashmere, as sheep wool has higher fibre friction properties. Thus, using some sheep wool in blends with yak wool has the potential to make the processing easier and cheaper and to provide high-quality outcomes.

The Bactrian camel is a formidable animal that is native to the steppes of Central Asia, mainly located in Mongolia. It has excellent adaptability as it can endure the harsh conditions in the Greater Central Asia region, both in the arid deserts and in the alpine tundra. Yak and Bactrian camels both grow beautiful soft fibre. As soft wool is the most appreciated and versatile fibre, a blend of soft yak wool and soft camel wool can satisfy domestic demand, as well as that of the international fashion world.

Yak wool has also been blended with other animal fibres, such as alpaca wool. Blended yarn of alpaca, yak and merino wool is promoted by the Lion Brand Yarn Company: "three luxury fibers are expertly blended into one perfect yarn. The merino adds softness and bounce, the alpaca adds luster and drape and the 15% yak adds warmth and a bit of mystery to this luxury yarn" (Lion Brand Yarn Company). The Italian designer Sara Lanzi produces a collection of sweaters made of alpaca wool and yak wool at 50/50 per cent (US$700 each), while Harris Wharf in London sells coats made of alpaca, yak and sheep wool, with a 33 per cent blend of each fibre (US$1,800 each). Other animal fibres blended with yak wool, whether in yarns or clothing, include bison fibre, mohair and qiviut.

Finally, silk seems to be very well adapted to produce beautiful yarns with yak wool and with yak/merino wool blends. The prestigious firm Eileen Fisher has designed exclusive garments made of yak wool and silk.

All of these blending examples clearly illustrate the bright future that yak wool may have in the fashion industry.

Yak and plant fibre blends

Plant fibres are often used in textile blends because of their renewability and wide availability (Peças et al., 2018). Cotton is by far the largest fibre crop globally, with almost 25 million tons of cotton produced per year, accounting for almost 40 per cent of the total textile fibre market (Van Dam, 2008). All other industrial natural fibres barely reach 6 million tons of

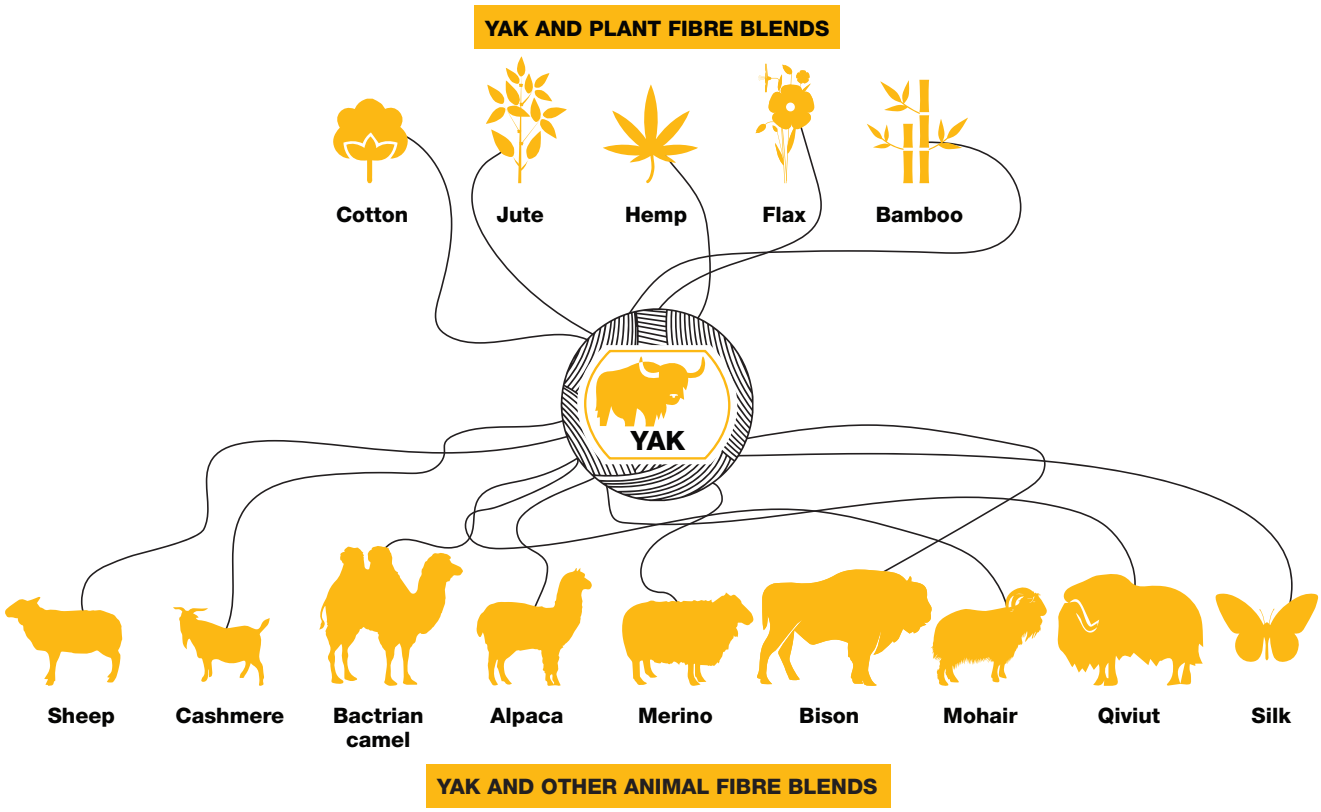
production, thus representing only 2-3 per cent of the textile fibre market. Cotton is cheap but the short fibre length results in some limitations to its application.

Jute is the most important natural fibre after cotton, and almost 85 per cent of the world's jute cultivation is concentrated in the Ganges Delta (Das et al., 2018). The first jute/yak wool blending experiment was jointly carried out by ICAR and NIRJAFT in Arunachal Pradesh. In the preliminary trial, 60 per cent yak wool and 40 per cent jute fibres could be comfortably processed using the jute spinning system. The yarn produced was bulky, with good strength and lustre, and can be used to produce outerwear garments such as jackets (Das et al., 2018).

Highly attractive for the Himalayan herders is the blended material formed from yak and hemp. The latter has been used in clothing for centuries because it grows naturally on the southern slopes of the mountain range. Because it is a long fibre, it can provide benefits over spinning short yak wool. Its abundance offers a promising framework for those wishing to combine soft yak wool with hemp to obtain a variety of original products of different quality and for different uses. The artisanal American-based company Rawganique, which specializes in organic cotton, linen and hemp products, launched the Unisex Hemp Yak Sweater, a sort of Himalayan blend, hand-loomed using a special combination of 55 per cent hemp and 45 per cent yak wool.

Coarse yak hair fibre has also been combined with other plant fibres such as flax, as well as synthetic cellulosic fibres such as bamboo and man-made fibres such as nylon, polyamide, acrylic, Tencel and recycled polyethylene terephthalate.

BOX 17 **Blending options**



Final products: current development and marketing prospects

Competitiveness through uniqueness

Even though soft yak wool and the derived final products are now considered emerging luxury commodities, it is quite difficult to find them in retail outlets, especially cashmere garments. Luxury animal fibres such as yak wool, cashmere, alpaca wool and mohair have a number of attributes that make them appealing to Western consumers. These attributes include their softness compared with other fibres; their rarity – the fibres are uncommon and found in remote countries; their mysterious origins compared with those of more commonly produced fibres; and especially because yak fibre, when managed by pastoral communities, has a very low environmental impact (Watkins and Buxton, 1992).

Upper-middle-class and socioenvironmentally minded consumers look for products made of cashmere, merino, mohair, yak, qiviut (musk ox fibre) and alpaca fibres. Among these, yak wool fibre is the most eco-friendly and diversely used. As mentioned earlier, yak are semi-domesticated animals, not extreme grazers, and their dung provides rural communities with fuel, thus preventing deforestation while enabling soil anchoring. Yak wool is a versatile product that can be blended with animal, plant and synthetic fibres, transmitting to the resulting fabrics its high-quality attributes.

Making of yak wool: a worldwide hallmark in eco-quality

Yak, herders and the high-altitude ecosystem have an intimate mutual relationship that, when translated into business terms, has generated a worldwide hallmark. Yak welfare depends on short daily movements, as well as on seasonal long-distance transhumance; indeed, the best quality of yak wool is found in the Khangai area of Mongolia, where yak live in open ranges, and in some parts of Sichuan, where the ranching–fencing system is not well developed yet. The best-quality yak products will always respect the conservation of the original natural conditions of the areas where yak originated. As recognized by Chinese scholars, the move from traditional to modern practices can create tensions and problems. Undoubtedly, challenges will arise if these practices are not sensitively integrated with the vast accumulated knowledge and experience of the herders (Ping and Xuezhi, 2016).

Specialization, diversification and integral development

To reach a broader market, the yak fibre sector must pursue greater specialization in product design and greater diversification of supply and products. Both of these developments will require an increased focus on fibre and textile quality. Identification of markets and the products desired is crucial, as is the creation of new markets through innovation, design and creativity. For instance, one of the most exciting fields for soft yak fibre, because of its breathability and thermal insulation, is the sportswear market. Although high-performance sportswear is generally associated with synthetic fabrics, there is a growing preference for natural and renewable alternatives.

Strategic alignments for future marketing

The yak market and related demands differ a lot between countries. For instance, yak wool is still an underexploited product in Central Asia and the Himalayas, without proper yak wool markets but rather isolated and small-scale initiatives. On the contrary, in China, the demand for yak wool has increased dramatically in the last two years. According to Qinghai

BOX 18 **Differences in animal fibres around the world**

Fibre	Animal status	World production (tons)	Animal ethics	Use	Processing costs
Vicuña	Wild	22	High	Luxury garments	High
Yak wool	Semi-domesticated	1,000	Very good	Multi-use	High
Camel hair	Semi-domesticated	2,000	Good	Coat industry	High
Mohair	Domesticated	6,550	Some poor	Multi-use	Medium
Alpaca wool	Domesticated	8,000	Good	Clothing	Medium
Angora rabbit wool	Intensive cages	10,000	Very low	Apparel	High
Cashmere	Domesticated	16,000	Good	Apparel	High
Merino wool	Domesticated	500,000	Medium, some low	Multi-use	Low

Xuezhou Sanrong, the largest company supplier of yak wool in China, after January 2017 prices for raw unprocessed yak fibre increased by about 100 per cent within eight months and prices for yak wool rose by more than 70 per cent (Qinghai Xuezhou Sanrong Group, 2019).

In Mongolia, the second-largest producer, there are less speculative and more cohesive relationships between producers and spinners. According to the Green Gold project, 100 tons of raw yak fibre are collected annually; however, through dehairing and scouring, this is reduced to 30 tons of pure yak wool, which is spun into about 25 tons of yarn annually (Weber, 2017).

The High Asia region is composed of a conglomerate of similar rural areas producing all of the yak fibre in the world, as part of an integrated package of concrete climatic-economic inputs/outputs. With such a delicate balance, both excessive fragmentation and concentration would probably deliver unexpected and unwanted consequences. Given the unique correlation between yak and High Asia, the conservation of the original herding system on which the products depend should be considered a priority; the right approach would generate projects with overall regional implantation and relevance. To properly design community-managed projects that have regional impacts and functionality, a strategical split of the High Asia region into sub-areas may be required:

- Central-West Mongolia and the adjacent Russian Federation republics of Tuva, Altai and Buryatia
- Central Asia – the high-altitude areas of Afghanistan, Kyrgyzstan and Tajikistan in the Pamir and Tian Shan mountain ranges
- China, centred on the Tibetan plateau
- The Himalaya-Karakoram area, including northern areas of Bhutan, India, Nepal and Pakistan.

Current status of the yak wool value chain: socio-economic evaluation

Value chain models and what they represent

The apparel industry is an ideal industrial sector "for examining the dynamics of buyer-driven value chains" (Appelbaum and Gereffi, 1994). The apparel value chain is composed of five main parts:

1. Raw material supply (natural fibres, synthetic fibres).
2. Provision of components manufactured by textile companies (yarns, fabrics).
3. Production networks made up of garment factories.
4. Export channels established by trade intermediaries.
5. Marketing networks at the retail level.

According to Gereffi and Memedovic (2003), the international textile industry follows the dynamics of buyer-driven value chains. In it, "profits come from combinations of high-value research, design, sales, marketing and financial services that allow the retailers, designers and marketers to act as strategic brokers in linking overseas factories and traders with product niches in their main consumer markets" (Gereffi and Memedovic, 2003). Today, the trend is to focus on the high value-added design and marketing segments, while in the yak wool value chain, the manufacturing process appears still too fragmented.

As inherited from leading Western countries, the value chain concept is conceived in a longitudinal linear way, with the main goal being to transfer the primary profit to the final product processor/seller. The yak wool production structure and business type are quite similar to those of other imported products considered to be luxury goods. It could also be included in a broader group of goods not considered luxury items, such as coffee or chocolate, but having an exotic origin.

Two craftswomen: ethnic Qiang woman in East Tibet (left); ethnic Aymara women in Bolivia (right)

It is important to understand that, for the typical wool textile supply chain, a lead time of about 18 months is required. The supply chain orders begin with the designers, who place orders with the spinners, who then have to source the raw materials, many of which originate in other countries. It takes time to process the raw materials, spin the yarns, make the fabric and finally construct the garments. There is a considerable time lag in this supply chain and it is not controlled by the raw material suppliers. For example, detailed analyses have been undertaken on the apparel wool supply chain from Australia, and where and to what extent value adding takes place along the supply chain.

The linear value chain model seems to correspond to the classical capitalist model, in which the import of raw materials at a low price ensures final benefits and control over the end-product market. This globally accepted economic model is also causing environmental collapse because of the increasing urban demand and the related need of developing countries to export. Among the positive effects of globalization is greater global environmental awareness; it is now better understood how some eco-regions are vital for keeping the Earth healthy. However, in the present-day scenario, any region is at risk of suffering irreversible damage because of the accelerated

depredation of natural resources, which is especially impacting Africa, Asia and South America. Unlike the previous colonial period, the extractive industries are now located not only in Europe or North America, but also in the countries where raw materials are found. Thus, whereas companies obtain substantial benefits from extracting valuable commodities such as minerals or fine woods, governments undergo fast development.

Because of increasing awareness, alternative economic models are gaining prominence and full acceptance, among which the circular economy model proposed by UNIDO should be mentioned (Geissdoerfer et al., 2018). The circular economy is based on the idea of private businesses supporting the transition towards a more sustainable system (UNIDO, 2010).

A further alternative to the classical value chain model is the ecosystem service value chain analysis (ESVCA), which includes environmental and anthropogenic components acting as driving factors in the generation of marketed and non-marketed goods and services. In this way, "ESVCA can contribute towards the provision of the potential to incentivise private and public investments into the sustainable management of ecosystems" (J.M. Rawlins et al., 2018).

Following this method, investors in the High Asia region should first ensure conservation of the area and then decide what types of actions can be developed there. The better way to ensure proper environmental management while achieving socio-economic viability is to make sure that native communities are managing the major part of the business, as they are the real experts in that realm.

Economic assessment: comparing current value chain models of yak wool

Undoubtedly, both the growing demand for natural products and the preference for more eco-friendly textiles are directly related to consumers' increasing awareness of environmental issues. For its part, the current demand for natural fibres has been translated into more diversified applications, and therefore a larger range of natural fibre products used, and this trend is expected to keep increasing (UPM, 2018). In comparison to synthetic fibres, natural fibres offer superior properties, such as biodegradability and abrasion resistance, facilitating a considerable reduction in the use of plastic-based materials in various regions, such as Europe and North America (CFC, FAO, 2008).

In traditional value chain analysis, the human factor, or in other words the labour force, is a less relevant component than the profit and loss account. In China, the world's largest garment-exporting country, average labour rates are 200-400 per cent higher than in its cheaper Asian competitors, such as Bangladesh, Cambodia, India, Indonesia and Viet Nam. Besides, average Free on Board (shipping) prices for significant export garment products are 40 per cent higher than the average United States import prices. The labour cost remains a negligible part of the garment cost (International Trade Centre UNCTAD/WTO, 2005), thus indicating that salaries and working hours are not determining factors for the final costs and selling prices of luxury products. Instead they depend on productivity translated into originality, quality and added value based on how the processing route was configured. Given that the product "markup" in the retail fashion industry is often 50-100 per cent, a consequence of locating these retail outlets in expensive locations in large cities, the last few steps of the marketing chain capture a large proportion of the total value added.

Yak fibre not only matches the preferences, trends and demands of consumers, but also fits with retailers' desire to exploit the cashmere-like quality of down fibres in international markets (Wiener, 2013). The good news for yak hair producers is that yak fibre is also demanded by specialized sportswear firms, the theatre and cinema industry, the wig and hairpiece industry and, finally, international fashion chains and e-commerce platforms, which sell it at moderate prices in a diverse range of qualities and blends (see Annex I).

The following sections provide a brief review of the value chains of some remarkable initiatives in the yak wool industry, with international projections. The following chapter concludes with the introduction of a practical project that has already been drafted as a separate document, which aims to contribute towards improving the future for the yak and its human companions in one of the less-favoured areas in High Asia: the Himalayas. This project proposal, called "Himalayak", acts as a first advance, and the most important, conclusion of this study. As the methodology used in this report was a combination of applied and engaged anthropology, the conversion of all of the partial findings into a real project is not only a logical outcome but also a commitment.

AVSF-CAAD (Khangai, Mongolia)

In Mongolia, there has been a dramatic expansion in the number of cashmere goats, thus contributing to pasture degradation. As discussed previously, the rise in the number of goats has been a consequence of strong deregulation of the herder sector and of climate change, which has prompted herders to invest in large animal stocks to cope with associated climate risks. Since 2004, AVSF has been working to reduce soil degradation and support yak herders in Mongolia.

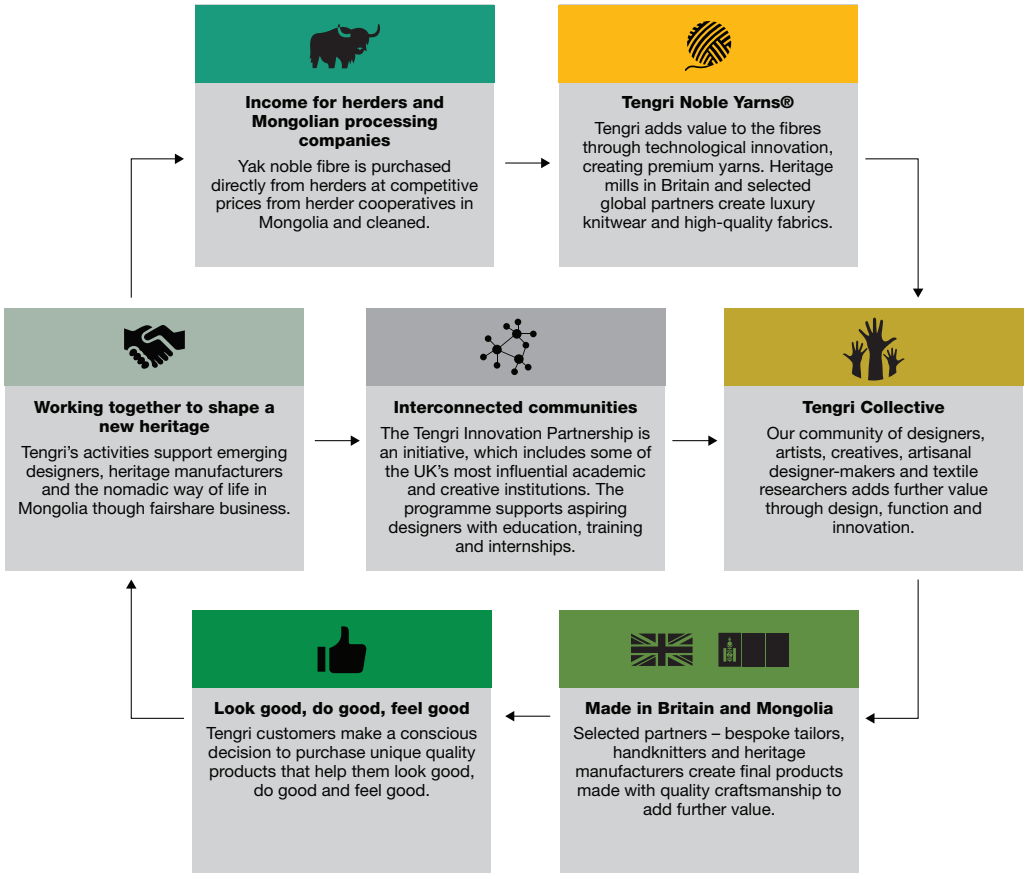
AVSF developed supply chains for the sale of high-quality animal products in national (meat and milk) and international (yak fibre and cashmere) markets. As a result, 120 families of the Monti Khangai cooperative in the Khangai Mountains (created with the assistance of AVSF) began exporting large quantities of yak wool to Europe and North America. AVSF has been assisting farmers in making livestock farms more ecologically sustainable and economically viable in Arkhangai. Mercy Corps Mongolia began providing training on yak wool combing for herders associated in cooperatives, as well as organizing trade fair events in rural areas (Erdenebileg et al., 2008). The cooperative now regularly sells yak wool and hair to Canada, France, Japan and Spain, with white and light-coloured yak hair in higher demand.

Tengri (Khangai, Mongolia, and London, UK)

Tengri's business model combines social and environmental awareness with luxury product development. The founder, Nancy Johnston, was aware that the unsustainability and overgrazing practices associated with cashmere goat farming were leading to desertification and compromising herders' futures. The Tengri business model follows a vertical supply chain that ensures that precious fibres get to the market without the need for middlemen. Through this linear "two-way channel fairshare" supply chain, Tengri provides yak fibre producers with a premium price split into two or three payments per year, to provide them with a stable income. The model also includes bonus payments in profitable years or in case of extreme need.

Winnie Lee, Tengri's designer and art director, helped Johnston define a brand identity inspired by Mongolia's history, cultural heritage and geography. Tengri now works with over 4,500 families and in 2018 produced 20 tons of yak wool per annum, thus significantly increasing the market value of yak fibre (Thomas, 2018).

BOX 19 **Tengri circular value system**

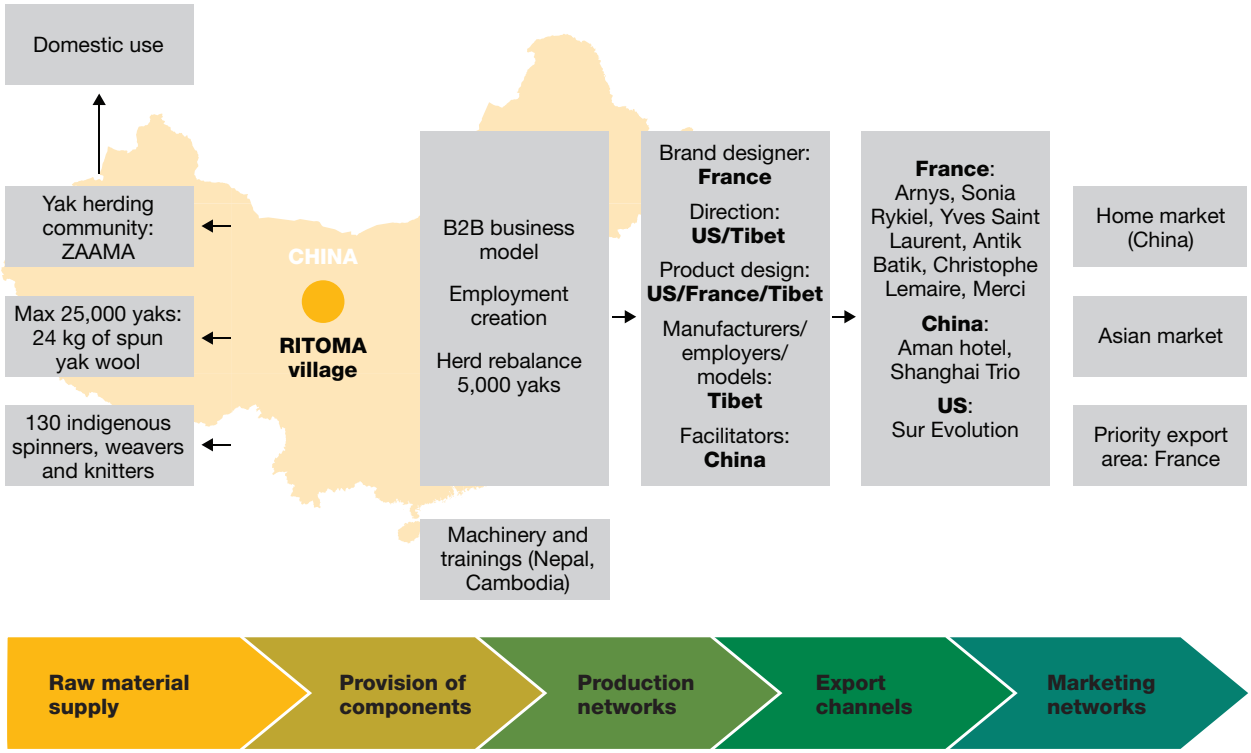


Source: Tengri website (www.tengri.co.uk/sustainability)

Norlha (Gansu, China)

Norlha is probably the only example in China of a community-based and community-managed (although partially) yak wool industry with international relevance. Its origin and development represent a balanced mix of cultures and combined efforts from Westerners and East Asian people (Tibetans, Chinese, Nepalis and Cambodians). The pilot project was launched in 2006 at Zorgey Ritoma, a nomad settlement comprising 230 families, 6,000 yak and 20,000 sheep. With the aim of creating job opportunities for disadvantaged pastoral people in their homeland to preserve their traditions, its founder, Kim Yeshi, a French-American anthropologist, started a workshop in 2007 and then hired and trained local nomads, who soon became skilled artisans. Norlha now employs 130 people, all former nomads or members of nomad families, who have spun, woven and felted for generations. Norlha employees have taken on managerial positions in production, sales and other areas; instead of herding the yak, they transform its fibre into a world-class product, becoming linked to the world beyond in the process. The employees can live and thrive in the village of their origin and their disposable income allows them to invest in better houses and education for their children. The yak is still the source of their livelihood and a vital link between the past and the future (https://www.norlha.com/).

BOX 20 **Norlha operative scheme**



Norlha represents one of the most interesting cases of a community-based yak wool brand, but with some limitations, namely, that production is mostly focused on precious scarves and a low level of community outreach. However, it clearly shows the right pathway that future and more ambitious projects might follow to develop a full supply/production chain managed by indigenous rural people.

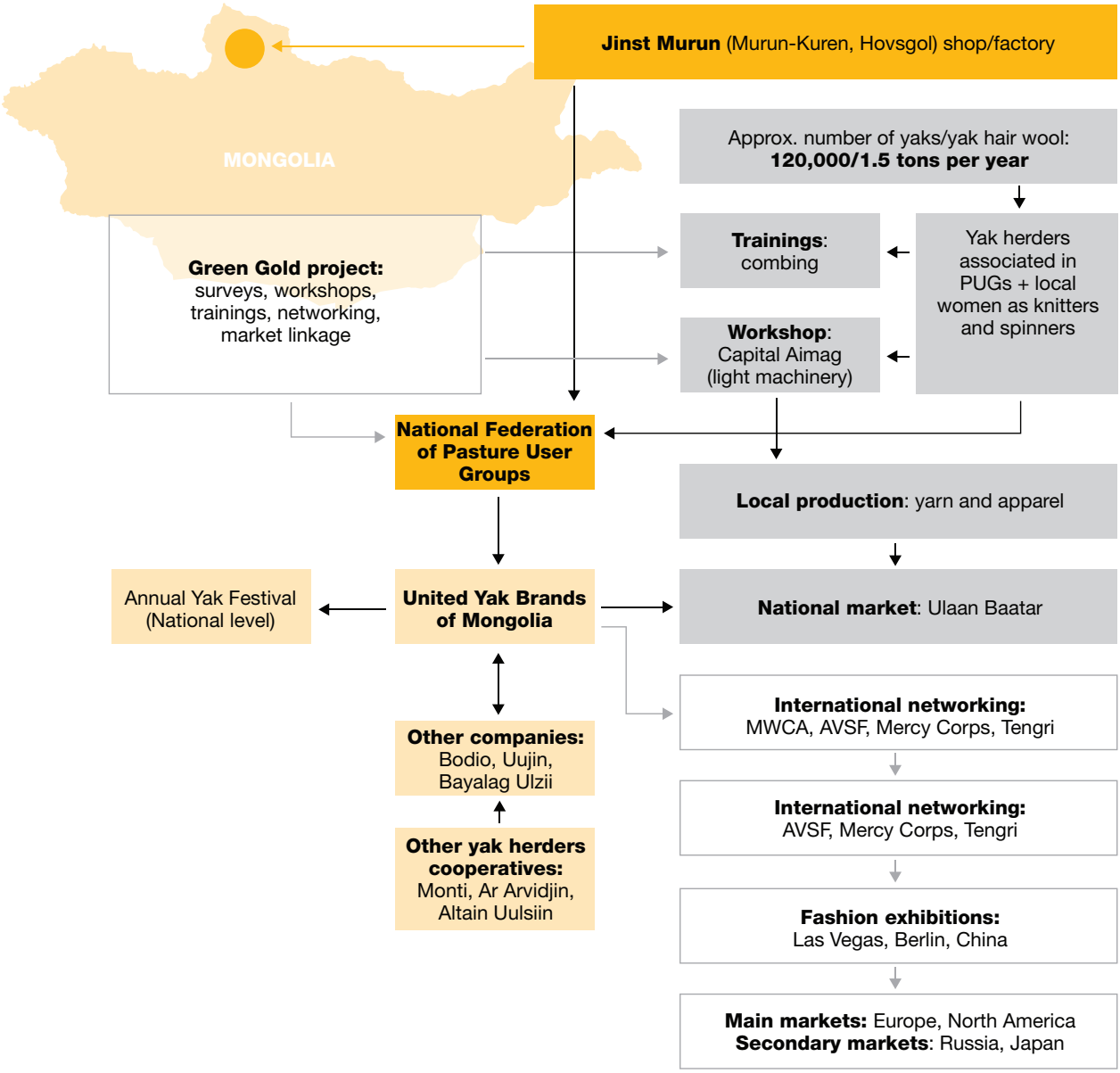
Jinst Murun (Khövsgül, Mongolia)

One of the most active yak wool companies in Mongolia is Jinst Murun. The company is an example of a yak wool business developed in the same area where yak hair is harvested; it is therefore partly managed by local entrepreneurs and villagers. Jinst Murun is integrated into a complex network at both the national and the international level. Based in Mörön, the capital of Khövsgül aimag, the company is strongly connected to SDC through the Green Gold project. Green Gold encourages the production of yak wool because of the growing global market for natural fibres, with the price of yak wool doubling in the last year, reaching almost US$10 per kilogram in Mongolia, as well as for its environmental sustainability.

Because of its privileged situation in a yak-herding area, Jinst Murun works closely with the Khuvsgul Pasture Users Group, part of MNFPUG, the largest pastoral organization in Mongolia, which "seeks to tackle the main threats for the livelihood of herders: insecure income, unsustainable rangeland use, and limited access to knowledge and markets".

Jinst Murun, thanks to its multiple partnerships and network, has reached the European and American markets.

BOX 21 **Key operations and partnerships in the Jinst Murun Company**



Shokay (Qinghai/Shanghai, China) comparative study

Shokay is a well-known and prestigious firm based in Shanghai. It defines itself as a company that has a commitment to corporate social responsibility (CSR) and is dedicated to promoting premium yak fibre, with a strong ethical motivation and an intention to achieve economy of scale. Shokay adopts the CSR business model to define its eco-social commitment (Di Capua, 2014); it strongly focuses its efforts on organizational communication and labour relations. Shokay also puts great effort into taking care of the whole production chain, controlling its diverse segments in order to achieve the best quality. Products and production methods are publicized in seminars and at conferences, focusing on topics such as social development, entrepreneurship and CSR. Through a differentiation strategy, the relationship between stakeholders and the corporate reputation greatly improved, as did the competitive advantage of the firm (Tsai and Wang, 2011).

CONCLUSIONS AND OUTCOMES

CHAPTER 5

Key observations

1. In natural regions, especially in the most fragile ones, before introducing any external industrial activity, its impact on the original productive ecosystems must be duly analysed.
2. The special regional ecosystem of High Asia lacks appropriate regulatory agencies for ensuring balanced development by integrated management systems that prioritize socioenvironmental protection. For example, in the Arctic, there is the Arctic Council, the Arctic Environmental Protection Strategy and the Association of World Reindeer Herders, which provide an adequate framework in this sense, but similar systems are lacking in High Asia.
3. High Asia is one of the most productive regions in the world from an environmental, biocultural and economic point of view, as it supplies different resources to nearly half of the world's population. However, it remains itself a rural area dominated by agropastoral practices, transhumance and barter systems. For about 10,000 years, yak have been supplying native inhabitants with a series of vital products and services in an extreme and hostile environment.
4. For historical reasons, High Asia and its fragile high-altitude environment have not achieved global protection, or the recognition of their crucial environmental role. On the contrary, this area has suffered a succession of traumatic political events derived from the occupation and expansion of different political powers, often antagonistic, external to the native eco-cultural contexts. As a result, marginalization, corruption, border tensions, economic backwardness and cultural colonization have turned the region of High Asia into a submissive territory.
5. China and India are, respectively, the second and the sixth largest economies in the world, but also the two most populated countries, representing 36 per cent of the total world population. Both factors explain the increasing pressure on the natural resources and land of the Himalayas and Tibetan Plateau, two emblematic areas in the High Asia region. In reality, the institutions working for socioenvironmental protection in these areas, mainly AKF, ICAR and ICIMOD, have been unable to generate a supra-regional awareness that is institutionally recognized, as in the Arctic region.
6. Because of its scarce capacity for institutional self-protection and the considerable pressure exerted from the adjacent lowlands, High Asia is currently a very vulnerable region that requires further involvement from the United Nations, international cooperation agencies from countries that are more socioenvironmentally committed, and those sectors in China and India that are more prone to integrated development models co-managed with rural indigenous communities. Innovative initiatives in the less populated countries of the High Asia region (Afghanistan, Bhutan, Kyrgyzstan, Mongolia, Nepal, Pakistan and Tajikistan) are a key source of examples of alternative development models.
7. The private initiatives that disregard native producers and indigenous communities, with speculative outside intervention, are harming the livelihoods of the people living there, as well as the yak population, thereby increasing socioenvironmental vulnerability and imbalances.

8. Inspired by the Association of World Reindeer Herders and with FAO support, the WYHA project, a global but regionally organized network of pastoralists, received some attention and funding as a way of institutionalizing both the demands and the economic opportunities of the agropastoral communities of High Asia. It would have served as a platform to rationalize markets around yak-derived products while protecting the rights of the native producers, who are the most interested in conserving the original environmental conditions that make that quality market possible.
9. Unfortunately, the WYHA did not receive enough institutional support and has sometimes even been perceived as interfering in the internal affairs of the countries included in the project. This attitude stands in sharp contrast to the results of the community dialogues taking place in the field among the yak-herding communities, the outcomes of which indicate the urgent need for high-altitude pastoralists to have opportunities similar to those of the Association of World Reindeer Herders in the Arctic region.
10. The subsidiary perception regarding the High Asia region and its native communities has had an impact on the current prevalent industrial scenario, in which local communities are mainly treated as raw material providers. This is demonstrated by the fact that most of the firms working with yak fibre prefer to purchase the raw material and transform it into luxury garments and high value-added products in the headquarters of these firms, for example in Shangai, London, New York, Ulaanbaatar, Xining, Barcelona, Moscow and Auckland.
11. With some exceptions, investments in the development of the yak wool industry based in yak-producing areas are rare. Even though the management of the trade in yak products by yak-herding communities would decisively contribute to promoting environmental protection, rationalizing production and stopping speculative practices, this is even rarer.
12. Greater support for pastoralists will entail better management of natural resources. Mobile pastoralism and its derived products and services have a value that is increasingly supported by the scientific community using compelling arguments. As direct managers of their ecosystems, the involvement of the indigenous pastoral and agropastoral groups in business initiatives on products generated in those areas will result in further benefits. Animals that are well treated, organically fed and reared in their original habitat are healthier and can produce better products while also contributing to maintaining the original ecosystems in a healthy condition.
13. The yak wool industry is currently split into two distinct segments of the same value chain: raw material production on one side and processing on the other side. More highly developed mountain countries, such as Austria, France, Norway or Switzerland, have made mountain development and economic progress compatible with each other by implementing balanced policies that recognize the importance of investing in these places according to "mountain laws". Empowering agropastoralists in the High Asia region will rebalance the previous unevenness caused by the historical factors described earlier, considering the current socioclimatic crisis as a more severe challenge.
14. In the case of the yak wool industry, the transfer of the processing segment to the original producers will help mitigate the effects of climate change on the incomes of the herders, and the rural exodus, by giving a more decisive role to the original inhabitants, creating employment in remote areas and generating a transferable knowledge chain, both interregional and intergenerational.

15. The indigenous peoples of High Asia have to be compensated for the environmental services that they have contributed. Medium-sized investments, mainly in equipment, training and marketing, represent the best tools to empower yak keepers and their neighbouring mountain farmers in carrying out the processing segment of the yak wool value chain. Increased benefits for native producers will also encourage new generations to stay in their homelands, perpetuating an agropastoral system that, far from being obsolete, is vital to counter climate change.
16. Investment plans should also aim at a total, although respectful, exploitation of the animal to reduce waste of primary sources; if yak capacities and opportunities are not fully used, rural communities may need to find alternative income sources outside rural areas. Moreover, the profit obtained by selling unprocessed yak fibre is very low; this is why the direct and local management of yak wool enterprises would add a substantial contribution in terms of social rooting, women's empowerment, education and market access, besides the increase in revenues from the selling of final products.
17. Fully exploiting the potential for yak wool could provide new opportunities not only for many yak herders; for those herders who also collect yak fibre it would represent a substantially more professional approach to fibre collection, with a focus on fibre quality and improved processing and marketing, which would bring in large and new income streams.
18. The Pamir–Tian Shan mountain ranges, covering areas of Afghanistan, Kyrgyzstan and Tajikistan, and the Himalaya-Karakoram region of Bhutan, India, Nepal and Pakistan offer two ideal eco-social contexts with different political realities. Both present a double climatic zone, with two biodiversity hotspots, including areas subjected to generous seasonal rain as well as drylands or alpine deserts, where the yak is the most suitable grazing species for grass regeneration and organic fuel production.
19. Tourism is an increasingly attractive activity for these uplanders as it allows them to connect with the urban market while obtaining extra income for herders and rural families. Yak herding requires a relatively low investment in terms of working time, which makes it possible for pastoralists to set up other activities.

Concrete evidence-based proposals

Yak fibre quality

There are two basic types of yak fibre, coarse hair and fine wool (down), as well as a range of intermediate-quality fibre (mid-coarse). Yak wool also ranges in quality, such as baby soft and premium down, each of which has different properties and suitable applications. The critical dehairing process should be carried out with regard to the potential applications of each fibre type. Promoting business initiatives based on the integral use of yak fibre would limit the number of yak, maximizing resources and increasing benefits for pastoralists. This report analysed the blending opportunities with both animal and plant fibres, giving preference to those fibres found in the vicinity of yak-breeding areas: cashmere, hemp, sheep wool, Bactrian camel wool, jute, cotton, silk, etc. Contemporary integral yak wool development initiatives should include a laboratory and design centre for exploring such options.

Processing and productive strategies

Carrying out projects with a regional or subregional scope that are managed by rural mountain communities is, as has already been discussed, a key step that should be further developed by promoting the use of modern and advanced techniques and machinery in conjunction with traditional methods, in an attempt to merge ethnic design and traditions with these modern methods.

Market access

After the lack of machines, market access is the biggest obstacle that the people of High Asia face when trying to develop their own industries. However, e-commerce platforms now allow easy contact with a multitude of retailers interested in niche products. Investing in internet access and training in e-commerce would increase the market access of pastoralists.

International standards adoption

The adoption by the European Union of the "mountain product" label represents a step forward in recognizing the extra value of those organic products that originate in LFAs. This model could be extended to all mountain areas following the Rio 2012 recommendations, or perhaps be adapted to High Asia's reality. Specific labels on eco-friendly textile production could be adopted from among the numerous existing eco-labels; one of the most globally accepted is Oeko-Tex Standard 1000, which includes both technical and environmental requirements. The UDAW could also be adapted to the High Asia region to promote and ensure yak welfare, including some minimum conditions to respect the original yak-grazing model: exclusive natural herbage diet, non-farming system, seasonal movements and traditional fibre collection techniques.

"It is crucial to establish yak raw materials processing enterprises not far from the yak breeding regions so as to create jobs, increase the income of mountainous regions, develop marketing and social infrastructure and so on. It would have a positive impact on the living standards of people in the yak-rearing areas" (K. Kachkynbaeva, 2002).

Added value: social, environmental and ethical

Diversification in production, quality, application, design and marketing strategies is vital in industrial community-based projects, which have less experience in business dynamics and market access. However, such initiatives are characterized by high added value precisely because of their rural location and management. As discussed previously, animal products derived from seasonally grazed herds should be labelled appropriately, advantageously commercialized, institutionally supported and globally protected. They have a higher value than products derived from farming, ranching and intensive industrial husbandry. The added benefit of industries developed in and by rural communities is triple: economic, social and environmental. Moreover, the long and often segmented value chain will be shortened and an exclusive designation of origin will be obtained.

Project proposal: Himalayak

In light of these research findings of a technical, sociocultural, environmental and economic nature, and according to the High Asia concept adopted as a biocultural framework, the project proposal Himalayak was designed as a first and significant conclusion. Here, a summary is provided, but the full proposal is ready to be analysed and implemented.

Summarized as a grassroots community-managed project on integrated yak fibre development, Himalayak is the first innovative regional-level proposal pursuing poverty reduction, value chain-generated rural employment and environmental rebalancing of the southern uplands of the Himalayas. The Himalayak project responds to the urgent need to increase rural farming income from low-impact activities in the extremely fragile high-altitude environment, such as mobile yak-herding practices. Yak fibre is the most easily exportable commodity among all of the yak-derived material services; it also has the highest potential to generate added value and does not require refrigeration. However, the animal fibre produced in these marginal and marginalized high-mountain areas is being monopolized by foreign-owned industries, relegating animal keepers to the role of mere suppliers and thus reducing not only their involvement in the value chain but also their profits, therefore reducing their resilience. The Himalayak project is divided into two phases, each of three years duration. Phase I is carried out in Nepal, whereas phase II will mostly take place in Bhutan and India. The goal of the first phase of the project is to establish a yak wool production hub in Nepal that relies on a yak fibre supply from Tibet and the rural communities in Nepal. The whole project is managed by the community, especially by indigenous women, and seeks to increase their income through the yak wool market by keeping the value chain in its original place, thus reducing its fragmentation and externalization in developed countries outside High Asia, and guaranteeing the communities' involvement in every phase of the value chain. The second phase of the project will then expand this model in Bhutan and India, thus further increasing the resilience of the people living in High Asia.

"Multiple drivers of change such as climate change, globalization, the liberalization of markets, and the privatization and division of common lands negatively impact pastoralist women, leading to the outmigration of men to urban centres and foreign countries for employment, among other impacts" (Verma and Khadka, 2016).

ANNEX I: List of potential partners

Countries	Firms	Imported material		Business type	Manufacturing and selling	
		Type	Origin		Method	Products
Spain	TEIXIDORS Barcelona www.teixidors.com	Raw	Mongolia (Khangai)	Eco-friendly fabric	Handmade	Home, clothing
	JUSTINO DELGADO Madrid www.justinodelgado.com	Raw	China, Nepal	Wig/hair retailer	Handmade	Wigs and hair extensions
Italy	MAEKO Milan www.maekotessuti.com/	Raw	N/A	Eco-friendly fabric	Machine-made	Yarns, fabrics, clothing
	MYAK Candia Canavese https://myak.it	Raw	Tibet (China)	Eco-friendly fabric	Machine-made	Yarns, fashion, accessories
	CASAGRANDE Belluno https://casagrande.store	Raw	N/A	Luxury products	Handmade	Yarns
	CASHMEREWOOL Biella www.cashmerewool.it/it	Raw	N/A	Luxury products	Handmade	Blankets, home, clothing
	ARTEMEST Milan https://artemest.com	Raw	Tibet (China)	Luxury products	Handmade	Home textiles
Austria	HEFEL Schwarzach www.hefel.com	Raw	Tibet	Eco-friendly fabric	Machine-made	Quilt, home textiles
Germany	PASCUALI Frechen www.pascuali.de	Spun/dyed	Tibet	High-quality yarns	Machine-made	Yarn
	MANUFACTUM Waltrop www.manufactum.de	Raw	N/A	Eco-friendly fabric	Machine-made	Blankets, apparel
	KAL Leipzig www.wearekal.com	Final products	India (Ladakh)	Traditional crafted products	Handmade	Home textiles, yarn, accessories
Sweden	SIDENGÅRDEN Visby https://sidengarden.se	Final products	Nepal	Natural materials	N/A	Clothing
Switzerland	ARTHA Zurich https://arthacollections.com	Final products	Tibet	Traditional crafted products	Handmade	Clothing
Russian Federation	SARLAG Khimki https://sarlag.ru/?lang=en	Raw	Mongolia (Khangai)	Natural materials	Machine-made	Yarn

Countries	Firms	Imported material		Business type	Manufacturing and selling	
		Type	Origin		Method	Products
UK	TENGRI London www.tengri.co.uk	Raw	Mongolia (Khangai)	Eco-friendly fabric	Machine-made	Luxury products, home textiles
	KNIT WITH ATTITUDE London https://knitwithattitude.com	Yarn	N/A	Eco-friendly fabric	Ethically sourced and cruelty free	Yak fibre knitting wool
	JÖTTNAR Cardiff www.jottnar.com	Raw	Tibet (China)	Technical base layer	Machine-made	Sportswear base layer
	KORA London https://kora.net	Raw	Tibet (China)	Technical base layer	Machine-made	Sportswear base layer
	KHUNU London www.khunu.com	Raw	Tibet (China)	Socially responsible	Machine-made	Apparel, accessories, home textiles
United States	ETSY https://www.etsy.com	Raw, yarn	China, Nepal, Mongolia	E-commerce	Handmade	Craft supplies
	ANICHINI Quechee https://anichini.com	Blankets	Nepal	Luxury products	Handmade	Clothing
	REYWA FIBERS https://www.reywafibers.com	Raw	Tibet (China)	Yak yarns	Machine-made	Yarn
Canada	IMRSHEEP Toronto www.imrsheep.com	Yarn	Tibet (China)	Yak yarns	Machine-made	Yarn
Japan	MUJI Tokyo www.muji.com	Raw	N/A	E-commerce	Machine-made	Apparel
Mongolia	UUJIN www.uujinyak.com	Raw	Mongolia	Yak herders cooperative	Handmade	Yarn, apparel
	JINST MURUN Mörön	Raw	Mongolia (Khovsgul)	Yak herders cooperative	Handmade	Yarn, accessories, apparel
China	CYAK Xining www.cyak.net	Raw	China (Yushu)	Socially responsible	N/A	Yarn, apparel
	NORLHA Ritoma www.norlha.com	Raw	China (Gansu)	Socially responsible	Handmade	Fashion, accessories
	SHOKAY Shanghai www.shokay.com	Raw	China (Qinghai)	Socially responsible	Handmade	Fashion apparel
	ROCKING YAK Shangri-La https://rockingyak.com	Raw	China (Yunnan)	Socially responsible	N/A	Yarn, fashion
	KEGAWA HERDERS COOPERATIVE Yushu http://plateauperspectives.org/en/project/kegawa	Raw	China (Qinghai)	Yak herders cooperative	Handmade	Raw wool
New Zealand	PEAK TO PLATEAU Christchurch	Raw	Tibet (China)	Technical base layer	Machine-made	Sportswear base layer

Epilogue: On methodology

This report is perhaps the first foray of anthropology into the domain of yak fibre. It aims to promote a sort of fibre sovereignty to increase benefits for the protection of and the engagement of local producers in the High Asia region. This study does not share the type of paternalistic view that looks at remote ethnic groups as stagnated societies anchored in fixed social roles. The rural people of High Asia's uplands are not only yak herders and keepers, not only pastoralists and agropastoralists, but also caretakers of their homelands and territories. They are traders and expert managers of their resources, although they have not been provided with the same resources as urban people and lowlanders.

There is, obviously, a central working line articulating this report. The primary strategy used here comes from applied and public anthropology, which prioritize a more active and involved role of the researcher with the target communities. Such a specialized field of social sciences "demonstrates the ability of anthropology and anthropologists to effectively address problems beyond the discipline – illuminating larger social issues of our times as well as encouraging broad, public conversations about them with the explicit goal of fostering social change" (Borofsky, 2011).

Anthropology is very useful for its capacity to cure human social diseases by providing recommendations and conclusions based on in-depth analysis in the field. Thus, anthropologists can be considered as a kind of "community doctor's cast", capable of assessing social diseases. By dissecting "social bodies", and intensively exploring inside, it is possible to correct social anomalies; however, applied anthropologists propose, in addition, providing practical solutions as an antidote.

Finally, this report would not have been possible without the previous experience of the WYHA project. It not only provided me with updated information on the diversity of yak-herding communities, but also generated an adequate multidimensional understanding of the High Asia region.

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