

Inclusive and resilient mountain food systems: Opportunities and best practices

Mountain food systems are unique, complex, and linked with diverse cultures. They support biodiversity and shape landscapes and nutrition security worldwide.



Introduction

Mountain food systems are key to improving socio-economic development, sustaining the livelihoods of 1.1 billion people living in the world's mountains (Mountain Partnership 2021) and supporting the conservation of crucial plant and animal biological diversity and the restoration of ecosystems (Rahbek et al. 2019). Globally, most of the mountain ranges are home to local communities and indigenous peoples whose food systems, livelihoods, and cultural identities are indivisibly linked with mountain environments.

Family farms grow more than 80 per cent of all the food produced worldwide (Lowder et al. 2021). In mountain regions, small-scale family farmers and pastoralists are the predominant producers and primary consumers of food. Yet, almost half the rural population in the mountains in developing countries is vulnerable to hunger and malnutrition, and the situation has worsened over the last twenty years, from roughly 2000 to the present day. Both climatic and nonclimatic challenges are posing risks to the sustainability of mountain food systems and the livelihoods of smallscale farmers and pastoralists.

This policy brief constitutes a call to action for governments to support the relevant institutions and stakeholders in creating sustainable solutions for food production systems and more fair and inclusive food value chains in

mountain areas. It presents practical

examples from the perspective of mountain peoples to guide government policy. It also makes specific policy recommendations with the broad aims of attracting youth back to agriculture and food-based livelihoods, mitigating food insecurity among mountain communities, and ensuring that healthy mountain ecosystems can continue to provide essential services. It also presents different examples and resources regarding relevant programmes from different mountain regions of the world (see Table 1). Engaging all the actors of the food systems — such as farmers, agroforestry producers, pastoralists, distributors, and consumers — and involving everyone in the management and benefit-sharing of mountain food value chains is crucial to achieving the relevant Sustainable Development Goals and ensuring that no one is left behind.

Mountain peoples' perspectives and practical examples to guide action

The following section presents messages that highlight mountain peoples' perspectives regarding mountain food systems, underline major challenges facing them, and provide practical examples to guide government action.

Engaging farmers, agroforestry producers, pastoralists, distributors, and consumers and involving everyone in the management and benefit-sharing of mountain food value chains is crucial to achieving the relevant SDGs.

1) Mountain food systems matter for all

Mountain food systems are unique, complex systems shaping landscapes and nutritional health worldwide.

Mountain food systems are nature's

insurance system: Mountainous areas host a rich variety of ecological systems and contain considerable genetic diversity. Of the 20 plant species that supply 80 per cent of the world's food, six (apples, barley, maize, potatoes, sorghum, and tomatoes) originated in the mountains. In addition, a large proportion of domesticated mammals (sheep, goats, yaks, llamas, and alpacas) originated or have been diversified in mountains.

Half of all global biodiversity hotspots (17 out of 34) are located in mountain regions. These contribute disproportionately to the planet's terrestrial biodiversity. Approximately 30 per cent of the total land identified as key biodiversity areas is located in mountains.

Mountain species coexist thanks to their different climatic preferences and have high genetic diversity, a prerequisite for adaptation to new conditions. Mountains also represent an important repository of agrobiodiversity that is likely to be key to the future of world food security in the face of climate change by providing a gene pool of resilient crops.

Mountain people cope with hard conditions and adapt to natural ecosystems in common ways:

Mountain communities have developed valuable traditional knowledge and practices regarding crop cultivation, livestock production, water harvesting, forestry, and agroforestry that are well adapted to natural ecosystems and biological cycles.

Mountain agriculture worldwide is embedded in landscapes, cultures, and societies, and is crucial for the subsistence of mountain communities. Households in these areas manage a wide genetic variety of agricultural crops and farm animals in a multitude of agroecological zones that are a result of differences in altitude and the prevalence of varied landscapes. Mountain people share a deep respect for nature, and have a holistic view of it, and as such, are careful stewards of the often scarce natural resources that surround them.

Mountain food systems support ecosystem functions globally:

Mountain producers as well as conscious consumers who support mountain food systems play a crucial role in the protection and retention of mountain slopes, which also contribute to the provision of freshwater for downstream populations. Mountain farming and food systems contribute to maintaining water quality, both in the uplands and lowlands, through appropriate farming and water management practices.

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Mountain food systems have high potential for food and nutritional security: Mountain environments include very fragile ecosystems but mountain food systems have a large potential for high quality and high value food production, and therefore for providing greater nutrition and income to mountain peoples.

2) Addressing the challenges being faced by mountain food systems

Loss of ecosystem services and plant-animal genetic diversity:

Traditional agroecology and diversity in mountain food systems are being impacted, sometimes adversely, by changes in dietary patterns and market demand, and by climatic and demographic factors. The recent Intergovernmental Panel on Climate Change's Sixth Assessment Report 2022 has revealed that almost half of the globally assessed species have shifted poleward or, on land, also to higher elevations. Hundreds of species have been lost due to an increase in the intensity and duration of extreme heatwaves (IPCC 2022). The importance of the highly heterogeneous mountain agrifood systems in combating these challenges has not been adequately recognised and supported the world over and needs solutions adapted to local context and micro-climatic conditions.

Socio-economic barriers: Every second individual in rural areas in the



Photo: Sajad Harati

mountains of developing countries is vulnerable to food insecurity (Romeo et al. 2020). The scattered food production in mountainous areas is of low volume and low yields and cannot compete with lowland volumes and prices. The poor infrastructure development in remote areas at higher altitudes creates difficulties in transportation and market access, which has been exacerbated recently due to the COVID-19 pandemic. Overall, mountain food systems have a low scale of production, high transportation costs, and inadequate facilities and infrastructure that is important for value addition and food chains (Rasul et al. 2019). Male outmigration to urban areas is also common in many mountain regions, leading to labour shortages in mountain agriculture and adding to the workload and responsibilities of women (Hussain et al. 2016).

Climate change-induced risks:

Mountain people depend heavily on climate-sensitive natural resources and risk-prone livelihoods (IPCC

2022; Rasul et al. 2019). In recent years, several mountain areas have experienced changes in temperature and precipitation patterns, a reduction in water availability for crops and livestock, and a degradation of rangelands. These changes are leading to a decline in the productivity of agriculture and rangelands (Adler et al. 2022; Biemans et al. 2019; Wester et al. 2019). Meltwater (from glaciers and snow) from the mountains is extremely important for agricultural and other uses during the dry season. The supply of meltwater in river systems has also been impacted by a rise in temperatures (Biemans et al. 2019). Climatic and non-climatic changes in mountain areas are likely to impact water supplies to agriculture and ecosystems, which can adversely affect the food security and livelihoods of billions of people in the mountains and downstream areas. In the Hindu Kush Himalaya (HKH), for instance, any variation in water supplies can impact the food security and livelihoods of around 1.9 billion people living in mountain and downstream areas (Immerzeel et al. 2020). The frequency and intensity of extreme climatic events such as floods and droughts have also increased (Wester et al. 2019; IPCC 2022), leading to negative effects on crop yields and the erosion of cultivable lands. To cope with varied growing impacts of climate change, scientific data needs to integrate indigenous knowledge and traditional practices for effective ecosystem-based adaptation (IPCC 2022).

Strengthening mountainbased food systems through successful approaches, practices, and tools

Promote the high mountain agrobiodiversity, traditional breeds, and speciality products: Mountains host significant plant and animal genetic diversity and are home to a wide range of locally adapted crops and livestock. Most mountain crops are less exposed to pesticides than those in lowland areas. However, they are often neglected and underutilized species (NUS). Most of these crops, such as buckwheat, barley, millets, amaranth, etc. are high in nutrition and resilient to climatic stresses. Due to their high potential to contribute to people's food security, nutrition and incomes, and being more resilient to climate change, most of these crops have been relabelled 'Future Smart Foods' (FUFs) (FAO 2017; Rasul et al. 2019).

labelling and geographical indications: Mountain food products are particularly attractive to conscious consumers because of their distinctive features and being viewed as clean and healthy. These perceived strengths of mountain food products need to be put to advantage via appropriate branding, marketing, and promotion. In this

regard, quality labelling, certification,

appellations of origin can communicate information about products, convey

geographical indication, and

Highlight linkages of foods to

culture and territory through

important messages to consumers, and provide a pathway for farmers and territories to achieve better recognition for their products and associated processes. This has been done in a few mountain regions (see Table 1).

Add value to mountain products by highlighting their benefits for biodiversity, the environment, and sustainability: Value addition of products does not only refer to processing or packaging. Value can also be created through highlighting their importance for biodiversity, the environment, and sustainability in marketing strategies. For example, in the mountains, farmers can adopt agroecological practices that contribute positively to water and soil conservation, biodiversity, a return of wildlife, and a healthy ecology and living environment for the producers through cleaner and safer working conditions. A basket of products approach, diversifying products grown on the farm and sold in the market is a crucial value-adding activity for mountain contexts, considering the major challenges of accessibility, scale, and markets.

Link local food systems to sustainable tourism. Promote agritourism, ecotourism, and community-based tourism in the mountains: Tourism is one of the fastest growing sectors in mountain regions, attracting 15–20 per cent of global tourists (World Tourism Organization 2018). This sector is



Photo: Esteban Tapella

an important source of livelihoods for mountain people, bringing new employment opportunities, and supporting traditional systems that would otherwise barely survive. Supporting sustainable tourism in the mountains is not just about controlling and managing the negative impacts of the industry; tourism is also uniquely placed to benefit local communities economically and socially, and to raise awareness of and support for conservation of the environment. The tourism sector has been heavily affected by the COVID-19 pandemic. The post-pandemic period provides an opportunity to restructure tourism models. Concepts such as community participation, empowerment, transparency, fairness, and equity can lead to the creation of different types of tourism as positive models for local and international tourism, such as agritourism, ecotourism, and community-based tourism.

Policy recommendations

Harnessing the potential of mountain food systems is key to retaining people in the mountains, attracting the youth back to agriculture and food-based livelihoods, mitigating food insecurity among mountain communities, and ensuring that healthy mountain ecosystems can continue to provide their essential services.

Context-based holistic policies are needed to support mountain food systems in order to augment mountain people's food security and nutrition, and improve their livelihoods while maintaining the health of ecosystems. Involved actors and their institutions need to be supported by political and financial mechanisms to promote different dimensions of sustainability and ensure justice across all phases of food systems.

It is important to identify strategies that can help overcome the systemic failures that lead to food insecurity in mountain regions. Presented below are some key policy recommendations that would help enhance food security among mountain communities, increase farmers' incomes, and augment livelihoods in mountain areas:

1. Promote and support livelihoods based on professional, profitable, and sustainable food production in mountain areas, targeting production systems to include a wide assortment of highly nutritional products.

- 2. Protect traditional, sustainable, and diversified food production and consumption which would simultaneously satisfy food and nutritional requirements of farmers and others, spread cultivation risks over a variety of crops, ensure crop rotation, and expand the range of products offered on the market, resulting in greater profitability.
- 3. Support mountain farmers in the commercialization of their produce, prioritizing the most easily accessible markets (that is, among the same mountain communities where the food is produced), and expanding market penetration when those closer are saturated and a broader market is needed, while recognizing that the farther away a market is, the higher will be its barriers to entry.
- **4.** Facilitate the creation of enabling institutions that sprout from collective actions by farmers, and which would support farmers across the value chain, from production to processing and market penetration.
- **5.** Develop systems that enable mountain populations to source food from other regions during periods of food scarcity or, in general, those items that cannot be sourced within their communities.
- **6.** Address the contrast of there being commodity trap risks while strengthening the commercial interest in traditional and biodiverse farmed products. In doing so:

- Promote the commercialization of a wide range of products in local markets;
- Identify the appropriate market channels for mountain products at the national level, including in urban areas, considering changing diets and needs; and
- Promote/protect traditional agroecological and diversified approaches to food production, prioritizing products with high nutritional content, with a few of these farming products aimed at a broader mass market.
- 7. Build cultural knowledge and awareness among consumers in mountain countries, and particularly among mountain people, about the importance of sourcing food from within their communities, prioritizing high-quality, nutritionrich food, thereby promoting organic and agroecological approaches to farming.

Farmers are the interface between nature and society; working with nature, they take care of their communities. Mountain farmers must be placed in a situation of being proud of farming and feeding their communities. It is also crucial to



Photo: Satpal Singh

recognise and value the pride and pleasure of rural mountain peoples in eating their local foods, that is produced following their ancestors' traditions, professionally, organically, and agroecologically.

The connection between nature, farmers, and their communities can be brought back as part of everyone's life, because, using the words of the American novelist and poet Wendell Berry:

A significant part of the pleasure of eating is in one's accurate consciousness of the lives and the world from which food comes.

Eating ends the annual drama of the food economy that begins with planting and birth.

Eating is an agricultural act.

TABLE 1: Mountain food systems' challenges and practical solutions to overcome them

Challenges to the sustain-ability of mountain food systems	Proposals and opportunities	Examples, tools, and resources
Half the rural mountain people in developing countries face food insecurity and malnutrition	Promote and protect traditional and diversified food production approaches, prioritizing products with high nutritional content, and have only one or two cash crops Implement insurance schemes against disaster risks in mountain agriculture to promote food security and viability Seek financial support, international expertise, and opportunities offered by financial resources mobilized within the SDG framework and implementation process to address the vulnerability of mountain communities to the lack of food security Invest in digital technology infrastructure and related capacity-building for data collection and	Regional drought monitoring and outlook systems for South Asia: Promotes the development of data products for quality agricultural drought-monitoring and outlook systems. Has been developed under ICIMOD's SERVIR HKH initiative, in collaboration with meteorological and agricultural institutions, and is being implemented in Afghanistan, Bangladesh, Bhutan, Myanmar, Nepal and Pakistan. Online Food Security Information System: It was developed in 2017 to map and visualize patterns of food security, poverty, and malnutrition in Nepal, with the support of the Ministry of Agriculture and Livestock Development, Nepal, the United Nations World Food Programme and ICIMOD's SERVIR HKH initiative Index-based Livestock Insurance (IBLI) programme: Successful agricultural insurance schemes implemented
	data analytics supported by machine learning and Earth observation to promote evidence-based planning and policy formulation. Only with sufficient disaggregated data, and effective monitoring systems and tools located in climate change hotspots will we be able to ensure that progress towards the zero hunger goal (SDG 2) will be on track	in Ethiopia and Kenya. For instance, it compensates livestock keepers when the forage in an area gets depleted following severe dry spells Slow Food Gardens in Africa: A network of people working across the continent to preserve biodiversity, add value to traditional knowledge and gastronomy, and promote small-scale agriculture
High-value, healthy, and nutritious mountain products cannot compete with larger scale, lowland food	Support the commercialization of a wide range of mountain products in local markets Promote inclusive agroecological value chains and eco-labelling both for a fair remuneration of the primary producers and to enable the adoption of healthy diets Encourage a targeted marketing approach	Mountain Partnership Products Initiative: A certification and labelling scheme that promotes fair prices for the primary producers - Globally Important Agricultural Heritage Systems (GIAHS): Launched by the FAO 20 years ago, this is a designation programme for agroecosystems inhabited by communities that live in an intricate relationship with their territory, and cultural or agricultural landscape
Technologies are not adapted to smallholder-based mountain food systems and mainly focus on plains agriculture	for select mountain products, focusing on the middle class and wealthy consumers at the national level and in urban areas in particular Scale up agroecological and nature-positive production systems, thereby enhancing ecosystem services and increasing productivity with the use of fewer resources through context-specific and environmentally friendly	One country one priority product initiative: An FAO initiative that aims to boost the value chains of special agricultural products to ensure food security, improve nutrition, increase incomes, and preserve the environment
		Val Poschiavo, 100% organic: A region in Switzerland pioneering organic practices and promoting agritourism. Lise of Geographical Indication: The products from this
	technologies for mountain niche products Support direct links between mountain communities and restaurant owners and cooks so that mountain food products and gastronomy can be appreciated and included in restaurants	Use of Geographical Indication: The products from this region have a sign that indicate their geographical origin and that they possess organic qualities linked to that origin

Challenges to the sustain-ability of mountain food systems	Proposals and opportunities	Examples, tools, and resources
Mountain areas are marginalized Mountain food systems are highly heterogeneous and need customized solutions based on local contexts and micro-climatic conditions	Develop e-commerce solutions for rural transformation (such as platforms with lastmile connectivity to reach all households). Bridge the digital divide and increase access to information and services in food systems Encourage a targeted market approach and ensure commitments by supermarket chains to buy mountain products and source locally Restore grasslands, shrublands, and savannah through the sustainable use of vegetation by livestock-based food systems Strengthen agrifood organizations and institutions in mountain areas, enhance collaborative actions among them, and develop public-private partnerships	Kusikuy: This is a digital application for the home delivery of mountain products in parts of Peru Agroferias Campesinas: A network of physical farmers' markets and delivery systems for smallholder producers in 21 regions of Peru. It seeks to promote family farming and health diets
		Participatory Guarantee Systems (PGS): A collaborative tool of standards and certification for smallholder organic farming systems Shade Tree Advice: An online tool that uses local ecological knowledge to help select appropriate species of shade trees in agroforestry WOCAT: This is a global database on sustainable land management (SLM) which details over 2,000 SLM practices
Mountain people are excluded from prioritized investments in agricultural and non-agricultural enterprises and have limited access to markets and credit	Promote the conservation and biocentric restoration of indigenous peoples' food systems Secure land tenure rights for resilient and sustainable mountain food systems Support blended financing mechanisms for small projects and initiatives locally owned by women and youth Improve transport and communication infrastructure as well as on-farm product handling facilities Strengthen the capacities of mountain communities in value addition, quality product handling, and marketing	CARPAT SHEEP: A Swiss-Romanian cooperation initiative whose overall goal is improved sustainability of livestock-based agriculture in the Romanian Carpathian mountains Ecuador: Declaration of the territory of the Cotacachi canton as a cultural heritage for agrobiodiversity Philippines: Dynamic conservation and sustainable use of agro-biodiversity in traditional agro-ecosystems The Global Mountain Ecosystem-based Adaptation Programme in Nepal, Peru and Uganda: A knowledge product that documents lessons learnt from the ecosystem-based adaptation project Mountain Agro-ecosystem Action Network (MAAN): A stakeholder platform for sharing information regarding
Mountain food systems are highly vulnerable to climate change and elevation-dependent warming. Climate change-induced multiple hazards strongly affect mountain people, in particular women	Promote local and public procurement schemes that target smallholder farmers and incentivize micro, small, and medium mountain enterprises to purchase food that is locally produced, or produced by women's and youth cooperatives, or which is organic or seasonal Support the financial inclusion of mountain-based small-scale producers through climate risk profiling Encourage the diversification of livelihood options (such as agriculture, livestock-rearing, agroforestry, and agritourism) to enable mountain communities to cope with climate change impacts in the short and long term	nutrition-rich agriculture, and healthy and diverse diets Resilient Mountain Solutions (RMS): An initiative developed by ICIMOD, RMS promotes testing and scaling up affordable nature-based solutions (such as agrobiodiversity, conservation of water and soil nutrients, and organic pest control), gender-responsive technologies, entrepreneurial ecosystems, and the use of digital technologies to build resilience in agricultural production systems in the Hindu Kush Himalaya (HKH) Quali Warma National School Feeding program: Developed by the Ministry of Development and Social Inclusion in Peru, this programme enables food to be provided to more than 290,000 secondary school children. Adaptation at Altitude Solutions Portal: A portal that brings together tested climate change adaptation

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