

Sustainable Food Security in the Mountains of Pakistan: Towards a Policy Framework

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The nature and causes of food and livelihood security in mountain areas are quite different to those in the plains. Rapid socio-economic and environmental changes added to the topographical constraints have exacerbated the problem of food insecurity in the Hindu Kush-Himalayan (HKH) region. In Pakistan, food insecurity is significantly higher in the mountain areas than in the plains as a result of a range of biophysical and socioeconomic factors. The potential of mountain niche products such as fruit, nuts, and livestock has remained underutilized. Moreover, the opportunities offered by globalization, market integration, remittances, and non-farm income have not been fully tapped. This paper analyzes the opportunities and challenges of food security in Pakistan's mountain areas, and outlines a framework for addressing the specific issues in terms of four different types of area differentiated by

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agro-ecological potential and access to markets, information, and institutional services.

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Mountains occupy more than one fifth of the Earth's land surface and are home to some 12% of the world's population, approximately half of them in the Asia Pacific region (Akramov, Yu and Fan 2010; Huddleston, Ataman and d'Ostlanl 2003). About 245 million people living in mountain areas in developing and transition countries are estimated to be vulnerable to food insecurity as a result of low productivity, subsistence economies, the constraints of terrain and climate, poor infrastructure, limited access to markets, physical isolation, vulnerability to natural risks, and high cost of food production and transportation (Rasul 2010; Rasul and Karki 2007; Tiwari and Joshi 2012; Ward, Amer, and Ziaee 2013; Huddleston, Ataman and d'Ostlanl 2003; FAO 2008).

Pakistan has made significant improvements in achieving food security in recent years, and is close to being self-sufficient in terms of the food dietary energy available to the population. However, the situation is not uniform across the country due to the variation in topographic, socioeconomic, and physical conditions across the regions, and not all areas are food secure. Especially the mountain areas tend to have higher levels of both poverty (Khan 2011) and food insecurity (SDPI 2009) than the plain areas of the country.

In Pakistan, almost 61% geographical area is mountainous (Agricultural Statistics of Pakistan 2013) which accommodates nearly 40 million people (Pakistan Bureau of Statistics 2010). The livelihoods and food security of mountain communities depend heavily on the local resource base at all elevations, although the specific agro-ecological and livelihood potentials vary considerably. Agriculture, livestock, and horticulture are the main sources of livelihood, with livestock becoming more important than arable farming at higher elevations. Remittances, small business, wage labor, tourism, and collection of medicinal plants and other herbs also contribute to livelihoods and food security. However, in recent years, various biophysical and socioeconomic factors have led to a depletion of the natural resource base across the Hindu-Kush Himalayan (HKH) region. This has resulted in a significant loss of ecosystem services, particularly in terms of soil nutrients, water, and biomass, and resultant decline in food productivity (Tiwari 2000). The reduced productivity has affected food security and increased the overall vulnerability of mountain people, as they have become more dependent upon food from outside and thus exposed to market fluctuations. Climate change is adding new challenges in terms of water availability and changing temperature conditions.

Pakistan's mountain areas are highly diverse and vary considerably in agro-ecological potential and access to institutional services, thus the food security issues also differ. To successfully address these issues, a framework is needed that takes this variation into account. The present study divided Pakistan's mountain region into four areas on the basis of agro-ecological potential and access to institutional services, and used these as a basis for exploring the food security issues and opportunities, and suggesting strategies for improvement. To the best of our knowledge, this is the first paper that outlines a framework for achieving food security specific to the mountain region of Pakistan. It is hoped that the findings will support the development of good policy instruments for improving mountain food security.

THE MOUNTAIN AREAS OF PAKISTAN

Five of Pakistan's eight administrative units (AUs) are mainly mountainous: from west to east, Balochistan, Federally Administered Tribal Areas (FATA), Khyber Pakhtunkhwa (KPK), Azad Jammu and Kashmir (AJK), and Gilgit-Baltistan (GB) (figure 1). The mountain areas are rich in natural resources such as water, forests, pasture, and minerals, and can play a vital role in the country's development. The northern mountains are the main sources of surface water in the country and provide the basis for irrigation and hydropower. They are drained by the Indus and Jhelum rivers and their tributaries, and contain the catchment area for the Tarbela and Mangla dams. The Indus river originates at about 3,000 meters above sea level (masl), and the Jhelum river at 4,500–6,000 masl in the perpetual snow and ice of the Hindu Kush Himalayan mountains. Direct precipitation, snowmelt, and glacier melt in the northern mountains is the major source of the Indus irrigation system. Valuable minerals such as antimony, aragonite (marble), baryte, chromite, fluorite, coal, magnesite, manganese, and soapstone are produced in KPK, FATA, and Balochistan. These areas also deliver a quarter of the country's total annual production of crude oil and natural gas, and KPK and AJK generate almost three-quarters of the country's hydel electricity (Pakistan Bureau of Statistics 2011).

Like in other mountainous regions in developing countries, livelihoods in the mountains of Pakistan are based mainly on subsistence agriculture, livestock, common pasture and rangeland, forest, and some non-farm activities. The amount of cultivable land is limited and average landholdings are generally small and insufficient to fulfill the food requirements. Currently, a substantial share of household income is derived locally, with livestock the main source of food and livelihoods. Livestock products are generally used for subsistence, although some households use them as a source of cash income (Ahmad, Islam, and Mirza 2012; Planning & Development

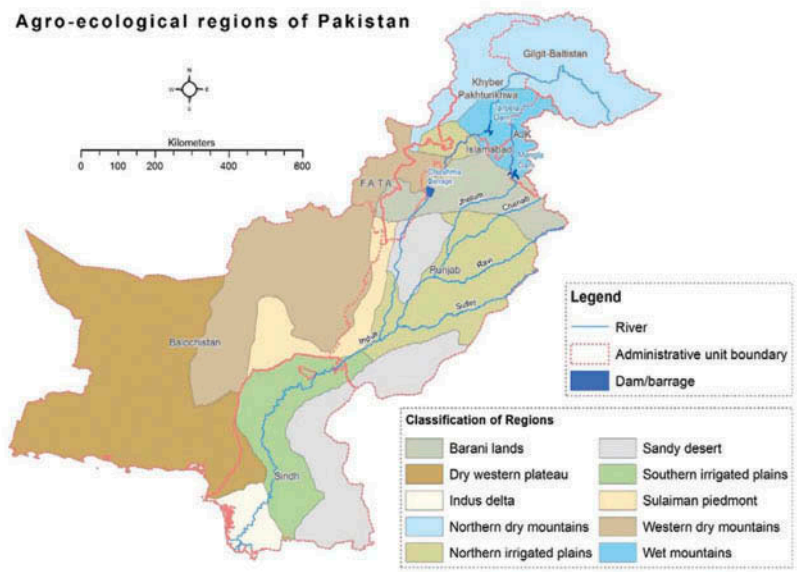


FIGURE 1 Agro-ecological regions and administrative units in Pakistan.

Department Northern Areas 2003). Although a substantial proportion of income is from agriculture and livestock, non-agricultural income from small businesses, services, remittances, non-farm wages, forests, and social safety nets (Israr and Khan 2010), also plays an important role. However, local products such as handicrafts, woodcarvings, and embroidery are not properly promoted and the marketing system is poor, reducing the potential for income generation.

Almost 60% of the geographical area of Pakistan is rangeland. Most of this rangeland is degrading due to increasing pressure from human and livestock populations coupled with frequent drought. The fragile mountain ecosystem is suffering from degradation of vegetation cover, deterioration of soil, and reduction in livestock productivity, which has further impoverished the pastoral communities. In addition to providing environmental services, such as carbon sequestration, watershed management, biodiversity, and ecotourism, rangelands are the major free grazing areas for livestock in general, and small ruminants (goats and sheep) in particular, throughout the year (Ahmad and Islam 2011; Mirza, Ahmad and Islam 2006). In Balochistan, these small ruminants directly or indirectly support the food security and livelihoods of close to 90% of the population (Ahmad, Islam, and Mirza 2012). Thus there is a need to take corrective action to conserve and enhance the productivity, sustainability, and ecological health of the rangeland ecosystem (Afzal, Ahmed, and Begum 2008).

FOOD SECURITY IN THE MOUNTAIN AREAS

The overall food security situation in Pakistan's AUs is summarized in [table 1](#). The two predominantly plain areas of Punjab and Sindh produce a surplus, although they do have food insecure districts. All five mountain AUs show a food deficit, which is highest in FATA, AJK, and GB. The mountain areas are particularly deficient in production of cereals and pulses, which contribute 50%–60% of the average calorie intake. The main source of cereals in GB is subsidized wheat from the plain areas; this is why there were a series of protests following the withdrawal of the wheat subsidy for GB in April 2014. The proportion of the population that is food insecure is also higher in the mountain areas than in the plains, with more than half the population food insecure in all mountain AUs except AJK. Of the 20 most food insecure districts in Pakistan, 19 are in mountain AUs—10 in Balochistan, 5 in FATA, 3 in KPK; and 1 in GB (SDPI 2009).

There are several food security issues in the mountain areas that need to be addressed. For example, although mountain areas have a considerable potential for production of fruit and vegetables as cash crops, farmers lack institutional support to intensify production. In Gilgit-Baltistan, less than 10% of total cultivable land was used for fruit production and 9% for vegetable cultivation in 2011/12 (Government of Pakistan and IUCN, 2003), and in Balochistan only 22% and 3.7%, respectively (of the cropped area) (Ministry of National Food Security and Research 2013; Agricultural Statistics of Pakistan 2013). Mountain farmers also face particular problems in inappropriate supply of credit and inputs, inadequate extension services, and low adaptive capacity for climate change (ICIMOD 2008; Shahbaz, Shah, and Suleri 2012).

TABLE 1 Food Security in the Mountains of Pakistan*

Administrative Unit (AU)	Local food production		Food accessibility index	Food insecure population (%)	Food security index
	Net food availability (kcal/day/capita)	Food deficit/surplus (%)			
Plains					
Punjab	3,022	+29	3.4	38.5	8.7
Sindh	2,563	+9	3.0	44.3	7.1
Mountains					
Balochistan	1,779	−24	1.7	61.2	4.5
FATA	496	−79	0.1	67.7	0.3
KPK	1,677	−29	2.7	56.2	5.3
AJK	540	−77	0.8	46.9	2.2
GB	1,280	−46	0.6	52.4	1.0
Pakistan total	2,562	+9	—	48.6	—

*No data for the Capital Territory as it is urban. Data Source: Hussain and Routray (2012), Hussain (2010), SDPI (2009).

There are also many problems that adversely affect livestock production, especially poor promotion, low yielding local breeds, inadequate veterinary services, low capacity of flock owners, and poor market infrastructure. However, although the local livestock are low yielding, their requirements are minimal and they survive in water and forage stress situations (Raziq, 2010) producing environmentally friendly quality organic products in a very low input system that contribute significantly to both local and national food security.

POTENTIAL AND OPPORTUNITIES

The mountains of Pakistan are heterogeneous in terms of elevation, topography, climatic conditions, and environment. They can be classified broadly into different agro-ecological zones (figure 1), each of which has different issues and potentials in terms of food and livelihood security. In general, mountain areas are not very suitable for growing cereals, but they have a huge potential for production of a wide variety of food and non-food products such as fruit, nuts, off-season vegetables, seeds, and medicinal plants, which can be critical for improving livelihoods and food security. The sources and characteristics of livelihoods vary considerably with elevation of the mountain range and are affected by agro-ecological conditions, market access, and institutional services. Mountain areas may also have different accessibility, vulnerability, and mobility issues, and different land use and food production systems.

In GB, for example, the mountain ranges can be classified into four subzones with different agricultural characteristics, and also a considerable variation in the supply of institutional services: double cropping (< 1,900 masl), marginal double cropping (1900–2,300 masl), single cropping (2,300–3,000 masl), and alpine pastures with no cultivation (> 3,000 masl). The higher ranges have relatively less vegetation and are snow covered for the greater part of the year, but are still suitable for some agricultural production. The double cropping subzone has potential for cultivation of wheat, maize, vegetables, and fruit; the marginal double cropping subzone for wheat, barley, buckwheat, vegetables, fruit, and nuts; and the single cropping subzone for potato, wheat, barley, peas, faba bean, and apricot and other fruit. Livestock rearing, either by landowners or transhumant pastoralists, is common to all four subzones (Government of Gilgit-Baltistan 2013). In Balochistan and FATA, the mountains are mainly dry with less vegetation; they are vulnerable to drought but have a high potential for fruit, vegetable, and livestock production. Balochistan is divided into seven agro-ecological subzones in terms of cropping practices based on elevation and climatic factors (IUCN 2006). All subzones are suitable for fruit and nuts, with some variation in terms of fruit species and varieties, and most have a potential for

vegetable cultivation, particularly onion and potato, and pulses (IUCN 2006). Balochistan is also divided into six different subzones in terms of livestock potential based on climatic factors and plant biodiversity (Kakar 2012). There is a huge diversity in the species of animals and plants in these subzones; sheep, goats, and camels can survive in all of the subzones, with some variation in breeds, but cattle are only found in three. The mountain ranges in major parts of KPK and AJK have a much denser vegetation cover as a result of the higher annual precipitation. These ranges have the highest potential in terms of cereals, fruit, vegetables, and livestock production.

Due to increased connectivity and mobility, particularly the increased use of mobile phones and the Internet, mountain regions are now becoming increasingly connected to national, regional, and global markets. There is also a growing demand for mountain products from these markets. This offers new opportunities for exploiting the potential of mountain niche products and enhancing the food security of Pakistan's mountain communities. Some of the key potentials and opportunities are presented briefly below.

Fruit and Nuts

Mountain areas have a substantial comparative advantage for fruit, nuts, and other high value products, and in Pakistan's mountain areas, the cultivation of horticultural crops is increasing. The proportion of the total country production of major fruit and nut crops grown in the different AUs is shown in table 2. Balochistan contributes substantially to the national production of apple, apricot, cherry, fig, grapes, peach, pomegranate, plum, and almond; KPK contributes significantly to the national production of apple, fig, loquat, peach, pear, persimmon, plum, and walnut; while the smaller mountain AUs of FATA and GB contribute significantly to the production of apricot, cherry, fig, mulberry, and walnut.

Off Season Vegetables and Seed

Mountain areas also offer considerable opportunities for the production of high quality seed potato, vegetable seeds, off-season vegetables, and medicinal plants. The climatic conditions are conducive and the mountain areas could potentially meet the whole country's requirement for seed potatoes and vegetable seed. The conditions are highly suitable for the production of medicinal plants. The area under potatoes is increasing year by year, and there is a huge potential especially for ladyfinger, beans, tomato, cucumber, spinach, peas, and onion (Ministry of National Food Security & Research 2013; KPK Bureau of Statistics 2011; IUCN 2006; Planning and Development Department Northern Areas 2003; Government of AJK 1998).

TABLE 2 Proportion of Fruit and Nuts Grown in the Mountains of Pakistan

	Administrative units in total country production (%)					
	Mountain AUs				Plains AUs	
	Balochistan	FATA	KPK	Gilgit-Baltistan	Punjab and Sindh	Pakistan
Fruit						
Apple	73.4	8.9	14.4	2.8	0.5	100
Apricot	58.2	1.4	4.5	35.8	0.1	100
Cherry	47.0	0.0	0.0	53.0	0.0	100
Fig	19.7	24.5	55.8	0.0	0.0	100
Grapes	88.3	1.2	1.6	8.9	0.0	100
Loquat	2.5	8.6	42.7	0.00	46.2	100
Mulberry	0.0	2.2	11.0	75.9	10.9	100
Peach	33.6	6.8	53.9	5.3	0.4	100
Pear	2.3	4.0	81.8	11.4	0.5	100
Persimmon	0.0	4.3	95.7	0.0	0.0	100
Pomegranate	64.8	2.3	3.1	7.9	21.9	100
Plum	45.9	5.1	43.8	4.90	0.3	100
Nuts						
Almond	88.3	1.7	2.5	7.3	0.2	100
Walnut	0.0	13.6	53.4	33.0	0.0	100

Note. Data for AJK not available. Data source: Government of Gilgit-Baltistan (2007), KPK Bureau of Statistics (2011), Ministry of National Food Security and Research (2013), Planning and Development Department, Northern Areas (2003).

Livestock and By-Products

About two-thirds of the mountain area—60 million hectares—is rangeland. The rangelands extend from the alpine pastures in the northern mountains, to the temperate and Mediterranean ranges in the western mountains and the arid and semi-arid desert ranges of the dry western plateau. They are an important resource for livestock raising, which is a key source of mountain livelihoods and plays a pivotal role in the lives of rural farmers (table 3). Livestock not only produce food items such as milk, butter, and meat, but also provide valuable by-products like wool. In the absence of other means of subsistence, livestock provide the mainstay of more than 75% of the rural population (Shafiq and Kakar 2006). Balochistan, FATA, and GB have a higher proportion of rangelands, which provide a source of fodder for grazing livestock, particularly goats and sheep. Opportunities to increase livestock productivity and the volume of by-products such as pashmina wool are growing. In KPK, the Ajar pastoralist community (around 7,500 landless households) market small ruminants worth USD 68 million per year (Ojeda et al. 2012). Mountain pastoralists in Pakistan have a highly treasured livestock genetic pool with special traits adapted to the rugged terrain, steep slopes, and poor-quality forage, and resistant to diseases. These resilient breeds are optimally suited to fulfill mountain pastoralists’ needs for food,

cash, and coverage against drought. Their productive and reproductive performances relative to body weight are higher than those of advanced breeds (Rahim et al. 2013; Saleem et al. 2013).

Non-Farm Income

A rise in non-farm income may help improve economic access to food items coming from plain areas when mountain production is insufficient. Some additional non-crop income options based on forest products and migration are also summarized in table 3. Forest products provide a substantial revenue in KPK and FATA and improved forest management may also provide additional income opportunities for local people.

Migration

FATA, KPK, and AJK, have a higher proportion of workers who migrate overseas for employment, suggesting that the inflow of remittances to these AUs is substantial. Remittances offer a possibility for investment to improve local

TABLE 3 Non-crop Options for Mountain Food and Livelihood Security

	Mountain AUs					Plains AUs
	Balochistan	FATA	KPK	AJK	GB	Punjab and Sindh
Livestock						
Livestock heads per capita	3.7	1.8	1.0	0.9	1.1	0.8
Livestock units per capita*	0.6	0.4	0.3	0.2	0.2	0.3
Sheep and goats						
Population ('000)	24,589	4,784	12,962	1,577	1,565	42,723
Animals per capita	3.2	1.3	0.6	0.5	0.9	0.4
Rangelands						
Proportion of rangelands in total geographical area (%)	78.9	48.3	45.1	53.9	46	
Forest						
Proportion of forest in total geographical area (%)	4.1	13.1	11.6	9.2	4.4	
Share in total revenue generated from forest products (%)	1.9	34.6	13.8	0.1	49.6	
Remitting overseas workforce						
Share in total revenue generated from forest products (%)	1.1	8.8	8.3	13.1	0.4	3.2

Note. Data source: Agricultural Census (1990), Agricultural Statistics of Pakistan (2013), Bureau of Emigration and Overseas Employment (2013), Government of AJK (1998, 2012), Government of Gilgit-Baltistan (2013), KPK Bureau of Statistics (2011), Pakistan Bureau of Statistics (1996, 2006, 2010), Pakistan Forest Institute, Peshawar (2012).

*Method for estimating livestock units adapted from FAO (2005).

food and livelihood security both directly and indirectly, through enhancing income opportunities.

CHALLENGES TO FOOD SECURITY

Although there is a wide range of potentials and opportunities, mountain farmers face several biophysical and socioeconomic constraints and challenges, which limit optimal exploitation of the potential and affect food and livelihoods security.

Biophysical and Environmental Challenges

The shrinking resource base is posing serious environmental constraints across Pakistan's mountain areas. Mountain agriculture is highly integrated with a high degree of interdependence among cropping, forestry, fruit growing, and livestock production. However, the mountain areas are experiencing accelerated deforestation; soil erosion; siltation of rivers, irrigation systems, and reservoirs; desertification; loss of biological diversity; and degradation of rangeland and pastures, which together have led to a loss of soil fertility, reduced agricultural productivity, and reduced food security.

Over the past 20 years, land rehabilitation with monoculture afforestation in Pakistan's mountains has obstructed transhumance routes for herders and forced them to accelerate their migration to upland pastures in summer. Early arrival at the summer pastures has accelerated degradation as the animals graze on newly sprouted grass hindering maturation. Afforestation programs that included plantation of fodder species would have been an effective means for fulfilling land rehabilitation needs while providing fodder to pastoralists for their livestock (Rahim et al. 2011). This lack of planning and resultant increased degradation may also have contributed further to climate change: a study in the Naran valley showed that high altitude pasture management contributes more than cropping to climate change mitigation through carbon storage (Ojeda et al. 2012).

The threat of drought is also posing serious problems of ecosystem degradation and water stress in almost all zones (Shafiq and Kakar 2006). Annual precipitation in the western dry mountains and dry western plateau (figure 1) has decreased, leading to drought conditions. Between 1996 and 2002, there was only 50% of normal rainfall in summer and 37% in winter. The drought resulted in a serious water shortage for agriculture which affected nearly 2 million acres of cultivable land and 9.3 million livestock. Drastic changes in the structure of plant communities in the degraded rangeland ecosystem, and shortages of fodder and water, led to the death of 1.76 million livestock; close to 80% of apple orchards were destroyed.

Food prices rose, and the food security and livelihoods of nearly 2 million mountain people were affected, resulting in reduced food consumption and migration of people from drought-affected areas to areas downstream. As a coping strategy, livestock owners substituted bigger animals and sheep with local goats, which are more resilient to water and fodder/forage-stress but can have negative long-term environmental impacts (Shafiq and Kakar 2006). With climate change, droughts continue to be a problem. The continued water stress has led to excessive pumping of groundwater, resulting in further lowering of the water table, especially in some parts of Balochistan, with a significant impact on local food systems and food security.

In contrast, in the wet mountain areas and northern dry mountains (figure 1), frequent fluctuations in the intensity of precipitation have led to an increase in flood hazards, affecting the resource base and infrastructure in both upstream and downstream areas. The devastating floods of 2010 left close to 8 million people vulnerable to long-term food insecurity, the majority of them in mountain areas (WFP 2010). This has led to renewed concerns about food insecurity and calls for further investigation of the vulnerability of mountain communities with respect to food security.

Socioeconomic Challenges

Transportation infrastructure, storage and marketing, income generation, diversification of food resources, and capacity building all have an important role to play in improving mountain food security. Poor marketing facilities and inadequate policy and institutional support mean that mountain farmers do not receive a fair price for their products, which affects their agricultural and food security. Especially the producers of vegetables and fruit suffer from poor access to markets as a result of the poor road network and infrequency of collection centers. This allows intermediaries to charge very high commissions, which reduces the returns to farmers. The agricultural marketing system and storage facilities are particularly underdeveloped in Balochistan, FATA, and GB. For example, GB is an important producer of fruit and off season vegetables, but the lack of storage, packing, and transport facilities, and rough handling, result in 30 to 40% post-harvest losses to fruits and vegetables (Ali 2012; Awan et al. 2012), with a high proportion of wastage for perishable commodities such as apricot, cabbage, and tomatoes. In Balochistan and FATA, people feed a substantial portion of harvested fruit and vegetables to their livestock due to the limited access to markets (Hussain 2010). The poor marketing facilities, combined with disease, water-stress, and vegetation scarcity, mean that the production of fruit and nuts such as walnut and apricots is stagnating, or even decreasing, in spite of increased prices in national and global markets.

Although the agricultural system and food production depend on local biophysical conditions and access to services, overall cash crop production has been increasing and cereal crop production has been declining.

Moreover, there is a huge shift from traditional varieties to new varieties and from traditional farming practices to new farming practices. This has led to a deterioration in the local food system and increased the dependency on external sources for food grain. Although integration into the market system has increased mountain farmers' access to food through cash crops, it has made them more vulnerable to food insecurity due to frequent price shocks and disruptions in the transportation of food as a result of natural hazards.

TOWARDS A FRAMEWORK FOR FOOD SECURITY IN THE MOUNTAINS OF PAKISTAN

Food is fundamental to human existence and critical for social peace and stability. In order to enhance food security and social peace and stability, the government needs to strengthen efforts to remove existing constraints and challenges and convert potentials into opportunities in mountain areas through policy, institutional, and technical support. Mountain food security cannot be achieved without secured livelihood options, and mountain livelihoods cannot be improved unless the productive resources, such as water, land, forest, rangeland, biodiversity, and the natural environment, are conserved and their access and optimal utilization ensured. Thus from the mountain perspective, it is necessary to take a holistic approach. At the same time, in formulating strategies for food security, it is necessary to take into account the mountain specificities, including the ecological and environmental conditions and the challenges, needs, and opportunities for mountain communities.

Essentially, Pakistan's mountain areas can be divided into four types of area depending on whether they have high or low agro-ecological potential and good or poor access to markets, information, and institutional services (table 4). Different development strategies are needed for each of these different types of area:

1. Strategies for areas with *high potential and good access to market and services* should focus on exploiting the existing potential as much as possible through land use intensification, efficient water use, crop diversification, commercial dairy, and growing of cash crops that offer higher incomes; private investment in production and post-harvest facilities should be encouraged.
2. In areas with *high potential but poor access to markets and services*, the focus should be on removing the marketing constraints and developing infrastructure and institutional support so that the existing potential can be exploited optimally and sustainably.

TABLE 4 Area-specific Approaches Based on Agro-ecological Potential and Access to Markets and Services

Agro-ecological potential and suitability	Access to markets, information, and institutional services	
	Good	Poor
High	<p><i>Areas with high potential and good access to markets and services</i></p> <ul style="list-style-type: none"> ● Enhance support for high value cash crops, e.g. fruit and vegetable cultivation ● Establish fruit processing and storage facilities ● Promote horticulture, commercial dairy, and intensive food crop production ● Encourage private investment in irrigation, land management, and the agro-processing industry through institutional support ● Provide incentives for overseas workers to invest remittances in small and medium businesses in mountain areas 	<p><i>Areas with high potential but poor access to markets and services</i></p> <ul style="list-style-type: none"> ● Improve marketing facilities for fresh fruit, nuts, dried fruit, vegetables, and livestock products ● Improve transportation facilities, ICT access, and others ● Promote high-value, low volume crops such as non-timber forest products (NTFPs) and medicinal plants ● Promote subsistence food crops ● Develop infrastructure to enable utilization of the mountains' high agro-ecological potential ● Promote livestock, and livestock products and by-products
Low	<p><i>Areas with low potential but good access to markets and services</i></p> <ul style="list-style-type: none"> ● Promote local products such as crafts (e.g., woodcarving, shawls, carpets, caps) and services for markets ● Promote conservation technologies that enhance agricultural potential and utilize local niches, and provide incentives for conservation ● Encourage agro-forestry, tree farming for timber, and NTFPs and medicinal plants ● Develop local off-farm employment opportunities to reduce out-migration (e.g., the Prime Minister's youth loan scheme) 	<p><i>Areas with low potential and poor access to markets and services</i></p> <ul style="list-style-type: none"> ● Provide incentives for conservation and sustainable use of resources and develop mechanisms for payments for ecosystem services ● Encourage out-migration and non-farm activities. ● Promote subsistence agriculture with zero-tillage, mixed cropping, and livestock production ● Promote eco-tourism and recreation ● Develop and harness environmental services

3. In areas with *low potential but good access to markets and services*, strategies should focus on improving the use of existing facilities to promote non-farm activities, and providing economic incentives and appropriate regulations to promote the sustainable use and management of resources.
4. Finally, in *areas with low potential and poor access to markets and services*, strategies should focus on the subsistence use of resources and facilitation of out-migration to reduce the dependence on local resources and ensure food security.

In addition to the area specific approaches suggested above, some general approaches are suggested for consideration:

- *Developing local food systems.* Mountain food security is different from food security in plain areas because mountain people's livelihoods depend heavily on ecosystem services (provided, for example, by forests, pastures, rangeland, and surface water), and livestock and niche farming products such as fruit and vegetables. Agriculture is heavily dependent on water from glaciers, snowmelt, and springs, but traditional irrigation systems such as the *kareez* system in Balochistan are deteriorating as a result of low investment and poor maintenance. It may not be possible to achieve complete food self-sufficiency in mountain areas due to the land and environmental constraints, but revitalizing the traditional irrigation systems would help to increase local food production and reduce the dependence on external food supplies. Furthermore, technical assistance and institutional support need to be strengthened to increase livestock productivity and improve rangeland management in order to improve the food security of livestock dependent communities.
- *Strengthening existing institutional support* can also help to improve local production systems, for example action research, extension services, supply of subsidized credit and inputs, and crops and livestock insurance schemes for mountain farmers.
- *Developing an organized marketing system.* Although considerable quantities of fruit and nuts are grown in the mountain areas of Pakistan, farmers do not receive a fair price for these products due to poor transportation and marketing systems, which discourages increased production. The low volume of production, and the scattered and disorganized marketing system, is a major challenge in marketing mountain products. It is important to improve the transportation and marketing systems and to organize farmers into groups to help strengthen their bargaining power, increase the efficiency of marketing, and enhance economies of scale in marketing fruit and vegetables. Developing economic corridors and promoting cross-border trade of mountain products should also be considered.
- *Developing storage and processing facilities.* Fruit and nut growers also suffer as a result of the lack of storage, processing, packaging, and standardization facilities, which again leads to farmers receiving lower prices for their products, as well as increased post-harvest losses, which reduce overall food availability. Policy support is needed to encourage private sector investment in storage, grading, processing, and packaging industries. The government could offer financial and other incentives for private sector investment in mountain areas and strengthen ongoing efforts to develop infrastructure in these areas. Poor farmers do not have the

resources to develop storage and processing facilities, thus common facility centers where farmers can bring their produce for processing should be established at least at the provincial headquarters. Introducing solar drying at community level would also be useful for drying fruits and nuts.

- *Enhancing export competitiveness.* To utilize the full potential of fruit and nuts, ongoing efforts to improve market access need to be further strengthened. Measures should be taken to enhance the export competitiveness of fruit and nuts, especially in dried form, including strengthening technical support, and financial assistance to improve processing, packaging, and marketing. Special incentives and support might be given to the transport of high value and perishable products with a high demand in export markets.
- *Developing an organic certification system.* Demand for organic fruit and nuts is growing, both in Pakistan and in international markets, but this potential cannot be utilized at present due to the lack of an accreditation and certification system. Although most fruit and nuts are actually grown according to organic criteria, farmers cannot obtain the premium 'organic' price due to the absence of such a system. Furthermore, most of the fruit and nuts grown in Pakistan are grown by poor mountain farmers in remote mountain areas; the government could lobby for duty free access to developed country markets for products from these areas.
- *Strengthening the existing agricultural marketing information system.* Information from the existing marketing information system does not reach mountain communities in a timely or useful way. The system needs to be strengthened through the use of ICTs such as mobile phones, local FM radio, e-information systems, and other mechanisms to improve farmers' access to market information.
- *Encouraging the productive use of remittances.* Many mountain communities receive considerable amounts of remittances from overseas workers. However, these are rarely properly invested in the mountain areas. Adequate incentives and awareness-raising are needed to encourage mountain communities to invest in their local area to generate income opportunities and contribute to food security.
- *Managing the northern mountains for water and other ecosystem services.* In order to ensure continued flow of water and other ecosystem services to the downstream, mountain watersheds need to be properly managed. Appropriate incentive mechanisms such as payments for ecosystem services need to be developed to encourage mountain communities to use and manage the watersheds sustainably. Managing the natural resources and ecosystem services will help improve livelihoods and food security in both mountain and downstream areas.
- *Community engagement in natural resource management.* Forests and livestock are an integral part of livelihoods and food security for mountain people. They provide food, wood, fodder, fuel, medicine, and many more

goods and services to the rural people of these areas. Involving the mountain people in the management of the forests and rangelands would help both to improve the management and to improve the livelihoods and food security of the mountain communities.

- *Non-farm income opportunities for youth in mountain areas.* Young people are migrating from mountain areas due to the lack of income opportunities. There is a need to generate non-farm income opportunities to reduce out-migration and improve local livelihoods and food security. The Prime Minister's "Youth Business Loan" scheme, with subsidized service charges for youth, could provide a very important step towards improving the non-farm economy in mountain areas. Capacity building of youth on small and medium enterprises will be required to ensure the use of loans is effective and productive.

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REFERENCES

- Afzal, J., M. Ahmed, and I. Begum. 2008. Vision for development of rangelands in Pakistan: A policy perspective. *Quarterly Science Vision* 14 (1): 53–58.
- Ahmad, S., and M. Islam. 2011. Rangeland productivity and improvement potential in highlands of Balochistan, Pakistan. In *Biomass – Detection, production and usage*, ed. D. Matovic, 289–304. Rijeka, Croatia: InTech.
- Ahmad, S., M. Islam, and S. N. Mirza. 2012. Rangeland degradation and management approaches in Balochistan, Pakistan. *Pakistan Journal of Botany* 44:127–36.
- Akramov, K. T., B. Yu, and S. Fan. 2010. Mountains, global food prices, and food security in the developing world. IFPRI discussion paper 00989 (June 2010). Development Strategy and Governance Division, Washington, DC.
- Ali, T. 2012. Untapped potential of dry fruits and export. <http://tahirkatlang.wordpress.com/2012/05/12/untapped-potential-of-dry-fruityield-and-export> (accessed June 9, 2014).
- Awan, S. A., A. Hussain, T. Abbas, and R. Karim. 2012. Assessment of production practices of small scale farm holders of tomato in Bagrote Valley, CKNP region of Gilgit-Baltistan, Pakistan. *Acta Agriculturae Slovenica* 99 (2): 191–99.
- Bureau of Emigration and Overseas Employment 2013. *Statistics on province-wise workers registered for overseas employment by Bureau of Migration and*

- Overseas Employment during the period 1981–2013*. Islamabad, Pakistan: Government of Pakistan.
- FAO. 2005. *Livestock sector brief: India, livestock information, sector analysis and policy branch*. AGAL. Rome, Italy: Food and Agriculture Organization of the United Nations.
- FAO. 2008. Food security in mountains: High time for action. Brochure of the International Mountain Day 2008. http://www.fao.org/fileadmin/templates/mountainday/docs/pdf_2008/IMD08_brochure_En_LR.pdf (accessed March 11, 2014).
- Government of AJK. 1998. *Agricultural Statistics of AJK*. Muzaffarabad, Pakistan: Department of Agriculture (Planning Unit), AJK Secretariat Chattrar.
- Government of AJK. 2012. AJK at a glance. Planning and Development Department, Government of the State of Azad Jammu and Kashmir. <http://pndajk.gov.pk/Documents/Book%202012.pdf> (accessed April 28, 2014).
- Government of Gilgit-Baltistan. 2007. *Northern Areas Agriculture Statistics 2007*. Gilgit-Baltistan, Pakistan: Department of Agriculture.
- Government of Gilgit-Baltistan. 2013. *Major agro-ecological zones of Gilgit-Baltistan*. Gilgit-Baltistan, Pakistan: Government of Gilgit-Baltistan Department of Agriculture.
- Government of Pakistan Bureau of Statistics. 1990. *Agricultural Census of Pakistan*. Islamabad, Pakistan: Bureau of Statistics.
- Government of Pakistan Bureau of Statistics. 2013. *Agricultural Statistics of Pakistan 2012–13*. Islamabad, Pakistan: Bureau of Statistics.
- Government of Pakistan and IUCN. 2003. *Northern areas state of environment and development*. Karachi, Pakistan: IUCN Pakistan.
- Huddleston, B., E. Ataman, and L. F. d'Ostlanl. 2003. *Towards a GIS-based analysis of mountain environments and populations*. Rome, Italy: Food and Agricultural Organization. <http://www.fao.org/3/a-y4558e.pdf> (accessed March 13, 2014).
- Hussain, A. 2010. *Achieving food security in Pakistan: Assessment of current situation and policy issues at national and regional levels*. Saarbucken, Germany: Lambert Academic Publishing.
- Hussain, A., and J. K. Routray. 2012. Status and factors of food security in Pakistan. *International Journal of Development* 11 (2): 164–85.
- ICIMOD. 2008. *Food security in the Hindu Kush Himalayan region*. A position paper. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.
- Israr, M., and H. Khan. 2010. An analysis of livelihood sources in hilly areas of northern Pakistan. *Sarhad Journal of Agriculture* 26 (4): 665–672.
- IUCN. 2006. *Water requirements of major crops for different agro-climatic zones of Balochistan*. Balochistan, Pakistan: Water Program, Balochistan Program Office.
- Kakar, A. R. 2012. *Livestock Ecological Zones in Balochistan: Camel, food security and climate change*. Balochistan, Pakistan: Society of Animals, Veterinary and Animal Scientists (SAVES). <http://camel4all.wordpress.com/2012/01/02/livestock-ecological-zones-in-balochistan/> (accessed July 7, 2014).
- Khan, A. U. 2011. Mapping and measuring of multidimensional poverty in Pakistan: Static and dynamic approach. PhD diss., PMAS Arid Agriculture University.

- KPK Bureau of Statistics. 2011. *Agriculture statistics*. Khyber Pakhtunkhwa, Pakistan: Government of Khyber Pakhtunkhwa.
- Ministry of National Food Security and Research. 2013. *Fruit, vegetables and condiments statistics of Pakistan 2011–12*. Islamabad, Pakistan: Author.
- Mirza, S. N., S. Ahmad, and M. Islam. 2006. The vagaries of drought in Balochistan and strategies to reduce economic losses. *Journal of Agricultural Agricultural Research* 3 (1): 39–42.
- Ojeda, G., H. Rueff, I. Rahim, and D. Maselli. 2012. Sustaining mobile pastoralists in the mountains of northern Pakistan. In *Evidence for policy series. Regional edition Central Asia No. 3*. Bishkek, Kyrgyzstan: NCCR North-South.
- Pakistan Bureau of Statistics. 1996. *Pakistan Livestock Census 1996*. Islamabad, Pakistan: Government of Pakistan.
- Pakistan Bureau of Statistics. 2006. *Pakistan Livestock Census 2006*. Islamabad, Pakistan: Government of Pakistan.
- Pakistan Bureau of Statistics. 2010. *Population estimates for 2005 of administrative units*. Islamabad, Pakistan: Government of Pakistan.
- Pakistan Bureau of Statistics. 2011. *Energy and mining (160–164). Pakistan statistical year book 2011*. Islamabad, Pakistan: Government of Pakistan.
- Pakistan Forest Institute Peshawar. 2012. *Khyber Pakhtunkhwa rangeland policy* (Preliminary draft). Khyber Pakhtunkhwa, Pakistan: Government of Khyber Pakhtunkhwa. <http://www.pfi.gov.pk/Ranglandpolicy.html> (accessed April 14, 2014).
- Planning and Development Department Northern Areas. 2003. *Agriculture and food security*. Background paper (prepared by A. A. Hashmi and Shafiullah). Northern Areas (now Gilgit-Baltistan) strategy for sustainable development. Northern Areas, Pakistan: IUCN Pakistan Program, and Planning and Development Department.
- Rahim, I., D. Maselli, H. Rueff, and U. Wiesmann. 2011. Indigenous fodder trees can increase grazing accessibility for landless and mobile pastoralists in Northern Pakistan. *Pastoralism: Research, Policy and Practice* 1 (2): 1–20.
- Rahim, I., M. Saleem, H. Rueff, and D. Maselli. 2013. Conserving indigenous livestock breeds to benefit mountain smallholders. In *Evidence for policy series. Regional edition Central Asia, No 6.*, ed. M. Arynova. Bishkek, Kyrgyzstan: NCCR North-South.
- Rasul, G. 2010. The role of the Himalayan Mountain Systems in food security and agricultural sustainability in South Asia. *International Journal of Rural Management* 6 (1): 95–116. doi:10.1177/097300521100600105.
- Rasul, G., and M. Karki. 2007. Pro-poor policy agenda for sustainable agriculture development in the Hindu Kush-Himalayan region: Talking Points 2/07. Kathmandu, Nepal: ICOMOD.
- Raziq, A. 2010. Younas, M., and Z. Rehman. Prospects of livestock production in Balochistan. *Pakistan Veterinary Journal* 30 (3): 181–86.
- Saleem, M., I. Rahim, S. Jalali, H. Rueff, M. Khan, D. Maselli, U. Wiesmann, and S. Muhammad. 2013. Morphological characterization of Achai cattle in sedentary and transhumant systems in Pakistan. *Animal Genetic Resources* 52:83–90. doi:10.1017/S207863361200080X.

- SDPI. 2009. *Food insecurity in Pakistan*. Islamabad, Pakistan: Sustainable Development Policy Institute (SDPI), SDC, and WFP.
- Shafiq, M., and M. A. Kakar. 2006. Effects of drought on livestock sector in Balochistan province of Pakistan. *International Journal of Agriculture and Biology* 8 (6): 657–665.
- Shahbaz, B., Q. Shah, and A. Suleri. 2012. Livelihoods, basic services and social protection in north-western Pakistan. <http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7782.pdf> (accessed March 13, 2014).
- Tiwari, P. 2000. Land-use changes in Himalaya and their impact on the plains ecosystem: Need for sustainable land use. *Land Use Policy* 17 (2): 101–11. doi:10.1016/S0264-8377(00)00002-8.
- Tiwari, P. C., and B. Joshi. 2012. Natural and socio-economic factors affecting food security in the Himalayas. *Food Security* 4 (2): 195–207. doi:10.1007/s12571-012-0178-z.
- Ward, F. A., S. A. Amer, and F. Ziaee. 2013. Water allocation rules in Afghanistan for improved food security. *Food Security* 5 (1): 35–53. doi:10.1007/s12571-012-0224-x.
- WFP. 2010. *Pakistan flood impact assessment*. Rome, Italy: World Food Program.