Although close to extinction, the snow leopard and other endangered wildlife are still poached. Only combined efforts by national and international agencies to prevent illegal trade can be effective.
(Photo: J. Hangartner)

High mountain areas: a wildlife habitat

Cristina Boschi, Andrea Haslinger, Riccarda Lüthi, Bernhard Nievergelt

The Pamirs are renowned for their unique biodiversity and have long been a focus of special interest for scientists. Few animals are adapted to the extreme habitat of this arid high-mountain region (see table below). On the whole, the diversity of the fauna in the Pamirs is rather limited, with only 20 species of mammals. There is a complete absence of insectivores and bats, which cannot survive in these severe climatic conditions (Kuznetsov, 1948). Given the limited opportunities available to the Pamiri people to meet daily needs and generate income, exploitation of wildlife resources is an economic necessity. Wildlife is currently a source of meat for local people and of trophies for foreign hunters (WWF 2002).

The deteriorating economic situation in the wake of the transition in Tajikistan and the introduction of trophy hunting have led to an overall increase in pressure on wildlife in the Tajik Pamirs. The Marco Polo Sheep *(Ovis ammon polii)* and Siberian ibex *(Capra [ibex] sibirica)*, whose habitats are in the Eastern Pamirs, are particularly affected. The status of the Marco Polo sheep, which is found on several lists of endangered or threatened species, is a focus of major discussions regarding the sustainable use of wildlife resources.

Marco Polo sheep and Siberian ibex

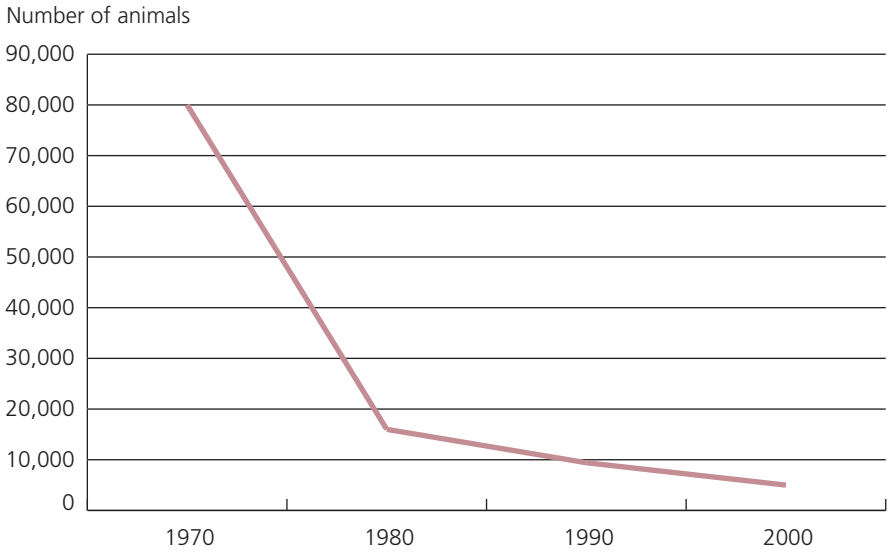
The survival of the Marco Polo sheep is of particular importance, as it can be considered practically endemic to the Tajik Pamirs, the small Wakhan Corridor of Afghanistan, the Pamir region of China, and possibly Hunza in Pakistan. Census data indicate a drastic decrease in the Marco Polo sheep population within the last 30 years, and even the population figures from the 1970s

Species		Estimated number (WWF)	Red List category (Krever)
Eastern Pamir			
Ruddy shelduck	*Tadorna ferruginea*	700–900	–
Mountain or Indian goose	*Anser indicus*	490	Vulnerable
Himalayan snowcock	*Tetraogallus himalayensis himalayensis*	2,000–2,800	–
Tibetan snowcock	*Tetraogallus tibetanus tibetanus*	90–100	Vulnerable
Tibetan sandgrouse	*Syrrhaptes tibetanus*	140–150	Critically endangered/endangered
Golden eagle	*Aquila chrysatus*	No data available	Vulnerable
Bearded vulture	*Gypaetus barbatus*	No data available	Vulnerable
Himalayan griffon	*Gyps himalayensis*	No data available	Vulnerable
Saker falcon	*Falco cherrug milvipes*	No data available	Endangered
Siberian ibex	*Capra ibex sibirica*	12,000–13,000	–
Marco Polo sheep	*Ovis ammon polii*	3,000–14,550	Vulnerable
GBAO			
Tolai hare	*Lepus tolai pamirensis*	2,500–4,000	–
Long-tailed marmot	*Marmota caudata*	250,000	–
Pamir fox	*Vulpes vulpes pamirensis*	1,200–1,300	–
Wolf	*Canis lupus desertorum*	180–200	–
Tien Shan brown bear	*Ursus arctos isabellinus*	10–12	Vulnerable
Central Asian otter	*Lutra lutra seistanica*	No data available	Vulnerable
Turkestan lynx	*Lynx lynx isabellinus*	20–25	Endangered
Snow leopard	*Uncia uncia*	180–200	Vulnerable

Estimated population of larger birds and mammals. (WWF 2002 and Krever et al. 1998)

The Siberian ibex – a source of revenue in the tourism sector – is not threatend species, unlike the Marco Polo sheep. (Photo: R. Middleton, AKDN)

appear to be exaggerated. The species is variously found on several lists of vulnerable, threatened and endangered species. Figures on the current population in the Tajik Pamirs range from 3000 to 14,550 animals, depending on the census methods and seasons. According to Prof. O. Aknazarov, Director of the Pamir Biological Institute, the total number of Marco Polo sheep at present is likely to be at the lower end of the above estimates, with a population of only 3000 to 5000 animals. Due to this species' economic importance, its status as a coveted trophy for sport hunters, its value of up to USD 35,000, and the fact that it is the focal point of diverging interests, population figures for the Marco Polo sheep are highly disputed. A comprehensive and independent census would probably be required for clarification.



Population of Marco Polo sheep in Tajikistan. (Source: Shackleton/IUCN 1997 and Aknazarov 2002)

The status of the much more widespread Siberian ibex is described as not threatened, although most populations face the risk of being severely reduced or even eradicated in many parts of their range (Shackleton/ IUCN 1997). According to estimates by the WWF, about 12,000–13,000 ibexes lived in the Eastern Pamirs in the year 2002. Wildlife in the Pamirs, particularly larger mammals (marmots, hares, snow leopards, Siberian ibex, Marco Polo sheep, etc.), are affected by (over-)hunting, interference from livestock and humans, and habitat degradation caused by livestock.

Hunting of wild ungulates

Although there is no doubt that hunting is the principal cause of the dramatic decrease in the population of wild ungulates, pressure from hunting varies in different areas of the Pamirs. Marco Polo sheep and Siberian ibexes are hunted mainly by local people and border patrol forces for meat in most regions close to settlements and roads. They are also threatened by legal sport hunting for hard currency, although to a much lesser extent. No more than 80 tourist hunting licences are granted per season for Marco Polo sheep (WWF 2002). Corresponding numbers for the Siberian ibex are lacking. Although the number of animals shot for trophies is far below the number shot for their meat, the effects of any type of hunting on the animal population must be considered with regard to sustainable use of this valuable resource (Shackleton/IUCN 1997).

The effect of hunting is seen not only in the decrease in wildlife population. Studies carried out at two sites in the Eastern Pamirs indicate that wild ungulates also respond to disturbance in terms of spatial and social behaviour. They retreat towards less accessible ranges with poorer vegetation and steeper slopes. They also switch to nocturnal activity, showing a less regular diurnal pattern, and live in smaller groups. Great hunting pressure also affects their behaviour when escaping. Alarmed animals run further away and disappear once they notice an intruder, while with less hunting pressure they soon return to their grazing and resting activities. Habitats are lost as a result, as observed at the test sites where Marco Polo sheep were excluded from optimal feeding grounds. Such enforced habitat change normally results in lower limits on population growth and negatively affects the physical condition of the animals.

Livestock and wild ungulates – competition and co-existence

In the high mountain regions of the Eastern Pamirs, where economic opportunities are very limited, herding of yaks, sheep and goats is the most important source of income and is done intensively. Consequently, it is not surprising that there is

Domestic animals such as yaks (see photo) and sheep prefer the same grazing areas as most wild ungulates. However, there is no evidence that grazing competition alone is a major factor that has a negative impact on the wild ungulate population.
(Photo: U. Lutz)

grazing competition on the small areas of good pastureland near the settlements, which are simultaneously typical wildlife habitats and ideal pastures for domestic animals. As a direct result, ungulates tend to shift their habitats to less disturbed areas at higher altitudes, on steeper slopes and in more remote areas. Such displacements to less suitable feeding grounds can have negative impacts on the condition and reproduction rates of wildlife populations.

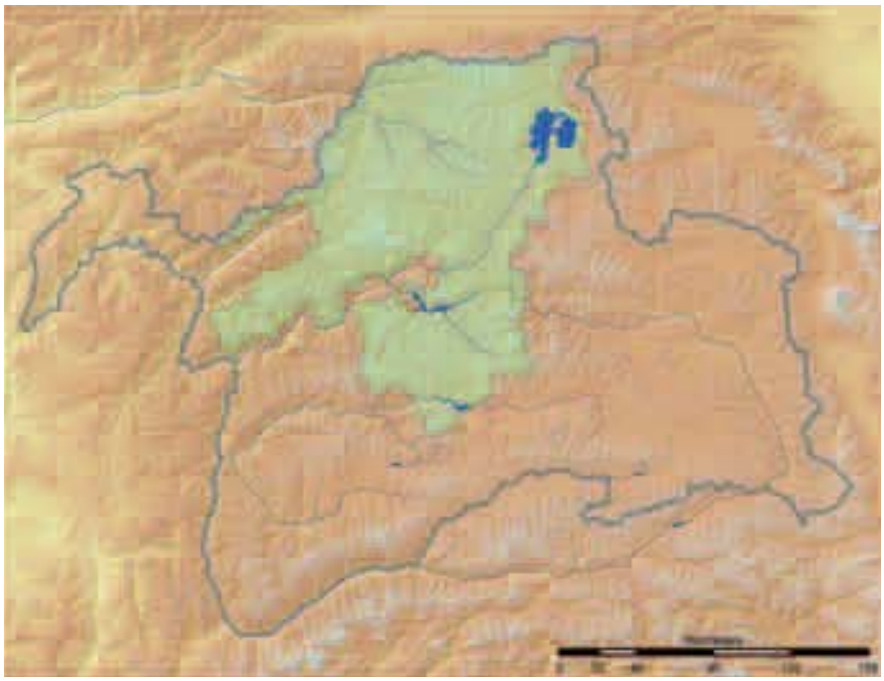
Indirect herding of domestic animals on rich feeding grounds in mountain valleys often results in changed behaviour patterns. In valleys with great and unpredictable hunting pressure, greater flight distance from herders, dogs and livestock was observed. The situation is different in areas with controlled and limited hunting. Here, it has been reported by locals that wildlife sometimes mixes with non-herded yaks while keeping a distance from sheep, which are almost always herded by a man, dog, or donkey to protect them against wolves.

In general, the impacts on wild herbivores from grazing competition with livestock do not seem to be a serious problem. However, competition should not be overlooked in summer pastures with unusually high sheep and goat stocking rates, as in the case of the Rankul area.

Probably more important for wild ungulates than grazing competition is the rapidly decreasing *teresken* plant. This dwarf shrub (*Ceratoides* spp.) is a valuable source of winter fodder for wildlife. The systematic gathering of this species by humans for use as fuelwood is having a negative impact on wild ungulate nutrition, particularly in winter. Animals can become susceptible to pronounced climatic conditions such as hard snow cover or extremely low temperatures. In summer, lack of *teresken* may reduce wildlife's capacity to accumulate fat reserves to survive the winter.

Combining conservation and economy

Given the limited options people in the Pamirs have to cover their daily needs, wildlife is an important additional resource. Among the various species, the Marco Polo sheep and the Siberian ibex play a crucial role, be it for food, hunting for sport, or wildlife observation safaris. The Marco Polo sheep, in particular, is a national asset that enjoys great international recognition. The reputation of this animal could stimulate international engagement in conservation projects and thus ultimately benefit other endangered species in the Pamir region as well. The strategies proposed below could be pursued to better meet the needs of the local population and protect the wildlife population, particularly the Marco Polo sheep and the Siberian ibex.



Location and extent of the Tajik National Park in the GBAO in 2002.
The sections of the park outside the boundaries of the GBAO are not shown.
(Source: Landuse Department GBAO, Khorog)

Local specialists and hunters at a workshop in Murgab. Compiling information about local conditions is a prerequisite for assessing the dynamics of habitat change. (Photo: C. Boschi)

Basic data on the Tajik National Park	
Mode:	Established in 1992 as National Park. Plans exist to include the Park as a Biosphere Reserve in UNESCO's Man and Biosphere (MAB) Programme and to enlarge its boundaries into neighbouring Kyrgyzstan to create an international transboundary protected area.
Location:	Mountain ranges in the northern part of Gorno Badakhshan Autonomous Oblast (GBAO), including the former Zakazniks, 'Muzkolski' and 'Pamirski'
Ecosystems:	In its southern part around Lake Sarez, the park includes unique, virtually undisturbed mountains; in the western part, mountain and forest landscape with rich fauna; in the eastern part mountain deserts, alpine meadows, and cushion flora; and in the northern part huge glaciers and rocky slopes
Current use:	14% of the area is used for agriculture; the remaining 86% consist of rocks, glaciers, snowfields and steep slopes. Two percent of the agricultural land is cultivated and 98% is used as rangeland (Badenkov and Buzurukov 1993)
Population:	2000–2500 Pamiri (Mountain Tajiks) and Kyrgyz people live inside the park
Size:	2.05 million ha ($^2/_3$ of the area of the Tajik Pamirs) within the GBAO
Objectives:	• Conservation of intact ecosystems, unique and various landscapes, flora and fauna, and historical and cultural monuments • Promotion of sustainable use of natural resources, tourism, environmental education, conservation of national traditions, improvement of living conditions • Realisation of research (botany, zoology, recreational resources) and restoration of natural, historical and cultural resources

Basic data on the Tajik National Park. (Source: Haslinger 2003)

Trophy hunting

As mentioned above, the Marco Polo sheep is one of the most valued trophy animals worldwide and hence a promising source of income. This fact can be taken as an invitation to institutions in Tajikistan to develop a system in which hard currency sport hunting in particular evolves into a dependable resource for financing needed conservation measures. Particular attention is necessary to ensure that an increased share of revenues find their way to local communities and that local people are fully integrated in the decision-making and allocation process. To achieve this, it will first be necessary to improve the decision-making basis. Given the uncertain character of data on wild ungulates (and other wildlife), the first step should be to establish a monitoring system. Secondly, since wildlife cannot be regarded as a hunting resource only, hunting by local people and tourists should be controlled and limited to a certain time of the year in specific areas, and be based on rules of sustainable wildlife management.

Breeding of wild ungulates

Marco Polo sheep and Siberian ibexes are well adapted to environmental conditions in the Pamirs. Both species can be kept in captivity due to their social system and natural grouping patterns: clearly visible age and sex classes (horn size, body size, etc.) promote a clear and stable social hierarchy. The high-quality meat of the Marco Polo sheep and Siberian ibex represents a further possibility for generating income.

The Marco Polo sheep and Siberian ibex are traditionalists in terms of spatial behaviour: they remain within their traditionally used areas. Therefore, immediate return into areas where they have been exterminated cannot be expected. Marco Polo sheep and Siberian ibexes bred on farms could serve as a breeding nucleus and be introduced in vacant areas. Introduction of such wild but habituated ungulates could also be an advantage in tourist areas: their shorter flight distance would facilitate wildlife observation.

Protected areas

Protected areas in Tajikistan are intended for maintenance of ecological balance, preservation of biological diversity, and collection of scientific information and data on interactions between humans and the environment. Currently three protected areas exist within the GBAO, covering an area of 27,500 km^2. Besides the huge Tajik National Park, Tajikistan has established the Zorkul Reserve near the Wakhan Corridor and the Muzkol Sanctuary. However, all three protected areas are still in the process of becoming operational or are still in the planning phase. Minimal available funding is currently a major limiting factor for effec-

A typical valley to be included in the Tajik National Park. Ecosystem conservation must ultimately be undertaken in cooperation with the local population and offer the benefit of improved living conditions. (Photo: J. Schneider)

tive implementation of park concepts. Once operational and provided with a modern zoning concept, these parks covering more than 50 percent of the Tajik Pamirs will greatly enhance the sustainable use of wildlife resources and could even become exemplary models of park management in similar mountain areas.

The Tajik National Park

To raise awareness among the local population of the Pamirs about conservation matters and sustainable use of natural resources, it is important to create alternative sources of income outside the dominant farming sector. The Tajik National Park presents a feasible option for meeting this requirement and thus minimising the pressure of exploitation on natural resources and ecosystems in the Pamir Mountains. For example, Marco Polo sheep could be an outstanding attraction in the Tajik National Park: given protection from hunting, these large mammals will learn to accept humans and thus be easily observable (Geist 1971).

Income from controlled hunting in defined areas could help finance infrastructure (and management) of the park. Therefore the experience of local experts with ecosystem management should be enhanced through adequate training and equipment.

The huge protected mountain area could become a Biosphere Reserve that includes not only the barren high mountain areas of the Eastern Pamirs but also the densely populated, rich but threatened ecosystems in the western foothills, thus conserving the rich biodiversity that could serve as a basis for further development.[1] Appropriate zoning and management of the park area would allow for a combination of protection measures, research, tourism, and sustainable use of fauna and flora. The park could be used for ecological educational purposes by raising awareness of the value and potential of the environment, as well as awareness of environmental threats. The involvement of local people in the decision-making process and in obtaining benefits will be a key element in implementation.

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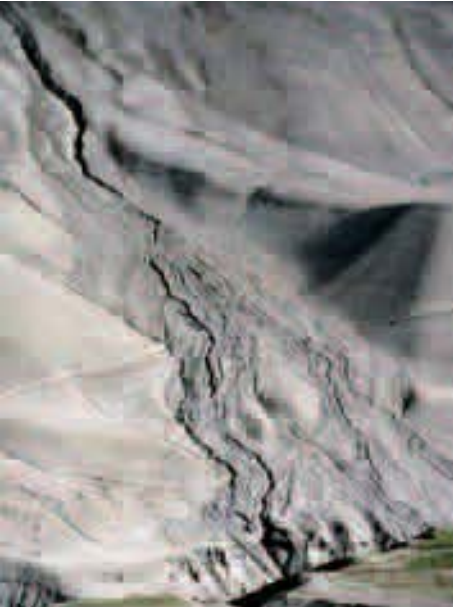
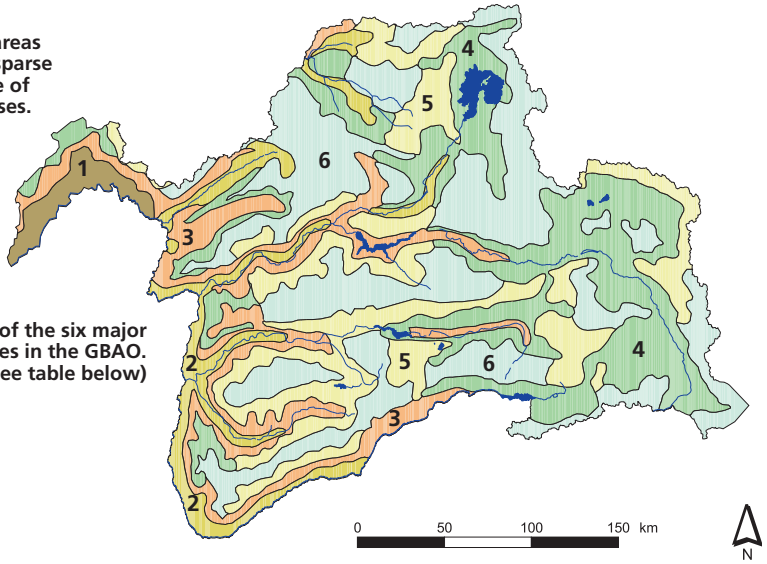
1 Within the framework of its Global Mountain Partnership Programme (GMPP), the United Nations University (UNU) is currently developing a programme entitled "Sustainable Management of Natural Resources in the High Pamir and Pamir–Alai Mountains: An Integrated and Transboundary Initiative for Biodiversity Conservation and Mountain Development in Central Asia", with the aim of contributing to this vision (see Hurni and Jansky 2001).



Geological conditions in vast areas of the Pamirs combined with sparse vegetation cover are the cause of various natural erosive processes. (Photo: P. Sieber)



Distribution of the six major ecosystem categories in the GBAO. (Legend: see table below)

Ecosystems and land resources

Christian Hergarten

Due to extreme climatic and geomorphological conditions, vegetation types in the Pamirs are extremely specialised. Given the physical conditions in the Pamirs, it is not surprising that resources such as vegetation, soils and wildlife are particularly vulnerable to any outside influence. Only through well-adapted and careful resource utilization practices can the Pamirs remain the home of an intact and productive ecosystem that provides a basis for sustainable livelihood systems.

Vegetation types

According to modern sources, the flora of the GBAO is composed of 2200 species of higher plants. Due to different microclimatic conditions resulting in different exposition, precipitation, slope inclination and soil composition, vegetation habitats are not distributed evenly throughout the Pamirs. Generally, the vegetation line is higher towards the centre of the mountain range. The ecosystems of the Pamirs can be subdivided into six major categories (see table and map).

	Ecosystem type	Characteristics/importance	Prominent plants (examples)
1	Mountain xerophytic light forest ecosystems (pistachio forets)	Dry, warm; small areas of the lower-lying western foothills of the Pamirs regulate surface runoff and serve as habitats for wild animals.	*Hordeum spontaneum* (wild relatives of barley), *Vicia tenuifolia, Amygdalus bucharica* (almond), *Diospyros lotus* (persimmon), *Zizyphus jujuba* (jujube), *Punica granatum* (pomegranate), *Vitis vinifera* (grape)
2	Mountain mesophyllic forest ecosystems (maple-walnut/ willow-poplar-birch forests)	These skirt the low-lying riversides of the Western Pamir (including Mesophyllic shrubs)	*Juglans regia* (walnut), *Acer turkestanicum* (maple), *Betula tianschanica* (birch)
3	Mountain coniferous forest ecosystems (small area in the Western Pamir)	Crucial for regulation/conservation of water resources (protecting steep slopes/ reinforcing river banks)	*Juniperus* spp.
4	High mountain meadow-steppe ecosystems	High biomass production; typical of the Eastern Pamirs	*Festuca altaica, Stipa kirghisorum* (feather grass), *Poa alpina* (meadow grass), *Carex melanantha, C. stenocarpa* (sedges), *Cobresia stenocarpa, Oxytropis savellanica, Thymus seravschanicus*
5	High mountain nival desert ecosystems	Very cold, little precipitation, high rate of evaporation (sublimation)	*Ceratoides* spp. (teresken), *Artemisia pamirica, A.Korshinskyi* (wormwood), *Ajania tibetica, Stipa glareos* (feather grass), *Oxytropis immerse, Acantholimon diaspensioides*
6	High mountain nival-glacial ecosystems	Very cold, rocky, frequent ice and snow	*Melandrium apelatum, Draba altaica* (whitlow grass), *Astragalus* spp. (milk vetch), *Saussurea glacialis*

The six major ecosystem categories in the GBAO (see also map above).

Land resources for agricultural use

Fragile ecosystems are endangered by intensified land use as a result of agricultural transformation and limited options for increasing the amount of arable land. In the Western Pamirs, the amount of arable land is currently about 24,000 ha,[1] which is roughly equal to 0.4% of the total area of the GBAO, or less than 0.12 ha per capita. Arable areas often have bright brown soils and are mainly located on alluvial fans in the deeply incised mountain valleys. In the Eastern Pamirs, high mountain desert soils predominate, allowing only very extensive forms of land use such as cattle grazing. The total area of pastureland is roughly estimated at about 7730 km² and little of the area with mountain steppe soils along meandering rivers can be used for fodder production.

Irrigation agriculture

Almost all arable land in the Western Pamirs is irrigated, owing to high evaporation rates and minimal rainfall during the summer. Irrigation agriculture can be found up to 3700 m. In general, however, soil quality and production are significantly

Proper planning and regular maintenance of irrigation systems are labour-intensive. Inappropriate schemes can lead to declining soil fertility, while leaking irrigation channels can trigger mudflows. (Photo: J. Schneider)

The forests in the Tajik Pamirs have almost completely disappeared over the last centuries, with only a few – frequently inaccessible – patches remaining today. (Photo: E. Kleinn)

reduced at these altitudes. Most of the fertile soils in valleys have developed under the influence of the diverse and highly threatened ecosystems of the Western Pamirs, such as the *tugai* forests.

Considerable efforts are being made to increase the yields from all crops. New species have been distributed to local farmers, and training courses in farming are being held for new and inexperienced farmers. These efforts have resulted in sharp increases in productivity and decreased dependence on food aid. But intensification has also led to the degradation of agricultural land, and signs of declining fertility are becoming obvious.

Agricultural techniques play a major role in preventing land degradation. Farmers seem to be aware of conservation practices such as crop rotation, fallow, contour ploughing, and cultivation of legumes for nitrogen fixation. However, they are often not in a position to apply such measures regularly, owing to immediate production needs or lack of funds. Soil fertility on agricultural land is gradually decreasing, especially as people use cattle dung for cooking and heating in winter. Chemical fertilisers do not appear to be a viable option, owing to their high price.

About 1000 ha of arable land have been reclaimed in the Western Pamirs during the last 2 years, aside from land used for intensified agriculture. However, such new areas are often very prone to degradation and must be observed carefully. The widely used practice of flood irrigation is an important trigger for wash-out processes, which sometimes result in gully erosion.

In general, both new and old irrigation systems have turned out to be key factors affecting both ecosystems and livelihoods in the Western Pamirs: most irrigation channels and systems have low levels of efficiency. Moreover, they are often built or carved underground on steep, unstable slopes, and leaking is a widespread phenomenon. It is quite common for these irrigation channels to destabilise slopes and trigger mudflows that pose a direct threat to settlements and cultivated areas.

Land resources in the Eastern Pamirs

Desert plains, steppes on high altitudes, and a harsh climate with little rainfall to alleviate desertification processes are the main bio-physical characteristics in the Eastern Pamirs.

Desertification processes have accelerated as a result of the prevailing large-scale pasturing in the past. As a result, high-mountain meadow plant communities were gradually replaced by inferior thorny herbs and desert herbs. The very shallow alpine desert soils of the pasture areas are highly prone to deflation and changes in protective vegetation. With the decrease in coal imports over the last decade, *teresken,* a slow-growing shrub, has been used on a large scale by locals for heating and cooking. As a result, soil depth has been reduced, desertification triggered, and the resource base that supports wildlife and domestic animals has decreased.

Small patches of high mountain meadow-steppe are found on pastureland, often in valleys with meandering rivers. Such meadows have much higher rates of fodder productivity. Even the soils are less subject to degradation, as they are consolidated by dense turf vegetation, while grazing intensity, particularly in the vicinity of settlements, is increasingly leading to deterioration of meadows.

Conservation and economic development

The major challenge to the ecosystem in the Pamir will be to strike a balance between protecting sensitive and limited agricultural land and meeting the livelihood needs of the local population.

In terms of immediate steps to preserve fragile natural resources, technical measures to relieve pressure on local fuel resources, such as the search for alternative sources of energy, will be essential. This could include reforestation of appropriate areas and effective protection of the last remaining forest patches in the Tajik Pamirs. The question of irrigation will have to be addressed by indirect measures that help to increase production and thus ease pressure on existing resources. Proper planning of new irrigation schemes and the rehabilitation, maintenance and appropriate operation of existing systems will be a necessity. Production that is more market-oriented and taps natural local potentials in a sustainable manner could also be an opportunity for development. The measures indicated above would certainly benefit from appropriate legislation that provides incentives and an enabling climate for investment.

Efforts that aim to preserve or restore natural resources cannot rely only on the measures described here. Synergies with other sectors of the economy will also need to be created in the long run. The chances for success will depend largely on considerable improvement of the economic situation at the community level.

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1 *http://www.grida.no/enrin/htmls/tadjik/soe2001/eng/htmls/landuse/tables.htm plus 1000ha new land (MSDSP).*

2 *http://www.grida.no/enrin/htmls/tadjik/soe/soils/soils3.htm*

Sources:

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