Chapter 8

Accessibility of the Bartang River valley and the Usoi Dam/Lake Sarez

8.1 Introduction

8.1.1 Objectives of the accessibility sub-project

- Determine the degree of accessibility of the Usoi dam for heavy equipment.
- Investigate the existing road infrastructure.
- Identify methods and route to construct/improve a road in the Bartang River valley.
- Assess project costs.
- Assess capabilities of local contractors to perform the work.

8.1.2 Carrying out of the above tasks

The sub-team carried out the above tasks by:

- Walking downstream from Usoi dam to the village of Barchidev.
- Travelling by car through the Bartang and Panj River valleys from Barchidev to Khorog.
- Travelling by car through the Kudara valley from Rukç to Kudara.
- Travelling by car along the major route from Khorog to Dushanbe, via Kulyab.
- Conferring with Tajik experts.

8.2 Accessibility to Gorno-Badhakshan Province and the Usoi landslide dam

8.2.1 Overall status of accessibility

The problem of the accessibility to Gorno-Badhakshan Province and the Usoi dam is not a local problem, it reflects the generally poor condition of transport in Tajikistan The condition of roads in Tajikistan is normally very poor; they prove unreliable from season to season, and most vehicles are obsolete.

8.2.2 Main routes from Dushanbe to Gorno-Badakshan

The Province of Gorno-Badhakshan, where Lake Sarez is located (fig. 1), can be reached from the capital, Dushanbe, by two routes:

- The first, via Osh, Kyrgyzstan, to the north and east of the Pamir Mountains and then south to Murgab and Khorog, is a high, difficult route, but represents the primary access road to Gorno-Badhakshan.
- The alternate route, currently under construction, reaches the city of Kulyab, and then follows the Panj River upstream along the Tajik-Afghar border to Khorog. This road, due to difficult terrain, limited design standards, and crude standards of construction, is even more unreliable and inaccessible to heavy traffic than the above route through Kyrgyzstan.

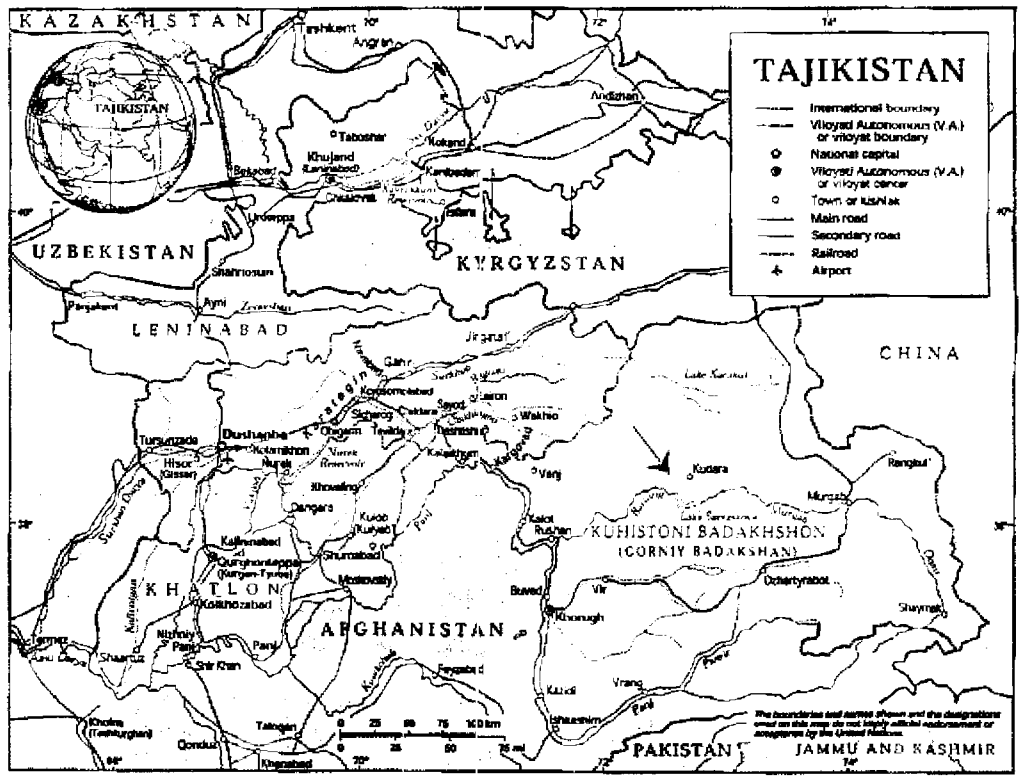

Figure 1. Map of Tajiskitan and surrounding area. Arrow indicates location of usoi dam/ Lake Sarez.
Source: Map No. 3765 Rev. 9 United Nations, Departament of Public Information Cartographic Section.

Place names mentioned in text:

Barchidev:	First village downstream from Usoi dam.
Bartang River:	Trunk river formed by joining of the Murgab and Kudara Rivers downstream from Usoi dam. Flows into the Panj River.
Dushanbe:	Capital city of Tajikistan.
Khorog:	Main city of Gorno-Badhakshan Province.
Kudara River:	Tributary stream that joins the Murgab River at the point where the two streams form the Bartang River.
Kulyab (Kuliab):	Main city located approximately midway on the route from Dushanbe to Khorog.
Gorno-Badhakshan:	Administrative region (oblast or province) on the main road from Khorog to Osh to Dushanbe.
Lake Sarez:	Lake impounded by the 1911 Usoi landslide.
Murgab River:	The river that feeds Lake Sarez and continues downstream to its confluence with the Kudara River to form the Bartang River.
Murgab (town):	Town in Gordo-Badhakshan on the main road from Khorog to Osh to Dushanbe.
Osh:	City in the Republic of Kyrgyzstan on the northern route from Dushanbe to Gordo-Badhakshan.
Pamir Mountains:	Major mountain range in southeastern Tajikistan; it roughly corresponds to the area of Gordo-Badhakshan.
Panj River:	River into which the Bartang River flows; it forms the border between Tajikistan and Afghanistan.
Rvahan:	Town at the confluence of the Bartang and Panj Rivers.
Usoi:	Name of the 1911 landslide that buried the village of Usoi, formed the Usoi landslide dam, and impounded Lake Sarez.

At present the most likely route to Gorno-Badhakshan from Dushanbe is the first alternative given above, which circles the Pamir Range from the north and east through the city of Osh, Kyrgyzstan, which has international railway connections If travelling non-stop by means of a modern, 4WD light vehicle, the 350-km-long road between Kulyab and and Khorog requires about 14 hours The entire Province of Gorno-Badhakshan can be considered to be very inaccessible for heavy vehicles and totally inaccessible to trucks with trailers.

8.2.3 Accessibility to Usoi dam

There are two traditional routes to Usoi dam and Lake Sarez:

1) upstream along the Bartang River valley, and
2) via the Kudara River valley

Access through the Kudara valley, which entails entering the upper Kudara valley after leaving the main Osh-Khorog road at Lake Karakul, was previously supported by the Soviet Union. Because the Kudara valley route is longer and more tortuous than that through the Bartang valley, this option has lost favor in recent years.

Accessibility via both routes is very difficult, topographic conditions are extreme, and the existing roads are absolutely inadequate for transport of heavy equipment. An access road for the purpose of mitigative construction at Usoi dam would require a paved surface, structurally adequate bridges, radius of curves of not less than 25 m, and gradients not exceeding 9 percent. Such an endeavour would require structural works (bridges, culverts, retaining walls, etc.) to deal with problems imposed by the local mountainous terrain. The required construction would impact substantially both the environment and the social conditions of the local population. Precious portions of usable terrain would be subtracted from human settlements In addition, road construction would encounter erosion and slope instability along the right-of-way.

Both routes pass through the village of Barchidev, about 20 km downstream from Usoi dam. However, no road exists between Barchidev and Usoi dam. On-site investigations have ascertained that construction of an access road from Barchidev to the dam crest is technically feasible, but would require a greater investment in money and time than the value of the structural intervention at the dam for which purpose the road would be constructed.

The only route that seems feasible for a Barchidev-Usoi dam road is along the lower slopes south of the Murgab River, from Barchidev upstream to the springs (seepage from the lake) at the base of Usoi dam, and then crossing the debris-flow deposit at the right end of the dam in a deep, wide trench leading to the dam crest. Construction and maintenance costs of such a road would be considerable. Local contractors would be unable to carry out construction works and, at international prices, costs could exceed US$ 800,000 per kilometre. Thus, construction of a road suitable for heavy traffic along the Bartang or Kudara River valleys upstream to the village of Barchidev and from Barchidev to the dam crest, would require such an enormous amount of investment as to strongly discourage this option.

8.2.4 Alternative routes to Usoi dam

Two additional possible access routes have been discussed.

- The first access alternative turns north from below the outlet from Lake Yashulkul on the Khorog-Osh-Dushanbe road. This route crosses a mountain range with passes exceeding elevations of 4,000 m, and ultimately enters a valley descending to Lake Sarez The terminus of this route is a bench, about 100 m above lake level, located immediately to the east of the existing base camp on the left (south) shore of the lake This bench, formed by an ancient landslide, is composed of a mixture of rock fragments and

soft mud. During an on-site inspection, tracks of trucks could be observed on the soft terrain. This observation indicates that heavy vehicles have traversed this high-elevation route, but there is no knowledge of the path taken by the road, which promises to be very high and difficult. The length of this possible route is about one third of that following the lower part of the Bartang valley, but the accessibility and engineering problems could be more difficult.

- The second route proceeds east from the town of Murgab This route is probably the key to access of heavy equipment to the dam crest and, realistically, is the only possible alternative to transport of this equipment by helicopter. This route leaves the Khorog-Osh-Dushanbe road at Murgab and proceeds down the course of the Murgab River to the upper end of Lake Sarez. Heavy equipment could then be transported by ferry from this point on the lake to the vicinity of Usoi dam. This route is considerably shorter than the one in the Bartang valley. In addition, inspection of available maps suggests that the topography crossed by this route is more favourable for construction of a road suitable for transport of heavy equipment than that of the connecting route from the Khorog-Osh-Dushanbe road. Other important advantages are offered by the possibility of reaching Lake Sarez directly from Murgab, saving at least a two-day trip, as compared to the Murgab-Khorog-Rushan-Lake Sarez route.

8.3 Rehabilitation of existing road in the Bartang Valley

8.3.1 Present situation

The installation of communication lines, equipment, and facilities connected with the early warning system in the Bartang River valley will require safe and efficient travel in every season along the existing road in terms of both operations and maintenance. Guaranteed access to the Bartang valley is essential for this to be possible

The topography and geomorphology of the Bartang valley are extremely difficult and unstable Erosion and landslides are common

Bridge in the Bartang valley. Photo credit: Bruno Periotto.

phenomena, and the right-of-way of the road frequently encounters critical situations where it crosses alluvial fans and/or torrents, or where it is immediately adjacent to the Bartang River. At present, the road is a rough track in such poor condition that it can barely be traversed using 4WD light vehicles. Average practical vehicle speed does not exceed 15 km/h, and, in the presence of snow or ice, the road cannot be travelled at all. The basic location of the route is adequate, but the alignment and longitudinal profile should be revised along 100 km of the 130 km connecting the villages of Rushan, at the confluence of the Bartang and Panj Rivers, and Barchidev. However, the first (i.e., downstream) 30 km of the road are in acceptable condition. The road also requires application of adequate gravel surfacing.

8.3.2 Summary description of needed rehabilitation of Bartang Valley road

The design criteria for this road will be determined by the complex morphology of the valley and by the limited abilities of local contractors. Geometric criteria and construction procedures commonly adopted in road construction would impact negatively the environment and the economy of the valley, as a result of the delicate environmental and cultural balance of villages that are located on highly erodible river terraces, alluvial fans, banks of raging rivers, at the toes of unstable slopes, and adjacent to primordial but sophisticated irrigation systems. Under such conditions, it is necessary to adopt pragmatic standards for design and construction. Rehabilitation of the road in the Bartang valley should be done so as to have minimum impact on the valley. Design standards should reflect the specific use for which the road is intended. The level of service to be aimed for, in terms of vehicle speed and maneuverability, traffic interruption, safety, and economy, should be consistent with the primary needs of continuous accessibility and minimal environmental impact. In addition, because of the considerable road lengths involved, any significant upgrading of design standards could lead to an enormous, unjustified increase of costs.

The principal parameters that should determine the road design standards are:

- Low, light traffic flow.
- Low design speed.
- Minimum impact to the road surface.
- Minimum cost of road-related structures.

Design criteria for the above elements are presented in annex 8-1.

The most typical feature of the existing road is its single-lane track. This single-lane roadway, a necessary choice at the time of original construction, must not be considered a limiting condition in future plans. Accessibility and capacity of the road can be increased by a proper number of turnouts placed alongside the single-lane track at regular intervals, together with required widening on curves. With these modifications, a single-lane roadway offers a satisfactory level of service, affords several technical and economic advantages during construction of the road and makes maintenance much easier than for the original single-track road.

In addition to adding turnouts and widening curves, priority should be given to improving the existing roadway. This can be achieved by construction of retaining walls made of steel-mesh gabions, in order to allow the road to follow the contour of the slopes as much as possible. Gabions should also be constructed to protect embankments from erosion where the road runs adjacent to the river and to protect the road across unstable slopes. Gabions and dry masonry walls (i.e., stone walls) will help to minimize slope excavation.

Crossings of most tributaries of the Bartang River, at locations without bridges, can be achieved by installing pipe or box culverts to serve as drains for average stream flow. At these sites, flood discharge can be controlled by installation of erosion-resistant, stone-paved overflow sections across the surfaces of the road embankments. Paved fords at stream level are recommended for crossing minor streams Paved fords are preferred to bridges for minor streams because:

1) they do not reduce the flow cross section; thus, they are not as subject to erosion during flood discharge as are bridge abutments;
2) they can be installed using local materials; and
3) they are easy and economical to maintain.

The suggested labor-intensive structural construction is consistent with local construction capabilities and requires limited use of heavy mechanical equipment. Training will be required for all personnel to ensure that construction is carried out properly, with minimal social and environmental impacts.

8.3.3 Estimation of costs for rehabilitation of Bartang Valley road

Improvement of the general alignment of the Bartang valley road to make it safe and comfortable for light vehicles, as well as adopting uniform design standards and construction procedures, will require investments estimated to be between US$ 300,000 and US$ 600,000 per kilometre. These high figures are justified by the very difficult terrain in the Bartang valley, as well as by the difficulty of access to Gorno-Badakshan, where the Bartang valley is located. These costs conflict with the extreme poverty of the local population. Adopting the suggested design standards and labor-intensive technologies, and involving the local population, will lower the estimated costs to approximately one fifth of those given above. Time required for reconstruction is estimated at approximately 36 months.

8.3.4 Maintenance of the Bartang Valley road

Maintenance of the Bartang valley road should be supported technically and financially primarily by the oblast (provincial) government, but carried out by local authorities and communities. Involving local communities and populations as much as possible in building and maintaining the road will make them able to assume primary responsibility for the road, creating considerable local employment, as well as pride in their accomplishment

8.4 Environmental and social aspects of reconstruction of the Bartang valley road

8.4.1 Existing environmental/social conditions in the Bartang valley

The morphology of the Bartang River valley is characterized by the alternation of narrow rocky canyons and wider valley floors with unstable slopes along the margins. The Bartang valley is very dry; rainfall does not exceed 100 mm/year. The Bartang River and its tributaries, which are fed by abundant snowmelt during the warm season, provide water for human activities and for agriculture. The only green oases of vegetation present in the valley are concentrated on alluvial terraces formed by deposition of debris, sand, and mud inside the meanders of the Bartang River or at its confluences with tributaries. Human settlements and agricultural activities are located on these oases Sophisticated irrigation systems divert river and tributary water to the fields by means of trenches excavated on the mountain slopes at slight gradients. The irrigation channels feeding water to the villages often cross or run parallel to the road without protection.

8.4.2 Potential environmental impacts

Planning for the rehabilitation of the existing road in the Bartang valley should consider the following potential risks:

- Road embankments running alongside the river could reduce the cross section of river flow, resulting in bank erosion, and thus causing retreat of inhabited landforms, particularly those prone to erosion.
- Increase in vehicular traffic could damage irrigation systems if the channels are not protected.
- Dust raised from the road and blown by vehicles could damage crops along the side of the road and pose a health hazard to local inhabitants
- Deep cuts in steep slopes could increase slope failures.
- Blasting should be limited or avoided wherever possible. Because of the high incidence of slope instability, indirect impacts of blasting could be disastrous

8.4.3 Social and economic impacts

Distances between individual villages in the Bartang valley vary from 4 to 28 km. The largest town, Rushan, is located approximately 130 km downstream from the village of Barchidev and 155 km downstream from the Usoi dam. Because of these distances, contacts between people of different villages are limited. People often walk from village to village, sometimes covering very long distances, because they lack efficient means of transportation or communication. There is no postal service in Tajikistan.

The installation of an early warning system in each village of the Bartang valley, based on a network of satellite telephones, which will also be usable as normal telephones, will raise the demand for transport in the valley. This communication, in fact, undoubtedly will induce

- Increased opportunity for inhabitants of the valley to trade and sell agricultural products and cattle to neighboring villages.
- Improved access to markets of the region.

A bridge in the Bartang valley. Photo credit Bruno Periotto.

- Possibility of developing new craft activities because marketing of these products will be improved.
- Possibility of introducing money-producing tourist activities, such as hiking/trekking/climbing and canoeing/rafting.
- Possibility of more easily accessing sanitary facilities, including disposal of village waste materials
- Improvement of social contacts among the different villages

Basic village development activities (irrigation, rural electrification, radio communication, etc.) are being promoted by NGOs (notably, the Aga Khan Development Network and Focus Humanitarian Assistance) in the Bartang valley. Improving the road to meet the above-described basic standards will help such development efforts to be more reliable and sustainable. Presently, this plan for rehabilitation of the Bartang valley road is the only proposed road activity that promises to have a meaningful benefit-cost ratio. The same cannot be said for any higher standard required for the transit of heavy vehicles aimed at structural interventions at the lake.

8.5 Road infrastructure in Tajikistan

Transport facilities in Tajikistan suffer from poor condition and relative inefficiency Seventy-five per cent of the paved roads require reconstruction or some rehabilitation Mountain roads are cut into landslide-prone slopes and are under permanent risk of destruction during the rain and flood season, mostly because of the absence of any kind of structural works.

8.5.1 Current status of mountain roads in Tajikistan

The process of construction of roads in Tajikistan, and particularly in the area of the Pamir Range, generally reflects the difficult economic situation in the country. Information supplied by Col. Sultan (State Committee on Emergencies), from road engineers on his staff in Khorog, and from the road maintenance personnel responsible for the roads in the vicinity of the village of Nusur in the Bartang valley, emphasize the scarcity of equipment and resources available for road construction and maintenance. Construction and maintenance of roads are carried out by state construction enterprises of national, oblast and rayon (regional and provincial) status, depending on the size and complexity of the works.

Engineers involved in road design, construction, and maintenance look unfavorably on road construction by private contractors. Roads are designed according to Soviet Union standards and norms, but, in actual construction and maintenance, standards and norms are generally ignored.

The vague information acquired from those responsible for transportation facilities in Gorno-Badhakshan indicates that construction, rehabilitation, and maintenance works are carried out without particular attention to design standards and with no regard for costs. Unit prices for most common road workings were not available

Engineers, mainly operations and maintenance staff, currently have limited design experience. They should receive training that will enable them to carry out high-quality and environmentally friendly methods of mountain road design, construction, and maintenance.

Traffic is normally occasional and, in secondary valleys like the Bartang Valley, is practically non-existent, mostly because of the very poor condition of the roads. Most of the vehicles are obsolete and lack maintenance. Trucks with trailers are very rare and only the main roads in relatively non-mountainous areas are accessible to such vehicles

Geomorphological and hydrogeological conditions in Pamir are critical to the transportation system. The roads are often located on steep talus slopes, on rocky sidehills, or across unstable landslides and seasonal torrents. Rainfall is meager, but the high seismicity of the region and the abundant snowmelt provoke rockfalls, landslides, and debris flows that negatively impact the transportation system.

Mountain roads - or, more appropriately, mountain tracks - are built without use of any structural facilities Because the constructors have available only earthmoving methods and equipment, the resulting alignments are extremely tortuous and bumpy. Sidehill cut-and-fill roads are built simply by cutting the slopes and placing the material in fills without installing retaining walls Thus, these roads have no protection from failure of either cut or fill slopes.

Roads usually have a single carriageway, and the average width does not exceed 3-4 m; in addition, roads often have no shoulders. Very tight and steep hairpin curves are common, and the gradient, for short stretches, can be as great as 15 per cent. Unpaved fords are common.

No gravel surfacing is used The road surface is simply that resulting from cutting of the terrain Roads have no curbstones; short walls made by dry stone masonry protect only a limited number of dangerous curves. Road signs are crude and rare.

Only 4WD light vehicles can travel these roads in relative safety; the average speed is, in most cases, about 15-20 km/h

8.5.2 Construction techniques

Plants and machinery used for road construction and maintenance date back to the period in which Tajikistan was part of the Soviet Union. This equipment commonly suffers from a general lack of maintenance, and much of it is out of commission because of a lack of spare parts.

Road construction methods have been observed by the author at construction sites along the major Khorog-Kulyab highway. Earthmoving makes intensive use of blasting techniques with the intent of displacing huge masses of rocks and, at the same time, to establish the approximate road section. The broken rock mass is then shaped into a roadway by 16-to-20 ton bulldozers. The surface of the resulting road, lacking any prepared base or a gravel surfacing, is extremely rough. Very large bumps are formed in the blasting process. The roads are also prone to local settlement, and the highly fractured rocks often are susceptible to local sliding activity.

8.5.3 Maintenance of mountain roads

Single workers from the village communities commonly carry out maintenance of mountain roads individually; the stretches assigned to each worker are usually 10-15 km long. This work is carried out mostly manually because there is no mechanized maintenance equipment or transport facility available. Where landslides occur, the resulting obstructions and damages cannot be removed or repaired, the road path is simply modified to cross over the debris.

8.6 Needed studies – assessment of accessibility to Lake Sarez

The most appropriate road route to the Usoi dam and Lake Sarez has not yet been identified. Therefore, the following studies are needed:

The topography and geology of the valley of the Murgab River upstream from Lake Sarez - and of a parallel valley between Murgab and Lake Sarez - are currently not well understood and are worthy of careful investigation. Adequate topographic maps of the area should be obtained, at a scale of at least 1:50,000.

An on-site study is needed to evaluate the feasibility of a road to Usoi dam and to estimate the cost of constructing such a road. Costs of transport on Lake Sarez by means of ferries should also be assessed Further investigations should be carried out to determine the accessibility to the region of Gorno-Badakshan using different means of transport, such as by road, railroad, or aircraft. A cost assessment of the transport of heavy machinery and equipment from other countries also would provide needed basic information.

Chapter 9
Human geography/demography

9.1 Introduction

The purpose of this sub-project was to assess the geographic/demographic situations of the settlements below Lake Sarez in the Bartang valley, downstream to its junction with the Panj River at the village of Rushan, and, from there, downstream along the Panj River to include the villages of Dehrushan, Barushan, and Shipad. This approach neglects the villages on the Afghanistan side of the Panj River, in part because of inaccessibility. The assessment also attempts to determine the number of people at risk in the event of any major natural catastrophe emanating from Lake Sarez, and to indicate the existing local ability to respond to, as well as to participate in, the introduction of an early warning system.

9.2 Prior state of knowledge

Earlier Russian/Tajik studies (over the last several decades) on the stability of the Usoi landslide dam/Lake Sarez did not consider the risk to inhabitants of the valleys downstream from the lake. Work in Gorno-Badakhshan Province, in general, supported by FOCUS - Humanitarian Assistance, has provided a much-improved data base on the actual number of villages, size of populations, and locations in relation to the rivers. Information on nutritional status, level of employment, and degree of food self-sufficiency has also been acquired. In terms of the Bartang valley itself, much of the specifically relevant data were collected by Donald Alford during his reconnaissance in October 1998, and which he is currently entering onto a GIS.

9.3 Current investigation

Apart from the short time spent in Khorog, work was restricted to one day along the Panj River between Khorog and Shipad, parts of two days in the Bartang valley with an overnight stay at Basid, and general observations during the drive out from Khorog downstream along the Panj. The severe restriction of the period of field observation was in large part due to transportation difficulties. Thus, the results are best classed as supplementary to those of Alford (1998).

Only a very small number of interviews (10) could be completed in the time available for this study. These took the form of standard questions with the aid of interpreters, followed by open-ended discussions relating to attitudes and locally perceived responses to the prospect of a disaster that might result from an outbreak flood from Lake Sarez. The general situation, based both on the interviews and on personal observations, indicates that the Panj River valley settlements, including Rushan, should be considered separately from those of the Bartang River valley.

Due to the small number of interviews this report is largely anecdotal and will depend upon the introduction of a series of working hypotheses that will need to be tested by future research:

- The older inhabitants are less concerned about the threat of Lake Sarez than the younger ones, especially those with small children. From this it would follow that the older inhabitants are less likely to respond to any disaster-response plan;

- People living closer to the lake (especially in the Bartang Valley) are much more sensitive to the potential dangers than those living farther away;

- Government and NGO discussions of the Lake Sarez problem in recent years have contributed to a degree of artificially increased fear of a possible catastrophe.

This Shipad lady was born in the house where her parents lived at the time of the 1911 earthquake that created the Usoi Dam and Lake Sarez. She has no fear of any flood arising from a possible outbreak of the lake. Photo credit: Jack Ives

9.4 Present situation

While some of the older residents maintained that they had lived all their lives downstream from Lake Sarez, as had their parents, and they did not believe that any significant danger existed, at the local government level some serious steps were being taken to prepare for a substantial threat. The villages along the Panj River had already identified sites to which existing houses and community buildings should be moved as a mitigative measure. Such a move would depend on completion of the anticipated flood-routing map and, equally important, on the provision of financial subsidies. It was stated that any such relocation would be planned in stages, and many of the existing buildings were probably already in safe positions. Thus, the latter could be used for emergency shelter in the event of a disaster occurring prior to the completion of any relocation action.

Throughout the area of the investigation, it is apparent that the overall level of education is remarkably high. Very intelligent discussions were possible concerning the difficulties of living in a hazardous mountain environment. As we have long since come to expect of people who inhabit such places, the local understanding of the many hazardous phenomena, such as seasonal floods, mud and debris flows, slides of various types, rock falls, and avalanches, is extremely high. Individual accounts of village response to mud and debris flows and slides of various types reinforced this view and left the impression that informal response systems already exist in the Bartang villages.

Equally important is the impression that the local people have a very close attachment to their environment – in simple terms: they love their mountains – and it should be clearly understood that one possible response to the assumed danger of Lake Sarez – relocation out of the area – may not be a responsible option. Despite this attachment to the local environment, the prevailing state of poverty, under-employment, malnutrition, and dependency on outside aid is very evident and is an apparent contradiction.

Most of the villages visited along the Bartang River (none farther upstream than Basid) are located on alluvial cones. These cones, built by a combination of geomorphic processes, including snow-melt floods, mud and debris flows, and slides of various types, are very active. It is assumed that

sections of the fields on the alluvial cones are subject to annual damage, at least. This is borne out by anecdotes related by villagers. At least this would indicate that the inhabitants are familiar with these processes and are accustomed to dealing with them – both in terms of responsive evacuation and subsequent repair.

Some of the larger villages have sections that are higher than the level of any predicted flood/debris flow in the Bartang. Thus, groups of buildings would be available to constitute initial safe havens. However, it must be emphasized that this would only provide refuge against initial loss of life. Any significant outbreak flood/debris flow, even of much lower magnitude than any worst-case scenario, would obliterate many entire villages and long sections of interconnecting road. In such an event, severe loss of cropland would raise the prospect of a massive evacuation programme. The route out of the Bartang valley on foot would be extremely hazardous and helicopter assistance would be necessary.

Data collected by Goulsara Pulatova indicate that in the Bartang valley some 30 villages with more than 7,000 inhabitants would be at risk in the occurrence of an outburst flood. Much of the town of Rushan (population more than 4,000) would be in danger, and, depending on how far the effects of such a disaster would extend down the Panj River valley, a total of more than 35,000 people would be under serious threat from a "moderate" flood event from Lake Sarez. The potential "back-water" area upstream from Rushan should also be taken into consideration.

One conclusion of this investigation is that the local inhabitants should prove to be very able participants in a training programme for early warning system operation and maintenance in response to actual hazard occurrence. Another conclusion is that systematic research on the human geography of the area is needed to build on these advantages.

Boys of the Bartang River valley. Their homes would be endangered only minutes after any landslide wave were to overspill the Usoi landslide dam and flood the Bartang. Photo credit: Jack Ives

9.5 Recommendations

1) It is urged that great care be taken in discussing the complex issue of Lake Sarez to avoid any unnecessary increase in degree of local alarm. Nevertheless, and in addition, many of the villages on the Afghan side of the Panj River, opposite and downstream of Rushan, need to be taken into consideration;

2) From the point of view of ability and intelligence of the local inhabitants, introduction of an early warning system should be feasible - there appears to be a high level of talent that would lend to training and operation;

3) Similarly, ability to accommodate training for emergency response, establishment of safe havens, and management of local people in a crisis situation, appears to be considerable;

4) Items (1) through (3) above would be greatly augmented if a systematic study of the human geography/demography were to be carried out. See Annex 9-1 for an outline of a possible research approach.