GOVERNMENT OF PAKISTAN

Water and Power Development Authority (WAPDA)

Kreditanstalt für Wiederaufbau (KfW)

REVISION OF THE FEASIBILITY STUDY OF KEYAL KHWAR HYDROPOWER PROJECT

VOLUME 3
REPORT ON ENVIRONMENTAL IMPACT ASSESSMENT

August 2007

Prepared by

Lahmeyer International GmbH, Bad Vilbel, Germany

National Development Consultants, Lahore, Pakistan

LIST OF VOLUMES

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF ANNEXES

ABBREVIATIONS

CBO	Community Based Organisation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ESSA	Environmental and Social Soundness Assessment
HEPO	Hydro Electric Planning Organization
HPP	Hydro Power Plant
IEE	Initial Environmental Examination
IFC	International Finance Corporation, A member of the World Bank Group
IUCN	The World Conservation Union
KKC	Keyal Khwar Consultant
KW	Kilowatt
NA	Northern Areas
NATCO	Northern Areas Transport Company
NGO	Non-Governmental Organisation
NWFP	North West Frontier Province
NTFP	Non-Timber Forest Products
PCDP	Palas Conservation and Development Project
RAP	Resettlement Action Plan
SCO	Special Communication Organisation
SWHP	Surface Water Hydrological Project
SHYDO	Sarhad Hydro Development Organisation
UNDP	United Nations Development Programme
WAPDA	Water and Power Development Authority
WWF	World Wide Fund for Nature

1 SUMMARY OF ENVIRONMENTAL IMPACT ASSESSMENT STUDY

1.1 Introduction

The EIA Study addresses the impacts caused by construction and operation of the Keyal Khwar Hydro Power Plant. It presents the results of environmental investigations carried out during Phase II of the Feasibility Study in 2007. Some subjects of the IEE Initial Environmental Examination works from 2006 have been verified, others have been newly investigated such as:

- Ownership of the land potentially affected by the project
- Fish stocks and fishery
- Residual discharge of the river, and
- Institutional aspects including legal framework.

Separately the Status Report addressing compliance with the WCD World Commission on Dams 2000 Strategic Priorities has been prepared.

The EIA Study has been based on the conceptual layout recommended by the Phase - I Study. Moving the location of power house (and therefore changed water way locations and facilities) towards the Indus River valley close to Patan, the selection of the dam site (Zeta site), and the confirmation of widening the valley road for construction purposes had been taken into account.

The overall assessment is that the project will make only limited impacts on the local environment. The major negative impacts resulting from the reduction in the river flows and the removal of houses for road widening and construction facilities can be kept within tolerable limits. Appropriate mitigation and compensation measures have been suggested. Environmental costs seem to be reasonable and would not endanger the entire project.

The continuation of the project is recommended because of compliance with the WCD requirements, the overall ecological compatibility and the high potential for enhancing economic and social conditions in the extremely poor Kohistan District area.

1.2 Overview of the Project Area

The Keyal Khwar catchment is located on the right bank of the Indus River 40 km upstream of Besham and 12 km from Patan. Nature and terrain of the upper catchment in the high Hindukush Mountains comprise rock and snow pack areas, alpine meadows, and glacier formations. The foothills and ranges below 2,800 m are covered with pine, cedar and spruce forest, which is an important natural resource of the Keyal tribe. The immediate Keyal Khwar valley and adjacent foothills up to 2,000 m elevation are covered with broad-leaved forest. Some 2,800 people are living in the immediate project area in the villages of Bandlo, Bair, Bach Gay, Soyan Bair and Sheshal and are largely dependent on the Keyal Khwar for domestic water.

The Keyal Khwar valley on the whole is characterised by steep mean gradients of 8 % (sometimes even more) and only very small alluvial land suitable for cultivation. The majority of residential houses and agricultural land is located on narrow terraces on steep foothill slopes, partially within degraded forest. Almost all water for irrigation and human consumption is from the Keyal Khwar, supplied by generally poorly constructed irrigation channels.

The steep slopes of the Indus River valley are barren with some remnants of bush and grass vegetation. Dominant environmental factors of the lowest part of the area at the confluence of Keyal Khwar and Indus River are the low rainfall, accelerated erosion, unstable slopes, grazing, traffic along the Karakoram Highway and firewood cutting.

1.3 Conceptual Design of the Project

The project foresees the construction of a concrete gravity dam on the Keyal Khwar some 500m downstream of the confluence of the Saimoo and Sanga Khwar tributaries. The dam will be some 37m high (measured from the original river bed) and create a small reservoir that extends some 420m upstream almost to the above mentioned confluence. The reservoir will be contained within a narrow canyon and it will submerge neither natural vegetation nor productive land.

A water intake structure (known as the power intake) will be constructed on the right valley flank immediately upstream and adjacent to the dam. This tower structure will sit, largely submerged, in the reservoir and divert water into the 7 km long headrace tunnel. From the headrace tunnel the water will drop through a deep underground shaft to a cavern powerhouse accommodating all the electricity generating equipment. After passing through the turbines, the water will be discharged to the Indus River through a short tailrace tunnel located some 3 km upstream of Patan village. The entire power generating scheme is underground. It has an installed capacity of 122 MW and will generate some 448 GWh per year on average. Some 75 % of this energy will be generated during the high flow summer months between April and August. During these months the project could generate for most of the day. During the low flow winter months, the project would generate only during the evening hours of peak electricity demand.

The energy generated by the Keyal Khwar powerhouse will be fed into WAPDA's national gird at the Duber Khwar substation in Patan village. For this, a substation will be constructed on waste land close to the Keyal Khwar powerhouse entrance portal on the right bank of the Indus. From there, a single circuit transmission line 2.5 km long and supported on steel towers will run to the Duber Khwar substation.

Access to the powerhouse entrance portal will be from an existing road that will require minimal up grading. Access to the dam site will be via the existing valley road which will require widening and realignment in order to carry construction traffic. The valley road widening, the excavation of the dam foundations and underground openings will all produce large amounts of material. Much of this material will, after crushing and sorting, be suitable as concrete aggregate, thereby avoiding opening up a quarry.

1.4 Legal Framework and Institutional Set-up

The Pakistan EIA legislation requires a formal investigation of environmental impacts. For any energy project an environmental assessment is to be carried out, either in the form of an IEE Initial Environmental Examination (for projects with lower magnitude of environmental impacts) or an EIA (for projects with larger magnitude of environmental effects). The Keyal Khwar HPP with 122 MW exceeds the limit of 50 MW, for which an EIA Study has to be prepared.

Explicitly the "Pakistan Environmental Protection Act, 1997" and the "Review of IEE and EIA, Regulations, 2000" do not demand any further environmental investigation and assessment after submission of IEE or EIA Study. The proponent after successful reviewing of the study and getting the formal approval from EPA, the Environmental Protection Agency, may commence construction immediately.

There is no mention of preparation of the EMP Environmental Management Plan. Only in the "Pakistan Environment Assessment Procedures (1997)" is there a guideline for preparation of an EMP. Despite this legal situation, the EIA Study prepared an outline EMP addressing the most important mitigation and compensation measures to be determined during the next project stage.

The other plan, which is internationally required before starting any construction, is the Resettlement Action Plan. Also this RAP is not mentioned in the above named EIA legislation. However, the Pakistan Resettlement Ordinance, 2001, does require this plan, when 200 or more persons would be relocated.

The EIA Study has to be submitted to the NWFP EPA for review. The general public is invited to participate in this review. In accordance with Pakistan and international requirements a close and early public participation has to accompany all project stages.

1.5 Diagnosis of the Environment

1.5.1 Traditional self-subsidence economy and poverty

The Keyal Khwar valley like many other catchments in this mountainous area of NWFP is undeveloped. The Keyal people are using the valley for traditional dwelling, cultivation and animal husbandry, for timber production, fuel wood cutting, power generation, and flour milling. There are no industrial or other economic sectors from which the people can make a living.

The major family income is from unskilled labour in construction or transport outside of the valley realised by some family members. The other big income portion is from traditional subsistence agriculture where every household in summer exploits the entire cultivated land of on average 4.6 kanal (2,300 m²) for growing maize, vegetable, fruit and feeding of few domestic animals. The yield from these crops satisfies less than half the food requirement of the local families. The rest has to be purchased.

Summer agriculture at higher elevations (above 2,000m) plays an important role in the traditional way of life. Rain-fed meadows are located at these higher elevations. Majority of family members with their livestock are moving in summer towards these other land holdings and houses. The forests in the valley and on the plateaus of the foothills are used for timber logging, grazing of domestic animals and fire-wood cutting in summer. In total only 25 % of the local population has access to electricity.

Most of the valley people are illiterate. Even schools for boys are often not working for various reasons (lack of salaries, unavailability of teachers). Girls cannot be educated due to the traditional system and lack of facilities. Medical service is not available. Despite very poor living conditions, the local Keyal tribal people are very committed to the Keyal Khwar valley.

1.5.2 Downstream water demands

The most sensitive ecosystem is the river course downstream of the dam, its aquatic life and adjacent small plots of alluvial land. At the present time, this river course provides water to irrigate some 93 ha of cultivated land, to supply 2,800 people and 7,400 domestic animals, to run 11 micro and one mini hydropower generators and 3 flour mills as well as to support limited natural riverine vegetation and wild life. In summer when demand is high the total water requirement is some 715 l/s of which 600 l/s is required to run the hydropower generators and flour mills and 75 l/s to irrigate the cultivated land.

1.5.3 Natural plants

Both valley slopes of the Keyal Khwar above the narrow alluvial strips up to 2,000 m are covered with broad leaved forest. Due to lower evaporation the forests on the north and east facing slopes are in a better condition. The forest in the Keyal Khwar valley has been partially cleared for human settlements such as Sheshal Keyal, Bair, Peshwa and Sarta. A pattern of randomly located houses, irrigation terraces, foot paths and remnants of the original forest characterise both banks along the Keyal Khwar. Compared with the lower alluvial zone the slopes are less valuable from a biodiversity and wildlife point of view.

Due to the impact of human activities on both vegetation cover and wild life, the project area is not as rich in biodiversity as the nearby Palas Valley on the opposite bank of the Indus. A total of 262 different plant species were recorded in the immediate project area – mostly cosmopolitan and weedy. However, eight species of Pteridophytes (fern), belonging to the vascular family were recorded. These fern species have restricted distribution in Northern Pakistan and the Himalayas. Most of the species are, however, found over a wide range of altitudes in their distribution range.

The only species endemic to North Pakistan that was collected in the Project Area was *Rhamnella gilgitica,* a rare tree species. It was rediscovered in Palas after it was collected from Gilgit in 1937 by Troll. Rarely distributed is another tree *Fraxinus raibocarpa,* which is confined to only a few localities in North Pakistan and Eastern Afghanistan.

The Indus River zone and some lower parts of the Keyal Khwar valley itself are severely degraded due to road construction, transport, grazing, and firewood cutting.

1.5.4 Wildlife

The most prevalent animal species observed in the Project Area are birds. This is due to availability of suitable food and nesting habitats. In total 19 bird species have been recorded, however none of them is included in the IUCN Red Data Book for Pakistan or in the Birdlife list of endangered species.

No small mammals were trapped during the 2007 field investigations. There was even no indication that they might inhabit in the Project Area. Presence of Asiatic Jackal (*Canis aureus*), Indian porcupine (*Hystrix indica*) and perhaps Jungle cat (*Felis chaus*) in higher parts of the catchment far beyond the Project Area could be presumed.

Two Agama species namely *Laudakia agrorensis* and *Laudakia pakistanica* were collected from different locations in the area. Both species are widespread in Northern Pakistan. The Red Data Book views them as *Least Concern* species.

In summary the Project Area has only very little importance from the wildlife status. Birds are the most important animals however none of the species recorded has high nature conservation status. Only two common Agama species occur in the rocky area around the dam site and other places.

1.5.5 Natural fish stocks

The Keyal Khwar compared to other water bodies in the region has limited aquatic life. Only two fish species, *Glyptosternum reticulatum* and *Schizothorax plagiostomus,* have been collected from the Keyal Khwar during the 2007 investigations. Fish usually migrate from the Indus River upstream into the stream and therefore have a maximum distribution in the lower reaches, as the 2007 fish inventory has revealed.

The natural conditions along the Keyal Khwar do not favour fish stocks. Neither spawning nor feeding conditions exist to support a wider variety of fish stocks and larger number of specimens. Due to the source from glaciers and snow pack areas the water temperature is quite low (likely not exceeding 10° C over a relevant period). Steep river bed gradients cause constant turbulence and high water velocity. And finally, the lack of plankton in the stream is not ideal for fish at all. Another natural condition affecting fish habitats and aquatic life is the instability of the river bed. During high floods big stones and boulders are rolling downstream destroying habitats, especially spawning and feeding areas of natural fish stocks.

1.6 Impacts Assessment

1.6.1 Impacts caused by construction

The main project structures like the dam, the underground water ways and the power house will not have significant adverse impacts on the environment. They are located either outside of villages or underground and will not harm the natural environment or human activities significantly.

The most significant impacts on the local human populations during construction will be ,firstly, the temporary leasing of residential and productive land in Peshwa Village on the right bank upstream of the dam for construction facilities and secondly the realignment and widening of the valley road for access to the dam site. Situated very close to the present road are 28 houses, some cultivated land, graveyards, a water mill, irrigation facilities and the Patan water pipe.

Although the construction of the underground water tunnel and the power house would not harm forests, animals, or houses, some adverse effects on forest areas around the two windows of the tunnel and the access road to the windows would occur. Valuable broad leave forest growing on the upper foothills would potentially be endangered by dumping rock material.

There would be no significant impacts on fish due to the very small fish population in the Keyal Khwar. Adverse effects on birds when establishing construction facilities during nesting period might occur.

1.6.2 Impacts caused by operation

The most significant impacts during the operational life of the project will result from diverting most of the river flow into the underground waterway at the dam site. It is proposed that at least 250 l/s should remain in the river by being released through the dam to the downstream river reach. This represents only some 15 % of the mean river discharge during the low flow months of December and January. However, according to the field survey, this quantity will meet all the downstream demands except those of some of the hydrogenerators and flour mills.

A further significant impact may occur during first impoundment of the reservoir on the Agama reptile population living among the rocks and boulders around the dam site and canyon. If this impoundment takes place during the hibernation period (winter) loss of wildlife would occur.

1.7 Mitigation Measures

1.7.1 Mitigation measures during construction

The most important measures to mitigate adverse impacts during construction will be a judicious selection of, firstly, the valley road alignment and, secondly, the location of the construction facilities for the dam. Detailed design must focus on improved road alignment avoiding relocation of houses. In order to reduce negative impacts on subsistence agriculture and food supply of local population, the acquisition of productive land for construction facilities (around batching plant) should be reduced as much as possible.

1.7.2 Mitigation measures during operation

The most important measures to mitigate the adverse impacts during the operational life of the project would be either (1) to release sufficient water to the river downstream of the dam (up to at least 715 l/s) in order that all current demands are met or (2) to supply electricity from the national grid to the valley thereby reducing the downstream demand for water by

600 l/s. The proposed release of 250 l/s will cover all the remaining demands for the foreseeable future.

1.8 Compensation Measures

The most important compensation measures are those for relocation of houses caused by road widening works, acquisition of land for widening of road and/or establishment of construction facilities. The compensation of lost houses, land, trees and income should be in accordance with international and national requirements and experience. Incentives should be offered in order to relocate the affected people voluntarily.

Other relevant compensation relates to reforestation for any damage to trees and forests or degradation of any natural plants. This will include the requirement to reforest lost trees in a ratio of 1:4. Part of the compensation measures would be the acquisition of degraded land and required actions for preparation of seedlings and seeding operations.

1.9 Outlines of RAP and EMP

The RAP is to be prepared when more than 200 people would be directly affected (means relocation of their houses). Taking into account the average size of 10 persons per household a RAP has to be prepared and implemented if more than 20 households (normally 20 houses) have to be relocated. Important part of this RAP will be compensation of lost land, houses, properties and other assets like lost income. The RAP will determine the land acquisition procedure, results, and allocation of land to the affectees. Prior to the construction of houses all infrastructure has to be established. Part of the RAP is the development of guidelines for a public participation programme. Finally the administration on the proponent side has to be defined.

The EMP is to focus on mitigating and compensating impacts on the physical and biological environments. This will include mitigation measures to prevent degradation of soils and land resources (mainly due to the land needs for construction facilities and the dumping areas). Potential impacts on the water quality are to be investigated and mitigation measures (removing the sewage discharge for example) to be determined. Damage due to sediment flushing practice will be described and mitigation actions have to be addressed. Requirements for a first filling mode of the reservoir in order to preserve reptiles and birds have to be included in the EMP.

1.10 Alternatives

The *Do – Nothing Alternative* has been analysed and rejected. Unlike its thermal power competitors, the Keyal Khwar Hydropower Project exploits a renewable and indigenous energy source. It will not deplete Pakistan's reserves of natural resources, it will not emit harmful gases and it will not increase the nation's dependence on imported fossil fuels. Moreover, in order to reduce poverty and improve economic and living conditions in the valley the implementation of the Project is highly recommended.

Alternative layouts have been investigated including waterway systems on the right and left valley flanks, different dam sites and both surface and underground powerhouses.

Compared to other hydropower schemes in Pakistan, the main components of the finally selected layout are relatively small in size and harmless in impact. Very few people will require to be relocated and very little productive land will be lost. Both these impacts can be minimized by careful design.

Alternative hydropower projects in other valleys were beyond the scope of the present study. However, WAPDA is investigating a number of hydropower schemes in the region. These

schemes are not considered as alternatives to Keyal Khwar, rather as complementary additions to Pakistan's renewable energy generating catalogue.

1.11 Benefits Associated with the Project

The direct benefits of the project will be up to 122 MW of electrical power and 448 GWh of electrical energy on average every year. During the high flow summer months this power will be available throughout the day and night to cover both peak and off-peak demands in the national gird. During the low flow water months, the power will be available to meet the short term evening peak demands. Further benefits will be an improved and safer valley road from the dam site to the Karkoram Highway.

The project will also offer the opportunity to provide grid electricity to the valley and thereby greatly improve both social and economic conditions.

1.12 Environmental Monitoring Programme

The most important requirements for monitoring in the forthcoming environmental works are addressed.

1.13 Environmental Cost Estimate

The overall costs of managing and mitigating the project environmental impacts have been estimated at some PKR 300,000,000.

2 CONDITIONS AND OBJECTIVES OF THE EIA STUDY

The EIA Study is part of the Feasibility Study Phase II as Table 1 illustrates. This staging assumed in this overview is based upon the European, in particular German legislation and permitting practice. It is assumed that the KfW will rely on the succession of certain stages (expressed are here the environmental works) to come to the permit for commencing construction.

Aspect	Feasibility Study		Engineering Design	Construction
Stage	Phase I IEE Initial Environmental Examination	Phase II EIA Environmental Impact Assessment Study	EIA Environmental Impact Assessment in Engineering Design	Environmental Monitoring and Management
Approach	Mostly using available (secondary) information	Field based information: fish, natural vegetation and wildlife, mandatory water release, impacts on households	Field based data collection continued, in particular on affected population or other environmental values endangered	Monitoring and management of environmental impacts on construction works
Output	Initial environmental assessment study	EIA Study	(1) Resettlement Action Plan (under certain conditions) (2) Environmental Management Plan (3) Environmental Costing	Regular monitoring (water quality, air etc.) Studies and supervision such as protection of local population and workers from noise and dust, safety, social compliance
Public Participation	Information about state of awareness	Information of the public	Consultation with all stakeholders and affected population	Public Consultations as required during the works

Table 1 Environmental assessment in project stages

Source: KKC 2006

There is the presumption that the project before start of construction works due to the KfW requirements will have to prepare Engineering Design planning, which itself have environmental assessments in form of

- Environmental Management Plan, addressing mitigation and compensation of plants and animals including fish
- Resettlement Action Plan, preparing relocation and compensation of affected population
- Environmental Costing.

However, the environmental legislation in Pakistan would allow starting immediately after successful completion and approval of the EIA Study to start construction (see Chapter 3.1.6).

The EIA study has been prepared based upon the Initial Environmental Examination Study 2006 worked out by Keyal Khwar Consultants during Phase I of this Project. Since the IEE report mostly used only available secondary data - supplemented by few field visits and interviews with stakeholders – the current project Phase II had to deliver primary, means mostly field-based information.

KfW and WAPDA as Clients are stating in the Terms of Reference as follows: “The socio-economic and environmental studies shall be continued during Phase II”. Furthermore – in accordance with the Terms of Reference – the following subjects need to be clarified:

- Ownership of the land potentially affected by the project
- Fish stocks and fishery

- Residual discharge of the river, and
- Institutional aspects including legal framework.

Furthermore required is the preparation of a separate Status Report about the achievements of the objectives of the World Commission on Dams (WCD) Report 2000.

The IEE Report (during Phase I) assessed that the project is judged to have limited adverse environmental impacts. Potentially negative impacts, such as changes of the Keyal Khwar hydrograph, impoundment of the reservoir, road construction, and disturbances in the narrow valley (e.g. of wildlife) had been assessed being able to be kept tolerable for local population, ecosystems and wildlife by developing an adequate conceptual design, construction measures and operation mode. The continuation of the project had been recommended because of the ecological compatibility and potential enhancement of the regional and communal development in the extremely poor Kohistan District area.

Since the conceptual design has been changed the current Environmental Impact Assessment has to follow up the above main issues under the conditions of the renewed design.

3 LEGAL FRAMEWORK AND INSTITUTIONAL REQUIREMENTS

3.1 Environmental legislation in Pakistan

3.1.1 IEE and EIA

Legal requirements for the Environmental Impact Assessment of the Keyal Khwar Hydro Power Plant are formulated in the Pakistan Environmental Legislation as follows:

- Pakistan Environmental Protection Act, 1997
- Review of IEE and EIA, Regulations, 2000.

The *Pakistan Environmental Protection Act* [1, p 1-36] formulates basic requirements for the Initial Environmental Examination and Environmental Impact Assessment. It pointed out "*No proponent of a project shall commence construction or operation unless he has filed with the Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Protection Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effect an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof*".

The Government of Pakistan furthermore adopted in year 2000 the *Review of IEE and EIA, Regulations.* Here for the Environmental Protection Agency relevant procedures for the proponent to reach compliance with environmental quality requirements, to categorise the project, to prepare the environmental assessment study (either IEE or EIA), to review the submitted study are determined. Furthermore the latter named Review of IEE and EIA Regulations determines the role of Environmental Protection Agency as approving governmental agency to reach those targets, and the public participation.

3.1.2 Delegation of power from Federal EPA to EPA of Province

The Federal EPA has delegated its powers to the Provincial EPA's (see Statutory Notifications S.R.O, 28th October 1998). Therefore the present report is to be submitted to EPA NWFP for their approval.

3.1.3 Pakistan Environmental Assessment Procedures

The Federal Environmental Protection Agency developed and issued in 1997 the above named document, which aims to become a package for "*comprehensive procedures and guidelines for environmental assessment in Pakistan*".

Principal documents included in Pakistan Environmental Assessment Procedures are as follows:

- Pakistan Environmental Protection Act, 1997
- Policy and Procedures for the filing, review and approval of environmental assessments
- Guidelines for the preparation and review of Environmental Reports
- Guidelines for public consultation
- Guidelines for sensitive and critical areas
- Pakistan Environmental legislation and the National Environmental Quality Standards
- Sectoral guidelines for major thermal power stations, major chemical and manufacturing plants, water supply projects, industrial estates, new township development, major roads, sewerage schemes, oil and gas exploration.

In addition in the document there are listed some other sectoral guidelines, which at the date of publication had not been drafted. To them belong: Irrigation and drainage, dams, forestry, municipal waste disposal.

Unfortunately so far sectoral guidelines for dams have not been prepared.

The sectoral guidelines are following a specific format:

- Sector overview of the industry and process
- Potential impacts on the environment
- Mitigation measures
- Monitoring and reporting
- Management and training
- Checklist of likely environmental impacts and mitigation measures.

3.2 Legally relevant subjects of environmental approvals

3.2.1 Categorisation of projects

The 2000 Pakistan Law "Review of IEE and EIA, Regulations" [1, p 64-84] determines in detail procedural subjects such as the categorisation of projects, which is in accordance with international practice of the World Bank (and other international financial institutions). Two lists of projects (Schedule 1 for IEE, Schedule II for EIA") addressing project types requiring an IEE respective under more significant adverse impacts an EIA. Regarding hydro power projects there the Consultant prepared the following overview in Table 2 on categorisation of projects in the hydro power sector:

Subject	EIA	IEE	No environmental investigation
Depth of impact	Projects likely to have significant adverse impacts	Projects with potentially adverse impacts	Projects unlikely to have significant or adverse impacts
Energy	Hydroelectric power generation over 50 MW	Hydroelectric power generation less than 50 MW	No information
Water management, dams, irrigation, and flood protection	Dams and reservoirs with storage volume of 50 million cubic meters and above or surface area of 8 square kilometres and above	Dams and reservoirs with storage volume less than 50 million cubic	No information

Table 2 Categorisation of Project in energy sector

Source: "Review of IEE and EIA, Regulations, 2000"

The Keyal Khwar Hydro Power Plant has a planned capacity of 122 MW, which would require in accordance with the criterion "*energy*" carrying out an EIA. However, as for the second criterion "*dam and reservoir*" the project hardly would be subject of an EIA or an IEE. The dam height is 37 m, whereas the reservoir volume is 240,000 m³, which means half a percent of the critical value for the EIA.

This makes clear that the categorisation is quite difficult using only the listed criteria. It underlines the need for a thorough screening before starting IEE or even EIA. However, both laws relevant for EIA and IEE do not determine any screening procedure, neither for the proponent nor for the needs of the Federal Agency to define the category of the project and the likelihood of adverse impacts. The Consultant suggests that the Environmental Protection Agency after reviewing screening results before starting detailed investigations should determine the required procedure of EIA or IEE.

However, for the time being in view of the criteria of power generation (and in accordance with the terms of Reference of the Client) an EIA Study will be conducted.

Despite the unclear requirements in the Pakistan legislation in the Keyal Khwar project there is a substantial need for a "full" environmental assessment due to the potential significant impacts on the hydrograph. The overall approach of the project is to derive as much as possible water for power generation from the stream into a different river (in this case the Indus River). Hence, one criterion to determine and assess "*significant impacts on hydrological regime, fish stocks, domestic water supply, vegetation and wildlife*" should be added to the law and attached Schedule I or II.

Notwithstanding these legal conditions in Pakistan, due to the requirements of both clients KfW and WAPDA a staging from IEE in Phase I towards EIA in Phase II was foreseen and had been carried out.

3.2.2 Information of the Federal Agency about a project

There is no requirement formulated in Pakistan Environmental Protection Act, 1997 and "Review of IEE and EIA " Regulations, 2000, about an early information of EPA (either federal or provincial), when commencing a project. The establishment of registers of IEE and EIA Projects, determined in Paragraph 21 of "Review of IEE and EIA, Regulations, 2000" [1, p 71], which is the obligation of the Federal Agency, is to be developed after getting the approval. That means there is no legal requirement for early information of EPA.

The Consultant therefore recommends including the need for a proponent to inform in the very first stage the Federal or Provincial Environmental Protection Agency on the intention to launch a project. Focusing on first written information by the proponent and the discussion of relevant subjects in a joint meeting between EPA and the proponent of the project should be confirmed conjointly. EPA in a final statement should inform the proponent about the categorisation of the project, the environmental components to be investigated, the project area, important stakeholders and their involvement and the general procedure, however, without determination of any time allowances.

The need to come to early considerations on the category and procedure of environmental assessments obviously is high as the Keyal Khwar project type explains. The possibility to require formal IEE or EIA investigations "Review of IEE and EIA, Regulations, 2000" in Schedule I and II formulates. In both Schedule I and II in the very last Paragraph the right is expressed that the Federal Agency is empowered to require for any other project, which may not be listed in the schedule, an IEE or EIA study.

Formal screening procedure (at that stage without detailed investigations) would be suggested to accompany this preliminarily stage and to ensure the liability of the proponent for appropriate actions to be taken to reach environmental compliance.

3.2.3 Submission of IEE and EIA Study

"Review of IEE and EIA, Regulations, 2000" requires filing 10 paper copies and 2 electronic copies to the Federal Agency. In addition it is required to submit an application (see Schedule IV of the law) and the copy of the receipt showing payment of the Review Fee (in accordance with the costs of the IEE or EIA from nil to Rs. 30,000).

Unless there is not requirement in the legal documents it is strictly proposed to submit the documents in English the tribal language, if Urdu is not spoken from the majority of affected people. Here the people mostly are speaking Kohistani language, but can speak and understand Urdu. Therefore the translation of the full EIA Study into Urdu is recommended.

Federal Agency is obliged to confirm within 19 working days that the sent documents are complete or additional information is required. There is also the possibility to return the study for revision, indication the matters to be improved or changed.

A table of content of the study supplemented by a list of other information such as minutes of meetings of interviews, results of questionnaires and others is missing. For checking the completeness of the study this would be an asset.

3.2.4 Review of a project by the Federal Agency

The "Pakistan Environmental Protection Act" in Paragraph 12(2) is addressing the need for reviewing the EIA respective IEE study. Beyond that law the procedure of reviewing is explained in "Review of IEE and EIA, Regulations, 2000" in Paragraph 11. The normal maximum review period for an IEE is 45 days, whereas the EIA review should be made within at maximum 90 days after issuing completeness of the study.

The review in accordance with Paragraph 11(4) "shall be based on quantitative and qualitative assessment of the documents and data furnished by the proponent, comments from the public and Government Agencies received under Regulation 10, and views of the committees mentioned in sub-regulations (2) and (3) above" [1, page 68]. "Review of IEE and EIA, Regulations, 2000" determines in Paragraph 23 the possibility to constitute an "Environmental Assessment Advisory Committee" under the Federal Agency for the review procedure. Its tasks are to "*constitute a committee to inspect the site of the project and submit its report on such matters as may be specified*" (Paragraph 11, 3).

3.2.5 Approval of a project by the Federal Agency

The conditions of approval are part of Paragraph 13 of "Review of IEE and EIA, Regulations, 2000". It stipulates: "Every approval of an IEE and EIA shall, in addition to such conditions as may imposed by the Federal Agency, be subject to the condition that the project shall be designed and constructed, and mitigatory and other measures adopted, strictly in accordance with the IEE/EIA, unless any variation thereto has been specified in the approval of the Federal Agency".

This and following subjects of Paragraph 13 pointing out clearly the legal conditions in Pakistan that the construction of this project after approval of IEE and EIA may be commenced. For the Keyal Khwar that means the clients may start the construction immediately after approval of this EIA Study (and the other works on design, hydrology, and infrastructure construction). The staging described in Table 2 in this case would not be valid.

The "Pakistan Environmental Protection Act" in Paragraph 12(2b) briefly is pointing out the conditions to re-submit the EIA study when the project is being contrary to environmental objectives. Paragraph 12(4) of the "Pakistan Environmental Protection Act" addresses the need for EPA to communicate the approval within four months after submission of the complete study of both IEE and EIA. If this approval within this period has not been formally submitted to the proponent, the project and the study had been failed. In 12(5) there is the exception highlighted that the appropriate Government "*may in a particular case extend the aforementioned period of four months if the nature of the project so warrants*" [page 22].

3.2.6 Legislation on RAP Resettlement Action Plan

Paragraph 13 "Review of IEE and EIA, Regulations, 2000" also implies to address mitigation and other (compensation) measures as part of the EIA Study. With regard to affected persons the requirement is to develop as main mitigation measure relocation of the affected persons. In accordance with the World Bank OP. 4.12 and BP 4.12 (which recently revised the Bank's policy) on Involuntarily Resettlement it would require - if the limiting value of 200 people is exceeded - to prepare a formal Resettlement Action Plan ("RAP") for mitigation of

impacts on the affected population. Where only a few people (e.g., less than 100-200 individuals) is to be relocated, appropriate compensation for assets, logistical support for moving, and relocation grant may be the only requirements. However, the principles on which compensation is to be based are the same as for larger groups. These international requirements are implemented in the Pakistan "Project Implementation and Resettlement of the Affected Persons Ordinance" (Draft September 2001).

3.2.7 Legislation on EMP Environmental Management Plan

The Pakistan Environmental Protection Act, 1997, and also the Review of IEE and EIA Regulations, 2000 do not require the provision of an Environmental Protection Plan. As underlined in the above Chapter 3.2.5 each proponent after getting the formal approval of the IEE or EIA in Pakistan may commence construction. For the Keyal Khwar that means the clients may start the construction immediately after approval of this EIA Study (and the other works on design, hydrology, and infrastructure construction). The staging described in Table 2 in this case would not be valid.

In contradiction to that the EPA Guideline "Policy and Procedures for the filing, review and approval of environmental assessments" (September 1997) describes in detail what has to be done for preparation of studies. An important section is about preparation of an environmental management plan (EMP), which is defined as *"document designed to ensure that the commitments in the Environmental Report, subsequent review reports, and Environmental Approval conditions are fully implemented*" (p 22). Regarding the schedule (see Environmental Stages in Chapter 2 and Mitigation in Chapter 3.2.6) this EPA Guideline highlighted that the EMP is "*a comprehensive document which is usually finalised during or following detailed design of the proposal, after Environmental Approval of the development application*" (p 22).

The preparation of a formal Environmental Management (or Action) Plan to mitigate and compensate impacts on the physical and biological environment the Pakistan legislation referring to the Review of IEE and EIA Regulations, 2000 (which had been adopted after the date of preparation of these guidelines) legally is not required. As referred mitigation and other measures would be part of the EIA Study. The proponent with the official approval of the EIA or IEE may start immediately construction.

3.2.8 Public participation

The "Pakistan Environmental Protection Act" clearly states the overall approach on public participation, when highlighting in 12(3): "*Every review of an environmental impact assessment shall be carried out with public participation and information will be disclosed during the course of such public participation*". Basic information and many examples are delivered in the "Guidelines for public participation" (1997), which is part of the "Pakistan Environmental Assessment Procedures", which is an official publication of Federal EPA. However, there is neither in this law nor in "Review of IEE and EIA, Regulations, 2000" more information about this early involvement of the public.

There are two opportunities to involve the public but only after submission of the IEE or EIA Study to the Federal Agency:

The one opportunity addressed in the law "Review of IEE and EIA, Regulations, 2000" Paragraph 10 is addressing the conditions of information and incorporation of the public after completing the EIA respective IEE Study. The law only requires that the Federal Agency will cause a publication of a notice in a national newspaper in both English and Urdu language and in a local newspaper of general circulation in the area affected by the project. The notice has to mention the type of project, exact location, name and address of proponent, and the places at which the EIA of the project can be accessed. Furthermore it is required to inform

in accordance with Paragraph 10(2) about date, time and place of public hearing of any comments on the project. The date of the hearing shall not be earlier than 30 days from the date of publication of the notice. The second opportunity is with the Federal Agency that in accordance with Paragraph 23 of the named law representatives of Non-governmental Organisations, of the industry and other experts may be invited as members of the Environmental Assessment Advisory Committee. However, the intentions of the proponent, to develop awareness about the project and to reach a common understanding of the likely impacts of the project already during EIA respective IEE investigations and compilation of the study is not determined yet. The experience also in the Keyal Khwar project says that this has to be done very early. Thus, the Consultant always informed the public during the intensive field works of geologists, surveyors, designers, environmentalists during 2006 and 2007 about the ongoing works.

Expressively in the "Pakistan Environmental Protection Act" the possibility of the Federal Agency is pointed out to exclude the public of the information and participation (Paragraph 12,3i). Based upon formal inquiry of the proponent justifying specific needs from trade, manufacturing or business activities, processes or techniques of a proprietary nature, or financial, commercial, scientific or technical matter the Federal Agency can decide to carry out the project without public participation. In the Keyal Khwar project that clause had not been applied. Moreover, a close contact to the affectees and local stakeholders, in particular Patan Tehsil Administration had been maintained.

3.3 Institutional requirements

3.3.1 Approving Authority Environmental Protection Agency EPA

Pakistan Environmental Protection Act (1997) determines in Paragraph 5 the structure, rights and obligations of the EPA in general and the function of both the Federal EPA and the Provincial EPA specifically. The overall objective of EPA is "*to exercise the powers and perform the functions assigned to it under this act*" [10, p 12]. There are two levels of EPA, the Federal and the Provincial. There is no determination in the above named law, which projects, either IEE or EIA are subject of the one or the other EPA. "Review of IEE and EIA, Regulations, 2000" only is announcing "*Federal Agency*".

However, the Statutory Notification (from 28 October 1998) informs that the Federal EPA has given power and function with regard to the Pakistan Environmental Protection Act, 1997 to the provincial Environmental Protection Agency of North-West-Frontier Province (NWFP).

3.3.2 Stakeholder analysis

The analysis of stakeholders revealed the following result in Table 3:

Proponent	**EPA**	**Government agencies and local councils**	**NGO**	**Potentially affected persons including influential individuals**
o WAPDA	o Environmental Protection Agency of the North-West-Frontier Province (NWFP)	o NHA for Karakorum Highway issues o Kohistan District Administration o Road construction Dept. NWFP o Patan Tehsil Council o Keyal Union Council o Neighbour Union	o IUCN Peshawar o WWF Peshawar o Palas Nature Conservation Project (EC/UNDP) o Aga Khan Foundation	o Jirga representatives of most affected villages o Representatives of the major tribes o farmers o millers o owners of hydro power plants

		Councils o Revenue Dept. o Department of Forestry o Dept. of Agriculture/Irrigation o SHYDO o Religious leaders		

Table 3 Stakeholder Analysis

Source: KKC 2007

The hearing (see 3.2.8) should invite representatives of the above institutions.

4 PROJECT AREA OF KEYAL KHWAR CATCHMENT

Project Area of the Keyal Khwar Hydro Power Plant in general is the catchment as it is roughly bordered in the satellite image (see Image 1) below:

Image 1 Keyal Khwar and Patan Khwar catchments

Source: Google Earth 2007

The catchment is located on the right bank of the Indus River 40 km up-stream of Besham and 12 km upstream of Patan. The Keyal Khwar ("Khwar" means stream) is a tributary of the Indus River, approximately opposite of the left bank tributary Chor (nowadays Palas) Nala ("Nala" is another local name for stream). The Keyal Khwar has two main tributaries Saimoo and Sanga Khwars (see Image 1). Their confluence, nearly the location for the designed dam has the geographical coordinates N 35°11' and E 73°01'.

The construction elements are located in partially in the Keyal Khwar catchment such as dam, reservoir, a section of the underground water conveyance tunnel, project road, temporarily labourer camps and required construction facilities. However, the conceptual design is based upon the transfer of the water through an underground tunnel system to the power house, which is located outside of the Keyal Khwar catchment in the Indus River catchment. The water from here will be released directly into the Indus River some meters upstream Patan town.

Nature and terrain of the upper Keyal Khwar catchment, which is determined by the mountains of the Hindukush Range, have an altitude of from 3,500 to 5,000 m asl (see Image 1, area without vegetation cover and ice on the right side, which is north). This terrain consists of rocks, snow packs and glaciers where vegetation almost does not exist. Here the Keyal Khwar is supplied because of the climatic balance that the annual precipitation in those higher zones exceeds the evaporation. Below this upper mountain zone there is a characteristic belt of coniferous forest (see Image 1), which starts around 2,000 (depending on the exposition) covering the area up to 3,000 m approximately. The majority of human settlements are below this coniferous forest, unless there are some villages mostly settled during summer.

The area, where potentially surge tank and power house in underground construction will be located, is part of the small catchment, which directly supplies into the Indus River (elevation between approximately 700 m up to 1,800). This from the altitude lowest zone mostly is barren land at the steep slopes upstream of Patan (see Image 1). Due to less rainfall, relevant erosion, frequent sliding, severe human impact from Karakoram Highway construction, permanent grazing and firewood cutting along the Indus River valley there is almost no vegetation. The immediate Project Area from the point of view of environment is this Keyal Khwar Valley, close to the river bed The altitude of the direct project area is between 667 masl, the confluence of Keyal Khwar and Indus River and 1,400 m asl, at the confluence of Saimoo and Sanga Khwar.

Administratively the Keyal Khwar catchment belongs to the Kohistan ("place of mountains") District of NWFP. The district headquarter is Dassu where the District Administration is located. Political head of the Kohistan District is the District Nasim, who is elected directly by the population. The administrative head is the District Coordination Officer, who administers the departments of Finance (including Planning and Audit), Works (Water Supply and Roads), Agriculture (Animal Husbandry, Forest and Wildlife, Fisheries and Cooperatives), Health (Basic Health Units, Rural Health Centres, Prevention, Medical and Dental), and Education (Primary, Secondary Schools and Sports), District Revenue, Taxation, and Social Welfare.

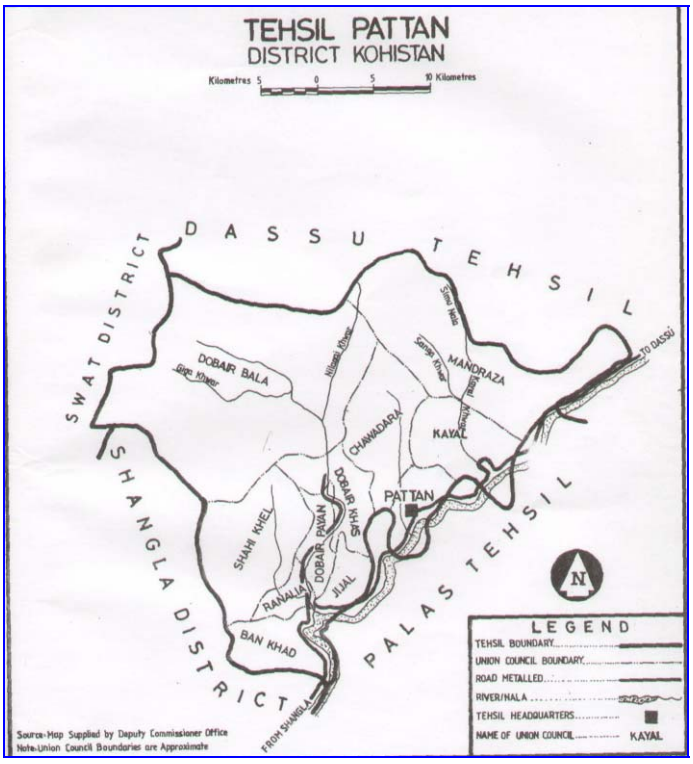


Figure 1 Administrative Structure and Catchment

Source: Census Report Kohistan District, 1998

The administrative subdivision named Tehsil is shown in Figure 1. The Keyal Khwar valley is part of the Patan Tehsil of Kohistan District. The Deputy District Revenue Officer administrates this Patan District Subdivision. Previously the valley was divided into two Union Councils, the Mandraza in the upper part and the Keyal Union Council in the lower part close to the Karakoram Highway along the Indus River (see Figure 1). Nowadays the Keyal Union Council comprises the entire Keyal Khwar valley.

The actual Project Area is determined by the potential construction and operation of the Keyal Khwar Hydro Power Plant. In most cases in the following study the Project Area is understood as the villages Sheshal, Soyan, Bach Gay, Bairlo and Bandlo. These villages are supplied by the Keyal Khwar. For the later impact analysis it might be necessary to determine a larger or a smaller area depending on the relevant impact (see Chapter 8).

5 CONCEPTUAL DESIGN

5.1 Overall Design

The Keyal Khwar Hydro Power Plant is one the projects currently under preparation by WAPDA using the flow of the small Indus tributaries of power generation. The Keyal Khwar itself originates the water mostly at an altitude of 3,500 up to 4,500 m, which indicates the high portion of snow and glacier ice melting with main discharge to be expected from April to August.

In previous investigations, including Phase I of this Feasibility Study, three dam options, including the currently preferred one, had been investigated. And, previously the power house was designed at the left Keyal Khwar bank below the village Leo (close to the Karakorum Highway). The IEE investigations during Phase I was based upon this overall design.

Due to the plan to build another big dam at the Indus River upstream of Pattan this design had to be changed. Current design studies fixed the dam location at the Zeta site (approximately 500 m downstream the confluence of the Saimoo and Sanga Khwar). Topographical and geological surveys have been carried out in 2007 in order to deliver basic information.

The dam will be a concrete gravity construction incorporating an overflow spillway, a series of three low-level outlets and a downstream protection apron. Immediately upstream of the gravity dam on the right river bank of the Keyal Khwar the water through the intake would flow through the high level headrace tunnel towards the underground power scheme. The length of the tunnel would be some 5.0 km through the right flank of the Keyal Khwar valley before making a dog-leg bend and running some 1.9 km under a mountain peak to a surge tunnel above Patan village.

From the surge tunnel, a pressure shaft drops some 625 m to a low level pressure tunnel, some 770 m long, which leads into an underground powerhouse housing two identical Pelton turbine generator units. The total installed capacity of the generating equipment is 122 MW at the high voltage side of the transformers.

The discharge from the Pelton units is conveyed to the Indus River through a free flow tailrace tunnel some 250 m long.

On average the project will generate some 449 GWh of electrical energy per year. During the dry months in winter (September to March) this energy will be generated during the 4 hour period of peak demand. During those days with extreme low flow this peaking generation time will be below the four hours period. During the wet months of May through to August, the energy will be generated throughout the day as base energy. Main design elements are illustrated in Table 4:

Design Element	Detail/feature	Description
Catchment	Keyal Khwar	162.8 km²
	mean monthly flow	9.15 m³/s
	design discharge	20 m³/s
Dam	site	Zeta (between Peshwa and Serto)
	elevation of dam crest	1,427.0 m asl
	elevation of Full Supply Level	1,422.5 m asl
	elevation of Minimum Operation Level	1,406.5 m asl
	height above river bed	37 m
	length of crest	116 m

Design Element	Detail/feature	Description
Reservoir	length	420 m
	area covered	15,800 m²
	total storage	240,000 m³
	live storage	190,000 m³
	riparian release	250 l/s
Low pressure headrace tunnel	type	underground with 2 windows
	diameter	3.8 m
	length	7,173 m
	excavated material	108,000 m³
Pressure shaft (steel lined)	elevation of top of shaft	1,360 m asl
	elevation of bottom oft shaft	736 m
	diameter	2.2 m
	number	1
	depth of shaft	624 m
Power house	number of turbines	2
	type of turbines	Pelton
Surge tunnel	location	400 m above Karakoram Highway
	upper elevation	1,449 m asl
Generation of electricity	design capacity	122 MW
	annual energy	448 GWh/a

Table 4 Salient features

Source: KKC 2007

5.2 Environmentally relevant design and operation features

5.2.1 Locations of dam, reservoir and intake

The dam would cross the asymmetric valley (which is approximately 100 m wide at the dam crest elevation), located downstream of the canyon above Bandlo Bazar, more or less in the middle of the valley, some meters upstream of the present foot bridge. The distance towards the downstream Bandlo Bazar is around 500 m. The eastern slope below Serto Village is quite steep, almost 90°, and determined by rock cliff. The western slope on the Peshwa Village side is covered with boulders mostly. Here some bush vegetation in particular in the higher parts exists.

The dam would have a height of 37 m and a crest length of 116 m. The reservoir would reach some 470 m length upstream into the canyon, but not reach Saimoo and Sanga Khwar and not submerge their small alluvial areas.

5.2.2 Construction facilities of dam

Facilities such as area for labourer camp, for batching plant, crushing plant and stock-piling of material such as rocks, grained rocks, sand, and cement are needed close to the dam site constructions works. There is the requirement close to the dam site, which means under the current terrain conditions to locate these areas above the dam site on the right bank of the Keyal Khwar. The terraces intensively used for residential houses and cultivated land by the

Peshwa village farmers above the canyon is intended to be used temporarily, likely for two to three years.

Special levelling and terracing (combining two or three of the narrow, only 2-5 m wide terraces) would be required to establish some plain area suitable for batching plant, and crushing plant and stock-piling above the construction site of the dam. The total area estimated would be 47,000 m², not including place for vehicle parking and labourer camp.

5.2.3 Quarries

Approximately 108,000 m³ rock is needed for the concrete of the dam. This material will come from the widening works (20 m width, 40 m height, and 125 m length) of the canyon above the dam site. There is some cliff area on both sides of the stream potentially supplying the material needed.

5.2.4 Underground water headrace tunnel and windows

From the intake at the right bank of the Keyal Khwar in the reservoir (with a FSL at 1,422.5 m asl elevation) the 6.9 km long tunnel runs more or less parallel to the valley respectively later towards Patan close to the Indus River (see Map…).

There would be two windows for excavation and management of all regarded underground construction works. For both windows an access road from the regular valley road would be required. The terrain to reach the potential locations of the windows is extremely steep, which requires an alignment with double bends. Amount and location of rocks to be excavated and dumped close to the windows is to be decided later. However, the current location of windows is in the broad leaved and partially coniferous forest.

5.2.5 Road

The concept for all construction purposes is to use the existing unpaved road running from the Karakorum Highway at 1,000 m approximately along the Keyal Khwar valley on the right bank upwards to Keyal Khwar village (above 1,500 m elevation). Currently it is a very narrow, but jeepable track mostly directly located at the steep slope of the right bank. The length from the Karakorum Highway to the dam site location is around 5 km. There are 400 m rise on 5 km length, with a mean slope of 8%. There are some sections, where the slope is almost 15%. The width of the road is less than 2 meters. Even when widened the most complicated sections limiting the accessibility for heavy machines and trucks would be the hairpin bends.

5.2.6 Operation

The operational regime is determined by the storage in the small reservoir and daily diversion of water through the tunnel to the power house. The objective is to generate electricity in a daily mode depending on the availability of water. This would be in low water periods only some hours and would be extended up to continuous 24 hours running turbines in some wet season months (May-July). This approach includes that only some riparian release would remain in the Keyal stream itself downstream of the dam.

The diversion of water is based upon the riparian release of 250 l/s water downstream from the reservoir to the Keyal Khwar at every time. This figure had been estimated based upon the water needs presently, which is – excluding all electricity generators – around 115 l/s (see Chapter 7.4.8). The amount of 250 l/s water for downstream users (thus more than twice of the present consumption) does not include the demands for the downstream smaller hydro power generators. This figure relies on the approach to use the 600 l/s water more beneficially for electricity generation in the high head hydro power plant of Keyal Khwar. And, it includes the supply of electricity under acceptable conditions to the present consumers. One general policy behind this approach is to reduce line losses. That means the Keyal

Khwar HPP electricity should supply in first order to NWFP and not far regions, where those line losses would be multipled against the real consumption of the entire Keyal Khwar valley.

5.2.7 Sediment flushing

There is the design to empty periodically the sediment, which has been collected during operation through sediment flushing gates. During high floods the high amount of water and the speed of the stream will be used for flushing down the sediment towards the lower Keyal Khwar reaches.

5.2.8 Surge tank and power house

Main elements at the end of the water conveyance system are the underground surge tunnel from where a pressure shaft drops some 625 m to a low level pressure tunnel, some 770 m long. From here the water would reach directly the underground powerhouse close to the Indus River valley below the Karakorum Highway. Two Pelton turbine generator units would be installed. The total installed capacity would be 122 MW. From here the electricity would be supplied to a transmission line along the Indus River valley. And, the discharge from the turbines in the power house through a free flow tailrace tunnel (250 m length) would run to the Indus River.

6 BASELINE STUDY SOCIO-ECONOMIC ENVIRONMENT

6.1 Socio-economic conditions in Kohistan District

Location and Administrative Structure

The district situated in the extreme North East of NWFP Province, was created in 1976. In the East its boundaries touch Northern Areas of Pakistan, in the east is located the Mansehra District, Batagram District in the South, in South West Shangla and in West is Swat District. The River Indus passes the district in the middle dividing into two distinguished parts. The district has been divided into three Tehsils for administrative control, which are Patan, Dassu and Palas. The district headquarter is located at Dassu. The Tehsil headquarter is at Patan, which is about 16 km from Keyal Village. The Keyal valley is located in Patan Tehsil.

History and Current Tax System

Kohistan has some particular historical terms. It before 1951 belonged to Swat State and left hand side was a tribal area situated on the boundaries of Hazara District called as Yoghistan. In 1969 both parts of Swat Kohistan and Hazara Kohistan were amalgamated and raised to district status. The people in Kohistan District do not pay tax on properties and economic activities due to these historical roots. The land ownership conditions and water user rights are also related to the tribal conditions as in other parts of NWFP.

Area and Population

The gross area of the district is 7,492 km². The total population of the Kohistan District during 1998 Census was 475,000 inhabitants. The cultivable area of the district is 37,000 ha, out of this 20,000 ha are irrigated and the remaining is rain-fed land. The area under forests is 185,506 ha. The statistics on lands and forest area are estimates. A detailed inventory of areas and settlement has not been carried out so far. The population on the right bank of the Indus River speaks Kohistani language and the people on the left bank of river Indus River speak Sheena language.

Present Social and Economic Conditions

The population of Kohistan District is very poor. The tribal system, non awareness due to lack of education and poor accessibility in the mountainous areas are the characteristics of the district. The people of the district strictly follow their customs and traditions. The elders of tribes and religious leader command special respect. Non awareness and lack of basic infrastructure requires preparation of special development schemes and programming run by NWFP and the Federal Government of Pakistan, to become the district a part of national development scenario. The socio-economic indicators of Kohistan District as compared to NWFP are shown below see Table 5:

Item	Unit	NWFP	Kohistan District
Area	km²	74,521	7,492
Population (1998)	Million inhabitants	17.7	0.475
Population density	inhabitants per km²	238	63
Cultivated area	Million ha	1.7	0.037
Population per cultivated land	inhabitants/ha	10.4	12.8
Irrigated area million	ha	8.5	0.020
Total area under forests	Million ha	1.3	0.186
Total Literacy rate	%	37.3	11.08

Item	Unit	NWFP	Kohistan District
Literacy rate of male	%	52.8	17.23
Literacy rate of female	%	21.1	2.95
Higher secondary schools	number	196	I
Colleges	number	96	0
Vocational colleges	number	38	0
Hospitals	number	143	0
Rural health centre	number	81	3

Table 5 Basic economic data of the Kohistan District and NWFP

Source: Kohistan District Administration, 2003

Education and literacy

There are 72 middle schools in the district, of these 68 are for males and 4 for women. Primary schools for boys are 460; from which 337 are *Masjid schools (Mosque schools) and 5 Maktab schools* (small village schools) schools. Primary schools for girls are 236 and this numbers are 82% of boy's school. There is neither vocational school in the district nor a technical college. A boy's degree college in Dassu is under construction.

The overall literacy rate is very low in the district, only 11.08% as compared to provincial figure of 37.3%. The literacy rate for female is extremely low that is 2.95% as compared to 21.1% for the province of NWFP. The CBO Keyal Village has informed that an intermediate college has been established at Patan.

Health Facilities

Like education Kohistan is the most under privileged district in health facilities. Due to extreme poverty in the district and unhealthy environments and under-nourishment the diseases like malaria, hepatitis, dysentery, asthma, scabies tuberculosis and leprosy are common in the district. The number of patients is increasing with time. The health facilities are very poor. There is one Medical Centre in the district responsible for vaccination against epidemic diseases. The health facilities are under-developed for the population and the number of patients and diseases. Following health facilities exist in the district: Three rural health centres, 34 basic health units, 1 civil dispensary, 2 leprosy centres and 1 tuberculosis centre.

Social Welfare

There are industrial homes for women located at Dassu and Jhander Kot. These homes can accommodate about 40 trainees, who train females in sewing, dressing, embroidery, and designing. There are eight NGOs registered with Social Welfare Department and are working in different parts of the district.

Fisheries

There is information about a high potential for trout fish culture in the nullahs of the Kohistan District. One hatchery was already established in Duber for multiplication of trout fish.

Forests

The Project Area belongs to the forest division Patan, which has 26,518 ha area. Responsible administration is the Forest Department of the Kohistan District in Dasu.

6.2 Population

6.2.1 Population in Keyal Union Council area

The number of population living in the area of the Keyal Union Council, which is almost identical with the Keyal Khwar catchment, is listed in Table 6:

Settlement	Population 1998	Projection 2006 with 3.13%
Asso	124	154
Bach Gay	78	97
Bair	393	488
Bairlo	170	211
Balindrat	331	411
Banda	94	117
Benua	95	118
Bandlo	80	99
Charto	290	360
Daber	189	235
Dehro	175	217
Dhope	246	305
Gel	132	164
Harigah	1.220	1.514
Jabba	153	190
Jano Bvin	79	98
Keyal Village	605	751
Keyun Sero	203	252
Maidan	227	282
Peshwa	363	450
Pogalay	344	427
Qillah	453	562
Sen Steel	570	707
Serto 1	522	648
Serto 2	282	350
Sheshal Keyal	962	1.194
Soyan	293	364
Sungai	85	105
Swar Steel	1.238	1.536
Total Keyal Union Council	**9.996**	**12.403**

Table 6 Population of Keyal Union Council in 1998 and 2006 (projection)

Source: Census Report Kohistan District, 1998

The population of all villages at that time was almost 10,000 (exactly 9,996 persons see above in Table 6). Using the natural growth rate of 3.13% (Census Report 1998) the population number should have risen up to more than 12,000 inhabitants (2007). Predominantly the population is living in settlements and single houses in three areas, on the bottom of the Keyal Khwar valley, at the slopes and on the foothills above the Keyal Khwar valley. The biggest village is Harigah.

Image 2 Geographical location of important villages

Source: Satellite Image from Google Earth 2007

6.2.2 Population in the Project Area

The Project Area is the immediate zone of the Keyal Khwar valley with those villages, which are supplied by the Keyal stream itself. Following Table 7 shows the villages, which are using the Keyal Khwar for drinking water (both for humans and animals), for irrigation, for milling and hydro power generation:

Villages	1998 Census	KKC projection 2007 May 2006	Actual survey February 2007
Sheshal	962	1,194	1,342
Soyan	293	364	385
Bach Gay	78	97	176
Bairlo	170	211	236
Bair	393	488	556
Bandlo	80	99	115
Total	**1,976**	**2,453**	**2,810**

Table 7 Population of Villages in Project Area

Source: Census data and KKC Socio Economic Survey February 2007

While in 1998 almost 2,000 persons were enumerated, the population during 2007 investigations was counted with more than 2,800. The observations in the Keyal Khwar area revealed early marriages and large family size of 8 to 10 people, which made understandable the observed higher natural growth rate of 4% (see above growth). The inventory made in the above Keyal Khwar Project Area villages from 2006 to 2007 revealed even a rise up to 6%. It results in a high number of young people (0-18 years), which is in the range of 60%.

However, there are some sign that this trend will not continue, at least not with such an extreme high natural growth rate of the population due to more education (see Chapter Education and Literacy ….).

6.2.3 Tribal Structure

Keyal tribe settles permanently in Keyal Khwar valley and Keyal Union Council area. The Keyal tribe has four sub-tribes and each sub-tribe has several families. Keyal people (Kayal Khel) do not live in other valleys around. Even in Patan valley, where the majority consists of members of the Kashekel, Haiderkhel and Serkhankhel tribes none of the Keyal people are living permanently there. The classification of sub tribe and families is given as below in Table 8.

Clans/group	Sub Tribe	Main village	Families
Keyal 1	Bahadarkhel	Serto	Shahzamankhel, Mohammadkhel, Mhabbatkhel
	Harifkhel		Shanekhel, Thalekhel, Ruslakhel, Rehamanakhel
Keyal 2	Barekhel	Peshwa	Gujarkhel, Wallokhel, Banjalkhel, Kaprakhel
	Kunnakhel		Razokhel, Khushkhel, Punderkhel

Table 8 Sub-tribes in the valley

Source: KKC Socio Economic Survey, February 2007

Only one tribe the Keyal tribe settles permanently in this valley and Keyal Union Council area respectively. There are four sub-tribes in the valley, namely Harifkhel, Radikhel, Kunnakhel and Barekhel.

The above named Keyal clans and sub-tribes have their specific economic targets to realise economic gains from land and forest in the valley. These groups compete for representation on all government forums, job opportunities in road and irrigation canal construction or reconstruction, in forestry, in downstream jobs, and also claim for an equal share of new economic opportunities in the valley such as employment during construction and operation of Keyal Khwar power plant. Due to prevalent illiteracy, significant poverty and low level of economic opportunities there is occasional turmoil between clans, sub-tribes and communities on how to share the economic opportunities. However due to belonging to the same tribe and many inter-marriages in general they live peacefully together in the valley.

They participate in each other marriages and death ceremonies. Each sub-tribe has an elder man and these elder men lead their sub-tribes at a Grand Jirga meeting, which final resolution will be accepted by everybody.

6.3 Land Use, Agriculture and Forestry

6.3.1 Land Use

The land use pattern follows on the one hand the geomorphologic structure and the climatic (vertical) zones. On the other hand the land use is the result of the man-made activity in the

valley since generations. The following overview in Table 9 demonstrates the mostly vertical structure of land use types and their pattern.

Land use type	Elevation in m asl	Decisive factor(s)
Glacier and snow pack	> 4,000	Climate
Alpine pasture	3,500-4,000	Climate
Timber wood	2,000-3,500	Climate, soil and forestry measures
Settlements	1,000-2,200	Soil, water and land availability
Cultivated, mostly irrigated land	< 2,000	Terraces and water derivation channels constructed
Barren land	1,200-1,500, partly below 1,000	Geology, geomorphology, over-grazing
Unpaved Roads including Kara-koram Highway	1,000-2,200	Access of settlements with Kara-koram Highway
Dry rangeland	Mostly < 1,000	Rock, overgrazing

Table 9 Land use zones in Keyal Khwar valley

Source: KKC May 2006

Due to the very narrow strip of alluvial plain with the Keyal Khwar itself mostly the settlements and their cultivated land is located on steep terraces, see Picture 2 of Sheshal Keyal Village.

Photograph 1 Sheshal Keyal Village and alluvial plain with irrigation channel

Source: KKC May 2006

The most intensive land use pattern is to be observed in the lowest valley mosaics:

Land Use Mosaic 1: On the lower valley reaches from the Keyal Khwar river bed some hundred meters above, since generations the alluvial plain nature has been changed for parcelling of cultivated plots, construction of water derivation channel for irrigation and the construction of valley road. Some stone houses ("*Kachha*") normally were built on the edge of the valley bottom. Fruit trees accompany this land use pattern of the valley bottom area.

Land Use Mosaic 2: The slopes and foothills itself at an altitude from 1,200 up to 2,000 m asl carry mostly broad leave trees, to which many fruit trees as apple, walnut, fig, almond, mulberry and wild olive belong. In the upper part of this zone continuously the trees change towards pine and other coniferous species.

Photograph 2 Shops in Bandlo Bazar

Source KKC May 2006

On the top and at the steep slopes of the foothills on both sides of the immediate Keyal Khwar valley settlements are located. They are linked with the valley outlet at the Karakoram Highway through the only valley road. These settlements are included into the forested zone. Some small cultivation areas surround these settlements. Availability of irrigation and drinking water is the key issue. Some shops are placed along the valley road. These shops are located within geographical limits of Bandlo village (see Picture 2).

Small hydro power plants and water mills are stretching along the stream reaches. Cemeteries due to the limited terrain mostly are dispersed. Mosques are established inside of the villages. Buildings of communal origin such as schools are placed in the villages as well. Buildings for dispensaries (only one in Keyal Village), Union Council or other function do not exist. One driver hotel is located directly at the Keyal Khwar, where it meets with the Karakoram Highway.

6.3.2 Farming and Crops

Cultivated land in the valley is limited due to the small alluvial plain and the steep slopes of the foothills. The average of area of land holding is 2.0 kanal (approximately 1,000 m²). Main source for the daily food supply of the Keyal population traditionally is the production of cereals. In general all households have some land, where they are cultivating them. First cereal crop is maize, grown on 95 % of the entire cultivated land. Traditional varieties of maize, which are liked for *Nan* making but low responsive to fertilizers, are grown in the valley. Sowing season of maize is June. The harvesting is done in October. Maize is stored in wooden boxes for consumption in next summer. Maize is preferred for bread production ("chapati or nan"). The cereal production does not cover the consumption needs (see also Chapter Income and Expenditures).

The area grown with maize in the Project Area is shown in the Table 10 below (one maund is equivalent to 40 kg):

Name of Village	Maize production 2006 in maund	Maize production in kg	Area in acres	Area in ha
Sheshal	1,973	78,920	79	32,0
Soyan	424	16,960	17	6,9
Bach Gay	194	7,760	8	3,2

Bairlo	275	11,000	11	4,5
Bair	1,487	59,480	59	23,9
Bandlo	150	6,000	6	2,4
Total	**4,503**	**180,120**	**180**	**72,9**

Table 10 Maize production and agricultural lands in Project Area

Source: KKC February 2007

The above information is based upon the harvested maize of year 2006. Unfortunately the farmers cannot estimate the size of their land holdings. Thus, for a rough calculation how much land is used in the Project Area, these harvest figures in Kilogram were divided by the assumed yield of 2,500 kg/ha. The mean yield in the Kohistan District is 2,200 kg/ha, while in entire Pakistan almost 3,500 kg/ha. However, due to the availability of water the slightly higher yield was assumed. There is no information whether the yield is different between the villages due to natural conditions including soil and water availability or maintenance and therefore the area of cultivated land would be different.

Although the farmers have started using urea fertilizer to cultivate crops, although in small quantities, the yield of maize is stagnant and very low as compared to this Pakistan average.

Wheat as winter crop with regard to bread is the second cereal and mostly served to guests. The area under winter crops is very limited to only a few plots. In 2007 it was approximately 2 acres (0.9 ha). During winter only some plots are occupied by wheat and vegetables. The most important reason is that the domestic animals are at that season in the valley (in summer they are on higher altitude), which is why they would eat everything, if fences would not protect the crops. And, the Socio-economic Survey in 2007 revealed that the cost for fencing would increase the production cost. The net price for wheat would be lesser than the market price. There may also be some other issues such as the weak irrigation facilities and practice and the unfavourable climatic situation in winter.

Name of Village	Maize production in kg	Population in 2007	Maize production per head of local population
Sheshal Keyal	78,920	1,342	58.8
Soyan	16,960	385	44.1
Bach Gay	7,760	176	44,1
Bairlo	11,000	236	46.6
Bair	59,480	556	107.0
Bandlo	6,000	115	52.2
Total	**180,120**	**2,810**	**Average per head 58.8**

Table 11 Maize production 2007

Source: KCC 2007

The average of maize production (see Table 11) during one summer crop period is 58.8 kg/capita. Bearing in mind the average of demand for maize flour for bread of 140 kg/year the cultivation is not sufficient. This is caused by the explained situation that during winter there in general is no harvest of any cereals.

The cultivated land is located on the valley bottom, on terraces at the slopes and on top of the foothills. The area is irrigated by a number of derivation channels taken out from the Keyal Khwar by individuals as well as by the communities. Three previous derivation channels for foothill land of Sheshal starting from Soyan irrigating the foothill land of Sheshal, Bach Gay and Bair recently have been replaced by 10 cm water pipes. This replacement was financed under the Barani Area Development Programme. Water pipes and derivation channels run at gravity flow taken out from higher altitudes in upper reaches of Keyal Khwar.

Photograph 3 Plot of wheat cultivated in Sheshal village

Source: KKC February 2007

During winter 2007 vegetables were grown on small plots, which in total were two acres (0.9 ha). These vegetable fields include cabbage, radish, turnip, spinach, swanchal (a local vegetable). Some natural growing leafy plants are used as *Sag* (green vegetables, which is used in *Lassi* or simply cooking and adding of butter) specially eaten with maize bread.

6.3.3 Fruit trees

Important is the production of fresh fruits such as apple, grapes and mulberry. The varieties naturally grown here could be found in the valley itself, on the slopes of the foothills and on the plateau (between 1,800-2,200 m). There a small orchard (0.02 ha) recently has been planted in Sheshal village. The fruits species are *Faa* (local black berry from natural trees); Amlook (black berries, which will be dried) is of inferior quality due to small size of berries, walnut, apple, apricot, peach, lemon, and mulberry.

According to the local tradition fresh fruits are not sold in the market and surplus is distributed among neighbours and friends. Any surplus of dry fruits is sold on the market such as walnut. It is consumed by the local people themselves. Walnut and amlook are of commercial importance. A few plants of orange have also been observed in Sheshal village.

The total number of fruit trees in the Keyal valley is 969 (Sheshal 22, Soyan 56, Bach Gay 26, Bairlo 145, Bair 371, and in Bandlo Village 49). In addition the most residents of these villages also own fruit trees at their lands at higher altitude, which contribute to the family income in the form of consumption and also sale proceeds. No regular irrigation system has been planned for the fruit trees. All water they receive from stream, irrigation to terraces or from any rainfall.

6.3.4 Animal Husbandry including Bee Keeping

All Keyal Khwar households possess animals such as buffaloes, cows, goats, sheep, donkeys, horses, and poultry. The information gathered during Socio-economic Surveys 2006 and 2007 is that on an average each household has 2-3 cows, one donkey, 15-20 goats and sheep, 6-7 poultries. The number of these livestock was counted during the Socio-economic Survey carried out in February 2007. The results are illustrated in Table 12 below:

Village	Buffalo	Cows	Donkeys	Goats	Total livestock	Poultry
Sheshal	33	384	132	3,339	3,888	1,050
Soyan	14	132	52	612	810	336
Bach gay	6	51	15	281	353	143
Bairlo	8	50	23	443	524	169
Bair	51	170	58	1,327	1,606	463
Bandlo	7	17	7	144	175	42
Total	**119**	**804**	**287**	**6,146**	**7,356**	**2,203**

Table 12 Livestock in the Project Area

Source: KKC Socio- economic Survey, February 2007

From this totally 7,356 heads of domestic animals approximately 83 % are goats and sheep (they do not distinguish), 11 % cows, 4 % donkeys and almost 2 % buffaloes. These animals in winter are kept near the farms, taking care of by women mainly, old family members and children. In summer mostly the domestic animals are fro grazing in higher altitude (see next Chapter 7.2.5). Poultry birds are also kept in houses.

The livestock are an important source for the daily food and also cash income. They deliver products such as butter, milk, cheese, meat, and eggs. These products normally do supply entirely the daily household needs. Milk is not sold. Wool and skins are mostly sold on the markets. The cattle are also store of wealth. Besides commercial sale of livestock they are used for ploughing and transportation as well.

Presently the stock of cattle consists of traditional small breed, which gives the cows an under-nourishing outlook. The milk yield of the traditional breeds is in the range of 1-2 kg per head/per day. Medium size breed of cross bread cows can also be seen in the valley, having slightly higher daily yield of 4 kg /head. However, despite these limiting factors livestock contributes almost twice to the family income as compared to crop production.

During survey only one Gujar (shepherd) living in Keyal valley was enumerated. He owns a limited number of goats and in addition he was working to graze 300 goats and sheep of other households, in particular during summer season. Wages of a Gujar is in the range of Rs. 19,000/year per household paid in kind and cash.

The feed consist of green and dry grass, green and dried maize stalk and leaves, green leaves of trees and bushes, especially wild olive growing on the slopes and plateau of the foothills. The concentrates in the form of maize grains in oilseeds cakes in limited quantities are given to the milking animals particularly during winter months.

In case of epidemics the livestock owner get advice from the staff of livestock dispensary located at Bair village. Veterinary medicines are used against animal diseases.

Beekeeping is not very commercially done. Only few farmers are doing beekeeping. The bees collect honey from the green and flowering foothills, which allows the farmer to sell it to neighbours mostly. The honey therefore is with Rs 500 per kg very expensive.

6.3.5 Transhumance of Livestock

The Keyal people are practising since centuries, vertical seasonal livestock movement, so called “transhumance”. From their locations in the Project Area, where they live in winter, they move during summer with the livestock to higher pastures. The main reasons are lim-

ited land and fodder resources in the valley as compared to the human and cattle population. Grazing land and fuel wood on the slopes is limited and cannot meet the full yearly needs. Thus, the people occupied also rain- and snow-fed land (rangeland and houses on higher altitudes (see Image 3) in villages such as Balkhand, Phagyl, Swar Steel, Jabb, and Asso. On further higher altitudes community grazing land at places like Banda Ghumtu, Chatter, and Dabber is available. In summer the temperature at these higher altitudes is mild. There is plenty of grass and fodder available in those places in summer. From higher altitudes they are utilising fuel wood either.

Image 3 Land use pattern in higher altitudes for summer transhumance

Source: Google Earth 2007

This movement starts at the end of April and almost all cattle, sheep and goats are moving at higher places. Only the herds and a subset of people tend to travel upwards. Often some families are moving over considerable distances towards temporary shelters in the upstream pastures in the Keyal and Patan catchments. On the rain-fed land on the top of the foothills these farmers also grow maize, collect and dry vegetable, grass (hay) and fuel wood. Before snowfall and severe winter begin families and livestock remove to the valley and lower altitudes. They carry along their dry fruits and dry grass fodder.

KKC investigations in 2007 revealed that population in the range of 15-20% remains in the valley from June to October. They are obliged to harvest the winter wheat in May and vegetable and first of all to grow the maize.

The winter in the valley is cold but less severe as compared to the higher altitudes. The grass, fuel wood and broad leave fodder trees in the valley and on lower altitudes are kept in reserve for use in the winter months.

6.3.6 Forestry, Wood Chopping and Non-Timber Products

Forest is an important natural resource for the Keyal Khwar valley. Most relevant timber trees are chir (*pinus roxburghi*) deodar (*cedrus deodara*), kail (*pinus wallichiana*), fir (*abies pindrow*), and blue pine (*picea abies*) and spruce (*picea morinda*) grown on higher altitude. In the valley the broad leave forest trees are main source of fuel wood and fodder for livestock

According to Kohistan District Forest Department information most of the households in the Keyal Khwar valley are dealing with forestry and wood chopping. Forest land is in ownership of the village communities in the Keyal Union Council area. The Forest Department develops 10 year plans for wood harvesting, for which individual contracts are awarded to local persons. This “forest contractor” employs local people for timber harvesting and the wages are reimbursed by Forest Department to the contractor. The contract defines which trees are to be harvested and to which place and date the timber is to be delivered. The timber desig-

nated for construction material and furniture is finally divided between tribe and forest department in the ratio 80:20. The income from the tribal share will be distributed among the families of sub-tribes on the basis of number of persons in the families.

The Forest Department furthermore is managing a tree nursery in Duber. A private nursery is active in Chawadara. Both nurseries offer regular work for preparation of seedlings and planting of small seedlings in the forests of the Kohistan District and Keyal Khwar Union Council area.

Due to the electricity deficit in NWFP in general and Keyal Khwar valley especially there is a market on firewood (for cooking mostly) in Patan, Palas, Duber, Dassu and Besham and along the Karakoram Highway at many special places. In particular women and children are collecting the smaller trees and bushes from the forest to use as firewood.

However, only one person of the Project Area during the interviews in April 2007 informed that he has sold the fuel wood on the market.

Forests also offer other products such as wildlife for hunting, berries and mushrooms. Rich medicinal plants naturally grow in forests and upper alpine meadows. Relevance in particular has *Banafsha* and mushrooms, both used in the traditional local medicine. Harvesting of Chelkhoza (seeds from spruce, fir and pine) was not acknowledged.

6.3.7 Housing

The population and hosing survey has shown that 97% Keyal own their houses and only 3% are living in rented houses. Some of the families who are living in rented house explained that their houses were ruined during recent earthquake and they will built their own house soon. As stone and cheap timber is available in the valley mostly houses are built of stone and wood particularly in the upper part of the valley, which are named *Pacca* houses. In the lower part of the valley only very poor *Kachha* houses are build from mud often without any glass windows or doors (see Table 13). Most of the houses have very poor ventilation, but all partially electrified. During winter the people are burning fire wood inside the houses in order to keep it warm. They also keep the animals in one room of the house during winter.

Name of village	Kaccha houses in %	Pacca (stone/brick) houses in %
Sheshal	52	48
Soyan	55	45
Bach gay	86	14
Bairlo	84	16
Bair	38	62
Bandlo	33	67
Total	**348**	**252**

Table 13 House types in the Project Area

Source: KKC survey February 2007

6.3.8 Land Holdings and Land Acquisition Procedure

Land resources in the narrow and steep valley are not available. The only resources are the further use of the slopes, which needs extensive terracing, and on the top of the foothills, where irrigation for the summer cultivation is not available. Due to high population growth, the natural conditions, in-availability of irrigation water, the very scarce employment market the pressure on land is extremely high. Due to the high natural growth of population and the

traditional inheritance succession the plots per household are becoming increasingly smaller.

The following Table 14 reveals that the average size would be 4.6 kanal (2,330 m²), which is not sufficient at all for self-supplying the big families. However, this calculation is based upon KKC estimation of land using the harvest data. Unfortunately, as discussed already, the local people do not know the size of their land.

Name of Village	Area in kanal	Population in 2007	Estimation of households	Estimated mean size of land in kanal (506.1 m²)
Sheshal	632	1,342	149	4.2
Soyan	136	385	43	3.2
Bach Gay	64	176	20	3.3
Bairlo	88	236	26	3.4
Bair	472	556	62	7.6
Bandlo	48	115	13	3.8
Total	**1,440**	**2,810**	**312**	**4.6**

Table 14 Estimation of size of land holdings per household

Source: KKC 2007

The prices for land therefore are rising quickly: The prevailing market rates for cultivated and irrigated land in the valley are Rs. 205,000 to 305, 000 per kanal (506.1 m²). It is obvious that land near to the valley road with good water supply receive higher prices.

The present adopted land acquisition procedure is:

- Every Keyal family/household owns some land.
- People from outside of the tribal structure cannot purchase land in the Keyal Khwar Union Council area.
- A local person belonging to the tribe offers his interest to purchase a certain plot of residential or agricultural land.
- The owner, who is normally the user, offers a price and the conditions for purchase.
- The Jirga of Keyal Khwar village fixes the value and other land acquisition conditions.
- The Patwari prepares the land record in accordance with the NWFP regulations.

This procedure is managed by the local authorities and the local Patwari. Keyal Khwar Union Council only has one Patwari for land issues. The Pakistan irrigated areas structure consists of another Patwari for water issues. Likely because of the structure of catchment and the private management of water in Keyal Khwar the position is not active.

According to the NWFP conditions the owners and/or users of land do not have to pay tax neither for renting nor for selling or purchasing. As the Keyal Union Council confirmed, land records so far do not exist.

Forests areas, rangeland, water bodies, and usage of water are common properties of the community.

6.4 Economic Conditions

6.4.1 Main Occupations

The main occupations of the heads of households are shown in following Table 15.

Occupations of the heads of the households	Percentage
Crop husbandry	38
Animal husbandry	7
Labour activities such as contractors and workers in construction, forestry	30
Governmental jobs	10
Trade including shop keeping and other business	10
Services, including drivers, water miller	5

Table 15 Estimation of present occupation in Keyal Union Council

Source: Socio-economic Survey 2007

All interviewed household heads reported that the above main occupations in construction, forestry, administration and business are main professions. Some workers are busy with wood chopping, working on saw machines, carpentry for housing. Some few men are flour millers.

As there are reasonable reconstruction activities in earthquake affected areas a class of contactors has appeared in the valley obtaining contract for construction works and mobilize labour from the valley to work on these contact. These contractors pay reasonable wages besides free food.

Furthermore there are some governmental jobs. More than 30 primary schools running in the Keyal Khwar Project Area provide employment opportunities. Some locals are working as teachers in these schools. However, mostly these individuals are working in WAPDA departments, Kohistan District and Patan Tehsil Administration as service employees.

A relevant local economic sector is transportation. Due to the remote location of the Keyal Khwar valley to markets such as Patan, Palas, Duber and Dassu, but also Besham, Batagram, Abottabad and Mansehra, Swat, Gilgit totally approximately 5 % of the heads of households are working as drivers. Some of them owe the vehicles while other work as employees to vehicle owners.

There are only very few shops selling products for the daily needs, which are not produced in the area such as salt, sugar, tea, soft drinks, and biscuits. The shops at Bandlo Bazar have been rented out at monthly charge of Rs 600 to Rs 1,200.

But all households in addition have a piece of land, where the entire family respective household also grows crops and has some livestock for the own supply. In such cases the crops and livestock are attended by in their absence. Those settlers without these occupations only have to survive based upon their land.

It has been estimated that about 20% of the labour force from the valley is working outside the Kohistan district in Pakistan (these are not include in the above Table 16), but none has been reported to be working outside Pakistan. The HEPO report 2003 indicated that many of them are working in the Gulf States.

Women are excluded from occupations outside agriculture. They are deprived from any other job opportunities due to the tradition and customs and the overall labour market situation. Their labour within the household structure carrying out child and family care, livestock management with feeding, milking, milk processing and cultivation (including seeding, maintenance and harvesting) remains unpaid.

6.4.2 Income

The income investigation as part of the Socio-economic Survey carried out in 28 households of the Project Area (villages Sheshal, Soyan, Bach Gay, Bairlo and Bandlo) revealed the following general results:

Description	Average income per family in Rupees	Percent of total
Crop husbandry	15,000	6
Fruit trees	8,800	4
Livestock	50,600	21
Dry grass	5,700	2
Fuel wood	14,000	6
Honey	1,100	0,4
Timber	15,400	0,6
Business	29,000	12
Labour	95,000	39
Services	23,000	9
Total	**257,600**	**100**

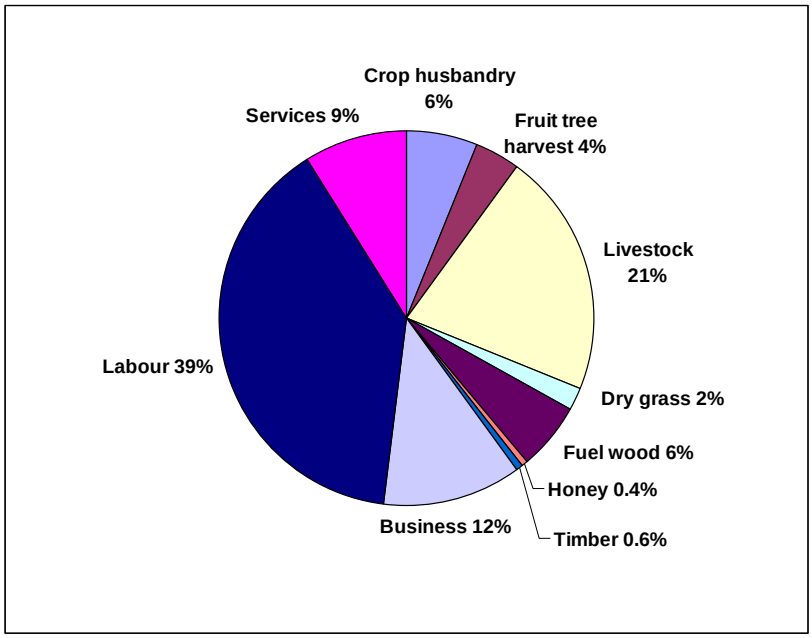
Table 16 Sources of Income

Source: KKC Survey April 2007

Earthquake Relief provided by the Earthquake Rehabilitation and Construction Agency (ERA) has not been included in the income of the valley.

The income from crop husbandry, fruit tree, livestock, hay harvest, fuel wood and honey collecting is realized from resources of the immediate Keyal Khwar valley as well from higher altitudes. The proportion is in general 50: 50 between land of the lower Keyal Khwar villages and the villages at higher altitudes.

The overall result is that the major income source is not the agriculture. Sixty percent of the estimated income of the households in the Project Area is supplied by activities beyond agriculture and forestry. The biggest part is the income from job opportunities outside of the Keyal Khwar valley. Mostly young male family members, often unmarried, work in the region of Abottabad and Mansehra in construction, business and trade, predominantly as un-skilled workers. The daily wages of unskilled workers are Rs. 150 to 200. Skilled workers have a wage rate of Rs. 300 per day. They are away from their families over months, sometimes years, which causes some social tensions. The information reported by the HEPO (2003) that many of them are working in the Gulf States could not be confirmed in the Socio-economic Survey in 2007. Only this money earned from outside job opportunities is 39 %. The locally produced income is with 40 % almost equivalent.



The income from timber is very limited. The income shown for timber is for the quantities harvested for use for building houses. Normally timber is harvested under forest department plan and last harvesting and income distribution to the population of the valley was made during 1992.

Figure 2 Income sources

Source: KKC 2007

Carpentry of local timber for furniture is not observed. Also, other handicrafts such as masonry locally learned are not available in the valley. Also in Patan, Dassu and Besham there are no training schools. Harvesting of so called non- forest products such as mushrooms and medicinal plants for commercial purpose do not play an important role in the income situation.

In general the outcome of the income investigation was surprising, that that in the interviewed 28 households the annual mean income was almost Rs. 260,000, which is a monthly income (in cash and in products) of approximately Rs. 21,500. The mean income in Pakistan is Rs. 4,500, which is however calculated on the job base. This relative high household income explains that in these Keyal Khwar households contribute three-four individuals. Nevertheless, the income situation indicates that the people are not that poor as it was expected.

6.4.3 Pattern of Family Expenditure

During the Socio-economic Survey carried out in 28 households of the Project Area also the mean expenditure of the households had been investigated. The value of family expenditure has been calculated on the basis of consumption from self production as well as purchased input. The domestic production has also been assigned the same financial value as those of purchased input. Food items account for 40 % of family expenditures. Items produced in the Project Area included in the food basket are maize, small quantities of red beans, wheat, vegetables, fruits, milk, butter, meat and honey. However, the major portion of food items, especially for bread making (wheat and maize) they have to buy in addition on the local market (mostly from the local millers).

Likely the most important result is that there are some savings, at least in the interviewed 28 households as Table 17 reveals:

Description	Average expenditure (in Rupees)	Percent of total expenditure
Food	96,500	40
Fuel wood	14,000	5
Clothing	19,000	8
Education	6,000	3
Medical	16,000	6

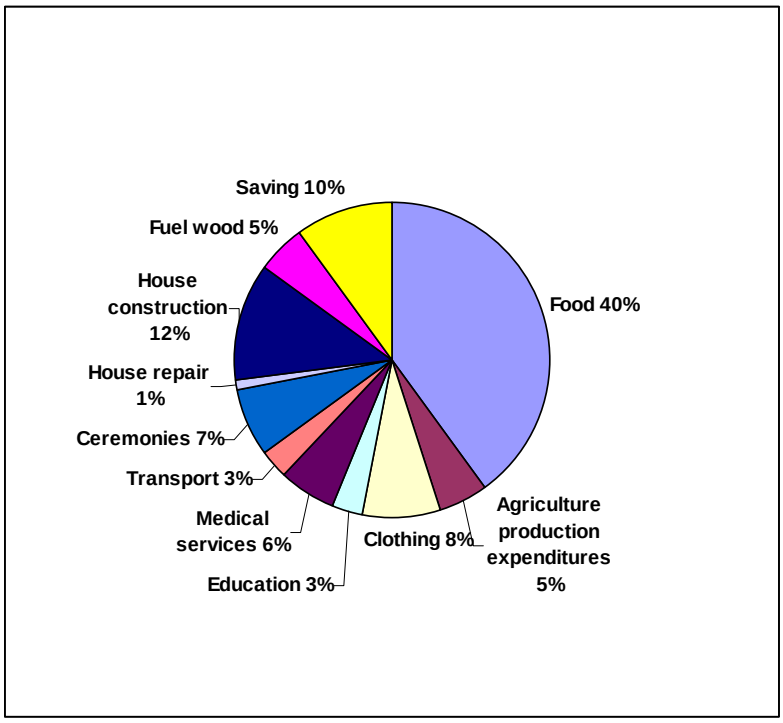
Transport	7,800	3
Ceremonies	16,000	7
Repair of house	1,000	1
Construction of house	32,000	12
production expenses	12,000	5
Saving	23,000	10
Total	**243,300**	**100**

Table 17 Patterns of Family Expenditures

Source: KKC April 2007

The overall investigations allow some general findings on income:

- Despite the situation that all households are dealing with agriculture the harvest does not supply the demands.



- Maize produced on their land only with 33 % supplies the annual consumption. Remaining 67 % have to be bought on the market.
- All demand on milk products such as butter, yoghurt and cheese is only produced locally.
- Fresh fruits, dry fruits and vegetables supply the needed vitamins.
- Surplus of dry fruits (if there is any) such as walnut is sold on the local markets.
- Very little is spent on health and education.

- Relative high amount is taken for ceremonies mostly marriages and funerals.

Figure 3 Expenditure estimation

Source: KKC 2007

Besides additional maize, rice and wheat flour is purchased to fulfil the cereal requirement of the population. Furthermore oil, sugar, tea, and poultry meat are important items purchased as food components. The expenditure on medical treatment of 6 % of total family expenses is relatively high due to the lack of medical treatment for chronic illnesses, which requires going to hospitals in Abbotabad and Peshawar. Expenses on ceremonies are also on rise, in particular those for marriages.

6.4.4 Local Market Relations and Communications

The local market places are generally Patan and Duber. Patan is around 10 km along the Karakoram Highway from the junction with the Keyal Khwar road. The way to Duber, which is a small but much frequently visited village directly located at the Karakoram Highway, is some kilometres away.

Patan is not only the centre of the Tehsil Union Council administration. It is the market for local products like fresh and dry fruits from Keyal Khwar valley. Here the local people from the Keyal Khwar valley and other valleys around buy items, which are not available in the very small shops in Keyal Khwar valley such as medicine, cloth, seed, construction materials, including electrical devices as lights and cable. In addition Patan is the place for some other services such as administration, medical care, education, and communication. Patan, in addition, is relevant for the access to the left bank of the Indus River, to Palas and the villages around. Here the only bridge allows crossing the Indus River between upstream Dassu and downstream Besham.

Regarding communication there is the assumption that the Keyal Khwar valley does not have any telephone communication. The next telephone for the local population is available in Patan. For emergency cases they may use telephone facilities in the Keyal Police station close to Leo Village at the Karakoram Highway.

6.4.5 Employment Market

There is no inventory and current statistics about the employment market in the Keyal Khwar Union Council area or at least the Patan Tehsil. Neither HEPO (2003) nor the interview with the Patan Tehsil Nasim delivered any information about working places and employment. There is the information that the employment market is under-developed. This is the result of the high natural growth of population, low education, and availability of skills, lack of sufficient industrial and construction working places.

Recently the Duber Hydro Power Plant construction started in Patan, which offered some employment opportunities for the many male job seekers in the region. Some additional work since 2006 was available in the area by Pakistan Army Special Communication Organisation (SCO) for linking Gilgit and Besham with a telephone glass fibre cable for mobile telephoning access in NWFP and Northern Areas.

The un-employment rate is very high, regardless of the situation of girls and women. This part of the society is still not included into any development projects and therefore even in the statistics not considered.

6.5 Water Use, Current Needs and Rights

6.5.1 Tribal Customs of Water Usage

Water in the tribal areas of NWFP is a public good. This is part of the traditional customs and rights. Tribal water rights are recognised by NWFP Government following "*Rawaj Abpashi Act*", (1951, revised 2004). In the Kohistan District for example previously 33 irrigation channels at the Kohat Toi River were constructed by the tribes. When the Tanda dam on this river was built in 1960s the water rights of these civil canals were kept intact and mandatory water of 25 m^3/s for downstream use had been released.

This requires recognising that any construction or even derivation of water in relevant amount derivation needs the consent of the local Jirga respective Jirgas. Nevertheless of use of water is very sensitive in tribal areas in NWFP, which even causes serious conflicts on water between the tribes. In June 2006 there were clashes in Parachinr (NWFP) between tribes on construction of water scheme in the area, in which six people died. Another exam-

ple is that the construction of Sherarkot-Koz-Sheryal irrigation scheme in Kohistan District was suspended by Irrigation Department due to dispute among local people.

6.5.2 Irrigation

In the Keyal Khwar valley a well-developed irrigation system exists, which is pretty well adapted to the natural conditions. There are totally six derivation channels taken out from the Keyal stream. One large channel from Saimoo Khwar to supply Sarta (above the confluence of Saimoo and Sanga Khwar) was financed by the NWFP government (unfortunately since the 2005 earthquake not functioning). The others are financed, constructed and maintained by the farmers themselves. Their resources of material and machinery are extremely small.

These gravity irrigation channels are mostly built of rock and functioning under the varying flows and water levels in a very simple matter that the people themselves adapt the intake to the current water level. Some older sections are built from wood. None of them was made from concrete.

Part of the presently implementing Barani ("*rain-fed*") Area Development Programme is the replacement of open derivation channels by 10 cm plastic pipelines also in the Keyal Khwar valley. This significantly reduces the previous high losses of water from the derivation.

On the top of the foothills of the Keyal Khwar the farmers practise to use the snow for irrigation and domestic purposes. The permanent thick snow cover (at least 0.5 m collected through five-six winter months) allows even irrigation from March to May from melting snow. Small channels deliver the water to cultivated plots on the top of the foothills in altitude of above 2,000 m asl, which do not have any other source than rain and snow.

The irrigation water demand depends on the main crops. Mostly the water is needed for summer crops, first of all for maize between June to October on every available plot of land. As explained wheat is not the main crop in the valley only small amount of water is used for winter crops (November, December) such as wheat and vegetables.

The total water demand for irrigation had been estimated by 74.6 l/s in summer. In winter it only would be 0.6 l/s.

6.5.3 Small Hydro Power Plants and Electricity Supply

The electricity supplies the Keyal Khwar valley is poor. Only 25 % of population in the Keyal Khwar valley has access to electricity. Mostly the beneficiaries are located in lower valley locations close to the stream, where eleven small power generators are operating as Table 18 illustrates:

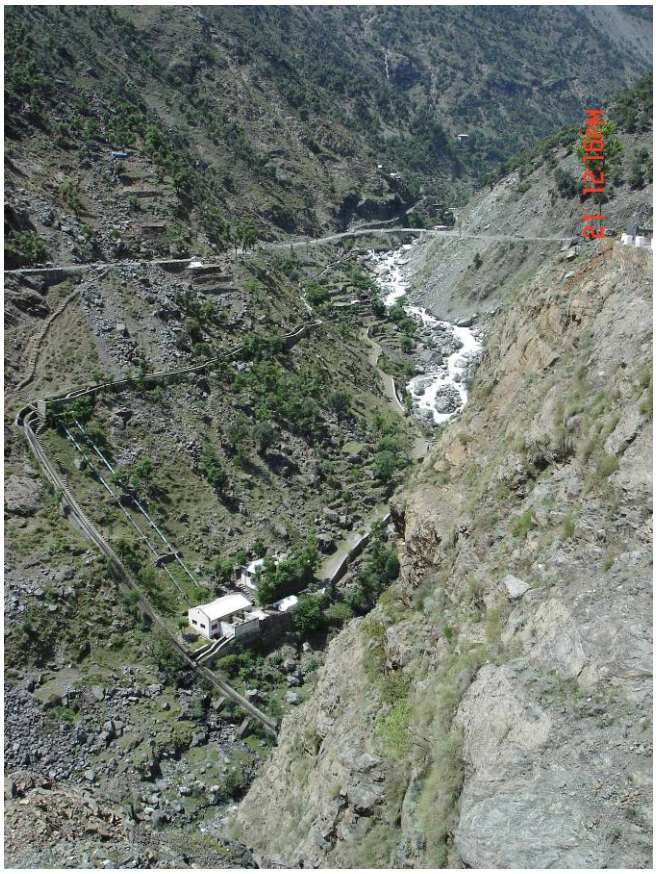
Location of generator(s)	Number	Capacity in KW	Beneficiaries	Bulbs	Supplied villages
Leo	1	5	50	90	Leo
Sheshal	3	27	250	450	Sheshal
Soyan	1	12	50	100	Soyan
Bach Gay	1	3	30	250	Bach Gay
Bairlo	2	20	350	480	Bairlo, Sapron, Harigah, other
Bair	2	8	80	130	Bair
Bandlo	1	20	200	500	Bandlo, Charto, Peshwa, Sarta
Total	**11**	**95**	**1,010**	**2,000**	

Table 18 Small hydro power generators in the Project Area

Source: KKC 2007

Except the three generators in Bandlo and Bair all remaining eight small hydropower generator including water pipes have been provided by the Keyal Union Council to the communities. This includes the construction of water derivation channels contributing labour or money (or both). The power lines have been constructed by contributing money.

The three others in Bandlo and Bair are privately owned. They were installed in 1995 (Bandlo, for Rs. 95,000) and 2007 (both in Bair, with 5 kW and 3 kW).



The user charge per bulb is between Rs 25 and 35, in one case even Rs. 45 per month per 100 W bulb.

Photograph 4 300 kW Hydro Power Station

Source: KKC May 2006

The management committees of eight hydro power plants have authorized the operators with the consent of Union Council Nasim to collect the tariff from the consumers and also to maintain the derivation channel, generator and power lines. The profit they can keep for their services. The 5 kW hydropower plant is being operated by the management committee and no extra payment is charged from the shareholders.

The operation during winter months sometimes is critical due to low flow in the stream. Regularly the generators are operating from 4 pm to 8 am. There is no shut down of small hydropower plants at night as consumers keep security light on during the night. During rain in winter they are operating 24 hours.

These 11 small hydro power stations are providing electricity not only in the valley but also to villages located in foothills like Sapron, Harigan, Peshwa, and Sarta. From this electricity supply are approximately 1,100 people benefiting.

Including the water for the three water mills the water requirement for these 11 hydro power generators had been calculated with 600 l/s.

A Hydro Power Station located at the down reaches of the Keyal Khwar was installed by SHYDO (see Photograph 4). It supplies electricity to the Patan Tehsil area. It is running in winter and summer for 24 hours. There is an offer of SHYDO to give this plant on long lease to the public.

HEPO (Feasibility Study Report, 2003, p 15) revealed the capacity as 300 kW and a water demand of 1,000 l/s. However, current investigations revealed the capacity of only 225 kW, which require 600 l/s. Except some downstream farmers this hydro power plant is using the water at the very end of the stream.

6.5.4 Domestic Water Supply

The current water needs for drinking water purposes of the local population in the Project Area (six villages) had been estimated with 0.7 l/s taking into account 23 l/day/person. This estimation is based upon approximately 2,600 people supplied by the Keyal Khwar. There are almost 200 persons in these villages, which get the water from the spring.

In general the very water for drinking water purposes for both humans and animals comes from the Keyal Khwar. Some houses in the lower valley parts are using the water directly from the stream. Many others households in the Project Area on the slopes however, have to derive the water through a channel or are using springs.

The most difficult water supply conditions are on the plateau of the foothills. Here some small Keyal Khwar tributaries are offering water, not always permanently; some of the houses are using snow even for irrigation. Shortages of water in end summer at higher altitudes are reported.

Water quality investigations of Keyal Khwar are not available. However, it is assumed that the water quality of the Keyal Khwar water is excellent, in particular in wet season and the upper reaches. There are no polluters except the discharge of animal or domestic sewage (in particular nitrate and phosphor) in the middle and lower reaches.

6.5.5 Water Transfer to Patan Valley

Since a long time water is derived from the Keyal Khwar at Bairlo Village and transferred through a 10 cm pipeline towards Patan valley. The estimated amount is 40l/s.

6.5.6 Flour Milling

In the Keyal Khwar Project Area are operating three water mills (two others are located above the area). Predominantly these mills due to the larger distance to other cultivation area of maize and wheat mostly only are milling locally produced cereals. HEPO (2003) informs that water demand for flour milling in winter from October to December-January is 80 l/s, which is not used but running through the water mills.

Salient income features of the three water mills are illustrated in Table 19:

Location	Annual income	Annual repairs	Annual wages	Net income
Bair	198,000	30,000	135,000	33,000
Bairlo	121,500	30,000	90,000	1,500
Sheshal	162,000	30,000	114,300	47,700

Table 19 Water flour mills in the Project Area and their income relations

Source: KKC 2007

The millers run their mill on commercial basis. The farmers deliver the grain to the mill and pay a charge of 4.0 kg flour per 40 kg grain to the miller. The capacity of mills is 30-40 kg flour grinding per hour. The millers in addition purchase in particular wheat, but also maize from the market. This flour will be sold to the customers in the Keyal Khwar valley due to the demand. As informed not all required wheat and maize for the supply of the local population grows in the Project Area.

One miller is also working as carpenter and ironsmith to the community. For this duty he is charged with 1,000 kg flour per year (based upon 10 kg/household).

The operation hours of the mill in winter (December to April) are 12, in one mill even 14 hours (7 am to 9 pm). In summer they operate normally only 5-8 hours.

6.5.7 Fishery

The 2007 investigations on fish stocks and fishery revealed that fish from the Keyal Khwar is neither a commercial product in Kohistan District nor a relevant source for the local food. There are only two species found in the Keyal Khwar. The one (*Glyptosternum reticulatum*) likely because of the very small size is not eaten by the people at all. The other species *Schizothorax plagiostomus*, which is a valuable game fish in this area, growing up to 60 cm length, is restricted to lower reaches of the stream (between Karakorum Highway Bridge and confluence of Keyal Khwar with Indus River).

The very limited number of fish stock is caused by cold water conditions on the one hand. The mean annual water temperature fluctuates between 7 and 10°C due to the glacial and snow pack origin. The other limitation is from the high velocity and turbidity. Fish from the Indus River due to torrential stream conditions during high water flow in summer does not migrate upstream in big numbers.

Only some people, mostly children are fishing with hand nets and rods and immediately sell the fish at the Karakoram Highway, which is mostly not caught in the Keyal Khwar but in the Indus River. At markets there are no fish shops. There is a governmental owned hatchery in Duber Bala and a private hatchery in Patan.

Hatcheries are located in Duber Bala (public property) and Patan (privately owned). Duber hatchery had been established in the year 1990 with the view to perpetuate the trout fish subsequently in suitable water bodies for enlargement of the specimens for fishing purposes.

6.5.8 Total Water Consumption from the Keyal Khwar

The present water consumption (see Table 20) was calculated taking into account the following conditions on water of relevant water users in the Project Area villages. The first row reveals the numbers of relevant objects, such as area of land under irrigation, number of persons supplied by the Keyal stream, heads of domestic animals, number of mills, number of small hydro power plants, and the diameter of the water pipeline to Patan. The second row delivers specific water demand data. In the case of the flour mills and hydro power plants rough calculations had been made for the water flow maintaining the facilities. There is no use of water and all objects are located along the stream, after processing releasing the water again to the Keyal Khwar.

Water use **Subject**	**Irrigation**	**Human drinking water**	**Animal drinking water**	**Flour mills**	**Power plants**	**Water transfer to Patan**
Basic quantities	Summer: Maize 180 acre (73 ha) Winter: wheat, vegetables 2.23 acre (0.90 ha)	Stream water 2,577 people	Number of Buffalo: 105 Cows: 748 Donkeys: 260 Goats: 5,612 Poultry: 2,041	3 mills Capacity 40 kg/h Winter: 18 h Summer: 12 h	11 small hydro power plants Total capacity: 95 KW Summer: 24 h Winter: 16 h 4 pm to 8 am SHYDO HPP 225 kW	4 inches pipeline (10 cm) From Bairlo Village
Water consumption	Maize: 508 l/acre (1,254 l/ha) Vegetable: 446 l/acre (1,102 l/ha) Wheat: 238 l/acre (588 l/ha)	23 l/day	Number of Buffalo: 39.6 l/day Cow: 24.8 l/day Donkey: 16.1 l/day Goat: 4.5 l/day Poultry: 0.4 l/day	11 generator and water mills: 600l/s SHYDO HPP: 600l/s		40l/s

Total water consumption in summer: 715.8 l/s	74.6	0.7	0.5	600	40
Total water consumption in winter: 642.0 l/s	0.8	0.7	0.5	600	40

Table 20 Salient features of total water consumption

Source KKC March 2007

The largest portion of water is required by the power generators and water mills and the 600 l/s is the water requirement for this propose.

6.6 Infrastructure

6.6.1 Road Structure and transport

The Keyal Khwar area is quite isolated because it can be reached only with difficulties due the structure of the catchment and the mountains. Transportation of persons and goods to Patan, Duber, Dassu or Besham is only possible along the only unpaved road of a length of about 5 km, which is more a footpath, linking the entire valley population with the other areas of Kohistan District. This way mostly is used by pedestrians with their donkeys, mules and horses.

In the upper areas of the catchment, due to its nature, geomorphology and mountainous character there is no access road to the neighbouring valleys as to Patan. Only one footpath links the Patan valley from Yozal Village with the Sanga Khwar valley, the right tributary of the Keyal Khwar. The highest point of this footpath is at 2,513 m altitude, which makes the transport of goods and persons quite difficult. Public transportation system in the Keyal Khwar road is not available. Only some smaller vehicles driven by locals are supplying the remote villages on demand.

6.6.2 Solid Waste and Sewage Water Disposal

The conditions for treatment of solid waste and sewage water from population and animals are totally unplanned and un-managed. There is no sewerage line in the valley and there are also no pit toilets in the houses. People discharge human excreta in the open. The Consultant views this practice is a cause of water borne diseases as gastroenteritis, dysentery etc. There is need of installation of pit latrines and sewerages line on both bank of the steam particularly up to the village Bandlo and upstream where feasible. The population disposes their waste such as garbage, household organics including animal dung, human excreta and other refuse into the nature, often into land close to their houses, cultivated plots and playing places of children.

In general the amount of generated garbage is much smaller than in town neighbourhoods. The people are poor, produce many products by themselves without any rest, and use many things for other purposes including fodder of the domestic animals. Common is the disposal of garbage in the Keyal Khwar water.

6.7 Social Conditions

6.7.1 Community Structure

The Keyal tribe is a community of brothers and sisters with the same origin, the same language and close family ties. The people still practise traditional rules and customs of the area, which are close to the Islamic order. The self-organisation of man including discussion of most important issues, joint work on common project in irrigation, power generation, road

maintenance, and construction of the mosque in general is continuing. Contentious question will be decided by the *Jirga*, the meeting of elders of the village. Basic principle in the local communities and Jirgas is to find a general consensus of the *Maliks* (chief of a village) of the area (HEPO 2003, p. 10).

6.7.2 Education and Literacy Rate

In Government primary schools in Sheshal village now supervised by the army about 250 students on roll. In interviews during February and April 2007 it was revealed that some rich and enlightened families have started sending their children for education to Patan, Besham, Mansehra and Abbotabad This trend of education in big cities could lead to permanent out migration from the valley. Education gives enlightenment, improves skills and also improves income. When the generation now in schools make homes will understand the advantages of small families in term of quality of life. The better skills shall provide them social mobility. One of the social gains of these impacts could be decrease in family size and also out migration. Expecting these changes the population growth rate shall fall to 1.9% in a decade time from, during the period 2018 to 2037. The growth of 1.9% is present national population growth rate in Pakistan

Using the growth rates the population if impact area villages and remaining villages of the valley have been projected for the year 2017 and 2037. The population of the villages for the years 1998, 2007 and 2037 are shown in the table below.

The Keyal Union Council in accordance to official figures has 34 primary schools (classes 1-5) for boys and girls, six middle schools only for boys (classes 6-8) and one boys high school (classes 9-10) in Keyal, the main settlement upstream of Sanga and Simo Khwar confluence.

However, already the literacy rate of the entire Kohistan District of 17.2% for male and 3.0% for female indicate the actual problems in education. According to 1998 census the literacy rate in Union Council Keyal is 16%. The Patan Tehsil estimates the literacy rate for the Keyal Khwar Union Council for female only 1%. As usually in rural areas of Pakistan the illiteracy rate is extremely high and in particular girls are mostly excluded from any education. There is no middle or high-school for girls in the Keyal Khwar area. In practice education in the Keyal Khwar Valley is suffering from

- Lack of funds for teachers
- Lack of funds for school buildings, facilities such as furniture, textbooks, devices
- In-accessibility of schools for children from distant villages in the mountains
- Requirements on boys to earn money and to assist in shop keeping, wood chopping
- Exclusion of girls from education
- Requirements on girls to work at home for all agricultural works and cleaning
- Lack of official accommodation for teachers in the vicinity of schools.

However this situation is affected by general factors and conditions in NWFP, which are the extreme low labour market, the traditional custom of depriving girls from any rights and the insufficient financial supply of schools system by the government.

6.7.3 Information

Information, if properly directed, can transform the society in positive direction. Main source of information in the valley is verbal communication. The discussions of the Consultant with the local people like elders revealed that there is no television in the valley. Twenty percent of the households have battery radios. And only a few people read the newspapers. The

awareness about the modern advancement in agriculture, livestock and other technologies is lacking.

6.7.4 Language

The Keyal population prefers to speak Kohistani language. Some people, mostly male, do speak Pashto and Urdu. Only very few do understand and speak English to some extent.

6.7.5 Religion

The entire population are Muslims. The 1998 Census of the Kohistan District declared only one person in the Keyal Union Council not belonging to Islamic religion. The larger villages have their own mosques. Some, in particular smaller villages do not have their mosque. Male Muslims in those cases have to walk for prayer to another settlement. Women prefer to pray at home.

6.7.6 Family Structure

The traditional Islamic family structure is very much prevalent in the investigation area, where male members dominate the decision-making power in most family relationships. Women mostly are excluded from these decisions. Traditionally the people are marrying early. The total number of household members in average, including parents and their children and grand parents is at least 10. Polygamous families still exist.

6.7.7 Gender

The gender differentiation is still dominant in the valley as in other parts of NWFP. In the daily life of larger settlements, such as Patan, Dassu or Besham women are not visible. Male people dominate all occupations in shops, restaurants, hotels, and service facilities. Women of villages mostly are not visible in public, except their work in agriculture. Mostly women are still deprived from school education. The gender situation furthermore is determined by preference of son over daughter, early marriage of girls, restriction on women's mobility, and poor sanitation conditions in particular for women.

However, in the daily life within their villages women contribute vitally to the economic survival of the poor households. This includes cooking, laundry, children education, but also cultivation of agricultural crops, livestock breeding including poultry. Their working day is extremely long. Despite the overall discrimination women are responsible for the daily life and taking over a huge work load.

6.7.8 Health Conditions and Medical Service

The medical care situation is extremely complicated in the Keyal Khwar area due to one government dispensary available at Keyal village for the population of 12, 400 people of valley. The incharge of this dispensary is a medical technician. The local population has to develop traditional methods of self treatment using many local herbal products. In emergent cases they have to go by foot or to hire a car in order to get the treatment or even surgery in Patan, Dassu or Abottabad. Most frequent diseases are reported and confirmed during interviews to be Malaria, Water born diseases (dysentery, typhus, cholera, hepatitis, and gastroenteritis), tuberculosis, leprosy, and skin infections.

Whether these diseases are caused predominantly by drinking water from springs or streams is to be investigated more carefully during EIA studies. The Consultant believes many of these diseases are caused due to general insufficient hygienic conditions in the households and families and close contact to their domestic animals.

7 BASELINE STUDY PHYSICAL ENVIRONMENT

7.1 Geology and Tectonics

7.1.1 Regional Tectonics

The project is located within the Creto-Tertiary Kohistan Island Arc sutured to Karakoram Micro-continental block along Main Karakoram Thrust (i.e. to Eurasian Plate further in the north) and in the south to the Indo-Pakistan Plate along Main Mantle Thrust. The Kohistan Arc is exposed in the northwestern Pakistan and is separated from Ladakh Arc by the development of Nanga-Parbat Haramosh Massif in the eastern side. Both structures Northern and Southern are well established geo-tectonic elements in North Pakistan and are seismogenic, hence considered active. The Main Mantle Trust is exposed along Karakoram Highway near Jijal Village where it crosses Indus River valley towards eastern side some kilometre after passing Duber Bazar.

The Main Mantle Trust trends more or less NW-SE in a distance of 20-30 km west to southwest of Keyal Khwar. The Patan and Duber Kale Faults are other major structural features closer to the Project Area, which is also seismically active. It can be expected that the close vicinity of the project site to active faults and shear zones will have some impacts on the geologic and tectonic conditions of the project sites in the valley.

The Indian Plate meta-sedimentary complex south of Main Mantle Trust consists of schists of various grades marbles, amphibolites, and others. They are exposed in the south of Main Mantle Trust, described as Besham meta-sedimentary group. On the basis of major rock types, the Kohistan Arc sequence can be classified into:

- Jijal Complex including Jijal layered ultramafic, garnet pyroxenites and garnet granulites
- Komila Amphibolites (mainly amphibolites, tonalites, plagio-granite)
- Chilas Complex (mainly gabbro-norite with ultramafic-mafic association)
- Gilgit (Jaglot) Met-sedimentary Complex,
- Kohistan Batholith (Calc-alkaline granitic belt),
- Dir-Kalam-Singal and Chalt volcanics, and
- Yasin meta-sedimentary group.

The project area is located between Patan Fault north of Main Mantle Trust, Duber-Kale Fault to the west and Jhal-Koamila Shear Zone in the north. There are at least four local thrust faults outcropping across the Keyal Khwar towards upstream side. These thrusts are sub-parallel to each other. The sheared-breccia zones are ranging in width from 20 cm to 1.5m. The striations at the base of hanging walls are noticed, which give a general north-south shear stress direction in the area.

7.1.2 Regional Seismicity

The project area is located in the "Hazara-Swat-Kohistan" seismic province and shows mostly E-W-trending folds and faults. The deformation within this zone is primarily the result of thrusting and of a deep crustal decollement process associated with the collision between the Indo-Pakistan and Eurasian Plates. Tele-seismic located events, however, do not align with any of the mapped surface faults or micro-seismic defined faults. At least some of the earthquakes may be related to the major mapped structures.

The tele-seismic data for northern Pakistan show a concentration of seismic activities in three main zones around the project area:

- Hindukush region in the NW,
- Darel-Tangir-Haran valley region in NE, and

o Indus-Kohistan seismic zone in the south-east.

Results of a micro-earthquake survey have shown a seismic trend similar to that depicted by tele-seismic events. Deep seismicity (70 to 300 km) is related to the Hindukush zone, while shallow seismicity (< 25 km) is dominant in the Kohistan and the Project Area.

During the years 1964 and 1992 in total 71 earthquakes took place in a distance of 100 km of the project area, 26 of which were of the magnitude of M5, and two were of M6. The strongest earthquake occurred on 28.12.1974 in the village of Shitgal in Duber Khwar valley near Patan with M6.2 (epicentre: 35.1° N, 72.9° E, hypocentre between 15 and 22 km depth).

Most important of these seems to be the Patan Fault, which is at a nearer distance of HPP structures of the Keyal Khwar Project. The assumed hypo-centre depth of 20 km for assumed earthquake events along MMT and Patan demonstrate the seismic risk of this area. According to the "Seismic Zone Map of Pakistan" the project area lies on the edge of "Zone 2: Moderate damage". However, the distance to "Zone 3: Major damages" in North Mansehra and South Swat regions, which is less 30 km distant, may justify the assumption that "a more conservative coefficient may be adopted". This means that the area would allow designing of structures other than nuclear structures, large dams, and structures containing highly toxic chemicals.

The maximum credible earthquake (MCE) on the basis of the distances from the active faults and regional seismicity is assumed during the previous studies as magnitude M7.2 and horizontal ground motion acceleration is given as 0.4g for dam site and 0.42g for powerhouse site.

7.1.3 Geology

The bedrock of the Keyal Khwar Project Area is mainly composed of metaplutonics amphibolites. They are composed of bedded, banded and massive amphibolites with intrusions of plagio-granites. Mainly the amphibolites are metamorphosed volcanic and plutonic igneous rocks with metamorphosed sedimentary rocks (having similar properties as amphibolites). These amphibolites are well foliated, dark coloured in the south with little variations in composition, texture and other characteristics. High grade with typical presence of almandine (garnet) and quartz contents is characteristic. Tonalite, quartz diorite and garnet bearing diorites are exposed near confluence of Saimoo and Sanga Khwar starting from 100 m upstream of Bandlo Bazar. The foliation is mostly weak to well develop.

The slopes are covered mainly by slope wash, terrace deposits and overburden of varying thickness. Some of the slopes contain Scree from excavation works or debris from rock slides in places. Generally the slopes on the right bank of Keyal Khwar are relatively gently (<45°). The left bank has very steep slopes (55-80°); at some places cliffy and rather inaccessible mostly in the lower parts along the valley.

Patan powerhouse geology is mainly represented by Patan gabbro and inter layered hornblendite diorites, well exposed along KKH outcrops.

The creek is filled with gravel, cobble and boulders. The latter may reach estimated volumes of up to 30 m^3 or even more. Due to the strong to very strong current only little quantities of sand can be expected in the alluvial deposits. The thickness could not be measured but it is assumed that it may reach 20 m as experienced in Duber Khwar.

7.2 Geomorphology and Soils

The entire Keyal Khwar catchment belongs to the mountainous zone of Hindukush. Due to high difference of altitude between 700 m asl (at the confluence of Keyal Khwar with the Indus River) and 4,904 m asl at the highest peak of the catchment in the northern part (Kandro

Pandao) there are various geomorphologic and soil zones, following the altitude predominantly. The immediate Project Area below the confluence of Saimoo and Sanga Khwar is determined by two major units:

- o Foothills between 1,800 and 2,200 m (Zone A)
- o Alluvial zone at the bottom of the Keyal Khwar valley Zone B).

Main geomorphologic and soil features of the Project Area are represent in Table 21:

Geomorphologic unit	Terrain and slopes	Soil	Land use
A Foothills up to 2,000 m, with steep slopes	Steep terrain of the U-Valley with slope mostly between 55 and 80 %	a) some exposed bedrock (amphibolites) areas	None
		b) sandy soil cover, very dark greyish brown to dark brown soil, mostly 10-20 cm deep	Forest, fruit trees, grazing, residential houses, tracks
		c) cultural soils at terraces: dark brown	Cultivation of maize mostly
	Two sections with canyons 90% (see Picture 4)	None	None
B1 Keyal Khwar alluvial zone, lower section Altitude: 700- 950 m	alluvial strip up to 100 m from confluence with Indus River up to Keyal Khwar bridge crossing the Karakorum Highway (with terraces	cultural dark brown soils, close to the stream with gleyic properties, mostly irrigated grain: sand-silt, gravely close to the slopes	Cultivated land, on slopes houses
B2 Keyal Khwar alluvial zone, middle section Altitude: 950-1,430 m	alluvial strip of mostly 30-40 m width from Keyal Khwar bridge at Karakorum Highway to the confluence of Saimoo and Sanga Khwar At dams site accumulation of gravels, terraces	cultural dark brown, irrigated soils mostly partition of gleyic soils smaller mostly sand soils, mainly gravely	Residential and cultivated land decreasing, valley road

Table 21 Geomorphologic units, terrain, soils and land use

Source: KKC July 2006

Geomorphologically the immediate Keyal Khwar valley is divided into two units: the one unit is Zone A, the foothills including slopes up to 2,200 m asl The other unit B is the narrow alluvial strip at the bottom of the valley.

Photograph 5 Canyon below Bandlo Bazar

Source: KKC May 2006

The soil pattern at the slopes is characterised by sand-silt brown to dark brown soils covering the bedrock, which is in the entire area amphibolites. These soils are only rain-fed. Due to the high slopes the rain water is running down. These dry areas are covered with the broad leaves forest. The soil in particular in the lower parts partially is eroded due to human impact from settlements with houses, many footpaths and grazing areas. Much slope area from the lower main Keyal Khwar valley up to Peshwa and Sarta is cultivated. For this purpose terraces were constructed, which are irrigated by water from upper Keyal Khwar reaches. These soils are also rain-fed and snow-melt fed due to the relevant snow cover in winter. Here soils with a dark brown colour with sand-silt structure are developed. These soils allow cultivation of maize and vegetables. Many fruit trees are growing along the terraces and irrigation channels. Some parts are exposed bedrock without any soil cover.

The alluvial zone is determined by accumulation of gravels, but also of sand and silt. Near the stream gleyic soils have been formed in the sand-silt grain due to the seasonal or permanent high degree of soil moisture. In winter the ground water level normally is low and in summer due to the abundant melting water high, sometimes even flooding the soil area. This area of gleyic soils in relation to the brown dark soils at the slopes of the foothills is small. It is intensively used by the local population for cultivation.

Climate

7.2.1 Representative Climatic Stations

There are no climatic stations within the catchment area of Keyal Khwar. However, the following climatic stations (Table 22) are located in the nearby areas and used to assess the

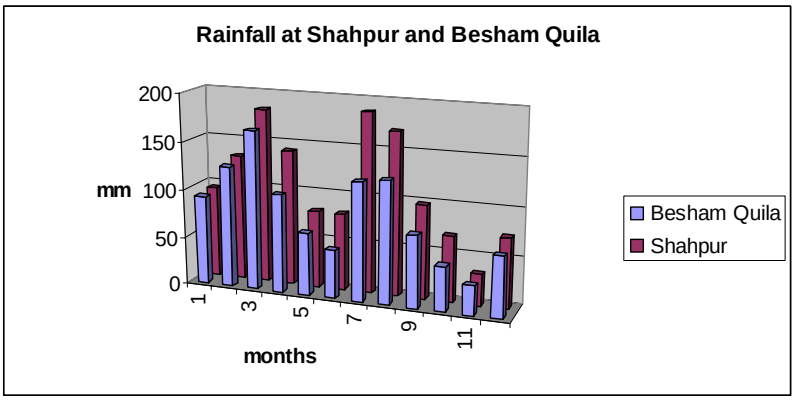
pattern of the climatic parameters in the catchment:

Climatic station	Altitude (m asl)	Observation period	Operation by
Besham Quila	480	1969-today	Surface Water Hydrology Project (SWHIP) WAPDA
Patan		2005 only	Pakistan Meteorological Department (PMD)
Bana	1,340		Sarhad Hydel Development Organisation (SHYDO)
Shahpur	2,012	March 1996 – March 1998 1990 - 2003	Surface Water Hydrology Project (SWHP) WAPDA
Karora	930	from 1971-1990	Irrigation Department NWFP
Shangla Pass	2100	since 1994	Snow and Ice Hydrology Project (SIHP) WAPDA

Table 22 Climatic Stations in NWFP close to the Keyal Khwar area

Source: KKC July 2006 (using WAPDA data mostly)

The most reliable and long term precipitation and temperature data are recorded at Besham Quila and Shahpur stations (see Figure 5). The most representative for the Keyal Khwar catchment is Shahpur, may be even Shangla Pass due to their altitudes. Besham Qila with 45 km distance is the nearest one, but due to the altitude of 480 m and the location inside of the Indus River valley, which likely has its own local climate with higher heat in summer, not very much representative for the catchment. The Keyal Khwar is supplied by the glaciers and snow pack areas in the upper catchment area over 2,000 up to 4,900 m altitudes. Estimated only 20-30 % in the project area is located below this altitude (see Map 3, Ecosystems). Therefore the mountain station Shahpur seems to be the most representative.



Since 2005 in addition the climatic data of the Patan station is available, however only having a short observation period.

Figure 4 Mean monthly rainfall at Shahpur and Besham Quila

Source: KKC July 2006 (data WAPDA)

In the following the climatic characterisation is built upon both climatic stations: Shapur as the station with the same altitude as the impact area and Besham because of the nearness to Keyal Khwar project area and the location at the Indus River.

7.2.2 Rainfall and snow

The climatic registration in NWFP indicates that precipitation follows some pattern such as that the rainfall in this mountainous area of NWFP increases from south to north up to a line from Swat to Besham. From there the precipitation continuously goes down northwards (for example in Chilas to drop down under 200 mm/annum).

The other general pattern is the increase of rainfall with the altitude; so that the lower parts of the immediate Keyal Khwar project area receive much less precipitation than the upper catchment areas. From seasonal aspect another pattern is that the rainfall throughout the year has two peaks in March and August. The winter rainfall is mostly induced by westerly air masses from the Atlantic Ocean, while the summer peak is due to the monsoon due to easterlies.

The annual rainfall in the Keyal Khwar immediate project area should be approximately the same as at Shahpur. There the yearly mean rainfall is 1,342 mm.

The rainfall in Besham Quila, which is nearer to Keyal Khwar but much lower the precipitation, is only 1,071 mm. As the diagram demonstrates the rainfall takes place in similar amounts during winter and summer. Characteristically are high maximum daily precipitation recorded at Besham Quila and Shapur during summer, which are sometimes higher than the maximum daily precipitation during winter. Maximum daily precipitation of 130 mm was recorded on 25.07.1995 at Shahpur.

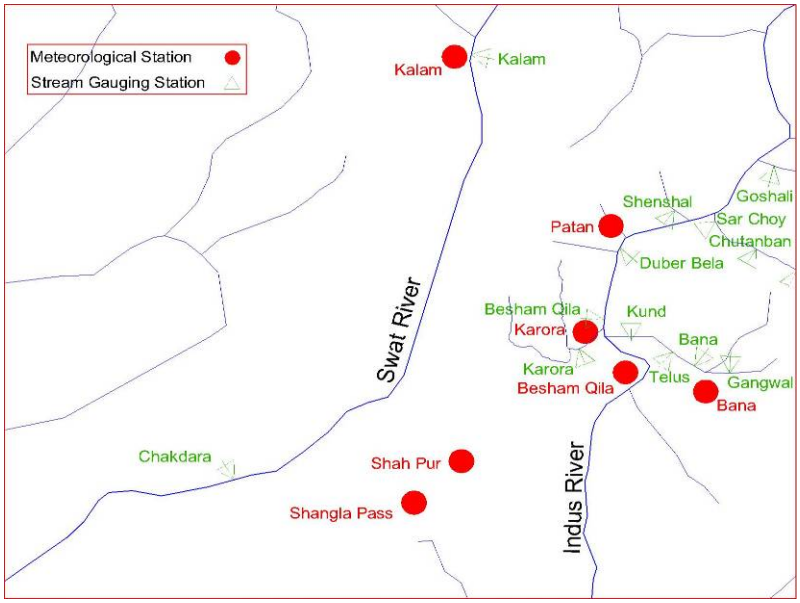


Figure 5 Climatic and Hydrological Stations

Source: KKC July 2006 (information from WAPDA)

Much of the rain in particular in winter, but in higher altitudes also in summer, falls as snow. The partition of snow from the entire annual rainfall is estimated by the Consultant with 60 %. The Keyal village farmers inform that in average during three winter months in their village at 1,600 m altitude there is one meter snow cover. It is obvious that snow for the settlements is an important source for irrigation and domestic use, because the Keyal Khwar water is not available at all places.

7.2.3 Temperature

The average air temperature during the year in the Keyal Khwar should be “between” the Shapur and Besham Quila conditions, as justified before. That means the minimum temperature the Keyal Khwar area has during January and the maximum during June. The warmest area of the catchment is the outlet of the Keyal Khwar to the Indus River, which should have the same temperature regime as Besham Quila. Very likely the mean minimum air temperature in winter in the lowest parts of the Keyal Khwar catchment is around 10 °C.

In the higher part of the project area (around Keyal village, Peshwa and Sarta) the January and February temperature is to be assumed around Zero degree Celsius and below. The mean monthly temperature for June to August in the Keyal Khwar lower reaches is estimated with 30° C as it is recorded for Besham Qila (31.5°C during June). The upper Keyal Khwar project zone between 1,500 and 2,000 m asl does not reach in June 20° C monthly average.

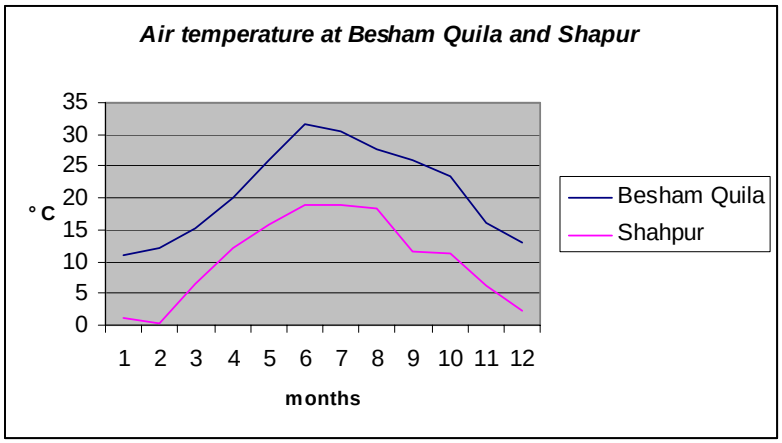


Figure 6 Air temperature at Besham Quila and Shapur

Source: KKC 2006

Naturally there are hot days in summer, in particular on the south-faced northern slope up to Bair. This has its consequences in the asymmetric structure of vertical zonation of coniferous forest (see Chapter 7.2.6) and in the relatively late start of seeding period of maize, the main crop (see Chapter 7.2.5).

Absolute maximum temperature at Indus River, measured in Besham Quila, is 47.3 °C, recorded on 16/06/1973. The higher villages upstream from Keyal village along the Sanga and Saimoo Khwar would have a moderate climate, as recorded at Shahpur station. Available records (15 months) of the high altitude station at Shangla Pass show a similar pattern of temperature changes. During the period October 1993 to December 1994 mean monthly minimum temperature was recorded during July 1994. Minimum recorded temperature at the high altitude station is -6.6 °C on 30/12/1994 and maximum temperature is 29.1 °C on 7/6/1994.

The Keyal Khwar immediate project area has its altitude between approximately 1,000 (Bridge at Karakorum Highway) and 1,430 m asl (end of the reservoir). The facilities of the power house in the Indus River valley are close to 700 m.

7.3 Hydrology

7.3.1 Hydrological Stations

The gauging station named “Keyal Khwar” Sheshal is located about 400 meters upstream of the Karakorum Highway. The catchment area measured to the hydrological station is about 154 km^2 with a mean altitude of 3,272 m asl.

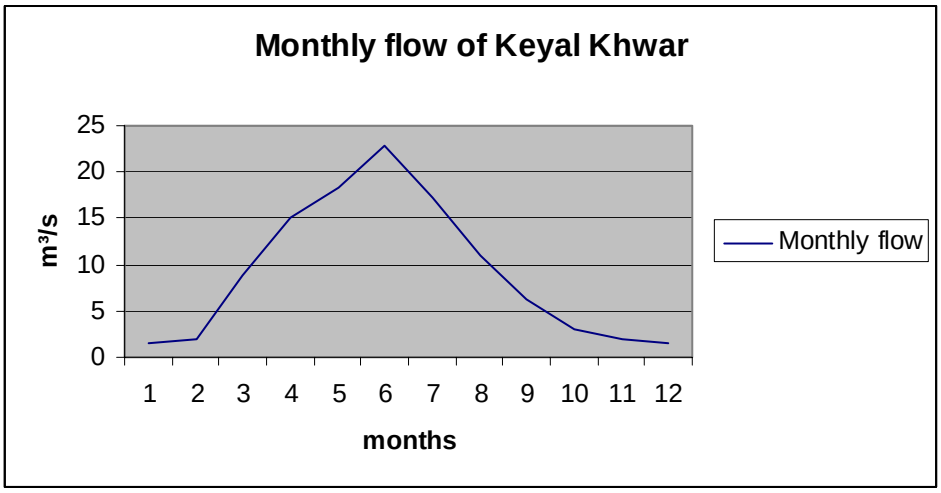
In order to extend the records of Sheshal and to confirm the overall climatic conditions of the flow pattern of Keyal Khwar additional hydrological stations (see Figure 4) with similar climatic-hydrological pattern were considered. These additional stations are Chakdara (Swat River), Kalam (Swat River), Karora Gorband (Khan Khwar) and Kunhar (Naran River) with sufficient long-term registration and operation close to the Keyal Khwar catchment.

7.3.2 Keyal Khwar Hydrograph

Mean monthly flows at Keyal Khwar gauging station (adjusted by the above explained procedure) are illustrated by Figure 7. There are two main issues: The first one is the high seasonal fluctuation of the hydrograph. The other issue is the spring and summer peak, beginning with March and lasting at least up to September.

Figure 7 Mean monthly flow of Keyal Khwar

Source: KKC 2007



The winter rainfall peak does not deliver input to the stream because of the temperature at that time in altitudes above 2,000 m. Most of the rain is falling as snow. The melting period begins in March and goes to September, which is due to the high altitude of the catchment. Glaciers and snow pack in the highest catchment areas above 4,000 m up to almost 5,000 m asl are delivering their input in average during April through June-July.

The highest mean monthly flow is 22.8 m³/s in June. Highest ever registered flow at Keyal Khwar gauging station was 63 m^3/s. Due to the climatic conditions during winter period most of the precipitation in the Keyal Khwar area is collected as snow pack. As it is informed by the local people in winter months December, January, and February there is a full snow cover of up to 1.0 m still in altitudes between 1,400 and 1,800 m asl (Keyal, Peshwa and Serto village). During the winter months December and January the average flow therefore is only 1.47 respective 1,54 m³/s, which is only 6.5 % of the maximum monthly average flow in June. Recorded are even monthly mean flows below 1.0 m³/s in those winter months. Lowest minimum flow was recorded with 0.56 m^3/s in January 1996.

However, these flow characteristics enable the entire life in the Keyal Khwar valley since generations for irrigation (agricultural demands in this winter period naturally because of the temperature regime is very low), water milling, power generation and domestic use.

The mean annual discharge at the Keyal Khwar dam site is 10.5 m^3/s. The mean annual run-off is approximately 2,059 mm.

Floods for the Keyal Khwar had been estimated which might be between 455 m³/s (for the five years probability) and 1,014 m³/s for the 100 year case. This is due to the classification of the Patan area into the region "moderately affected by monsoon rains". In this region maximum floods are originated by snowmelt, but extraordinary events during the monsoon can generate maximum floods.

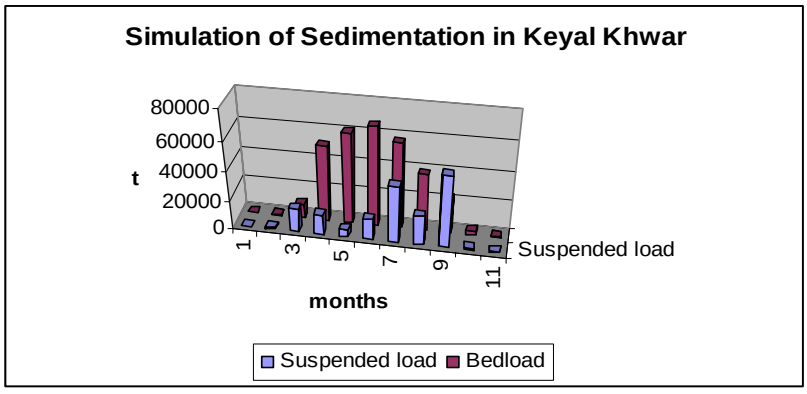


Figure 8 Suspended and bed load at Keyal Khwar

Source: KKC July 2006 (data HEPO 2003)

Sedimentation is especially important due to the high rates of transported sediments in high mountain streams like The Keyal Khwar. For the construction of the reservoir and the periodical necessary flushing procedure the knowledge about the amount of material trapped in the reservoir is very much important. The suspended load is distributed across the whole section of the river and will be flooded down also after construction, whereas the bed load

moves on or near the river bed and after construction of the dam will be collected at the upper reservoir area.

Both types of sediment transport, bed load and suspended load, are dependent mostly on the stream such as slope, which is at the Keyal Khwar approximately 10%, the turbulence as well as the characteristics of the catchment such as geology, topography, vegetation, and rainfall intensity. Presently no measuring data is available on sedimentation for the Keyal Khwar. Thus, the sedimentation illustrated in Figure 7 has been simulated based upon the overall natural conditions.

7.3.3 Water Quality

There are no water quality data available so far. However, considering the overall conditions of the Keyal Khwar valley, there is no source for pollution except the domestic waste from human and animal excreta.

There is no canalisation and sewage system. The lavatories in the Project Area are operating mostly as dry toilets. Much of the animal excreta are used as fire material and as natural fertiliser. Only few houses directly discharge human excreta into the river. Due to the high water flow and the little number of population directly discharging into the Keyal Khwar the risk of pollution, in particular an increase of nitrogen and phosphorus is unlikely.

8 BASELINE STUDY BIOLOGICAL ENVIRONMENT

8.1 Vertical vegetation zones

8.1.1 Overall determination

Biogeographically the Project area falls into *Irano-Turanian* mediterranean floristic province. Plants and their ecosystems in the Keyal Khwar catchment follow the location in the transition zone between the Monsoon zone and the mediterranean climate. This is addition is transformed by the mountainous structure (see Annex 9, Map 3 Ecosystems). Thus, an interaction of the floras of Central Asia, the mediterranean and *Sino-Japanese* region is seen.

The highest altitude the Project Area (determined by the Keyal Khwar catchment) in the northern part is at 4,904 m asl, while the lowest part the Project Area has is in the Indus River valley (upstream of Patan) at around 600 m. Therefore, the aridity grows towards south, the humidity towards the northern mountains. This mostly vertical zonation of ecosystems is characterised by following features (which naturally corresponds to the land use zone).

8.1.2 Colline and sub-montane zone

Most of the areas along Keyal Khwar fall under the colline and sub-montane zone ranging from 850-2,000 m altitude above mean sea level. The zone is characterized by dry slopes and does not show strong influence of monsoon rains in the summer months. Lower parts of the valley from 1,000-2,000 m are widely covered by evergreen sclerophyllous vegetation mainly dominated by *Quercus baloot* and *Olea ferruginea.* The trees appear stunted in growth, heavily lopped and reduced to scrub forming an open kind of vegetation. Some large patches of tall oak and olive trees forming almost closed canopy forest are seen in certain areas. Oak trees infested with a parasitic plant *Korthalsella opuntia* can be seen throughout the area. The vegetation is not very dense at any given point rather in several areas it is more open and scattered but it exhibits rich species diversity, which may be attributed to a wide variety of niches provided by topographic phenomena. A few scattered shrubby trees of *Acacia modesta and Dalbergia sissoo* are growing near Indus River. Several species of deciduous trees are found throughout the valley forming indistinct communities along with oak and olive.

In *Quercus baloot* and *Olea ferruginea* association *Olea* is gradually replaced by *Fraxinus xanthoxyloides* on drier slopes with some scattered trees of *Pistacia khinjuk. Acer pentapomicum* is common throughout the valley. Other notable deciduous trees are *Ziziphus mauritiana, Ficus palmata, Celtis caucasica, and* species of *Salix* and *Populus.*

The undergrowth varies from place to place depending on the topography, soil and moisture availability. Some of the common shrubs found throughout the area are *Cotoneaster sp., Plectranthus rugosus, Rhamnella gilgitica, Punica granatum, Maytenus royleanus, Caragana brevispina and Ziziphus oxyphylla.* Common climbers include *Vitis jaquemontii, V. parvifolia and Jasminum officinale.* Varieties of perennial and annual herbaceous plants form a thin ground layer in the colline and montane zones. *Rumex hastatus,* a low growing bushy perennial with striking fruits is common especially on steep moving slopes. Other frequent species include *Nepeta sp., Dianthus sp., Delphinium swatense, Bupleurum subuniflorum, etc. Bunium persicum,* locally known as 'ayan', is an economically important species common in the lower zone. The young seeds, used as flavouring spice/condiment, are collected from the wild plants and sold in the market.

A number of other species are used locally for medicinal purposes. Some open grassy patches are common throughout the area. Commonly occurring species are *Apluda mutica Themeda anathera, Setaria sp. Phacelurus speciosus,* and *Digitaria sp. Pennisetum sp.,* and

Calamagrostis pseudophragmites genellay grow in moist localities. Tall bunches of *Aristida cyanantha* are common on steep dry slopes. Extensive areas on dry slopes in the valley are covered by *Cymbopogon jwarancusa.* Grasses play an important role in this colline zone for grazing animals during winter when higher pastures are covered with snow. Several species are important as fodder such as *Bothriochloa, sp., Apluda mutica, Themeda anathera. Eulaliopsis binata* is extensively used for floor covering in the villages. Most of the grasses have a widespread world wide tropical and colline distribution.

Near the settlements and villages some trees with edible fruits like *Diospyros lotus, Juglans regia, Ailanthus altissima, Morus alba, M. nigra* and *Crataegus songarica* are occasionally grown along cultivated fields and near houses. Weedy and ruderal plants are common in and around cultivated areas e.g., *Cannabis sativa, Urtica dioica, Conyza canadensis, Amaranthus sp., Bidens bidentata, Hibiscus trionum, Commelina benghalensis.*

At higher altitudes deodar (*Cedrus deodara*) and blue pine (*Pinus wallichiana)* trees are growing among the *Quercus baloot* forest. Above 2,000 m *Quercus floribunda* appears with some *Quercus baloot* and *Cedrus deodara* but it is not a dominant species in the area.

8.1.3 Montane zone

In general the montane zone, which in general has an altitude between 2,000 and 3,000 m is determined by three main types of forests:

- *Cedrus deodara* forests on dry slopes distributed between 2,000-2,800 m
- *Abies-Picea* forests on moist slopes found between 2,500-3,200 m
- Deciduous broad-leaved forests mainly found on valley floor from 2,200-2,800 m

The distribution pattern of these dominant communities mainly depends on the aspect of the slope and altitude. In some areas all species can be seen forming mixed patches. Some shrubs and herbaceous species are common throughout the montane zone in all types of forest communities like *Viburnum grandiflorum, Rosa macrophylla*, *Podophyllum hexandrum, Dryopteris ramosum, Hackelia macrophylla, Stellaria monosperma, etc.*

Continuity of the forests along steep slopes is frequently interrupted by vertical strips created by moving snow avalanche. These strips are generally occupied by various species of shrubs or herbs depending on the degree of disturbance caused by moving snow and accumulated soil. The composition and structure of these communities changes vertically with increasing altitude. In some places dense growth of shrubs with occasional broad-leaved deciduous trees occupies these strips where enough deep soil and moisture is available.

Species of *Salix* and *Lonicera* with some small trees of *Sorbus lanata, Prunus cornuata* and *Acer caesium* with some *Betula utilis* generally occupy upper shady and moist slopes. At lower altitudes *Parrotiopsis jacquemontiana* forms dense shrubby growth with some other species like *Sorbaria tomentosa, Indigofera heterantha and Acer cappadocicum.*

Cedrus Deodara Forests

Cedrus deodara forest adjoining the *Quercus baloot* forest generally occupies fairly dry southern and western slopes and sometimes forms pure stands. Mature trees are more than 40 m tall. On exposed sunny slopes due to insufficient moisture in the soil shrubs do not form an important component of the vegetation. Some perennial herbs and annuals like *Artemisia, Lespedeza, Pimpinella, Viola, Brachypodium sylvaticum,* etc., form a loose herbaceous ground layer. Cool shady eastern and northern slopes with some moisture in soil favour the growth of *Pinus wallichiana* with relatively dense undergrowth. In some localities *Parrotiopsis Jacque-Montana* forms dense undergrowth with a reduced herbaceous layer.

In some localities *Quercus floribunda* is found as associated species above 2,000 m. At lower altitude from 1,800-2,200 m *Quercus baloot and* Q. *floribunda* grow side by side together with a few trees of *Pinus wallichiana.* Generally shrubs and herbs form thin growth in the *Cedrus* forest but in shady areas relatively dense patches of shrubs like *Cotoneaster sp., Indigofera heterantha, Abelia triflora, Lonicera quinquelocularis, Jasminum humilis,* are growing with few herbaceous species on the ground. Common herbaceous species include *Lespedeza juncea, Leptorhabdos parviflora, Clinopodium umbrosum, Fragaria nubicola, Viola canescens, Brachypodium sylvaticum, Dactylis glomerata, Piptatherum gracilis etc.*

Abies pindrow-picea smithiana forest

These forests are generally found on moist upper slopes facing north or east or along ridge crests from 2,500-3,000 m. The main species include *Abies pindrow* and *Picea smithiana. O*ccasionally in some areas *Pinus wallichiana* and Cedrus *deodara* are also growing in these forests. Some tall isolated trees of *Taxus wallichiana* reaching considerable height (up to 40 m) are occasionally found in these forests. The undergrowth is species rich as well as dense to moderate depending on the humus accumulation and slope inclination. Several shrub species including *Viburnum sp., Rosa macrophylla, Indigofera heterantha, Rubus irritans, and Lonicera sp.* form the undergrowth. A rich variety of herbaceous species appears just after the snow melt which include *Primula macrophylla, P. rosea, Trollius acaullis, Anemone sp., Podophyllum hexandrum, Paeonia emodi,. Pseudomertensia sp, Viola sp., Impatiens sp., Sambucus wightiana, Lindelofia longiflora, Silene vulgaris, Senecio chrysanthemoides Aconitum heterophyllum, A. laeve, polemonium coeruleum* and some fern species*.*

Narrow strips between forest areas are common which are created by sliding snow avalanches, which prevent growth of tall trees. These areas have rich growth of herbaceous plants and low growing shrubs. Common species in these areas are *Lonicera sp., Salix sp., Viburnum sp., Rosa macrophylla* and *Betula utilis. Bergenia stracheyi* is frequent on moist and shady rocky habitats and forms large patches. Most of the small summer villages are situated in these coniferous forests. Graziers moving in these villages during summer depend on these forests for firewood and logs for repair of their huts. These forests are the only source of fodder to grazing animals in early spring while they move to higher alpine pastures later in the season. Some areas show signs of intense grazing with hardly anything left behind.

Broad-leaved deciduous forest

Deciduous broad-leaved tree communities occupy the valley floor along streams from 2,200-2,800 m. In some places some times narrow strips of broad leaved trees ascends higher up along Scree slopes where deeper soil and enough moisture is available. A variety of species form more or less close canopy forests including *Juglans regia, Acer caesium, A. cappadocicum, Aesculus indica, Prunus cornuata, Populus ciliata, Sorbus lanata, etc.* The dominant species and percentage area cover vary from place to place. Generally *Juglans regia, Aesculus indica* and *Acer spp,* make up patches dominated by one or two species covering about 30-40% of the area and accompanied by other species thus giving the community a mosaic kind of appearance. The community is multi-layered with trees of different heights, which gives it a dense appearance. At higher altitudes along the valley floor *Betula utilis* becomes dominant in the community replacing *Juglans regia* and *Aesculus indica, which* are more common at lower altitudes. Height of the main tree species varies from 8-20 m approximately. On several locations the ground is filled with large rocks and big boulders. Root bark is collected from *Juglans regia* trees on commercial scale. For this purpose two year old roots of mature trees are dug out, bark is removed and dried for sale. Several mature trees are dying due to excessive damage. The undergrowth also varies from place to place depending on the density of canopy and depth of humus layer and underground substrate. Common species of shrubs in these communities include *Viburnum cotinifolium, V. gradiflo-*

rum, Sorbaria tomentosa. Herbaceous species in the forest include *Hackelia macrophylla, H. uncinata, Podophyllum hexandrum, Trillidium govanianum, Asparagus filicinus, Polygonatum multiflorum, P. geminiflorum etc.*

Broad-leaved forests are subjected to heavy grazing by passing herds, which make their way through these forests. Young roots of *Juglans regia* are extracted on commercial scale. This unchecked practice is not only killing several mature trees but it is also disturbing the ecological balance of the entire community. There is little under growth in areas where the soil is regularly disturbed / trampled by grazing animals.

Sub-Alpine and Alpine Zone 2800-4500m

The zone is not included in the project impact area however it is an important part of the catchment. It is difficult to draw a definite line between sub alpine and alpine zone. Generally sub alpine dwarf shrub communities and *Betula* forest start within upper montane forest communities from 2,800 m and extend up to the zone of alpine meadows up to 3,500 m. At higher altitudes, above 3,300 m vast areas are covered by meadows. Typical sub-alpine plants in such an area include *Sibbaldia cuneata, Bistorta affine* which carpet the area in large patches with some deep soil. On moist rocky outcrops *Rhodiola quadrifida, Pedicularis punctata, Saxifraga asarifolia, S. stenophylla, Bergenia stracheyi* are expected. However, there is a great variety of communities found in the alpine and sub-alpine zone in Kohistan, which occupy different habitats.

8.2 Plants and forests in the Project Area

8.2.1 Methodology

Floral diversity and forest investigations had been carried out in detailed plant inventories using test field method (see Chaudhry, A., 2007) in May 2007. The plant composition had been investigated on test plots (from 4x4 m for grass und shrub land up to 15x15 m for forests) at the dam and reservoir site, underground power house construction areas and along the access road. Vegetation was recorded by direct observation and plot based surveys, interviews with key informants in villages and results from previous studies. Wildlife and forest offices were visited and respective officers were interviewed.

The families, genera and species are arranged in family wise alphabetical order (see Annex 7).

8.2.2 Biogeography and floral diversity

The Project Area does not fall directly into a diversity rich area like that of Palas Valley due to its vegetation cover and impact from human activity. A total of 262 plant species were recorded from the area including eight species of *Pteridophytes*. The flora is characterized by the presence of species with restricted distribution range in Northern Pakistan and Himalayas. Most of the species are, however, found over a wide range of altitudes in their distribution range. The high percentage of cosmopolitan species, mostly weedy elements, is mainly represented in the Colline zone where the most of activities of the project are expected.

8.2.3 Endemic species

The only endemic species to North Pakistan that was collected in the study area was *Rhamnella gilgitica,* a rare species. It was rediscovered in Palas after it was collected from Gilgit in 1937 by Troll. The type was destroyed in Berlin herbarium during Second World War.

8.2.4 Rare species

Fraxinus raibocarpa is confined to only a few localities in North Pakistan and Eastern Afghanistan.

8.2.5 Threatened species

World Conservation and Monitoring Centre (WCMC) and Species Survival Commission (SSC) of IUCN have prepared a list of species with different categories of threats in their wild habitats. Some taxa listed in the WCMC list in the endangered categories include *Aquilegia nivalis, Arnebia benthamii, Gentianodes cachemirica, Trollius acaullis, and Trillidium govanianum.* The taxa included in the vulnerable category include *Acer caesium.*

Taxa for which sufficient information is not available, but are threatened or vulnerable in other countries in their distribution range include *Abies spectabilis, Aesculus indica, Pistacia khinjuk, Rheum webbianum, Staphylea emodi, Taxus wallichiana, and Ziziphus oxyphylla.* These species can be placed in vulnerable category as their habitats are subject to natural and human disturbance and the population size is not large enough.

8.2.6 Economically Important Plant Species

The firewood requirement of people living in the Palas areas of Kohistan has been estimated to be 1.5 m^3 per person (World Bank Study/GTZ/Khattak, 1996). This estimate can also be applied to the conditions existing in Keyal valley. No concerted study has been conducted on this issue Keyal valley.

8.3 Present pressure on biodiversity in the Project Area

8.3.1 Colline and sub-montane scrub

Winter settlements and the main agricultural areas are mostly located within this zone. Agricultural land covers very little of the land area. Much of the dry scrub forest remains unaffected by land clearance. There is no evidence of recent clearance. Available suitable land for agriculture apparently having been cleared long before. The dry sub-tropical forests at first sight economically unproductive are very important to the traditional agro-pastoral economy. Many of the tree species are browsed by domestic livestock in spring and autumn. In particular the oak *Quercus baloot* is essential as a fodder tree. Traditionally only dead and fallen wood is collected for fuel wood. Lopping is done on rotational basis. Certain areas have extensive closed canopy *Quercus baloot* forests but such patches are rare and very small. Natural disturbances include land slides, heavy rains and disease (insect attack and other parasites). The attack of parasite *Korthalsella opuntia* on *Quercus baloot* is quite common in the valley.

8.3.2 Montane forests

In many areas the temperate forests have been affected by clearance for agriculture, grazing of domestic livestock and the local use of forest resources. In the study area broad-leaved forests are affected by lopping and browsing. However, domestic livestock populations in the area are low in relation to many parts of Pakistan's Himalayas, and local information suggests livestock numbers have declined in recent decades. In this zone, the walnut *Juglans regia* population is declining due to extensive extraction of root-bark.

The summer villages are located at different altitudes in the montane zone. The areas around these summer settlements are disturbed by human residents and their grazing animals in various ways. The extent of human disturbance in coniferous forests is low thus causing little change in the structure of the forests or species composition. Natural disturbances are caused by slipping snow, soil erosion due to heavy rainfall on steep slopes and land slides. In broad-leaved forests heavy insect attack was observed during surveys in the area.

8.3.3 Sub-alpine birchwood

Substantial disturbance has occurred at the upper edge of the temperate forests, and in the sub-alpine woodland and scrub zone, in areas adjacent to pastures. The forests have been damaged by the use of timber for summer housing, lopping for fuel wood, and the prevention of regeneration by uncontrolled grazing. Such pastures become degraded and dominated by unpalatable species like *Pteridium aquilinum* and *Cirsium falconeri.*

8.3.4 Alpine Meadows

The alpine zone has suffered substantial disturbance from grazing of domestic livestock in and around pasture areas. Very steep alpine slopes are unstable due to movement of snow and heavy rains in summer cause gully erosion in some areas. Gentle slopes are more favourable grazing areas for livestock thus suffer from overgrazing.

8.4 Land use cover

The land use is the result of the natural conditions (as described above in Chapter 9.1) and the impact of human activities. The water course of Indus River (blue thick line in the lower part, the south) and the thin blue lined Keyal Khwar (only showed up to the confluence of Saimoo and Sanga Khwar) determine the Project Area. The upper parts are determined by various types of forest, whereas the Indus River valley and lower Keyal Khwar is mostly freed from any vegetation. Only bare rock and soil, partially due to the severe slope is eroded.

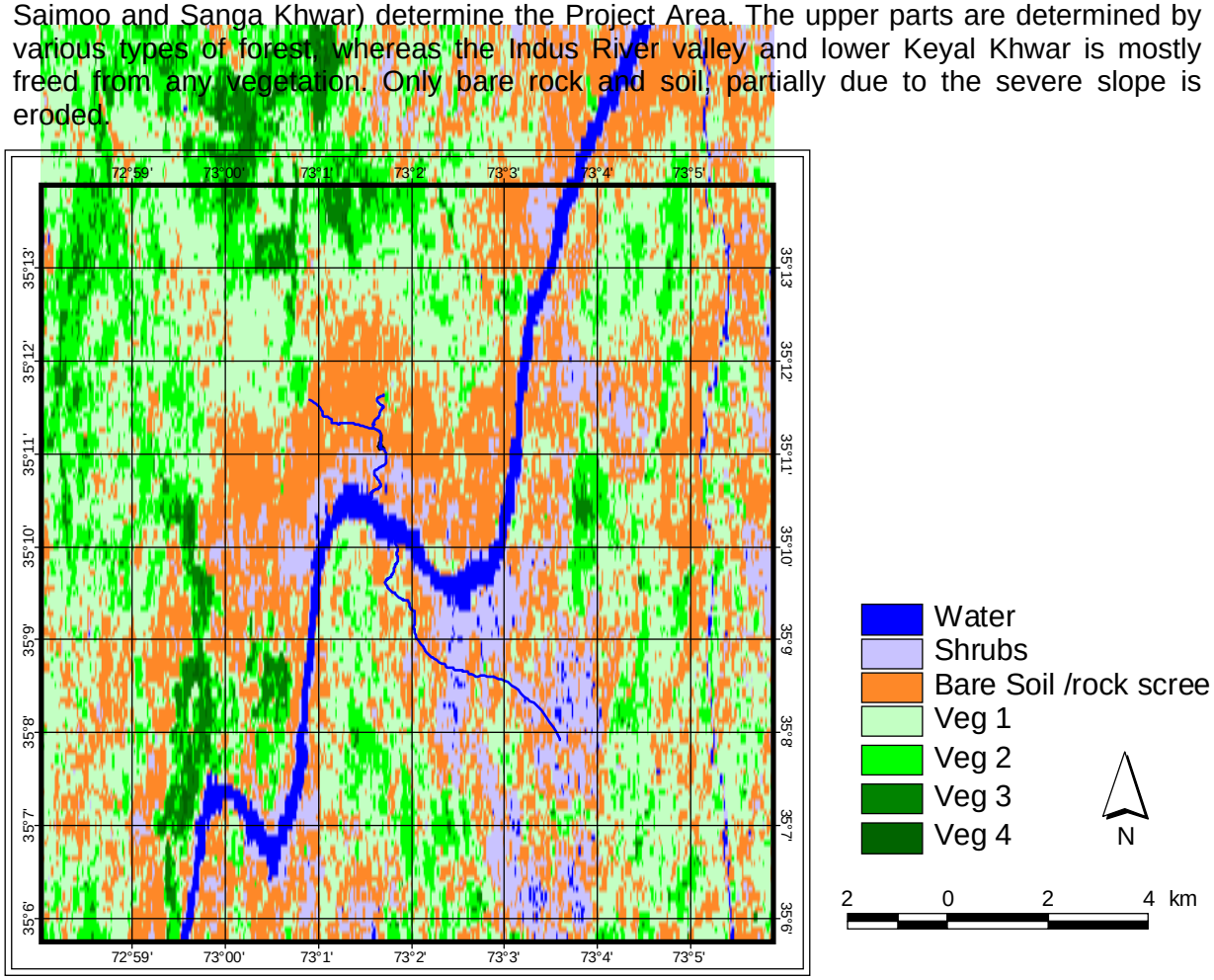


Figure 9 Land use cover

Source: KKC, Satellite Image Interpretation, Chaudhry, A., June 2007

These most important land use categories are quantified concerning their coverage by vegetation:

Land use	Land use characteristics	Vegetation coverage
Bare soil and rock Scree	Bare land, Scree, slopes	Coverage by grass or/and shrubs less than 10%. No trees occur here or they are in shrub form. Annual crops here usually consist of small scattered agricultural plots within the landscape.
Shrubs	Shrubs, almost no trees	Coverage by bushes from 20 to 40%. Grass mostly, rocks outcrops, cliffs.
VEG 1	Trees, scattered with some scrubs	Coverage by trees from 10 to 20%
VEG 2	Woodlands	Coverage by trees from 20% to 50%
VEG 3	Disturbed closed forests	Coverage by trees from 50% to 75%
VEG 4	Undisturbed closed forests	Coverage by trees more than 75%

The differences between the land use classes are caused by the interaction between natural conditions (climate, geomorphology, rocks, and vegetation) and human activity spread out through the entrance of the valley from the Indus River valley. The human influence in general continuously moving upstream is reducing. There is some influence from settlements, cultivation, deforestation and animal husbandry in the most southern and lowest valley parts of the immediate Project Area. Human influence in the most upper parts almost only comes from wood chopping, fire wood cutting and animal husbandry during summer. In the highest zones (and most northern) there is no human impact on the environment.

8.5 Terrestrial fauna

8.5.1 Methodology

The valley is very narrow and there are hardly any large plains or large agricultural fields to support a varied fauna. The bird species met with or considered to be visiting the area are resident. Presence of some summer breeders was noted. Similarly winter migrants and passage migrants are also expected to occur. The birds observed in different habitats and locations have been given in Appendix 2. The consolidated list of birds seen is given in Table 23. Some birds expected to be visiting or resident have been given after this table.

8.5.2 Birds

Bird species identified during the field visit in April 2007 are given in Table 23 below:

Number	Common Name	Scientific Name	Status
1	Plumbeous redstart	Rhyacornis fuliginosus	Local migrant
2	White-capped redstart	Chaimarrarnis leucocephalus	Resident
3	Brown dipper	Cinclus pallasii	Resident
4	Eurasian kestrel	Falco tinnunculus	Resident
5	Eurasian sparrowhawk	Accipiter nisus	Summer breeding
6	Blue whistling thrush	M yiophoneus caeruleus	Resident
7	Slaty headed parakeet	Psittacula himalayana	Summer breeding
8	Yellow wagtail	Motacilla flava	Winter migrant

Number	Common Name	Scientific Name	Status
9	Greenish warbler	Phylloscopus trochiloides	Summer breeding
10	Great tit	Parus major	Summer migrant
11	Golden oriol	Oriolus oriolus	Summer migrant
12	Ashy drongo	Dicrurus leucophaeus	Resident
13	Common myna	Acridotheres tristis	Resident
14	Rock bunting	Emberiza cia	Resident
15	House sparrow	Passer domesticus	Resident
16	Lammergeyer	Gypaetus barbatus	Resident
17	Himalayan griffon vulture	Gyps himalayensis	Resident
18	Little forktail	Enicurus scouleri	Resident
19	Jungle crow	Corvus macrorhynchos	Resident

Table 23 Species of birds in the Project Area

Source: KKC, Chaudhry, A., June 2007

There is a possibility however, that other bird species may also occur in the area at different times of the year or in different seasons. Literature was searched to find out the bird species, which may possibly occur in the area and have been reported from the nearby vicinities. Such species may include: Chukar (*Alectoris chukar*): resident; Blue rock pigeon (*Columba livia*: resident; Laughing cuckoo (*Streptopelia senegalensis*): summer breeding; Hawk cuckoo (*Cuculus varius*): summer breeding; Koel (*Eudynamys scolopacea*): summer breeding; Common kingfisher (*Alcido* atthis): resident; European bee eater (*Merops apiaster*) Summer breeding; Eurasian roller-Kashmir race (*Coracius garrulous*): summer breeding; Himalayan Jay (*Garrulus* glandarius); Masked wagtail (*Motacilla alba personnata*): summer breeding; White cheeked bulbul (*Pycnonotus leucogenys*): resident; Rock thrush (*Monticola solitarius*): resident; Rock thrush (*Monticola saxatilis*): summer breeding; Rufous backed shrike (*Lanius schach*): passage migrant; Black drongo (*Dicrurus macrocercus*): summer breeding; Paradise flycatcher (*Terpsiphone paradise*), local migrant; Grey tit (*Parus major*), summer breeding; and Hume's wheatear (*Oenanthe alboniger*): resident.

This list may again not be exhaustive again and there may remain a possibility of the occurrence of a vagrant species. But this would only be a one time occurrence hence such species cannot be considered part of the bird fauna of the Project Area.

During June 2007 investigations in the various test sites most relevant bird nesting habitats have been revealed such as

- Trees and shrubs
- Barren stony slopes, boulders, fissures or hollows in boulders, foot of steeper cliffs
- Rock ledges, rock clefts or cavities
- Logs, eroded roots of trees.
- Rodent burrows
- Crevices in ground
- Ground scrapes in the lee of a bush or grass clump
- Brood parasites.

The species so far recorded from the area or considered to be occurring at one point of time are not included in the IUCN Red Data Book for Pakistan or in the Birdlife list of endangered species.

8.5.3 Mammals

During five trap nights no small mammal could be trapped. There was also no indication of the occurrence of small mammals.

Presence of Asiatic Jackal (*Canis aureus*) and Indian porcupine (*Hystrix indica*) was confirmed. Jungle cat (*Felis chaus*) may also be present. No large ungulates / herbivores were present in the area of influence.

None of the mammalian species is considered to be endangered or included in the IUCN Red Data Book.

8.5.4 Reptiles

Two Agama species were collected from different locations in the area. Of each species three specimens had been found. The species were later identified as:

1. *Laudakia agrorensis* (Stoliczka, 1872): Agrore Valley Agama (Agrore valley is located in Hazara District, NWFP)

2. *Laudakia pakistanica* (Baig, 1989): Northern Pakistan Agama

The location was N 35° 06' 56.7" and E 73° 00'.37.2". The altitude is 794 m asl.

Both the species are *Least Concern* species.

8.5.5 Amphibians

No amphibian species during the survey were recorded in the area.

8.6 Fish Stocks

8.6.1 Previous information on fish stocks

There is information mostly published and gathered also from the Fishery Department in Dasu on fish stocks of the Indus River. Common species here are *Salmo trutta fario* (brown trout), *Oncorhynchus mykiss* (rainbow trout), and *Schizothorax plagiostomus* (Swati fish) and others.

The 2006 IEE investigations (from Patan Tehsil Administration and local people) resulted that the Keyal Khwar has no fish stocks at all, which is explained by most of the sources with the high velocity of Keyal Khwar not allowing migration of fish from the Indus River into this tributary. Contrary to this information the Head of the WWF Palas Conservation and Development Project stated that between Dassu and Besham there is no fish in the Indus River at all, which might be the explanation, why there is not fish in the Keyal Khwar. And, finally Prof. Dr. Muhammad Ramzan Mirza (previous Head of Department of Zoology, Government College Lahore) in June 2006 viewed that there is the possibility of occurrence of following fish species in Keyal Khwar:

- Glyptosternum reticulatum (chikar)
- Triphlophysa spp.
- Schizothorax plagiostomus (Swati fish)

He also mentioned that the fish should be present in Indus River between Dassu and Besham as in other parts of the river. In order to determine the real situation about the availability of fish and aquatic conditions, (see Rafique M, June 2007) during this EIA Feasibility

Phase II a detailed field investigations had been carried out in April 2007, the results of which are described in the following paragraphs.

8.6.2 Fish related natural conditions prevailing in the Keyal Khwar

The water temperature ranged in April 2007 from 8° C to 10° C in the Keyal stream, which is due to the glacial and snow pack melting. Very close to that was the water temperature in the Duber Nullah where 9.5 to 10.5° C had been measured. The water temperature of some springs in Keyal Khwar area was 11° C. Interestingly, at the same time the water temperature of the Pattan Nullah was recoded as 17° C, which is much likely due to the lesser slope of the stream.

The temperature of the main Indus River was recorded as 11° C, whereas the water temperature of the fish tanks at Duber Bela Hatchery was 14° C.

The slopes in the Keyal Khwar were found different than that in the adjacent Duber nullah. The altitude difference between the Dam site and Karakorum Highway was recorded as 440 m in a stretch of 6 km, which would be an average slope of 73 m per 1,000 m. The height difference in Duber Nullah from trout the fish hatchery to Duber Town in a stretch of 17 km was recorded as 689 m, which would be a slope of 40 m per 1,000 m.

Thus, the speed of water of Keyal Khwar recorded by float method (in high water seasons) was high at between 6-10 km/hour with an average of 8 km/h, whereas the water speed in the Duber Khwar was recorded with 5 to 6.5 km/h.

The feeding conditions for fish due to constant turbulence, high water speed, gorgeous nature, and low temperature of water in the Keyal Khwar are not ideally for carnivorous fish. Another impact on potential fish habitats and aquatic life is the instability to the river bed habitats. The river bed in most of the stretches is determined by big stones and boulders, which are keeping on rolling due to the relative high slope and water speed.

8.6.3 Fish Stocks in Keyal Khwar

The Keyal Khwar is little different as compared to other streams in the Kohistan. It has highest slope as compared with all the other streams in the Kohistan. It has a slope of above 70 m per 1,000 m as compared to adjacent Duber Nullah, which has a slope of around 40 m per 1,000 m. This high slope makes the Keyal Khwar a very torrential stream with high water speed.

Only two fish species *Glyptosternum reticulatum* and *Schizothorax plagiostomus* have been collected from Keyal Khwar during the present studies:

The species *Glyptosternum reticulatum* is quite widespread in the stream as Table 24 points out:

Glyptosternum reticulatum McClelland, 1842 **Dorsal view**	
English name	Cold water cat fish
Local name	Chaghathi
Distribution in Pakistan	This fish inhabits cold waters of the rivers and streams in the mountain regions of Pakistan. It is also distributed in Hunza, Gilgit, Chitral, Upper Swat, Neelum valley and other rivers in Kohistan. The fish is distributed in Afghanistan, Pakistan, India and Tibet (China) as well.
Distribution in the Project Area	In the project area, this fish is distributed in the area between the Keyal village and the bridge on Keyal Khwar at Karakorum Highway. Only one specimen of this fish was collected from Keyal village upstream of the potential dam site. It was, however, found quite abundant in the Bandlo area some meters below. The species continuously exist in the middle and lower reaches and shows maximum abundance in the stream up to Keyal Khwar Bridge at Karakorum Highway. The fish was found here abundant in shallow water and pools. None specimen was recorded in the downstream water course between Keyal Khwar Bridge and confluence of the Keyal Khwar with the river Indus.
Abundance	50-100 specimens per kilometre
Nature Conservation Status	The species in accordance with the List on Fish of the Red Data Book Pakistan is neither indigenous nor rare and endangered.
Fishery Information	This fish is widely distributed in high altitude areas in the north. Kohistan is the south most distributional limit of this fish in the river Indus. It is a bottom dwelling fish and not capable of swimming in torrential rivers and streams. It, however, has the capacity of moving in Mountain Rivers through the stones in the bottom of the rivers and streams. The fish attains a length of 16 cm. The local people do not consume this fish.

Table 24 Fish species *Glyptosternum reticulatum*

Source: KKC 2007

The other species *Schizothorax plagiostomus* was found to inhabit the area from Karakorum Highway Bridge to confluence of the Khwar with Indus River:

Schizothorax plagiostomus Haeckel, 1838 **Dorsal view**	
English name	Snow carp
Local name	Mahu Shum
Distribution in Pakistan	It is commonly found along the Himalaya, from Jammu and Kashmir to Assam, Sikkim, Bhutan, Nepal, Pakistan and Afghanistan. Inhabits rivers and prefers to live among rocks. This fish has quite a widespread distribution in cold waters of Pakistan. It is found in Northern areas, Kohistan, Hazara, Swat, Dir, Assad Kashmir and in certain areas of Punjab.
Distribution in the Project Area	The species is widely distributed in the Indus River, Palas valley, and Duber valley and in the Pattan Nullah. Its distribution in Keyal Khwar is restricted to the lower reaches.
Abundance	100-200 specimens of this fish in the area from confluence of Keyal Khwar with the Indus River up to the highway bridge.
Nature Conservation Status	The species in accordance with the List on Fish of the Red Data Book Pakistan is neither indigenous nor rare and endangered.
Fishery Information	This species is a valuable game fish and attains a maximum size of 60 cm. As this species is primarily a bottom feeder, it prefers the area near a big stone submerged in water. It breeds during April-May, before the monsoons flood the rivers and streams. The fry grows to such a size as to bear the rigours of the floodwaters. The flesh of this species is much relished.

Table 25 Fish species *Schizothorax plagiostomus*

Source: KKC 2007

8.6.4 Fish Stocks in Indus River section and tributaries

The following fishes have been recorded in the Indus section around Pattan:

- Schizothorax plagiostomus
- Racoma labiata
- Schizopyge esocinus
- Triplophysa choprai
- Glyptothorax stocki
- Schistura naseeri
- Glyptosternum reticulatum

Fish species *Racoma labiata* and *Schizopyge esocinus*, though, economically important fishes yet are not very common in the Indus River in the vicinity of Pattan. Both these species are, however, recorded in the areas, both, upstream and downstream of the Kohistan.

The species *Triplophysa choprai* is common in the Indus River in the vicinity of Kohistan. It is also found in Swat, Dir and parts of Hazara.

Glyptothorax stocki is not a common fish in the area but two specimens have been recorded downstream the confluence of Duber Nullah with the Indus.

Schistura naseeri is not found in the main river Indus but has been recorded from the Alpuri Nullah near Besham and in the Alai Khwar. It is a common fish in this area.

8.7 Nature Conservation

In Palas (opposite to Patan) since 1994 the Palas Nature Conservation and Development Programme has been launched, which is funded by WWF, the EC and UNDP. Currently they are active in a special Non-Timber Forest Product project (NTFP), which aims to support the forest ecosystems and the economic use of forests.

However the Keyal Catchment has not been covered under any nature conservation and development programme.

9 IMPACTS ASSESSMENT

9.1 Synopsis of Environmental Impacts ("Matrix")

The analysis and assessment of project impacts is central part of the EIA Study in hand. It will base upon the investigation of distinguished categories such as:

- o Significant adverse impact
- o Significant adverse impact, for which a design or/and operation solution can be developed
- o Adverse impact, which is potentially significant but requires further studies
- o Insignificant adverse impact, and
- o Significant environmental enhancement.

The "Matrix of Environmental Impacts" (see Annex 7) reveals the synopsis of most relevant ore most important impacts, distinguishing impacts during construction and those caused during operation.

9.2 Impact Area

The impact area is that territory, where effects will occur. The area depends on the scope of impact and its characteristics such as

- Physical impacts: such as excavation, widening of road corridor inducing loss of land for cultivation, damage of houses, noise and dust emission temporarily during construction. The range of impacts normally is only some meters to decametres.
- Hydrological impacts: such as change of hydrograph, pollution results in a potential change of conditions (natural, economic and social) in downstream area. These impacts might have a much larger impact area depending on the catchment.
- Biological impacts: such as degradation of habitats by forest chopping measures, dumping of earth material, construction of road or other corridors. Here often only local effects are relevant. However, some animals have a larger space for their migration, which might cause effects in a larger area.
- Economic and social impacts: such as damage of houses, cultivated land, deteriorating the social cohesion of a community. Often only limited scope of impacts, but sometimes a village might be affected from an impact far away.

The impact assessment therefore cannot determine the scope of impacts in metres. It depends on the concerned subject.

9.3 Impacts on social environment during construction

9.3.1 Damage to settlements, houses and population during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on settlements, houses, other residential properties and the population	**X** Batching plant in Pashwa (above the dam site), widening of road			**X** Underground works	

General assessment

Direct impacts defined as displacement of population as result of construction of various engineering infrastructures such as dam, widening of road, and batching plant area would affect a number of houses and residential properties. The total number of houses to be relocated temporarily of permanently depends on the further design works. The exact area and location needs to be determined during Tender Design Phase. Above 200 affected people a formal Resettlement Action Plan is to be prepared. Indirect impacts such as noise, economic and social disturbances might have an effect on local population either.

Dam

At the dam site there are no direct impacts because absence of any residential buildings and assets.

Batching plant

Batching plant, crushing plant and stock-piling areas will be established for 2-3 years construction time in the lower part of Pashwa Village above the dam site. A number of residential houses have to be removed for these construction facilities. This will affect significantly people of Peshwa. Furthermore noise and dust emission during construction works might impact on the Peshwa population, to some extent the Sarta villagers, which lives close to the batching plant.

Road widening

The present road is very narrow and needs to be widened and changed (extremely narrow bends) for heavy vehicles and machinery. In total in the six villages of the Project Area 28 residential houses (in addition three stables) with more than 500 residents located in the first corridor (0 to 5 m mostly on the left side of the existing road margin) have to be relocated. Some graveyards (with approximately hundred graves) close to the houses would be affected. However, there would not be affected the entire graveyard.

For construction much transport by mostly heavy vehicles for persons and goods including big bulk will increase significantly noise and dust emission affecting adversely the local population.

Water conveyance system, windows and access roads

Due to the underground works and the location almost at the upper slopes and partially top of the foothills no human settlements will be affected.

Powerhouse and surge tunnel

Power house and surge tunnel are located close to the Indus River. Due to the underground works no settlement or single house would be affected.

Quarries

Quarries for excavation of approximately 100,000 m³ rock for concrete processing in the lower part of the canyon above the potential dam site would not have a significant impact on the local population because no houses or residential properties would be affected.

Blasting and transport will cause noise and dust affecting the lower part of the villages Pashwa and Sarta.

9.3.2 Damage to agricultural activities during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be	Adverse impact, which is potentially significant but requires fur-	Minor or insignificant adverse impact	Significant environmental enhancement

		developed	**ther studies**		
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on agricultural activities	**X** Batching plant in Pashwa (above the dam site), widening of road, Cultivated land at dam site			**X** Underground works, locations close to the Indus River	

General assessment

Similar to the above explained impact there is a significant impact on cultural land of Peshwa Village during construction. There are furthermore some impacts from the road widening, which requires taking land. The temporarily use of 47,000 m² cultivated land and permanent loss of additional cultivated land due to the road widening and other measures would significantly affect the farmers. They cannot produce their usual summer crop maize and some vegetable. In addition some fruit trees have to be chopped, which means that this fruit cannot be used in winter for their own supply or being sold on the markets or to neighbours. These construction works would deteriorate the traditional self-supply of these farmers. Incentives should be given to support the temporal use of this land.

Dam

In the valley of the potential dam site there is some alluvial land, which is used for cultivation. Around 150 m² cultivated land would be lost due to the construction activities around the dam site.

Batching plant

Temporarily (likely 2-3 years) cultivated land for construction facilities is required. The estimated land need is for:

- Batching plant: 14,000 m² (27.7 kanal)
- Disposal area: 18,000 m² (35.6 kanal)
- Storage area: 15,000 m² (29.6 kanal).

Areas for parking of machinery and labourer camps are not included yet. The withdrawal of totally 47,000 m² (92.9 kanal) would affect significantly the agricultural activities and spoil the traditional self-sufficient system of Peshwa.

Road widening

For widening of the present valley road 25 plots cultivated land would be touched to some extent. In addition some fruit trees would be endangered. The road alignment study will reveal how much land and at what location land will be claimed for permanent use.

Water conveyance system, windows and access roads

The works for the construction of the water conveyance system in underground works will not affect any cultivated land or fruit trees.

Powerhouse and surge tunnel

The steep slopes of the Indus River where the power house and surge tunnel will be located there is no cultivated land, no fruit tree and also almost no grass for livestock. There is no impact on agricultural activities.

Quarries

Excavation of quarries in the lower part of the canyon above the potential dam site would not have an impact on cultivated land.

9.3.3 Deterioration of forestry activities during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on of forestry activities	**X** Construction works for Water conveyance system, their windows and access roads		**X** Locations for dumping of earth material	**X** Dam, power house, surge tunnel, road outside of forests	

General assessment

Significant impacts on forestry activities potentially would occur only in the construction works of the water conveyance system, which is located on the slopes and partially plateau of the left bank foothills covered by a dense and productive broad leaved forest. In particular the access roads from the valley road to the windows and their dumping areas for rock and other earth material from the underground works would affect adversely forests and forestry activities. All other construction works are located outside of forests.

Dam

There is not forest in the dam site area. There are some trees close to the present foot bridge, which would be needed to remove. There is no significant impact on forestry activities.

Batching plant

The establishment of construction facilities such as batching plant, crushing plant and stockpiling areas would not have an impact on forestry activities. Beside some fruit trees there is no any forest tree.

Road widening

The widening works of the present valley road would not have a significant impact on forestry activities because of the absence of forest along the road.

Water conveyance system, windows and access roads

The construction of the headrace tunnel located in the left valley flank foothills might have some minor impact on forests. In particular the access roads from the valley road to the two windows and the dumping area for rock and other earth material from the underground works would affect adversely forests and forestry activities.

Powerhouse and surge tunnel

The steep slopes of the Indus River where the power house and surge tunnel will be located have no forest. No impact on forestry activities would occur.

Quarries

Quarries in the lower part of the canyon above the potential dam site would not have a significant impact on forestry. Only some single trees are growing on the cliff.

9.3.4 Damage to fishery activities during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on fishery activities				**X** There is no fishery.	

There are no fishery activities in the Keyal Khwar. Some fish is caught only for self-supply from the Indus River.

9.3.5 Degradation of irrigation and drinking water supply during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on irrigation or water supply				**X** No change of hydrograph during construction	

General Assessment

During construction the water diversion will go through a water pipe in the stream area. There is no impact on downstream hydrograph and irrigation or water supply.

9.3.6 Damage to electricity generation by small hydro power plants during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on electricity generation by small hydro power plants				**X** No change of water release	

General Assessment

During construction the water diversion will go through a water pipe in the stream area. There is no impact on downstream hydrograph and irrigation or water supply.

9.3.7 Damage to water milling activities during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on water milling activities				**X** No change of water release	

General Assessment

During construction the water diversion will go through a water pipe in the stream area. There is no impact on downstream release, which potentially would affect water milling activities.

9.3.8 Threats to transportation during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on transportation	**X** Increase of traffic on valley road and Karakoram Highway			**X** Damage of three foot bridges due to road widening works	**X** Widened road later will improve business activities

General assessment

All construction works require goods such as big and heavy machinery, turbines, transformers, pipes, steel, and timber, cement and earth material to be brought to the various locations. This would affect significantly the Karakorum Highway, which is the only road to link NWFP and Northern Areas with the middle and southern parts of Pakistan. Significantly the number of cars and trucks for transport of goods and persons on the valley road would be raised. I addition there would appear threats on human and animals from noise and dust.

There would be a positive impact on transportation due to the better quality and much higher capacity of the road after widening.

Dam and batching plant

Much transport would be required for supplying the dam site, including batching plant above with persons and goods. All this transport would significantly raise the frequency of vehicles and connected with that the risks of accidents.

Road widening

The widening works of the present valley road would establish during these works some impact on general transport of the villagers along this road.

Water conveyance system, windows and access roads

The need to bring machines and heavy bulk to the windows of the water conveyance tunnel would affect the present transportation situation on the valley and Karakorum Highway significantly.

Powerhouse and surge tunnel

Transportation on the Karakorum Highway would significantly being affected through the transport of power house facilities including turbines.

Quarries

Quarries in the lower part of the canyon above the potential dam site would not have a significant impact on transportation. The rock material would be shifted directly from the quarry down in the canyon to the batching plant.

9.3.9 Deterioration of business activities during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on business activities				**X** Impact on Bandlo Bazar and Bairlo	**X** Widened road later will improve business activities

General assessment

There a not so much business activities in the Keyal Khwar valley (beyond electricity generation, water milling). Only potentially affected would be low range trade activities in selling some groceries in wooden shops. Thus, the widening or the road would have some, but lastly minor significant impact on those small business activities.

However, the improved road conditions and the increased income could enhance business activities.

Dam and batching plant

The construction activities around the dam including batching plant in Pashwa Village would not impact any wooden shops.

Road widening

The widening works of the present valley road would affect adversely the business activities of the 33 shop keepers in Bandlo Bazar. These businessmen would loose their existence. There are in addition 15 wooden shops endangered in Bairlo.

Water conveyance system, windows and access roads

The construction works of the water conveyance system, windows and access roads would not affect any business activities due to the absence of any wooden shop in that area.

Powerhouse and Surge Tank

The construction works of powerhouse, surge tunnel would not affect any business activities due to the absence of any wooden shop in that area.

Quarries

Excavation works in the canyon above the dam site would not harm business activities due to the absence of any wooden shop in that area.

9.3.10 Risk for safety of workers and local population during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on business activities on safety of workers and local population	**X** Blasting in the quarry area, tunnel, other widening works along the road, Falling risk from steep slopes and cliffs				

General assessment

For workers and local population there is high risk of falling down due to the mountainous conditions. The works for widening the road, rock excavation, terracing of area for batching plant and many other works

The other group of potential risks is the blasting works at the quarry or may be also for road widening.

Dam and batching plant

The establishing of larger terraces for the batching plant including crushing plan and stock piles and the work on these terraces include potential risk of falling down.

Road widening

There is also high risk of falling down for workers and local people when widening the present valley road. Sometimes there current road is ten and more meters above the valley bottom. If explosive material is used for blasting of rocks on the slope side there is additional risk for humans.

Water conveyance system, windows and access roads

There is risk from the use of explosive material for blasting in the underground works for construction of water conveyance tunnel, which would potentially affect workers. Local people should not be affected due to the distant locations of the windows.

Powerhouse and Surge Tank

There is risk from the use of explosive material for blasting in the underground works of power house and surge tank, which would potentially affect workers. Local people should not be affected due to the distant locations of these construction objects.

Quarries

High risks potentially may affect labourers and also residents on the adjacent land close to Pashwa and Sarta Village.

9.4 Impacts on physical environment during construction

9.4.1 Degradation of land and soil during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on business activities on soil and land	**X** Temporarily loss of land in Peshwa Village from batching plant	**X** Land take during construction can be minimised		**X** Power house, surge tunnel, road only minor effects	

General assessment

Demand for land is mostly relevant for the dam site including batching plant. A set of soil types composed by the alluvial zone and neighbouring boulders and rock cliffs would be required. The impact on soil and natural land properties is low, predominantly due to the small area needed for the dam.

Dam and batching plant

The construction activities around the dam including batching plant in Pashwa Village would temporarily use the soil. These cultivated soils on the terraces would be utilised for some years, which will change the soil properties in the upper horizon. The soils will be compressed. Contamination of the upper horizon with cement, oil residues and other chemicals might appear.

Road widening

The widening of the present valley road would require utilising land, which is presently used for other purposes. Most land however, will come from the slopes. The impacts on soil and natural land resources might be insignificant.

Water conveyance system, windows and access roads

The water conveyance system due to the underground works will not consume any soil or land resources. The land take for the construction of the two windows, their access roads and the dumping places for the excavated rocks would affect significantly the natural soils and land resources at those higher locations.

Powerhouse and Surge Tank

The powerhouse and surge tunnel due to the underground construction will not consume soils and land resources.

Quarries

The excavation of rock in the quarry close to the dam site will utilise some land of the canyon and its cliffs. However, the impact is insignificant due to the fact that the majority of the ground is of rocks and has no soil cover.

9.4.2 Threats on local climate, air and noise during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places	**X** Significant impacts on humans from noise and air pollution			**X** No impacts on local climate	

General assessment

There is no impact on the local climate from the constructions works. Impacts only will appear during construction on humans, caused by noise and dust emissions from machinery at the batching plant and heavy traffic along the road. Noise and dust in particular will occur around the quarry site.

Dam and batching plant

The batching plant, crushing plant and stock-piling area for the various materials after crushing the rocks will emit noise and dust and impact residential area of Pashwa Village. Noise would also affect some houses in the opposite located village Sarta.

Road widening

The widening works of the present valley road with bulldozers, excavators, and trucks will cause noise and dust emissions, which may affect the local population.

Water conveyance system, windows and access roads

The construction works by bulldozers, excavators, and trucks will cause noise and dust emissions around the window excavations and the constriction of the access roads. However, due to the distant local habitations there is no significant impact on humans.

Powerhouse and Surge Tank

Noise and dust emissions will not cause noise and dust emissions impacting residential houses and people due to the underground construction of powerhouse and surge tunnel.

Quarries

The excavation of rock in the quarry close to the villages Pashwa and Sarta will cause some threats to the local population due to the permanent and high emission levels of noise and dust in the narrow valley.

9.4.3 Changes of Keyal Khwar hydrograph during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance				**X**	

system, power house, quarries, construction facilities including dumping places on Keyal Khwar hydrograph during construction				No change of hydrograph due to water pipe	

General Assessment

During construction the water diversion will go through a water pipe in the stream area. There is no impact on downstream hydrograph.

9.4.4 Change of water quality during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on water quality during construction		**X**			

General assessment

Impacts may occur from the labourer camp and its sewage disposal. The sewage may pollute the Keyal Khwar immediately. Other potential impacts on the water quality of the Keyal Khwar might be caused by the use of various chemicals used for processing. To these risks belongs pollution of water by cement, fuel, lubricants and oil residues from cars and other vehicles and machines.

Dam and batching plant

Cement for concrete production, oil and lubricants batching plant, crushing plant and stockpiling area for the various materials after crushing the rocks will emit noise and dust and impact residential area of Pashwa Village. Noise would also affect some houses in the opposite located village Sarta.

Labourer camp

Impacts on water quality of the Keyal Khwar may occur from the labourer camp and improper sewage and solid waste disposal.

Road widening

The widening works of the present valley road with bulldozers, excavators, and trucks will cause noise and dust emissions, which may affect the local population.

Water conveyance system, windows and access roads

Contamination may appear from the named sources of heavy machines on rock and soils. Due to the distance to the Keyal Khwar there is only very little risk for water pollution.

Powerhouse and Surge Tank

Contamination may appear from the named sources of heavy machines on rock and soils. Due to the distance to the Keyal Khwar there is only very little risk for water pollution.

Quarries

Pollution of Keyal water would be possible due to the close location of the quarry to the stream. There might be some small risk.

9.5 Impacts on biological environment during construction

9.5.1 Damage to natural vegetation during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on natural vegetation	**X** Damage of natural vegetation along all roads (widening an new access roads to windows), dumping areas and windows			**X** dam and batching plant, power house, surge tank, water conveyance system aside from high valuable natural vegetation	

General assessment

Most significant impacts potentially would be related to the construction of the windows to the underground water conveyance system, the dumping areas of the rock and the access roads to the windows. The reason is the quite natural broad-leaved forest at these selected locations.

Dam

The construction of the dam would affect only in limited scale semi-natural bush vegetation. In general the valley has less naturalness because of the human influence of this location around the dam location.

Batching plant

The establishment of the batching plant would not harm any natural vegetation due to the cultivated land of Pashwa Village, which is mostly degraded and emptied from any natural plants.

Road widening

The widening works of the valley road will not affect adversely natural vegetation. In general all vegetation along the road is degraded by the traffic, but mostly by grazing of domestic livestock.

Water conveyance system, windows and access roads

The construction of windows to the underground water conveyance system, their rock dumping areas and access roads to the windows will likely have the most significant impact on natural vegetation, mostly natural broad-leaved forest with relevant undergrowth.

Powerhouse and Surge Tank

The construction of power house and surge tank due to the underground water will not have significance for any natural vegetation, which is at the steep slopes of the Indus River above and below the Karakorum Highway absent. Only some bushes remain here.

Quarries

The impact on natural vegetation is insignificant due to the absence of vegetation in the canyon.

9.5.2 Threats to endangered animals during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on endangered animals				**X** No or only very little number of species occur, birds may move to other habitats	

General assessment

The animal inventory revealed only a very small occurrence. Neither many specimens nor a high variety of species had been found. This is caused due to the high pressure from the local population on the animals. Partially they escaped due to traffic, noise, vibrations, grazing and erosion of original habitats. Partially, the bigger mammals mostly were hunted. In general the inventory did not reveal any rare and endangered species in the area.

Dam

The habitats around the dam site, determined mostly by rocks and boulders are prone for reptiles. But the agamas are also not widespread, which is likely due to permanent appearance of human using different footpaths crossing this area.

Batching plant

On the cultivated land despite birds there are no other animals. The impact on animals is insignificant.

Road widening

Animals along the road are not very much relevant. The habitats had been destroyed by grazing of livestock. And, the permanent traffic very likely expelled animals. The road only will have an importance for crossing because it main be assumed that during night some animals from higher locations will move downwards to the stream for drinking.

Water conveyance system, windows and access roads

The construction of windows to the underground water conveyance system, their rock dumping areas and access roads to the windows will likely have some impact on animals occupying the dense broad-leaved forest with relevant undergrowth. However, even the diversity and relevance from Nature Conservation point of view of animal species living there is low. Birds will flee during the construction works but likely return after completion of works.

Powerhouse and Surge Tank

Animals are mostly absent on the steep and eroded slopes of the Indus River valley, which means that there are insignificant impacts on animals caused by any construction works around the power house and surge tunnel.

Quarries

The impact on animals is insignificant due to the absence of them in the canyon. It might be assumed that some reptiles (the rock agamas for example) may occupy the cliffs above the stream. The likely will escape and find other habitats.

9.5.3 Threats to fish stocks during construction

Principal Impact	Significant impact	Potentially significant adverse impact for which a design/operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts from construction of dam, road, water conveyance system, power house, quarries, construction facilities including dumping places on fish stocks				**X** No rare and endangered fish species exist, only minor affect on stream during excavation and dam erection	

General assessment

The inventory of fish stocks only revealed tow species. Both are common fish species and widespread in the area. And there are many specimens of both species existing. In addition it may be stated that fish migrates from the Indus River mostly. Only some impact may occur on fish around the excavation of rock in the quarries and dam site construction. Through the diversion pipe upstream and downstream migration of fish would be possible.

Batching plant, road widening works, construction of water conveyance system at the upper slopes, and the power construction do not have any contact to the stream. No further impact on fish is to be expected.

9.6 Impacts on social environment during operation

9.6.1 Damage to settlements, houses and population during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation of Keyal Khwar HPP on settlements, houses, other residential properties and the population				**X** No impact	

General assessment

During operation of the Keyal Khwar Hydro Power Plant no impact on settlements, houses, other properties and local population would occur. With the operation the reservoir would be submerged up to 1,422.5 m asl. Even this reservoir would not have any adverse affect on the population. No settlements and other properties are located in the reservoir area.

There are some improvements for the local population after completion of the project: The few houses temporally removed for construction purposes will be re-established. And, the crest road will be available for the public transport. This will improve the accessibility of the left bank villages. Women of Pashwa Village are using the Keyal Khwar stream for doing the laundry. The higher water level would easy the procedure climbing down and up the steep slope to access the water.

9.6.2 Damage to agricultural activities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation of Keyal Khwar HPP on agricultural activities				**X** No impact on agricultural activities	

General assessment

During operation of the Keyal Khwar Hydro Power Plant there is no impact on agricultural activities. The amount of 250 l/s water released will supply sufficiently all agricultural land and cultivation. The 180 acres land (72.9 ha) can be cultivated with the water guaranteed in the stream. Due to the small reservoir and the high natural discharge there will be even during summer months an additional spill-out over the dam, which will in summer increase the available water.

The 4.7 ha (92.9 kanal) cultivated land temporarily used for batching plant and other construction facilities would be re-taken by the owners. Some additional works by the farmers to re-cultivate this land have to be done. The estimation of cost of works such as ground ploughing (due to the construction works the soil has been compressed) and levelling, maintaining the stone walls, re-construction of irrigation facilities has to be prepared in later stage.

9.6.3 Damage to forestry activities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation of Keyal Khwar HPP on forestry				**X** No impacts	

General assessment

There is no impact on forestry activities during the operation of the Keyal Khwar Hydro Power Project.

9.6.4 Damage to fishery activities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation of Keyal Khwar HPP on forests				**X** No impacts, fishery in reservoir unrealistic	

General assessment

Due to the lack of fishery activities in the Keyal Khwar there is no adverse impact on those economic activities.

The exploitation of the reservoir for fishery purposes (even with introduction of fingerlings) would not be suitable to sustain fish reserves for fishery because of

- relative cold water
- oligotrophic water, which does not offer much plankton, detritus and other fish food
- frequent (during winter months even in a daily mode) release of most storage water
- sediment flushing through the gates in high water season (5-6 cm long fingerlings)
- no suitable shallow water areas for spawning

Introduced fish could only grow up during summer. The fish growth rate due to the low nutrition water body would be very small. And due to the high daily fluctuation and emptying of the reservoir fishery would not become economically.

9.6.5 Damage of irrigation and drinking water facilities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on irrigation and drinking water supply and facilities				**X** Downstream irrigation and drinking water supply	

General assessment

The take-off of water from the Keyal Khwar would have a significant adverse impact on the downstream water exploitation pattern including irrigation and drinking water supply in the downstream villages of Bandlo Bazar, Bair, Bairlo, Bach Gay, Soyan Bair and Sheshal.

Taking into account the permanent riverain release of 250 l/s (see Chapter 5.2.6) the drinking water supply for humans and animals would not affected severely due to the matter of taking water. There is no in-house water supply from tap. All water is carried in special water pots by mostly children and women. Some of the houses have water-tanks for their water supply. The total amount of drinking water has been calculated with 0.7 l/s, which is only a small part of the supplied water.

The present irrigation system after lowering of the water table of the Keyal Khwar stream has to be adapted to this level. However, due to the more stable water level there are lesser adjustments required as presently. For summer cultivation approximately 75 l/s are required, which are supplied in the riverain release of 250 l/s. Even under the condition the farmers would need in future water for winter crop the guaranteed water amount would be sufficient.

The transfer of 40 l/s water through the water pipeline to Patan would not be damaged due to the sufficient amount of water but the intake procedure might be deteriorated.

9.6.6 Damage of electricity generation during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on small hydro power plants facilities and operation	**X** Damage of entire electricity generation and use Damage of four generators by road widening				

General assessment

The operational approach to provide only the riparian release of 250 l/s would adversely affect the downstream users. On the one hand the 11 small, generators, and the bigger 225 kW SHYDO hydro power plant could not generate electricity. Mostly they are established with funds from NWFP Kohistan District and with the work of local residents. Partially small generators were privately established by some individuals. These owners would loose their property and a permanent source of income (25-40 Rupees per 100 W bulb). And, on the other hand there are the users of the electricity in the valley, in particular those living closely to the Keyal Khwar, who would loose their electricity supply.

Four small hydro power generators are located in the road widening corridor up to 5 metre. Next investigations after completion of the road alignment have to confirm this potential damage.

9.6.7 Damage to water milling activities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on small hydro power plants facilities and operation	**X** Damage of water milling				

General assessment

The three water mills running in the Keyal Khwar downstream of the dam site would be affected by the reduction of the flow. Much likely the riparian release of 250 l/s would provide sufficient water to the water mills. However, the water intakes have to be re-established. The energy taken from the stream in the present mills is free of charge. The income of these millers might be would be reduced. Additional effort is to be made to re-establish the water intakes from the Keyal Khwar.

The water mill Bair due to the widening of the road would potentially be adversely affected. This mill directly stands beside the road (that means inside of the first five meter corridor). The income of the water miller would be endangered totally. And, the farmers bringing nor-

mally their maize grain to this mill would have much more effort due to the distance of another mill.

9.6.8 Enhancement of transportation during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on transportation				**X** No impact	**X** Widened road improve the overall valley infrastructure, Stream crossing procedures improved

The operation of the Keyal Khwar Hydro Power Plant would not cause adverse impacts on transportation in the Project Area. Opposite to this, it is to highlight that the overall transportation infrastructure significantly would be improved by the widened road.

Further enhancement is focused on improved crossing river conditions and accessibility of the left bank of Keyal Khwar. The stream crossing procedures due to the lower and more stable water level would be improved. Presently there is limited number of bridges existing. It may be assumed that in future much more of those foot bridges could be established.

9.6.9 Enhancement of business activities during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which a design/operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on business activities such as shops, workshops				**X** No adverse impact	**X** Improved road later will support business activities

General assessment

The operation itself would not have any impact business activities. However, the improved road in the valley up to Pashwa and Sarta (both closely locate to the dam) would support the business in general. Also the inter-valley business relations would be improved by the road. In particular the transport business would benefit. And, the access to the markets in Patan, Dassu and Duber for the Keyal Khwar population would be enhanced. This will improve the economic and social life, would enable the Keyal Khwar residents to work in those centres, to bring their agricultural commodities and timber to the markets.

9.7 Impacts on physical environment during operation

9.7.1 Damage to land and soil during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which a design/operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts of operation on soil and land				**X** Land take only in the canyon	**(X)** Land slightly extended, flooding and water logging risk reduced

General

The only impact during operation would that the reservoir would submerge land. This land-take would be permanently, despite the peaking mode of the power plant. All other construction elements do not have any changed land-take pattern.

Flooding and water logging processes, which are normally for the alluvial land, would be reduced or even wiped out. This would induce from the soil side of view a change from the present gleyic soil development conditions on the lower alluvial soils towards a semi or even non-gleyic soil. From the cultivation side of view it may stabilise the yield and harvest conditions.

There is the presumption that some small pieces of land due to the lowered water level and the lack of periodical floods of alluvial land would available for cultivation or other human purposes.

Reservoir

The reservoir would cover the bottom of the canyon down of the confluence of Sanga and Saimoo Khwar. There is only very little land and soil due to he geo-morphological and geological situation. The impact is insignificant.

9.7.2 Change of local climate and air during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which a design or operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on local climate and air				**X** Water body too small for changes of local climate	

General

The reservoir has a total storage of 190,000 m³. The water potentially would have some minor impact on the local climate due to the physical conditions: The energy from radiation would be transformed and collected at the reservoir level, which finally would raise the water

temperature slightly. However, due to the small area and the daily release of the water the increase rates would be very small.

There is the expectation that the local temperature in winter will be increased only a little. And, in summer the air temperature around the reservoir will be decreased to a very small extent. The same very small processes would appear with regard to the air humidity, slightly rising, in the vicinity will also increase a little. Overall impact of the reservoir on the local climate will be minor. And, also the effect on air would be negligible.

The reservoir would have a small positive impact on the air. In summer period there is often dust in the air, which would be collected by the reservoir water body. The air in the environment might become a bit cleaner.

9.7.3 Changes of Keyal Khwar hydrograph during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which a design or operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on Keyal Khwar hydrograph	**X** Significant reduction of water amount and water level, change of hydrological regime				**(X)** Deduction of flood events

General

The Keyal Khwar hydrograph currently is determined by high seasonal fluctuations and in particular spring and summer peaking and low water in winter. Diversion of most water to the Indus River (through the power plant) will bring significant changes to the stream.

There is the deduction of the quantity of flow in the stream. This in first order will change the character of the river, which potentially in future will not be such a torrential stream. It also might have some impacts on the downstream discharge, which is used for nature, aquatic and terrestrial wildlife. The character of the stream to some extent will be restored due to the permanent riverain release.

Looking more from the human side the flood pattern will be positively improved, as the dam will absorb the high flows, thereby causing minimum damages downstream. The extreme flood events may cause the downstream reaches, as they will pass the spilling or sediment flushing facilities and induce also flood events, however in a lesser frequency and smaller magnitude.

9.7.4 Degradation of downstream reaches by sediment flushing during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which a design/operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement

Impacts during operation on downstream valley by sediment flushing	**X** Significant increase of high water and sediment load				

General assessment

In order to prolong the reservoir's life regular sediment flushing will be carried out. Normally the flushing is done through the sluice gates provided on the side of water conveyance system. The normal water will have almost no sediment but during those flushing periods there will be a high percentage of sediment in the flood.

Due to the comparatively higher left bank flushing will cause more erosion of this left bank side. Flooding may adversely affect more the alluvial land downstream on the right bank.

9.7.5 Change of water quality

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on water quality				**X** Eutrophication of reservoir unrealistic , frequent withdrawal of polluted water from few sewage intakes	

General assessment

Despite the situation that no water quality data is available, there is preliminary assumption that with commencing operation the excellent water quality would not be changed significantly. The quite normal for a reservoir eutrophication process would not proceed. The daily emptying would not enable biological development in the upper reservoir water layer. The cold water conditions would not favour plankton growth in this oligotrophic water body. Furthermore potential nutrients from sewage mostly (there are no other pollution sources) would be moved downstream. In summary, physical (temperature) and bio-chemical (nitrogen, phosphorous, alga) parameters of the reservoir water are not changed in comparison to the current stream.

Furthermore there is the need to consider the risk of water quality changes in the downstream stream section caused by the essentially reduced amount water when only the riverine release of 250 l/s would be in the Keyal Khwar. Direct disposal of sewage into the water may have an negative impact on water quality. However, this seems to be unlikely due to the following conditions, which would prevent of such a phenomenon. To them belong:

- very small number of sewage water intakes (from toilets) exist (mostly dry toilets are used)
- turbulence of stream water would oxidise the organic waste components, and
- rapid downstream transport of waste to the Indus River.

9.8 Impacts on biological environment during operation

9.8.1 Damage to plants during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on natural vegetation and ecosystems				**X** Minor impacts due to submergence of reservoir	

General assessment

During operation of Keyal Khwar Hydro Power Plant there would only appear minor impacts on plants, plant associations or ecosystems. The only object generating damage to natural plants would be the reservoir. The area in general only has some natural vegetation covering the slopes and cliff. The canyon itself has on the whole length no alluvial land and plants.

9.8.2 Degradation of endangered animals during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on endangered and important species of animals				**X** Minor impacts on birds, other animals missing	

General

With the submergence of the reservoir and commencing operation there would be only minor impacts on natural animals. Due to the human pressure in the dam site valley and the inhospitable character of the canyon there is in the reservoir area only few number of animal species present.

Two reptile species potentially in the reservoir area could be expected. If the first filling would not happen during hibernation period (until March/April), which is quite unrealistic due to the low water flow, the reptiles (the rock agama presumably) would escape to higher locations in the canyon.

Only for birds there are quite valuable nesting and feeding habitats available. However, in the vicinity of these potentially submerged habitats many locations are available offering all types of identical habitats for the birds recorded or considered in the area. Even after submergence there would be plenty of habitats available for the bird species resident in the area, summer breeding, summer migrating or passage migrants. These birds would shift to alternate habitats available. None of the species recorded is endangered and listed in the Red Data Books of Pakistan.

9.8.3 Degradation of fish stocks during operation

Principal Impact	Significant impact	Potentially significant adverse impact for which an operation solution can be developed	Adverse impact, which is potentially significant but requires further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during operation on fish stocks				**X** Less relevance of stream as fish water body	

The operation of Keyal Khwar Hydro Power Plant in the whole would not harm natural fish stocks.

As the fish investigations revealed the aquatic conditions for fish in general are unfavourable. This is why only two common fish species had been recorded. The species in accordance with the List on Fish of the Red Data Book Pakistan neither are indigenous nor rare and endangered species.

Furthermore, going upstream due to reduced water temperature, unsuitable nutrition and increasing speed, in addition there is in the Saimoo Khwar a water fall, which works as barrier to fish, the fish habitats continuously are coming inconvenient for natural fish stocks. And, due to the large distance from the habitat of origin in the Indus River not much fish (or even none) is migrating in to the upper area. The only relevant section for fish is the lower Keyal Khwar reaches.

The dam therefore will not harm fish stocks. The amount of 250 l/s water released will sufficiently supply the current aquatic life in the main stream downstream of dam. The situation that the dam will erect a barrier for any fish migration could be neglected due to the current distribution and migration pattern of fish.

There is even the possibility of improvement of fish stocks in the reaches below the dam: The reduction of water during high water months from April through August will reduce the speed of the water. It also may be predicted that the water temperature would be raised to some extent. Extended shallow water areas would improve the spawning and feeding conditions of fish. This would make it easier for the fish to migrate upstream from the Indus River. More species than the two domestic ones and more specimens perhaps could move into the Keyal Khwar.

10 MITIGATION MEASURES

10.1 Mitigation of damages to Social Environment

10.1.1 Mitigation of damages to settlements, houses and population

Construction facilities

The need for removal of houses for the batching plant, crushing plant and stock piling of earth materials has to be limited as much as possible.

The locations of land required should be at the margin of the village, distant to schools, dispensaries, mosques and other facilities. The area required should not affect the village road directly. Machines and vehicles with highest safety, noise and dust emission standards have to be established. Works near residential areas is only allowed at day time between 8 am and 5 pm.

Road widening

Alignment and construction works for the widening of the road have to avoid damage or relocation of houses, graveyards, and other properties such as stables, water pipes, generators. In order to avoid damage of the above named sensitive residential objects candelabra should be erected.

Trees have to be preserved as much as possible. Where not possible the removal of valuable trees has to be prepared. Most modern machinery is to be used. Current international safety standards are to be applied.

The sewage treatment is to be organised with septic tanks. Potential contamination of the Keyal Khwar has to be avoided by treatment of any waste material. In order to mitigate potential pollution of soils and water appropriate methods of usage of cars, machine and car repair service have to be applied.

10.1.2 Mitigation of damages to agricultural activities

Construction facilities

The need for land for the batching plant, crushing plant and stock piling of earth materials has to be limited as much as possible. Trees have to be preserved, whenever possible.

Road widening

Loss of cultivated land has to be mitigated wherever possible.

Trees have to be preserved as much as possible. Where not possible the removal of valuable trees has to be prepared.

Labourer camp

The area for the labourer camp should be limited if possible. The location should avoid the use of any residential or cultivated land.

10.1.3 Mitigation of damages to forestry activities

Road widening

The demand on forest land, in particular valuable broad-leaved or even coniferous forest, for the widening of the road should be minimised. The two roads required for accessing the windows of the underground water way from the reservoir intake to the power house should be aligned where minimum forest will be damaged.

The need for dumping area of the excavated rocks from the underground works of the tunnel, power house and other facilities should be limited as much as possible.

10.1.4 Mitigation of damages to irrigation and drinking water supply

During construction phase the stream will be diverted through a water pipe. Disturbance of supply of water for irrigation and drinking water seems to be not relevant. When operating the riverain release will supply all needs as they have been estimated. This essential mitigation action will ensure the safe supply of water all over the year.

10.1.5 Mitigation of damages to electricity generation

During construction and operation adverse impacts on electricity generation and supply should be mitigated. Since the water released for downstream users during construction will not be changed the designed operation mode would harm the small hydro power generators.

Under the condition that 250 l/s will be released certain actions are to be taken by the proponent to ensure the current situation with regard to income of private owners of these facilities and to the users of electricity. The rule is to avoid any deterioration in terms of cash income or supply of electricity.

There are two principal options: The one is compensate the loss of generators and supply (see Chapter 12.5). WAPDA under this condition will supply 20 years electricity to all users under the same conditions as present. And, beyond this WAPDA will extend the electricity net for the entire valley and supply to the same conditions electricity. This substantially will improve the living conditions in the valley.

The other option would be to increase the riverine release up to 600 l/s in order to enable the continuation of the present conditions of electricity generation and supply.

10.1.6 Mitigation of damages to water milling activities

Currently three water mills are working in the Keyal Khwar reaches downstream of the dam. One of them might be affected by the widening works of the road. All three potentially would be adversely affected by operation of the dam, when only releasing 250 l/s.

All construction works have to avoid a direct damage of any water mill in order to enable continuation of the business for cash income generation and supply of flour to the local residents.

There are two principal options for mitigation of damages to the water millers and residents: The one would be as the present approach for operation is based upon to reduce the water release up to 205 l/s. Under the condition that all three water mills may operate only reconstruction works of the water intakes would be required. In the case the amount of water available for running the water mills does not maintain the stable operation WAPDA has to take actions in order to establish alternative power, presumably based upon electricity (see Chapter 12.6).

The other option is to increase the guaranteed permanent water release up to 600 l/s, which would allow the present mode of operation.

10.1.7 Mitigation of damages to transportation

The construction works, first of all of the widening of the road, might have an adverse impact on the local transport on the valley road. All works have to be carried out with the aim to avoid any disturbances of the regular traffic along the Karakoram Highway and the Keyal Khwar valley road itself.

All construction works have to be designed not affecting the regular transport. Blockages due to blasting or other works have to be avoided totally. Mitigation measures have to be prepared for those cases.

Threats of humans along the road by noise and dust emission have to be mitigated as well. Noisy works in areas where population would be significantly affected have to be done only during day time from 8 am to 5 pm. Vehicles and heavy machines have to meet international standards on noise, vibrations and dust emission.

10.1.8 Mitigation of damages to business activities

Most important business activities in the Keyal Khwar Project Area are the trade in the small wooden shops. Totally 48 shops are operation in Bandlo Bazar and in Bairlo. Any construction works have to be designed in that way to mitigate any adverse impact. Widening works should try to leave them untouched and to allow the customers to continue to shopping.

Under the conditions that the bend shortly above Bandlo Bazar will be changed in accordance with the requirements of the heavy bulk transport actions are to be prepared and to finance by the proponent to preserve or to replace, which would need certain compensation (see Chapter 12.7).

10.2 Mitigation of damages to Physical Environment

10.2.1 Mitigation of damages to land and soil

Any construction measure should be guided by the intention to exploit as less land as possible. All land in the Keyal Khwar is very limited and represents the most important basis for cultivation, grazing of livestock, and production of fuel wood and timber.

10.2.2 Mitigation of damages to local climate, air and noise

There is no significant impact of establishing the reservoir on the local climate. The air conditions for the human settlements even might be improved due to the cleaner air, little bit lower summer heat and some more wind coming from the reservoir inducing fresh and cool air in hot seasons.

Any construction measures, especially those inducing noise should follow international standards.

10.2.3 Mitigation of damages to Keyal Khwar hydrograph

The main subject of the Keyal Khwar Hydro Power Plant is the change of the hydrograph. The present utmost torrential stream would become much more balanced. Only in summer period, when the flow into the reservoir exceeds the live storage of 180,000 m³, more water than the guaranteed 250 l/s would be discharged. However, there is the assumption that the character will not be changed essentially. From the point of view of human exploitation the more balanced stream could be assessed positively.

10.2.4 Mitigation of damages to downstream damages by sediment flushing

Sediment accumulated during operation will be flushed through the sluice valves provided in order to prolong the reservoir's life. It is required to plan those sediment releases carefully in order avid damages downstream. Sediment traps in the Sanga and Simo Khwar close to the reservoir might be investigated.

10.2.5 Mitigation of damages to water quality

Any construction or operation measures have to be avoided, which may harm the water quality of the downstream reaches of the Keyal Khwar. This requires high standards on used vehicles and machinery, that no lubricants, oil, petrol or other liquids may pollute the water.

The labourer camp has to treat the sewage water before releasing into the stream during construction period.

If the water monitoring after commencing operation realise a significant rise of the pollutant any actions by the proponent are to be taken in order to avoid this water quality change. This may arise after significant reduction of water in the downstream Keyal Khwar due to the direct discharge of human excreta. If there is evidence for this situation the proponent has to prepare and fund actions for sanitation of the sewage water in the relevant locations.

10.3 Mitigation of damages to Biological Environment

10.3.1 Mitigation of damages to natural plants

Although no rare and endangered natural vegetation is growing in the Project Area all construction measures have to mitigate any damage of natural vegetation. Local NGOs should be incorporated for protection and preservation of natural vegetation.

10.3.2 Mitigation of damages to endangered animals

Since there is not much natural wildlife all construction activities should avoid any further disturbances in wildlife.

Two most important mitigation actions are linked to excavation and levelling works during construction:

- Mitigation of impoundment of the reservoir during hibernation of reptiles (winter up to April)
- Mitigation of excavation and levelling works during breeding period of birds (April-June).

10.3.3 Mitigation of damages to fish stocks

Although the fish stocks are very poor (number of species and of specimen with growing distance towards upper reaches) any disturbances of aquatic life during construction and operation have to be mitigated.

During construction the diversion of water through the water pipes has to preserve the regular flow conditions. Any pollution of water should be avoided.

During operation the riverine release of 250 l/s should maintain the limited fish stocks.

11 ALTERNATIVES

11.1 Do-Nothing Alternative

The overall outcome of the inventory is that there are not so many environmental relevant subjects, which would require certain actions to restore the environment.

The Keyal Khwar HPP in general will enhance the environmental situation in the Keyal Khwar village and significantly may contribute to improve the infrastructure, the income, and the overall living conditions in this poor part of Pakistan. The construction and operation of the Keyal Khwar HPP would enhance the following conditions:

- Supply of electricity to the national electric system of Pakistan to meet the power shortages at peak demand hours.
- Supply of electricity to the population in Keyal Khwar valley.
- Offering many job opportunities during construction
- Access to the local markets of Dassu, Patan and Duber
- Working skills of many workers
- Education and medical care services in the Keyal Khwar valley
- Less pressure to send family members for working to outside areas in Pakistan or abroad.

Therefore the *Do-Nothing Alternative* is not recommended from the point of view of reduction of poverty and necessary improvements of the economic and living conditions. The impact on the natural environment in general is very little in comparison to the improvements of the economic and social life of the local population.

11.2 Changes in Conceptual Design

11.2.1 Location of Elements of the Conceptual Design

- Dam site: The location of the dam closely below the outlet of the canyon of the upper Keyal Khwar does not affect natural structures (plants, animals, habitats) and would not significantly harm human activities or properties. And, the reservoir directly in the canyon will not have any adverse impact on natural and social environmental values. There is no better dam site location.
- Road: The widening of the road will benefit the entire population in the Keyal Khwar valley. Most of the land is already used by the road. Most of the adjacent land and nature phenomena are already degraded. The alternative would be to construct a new road in the forest area and would harm therefore much more natural forests and habitats.
- Underground water way and power house at Indus River slope: The matter of underground construction significantly reduces the impacts on the environment. Only some small areas would be affected due to the windows and dumping material. There is no alternative for these facilities.

An important place will claim in the next stage the improvement of the alignment of road. This will have essential positive affect on reduction of relocation of persons.

11.2.2 Location of HPP in other valley

Changes with regard to establish the Hydro Power Plant with the same conceptual design in another valley were not investigated due to the knowledge that WAPDA has completed prestudies to allocate potential hydro power plants. Naturally, most important criteria here was the available water flow and high headrace of more than 700 m. Bearing in mind that all other potential valleys in that Kohistan area – not considering their suitability from water and

headrace point of view - would have principally the same sensitivity of natural and human environment, there is no change of valley location recommended.

11.2.3 Changes of Design

The most important issue to be investigated is to reduce the dam height. From the environmental point of view a reduction up to 25 or only 20 m would not have a big surplus. The construction measures principally would not be changed, including construction road, camps, excavation places, quarries, storage places for earth material. The only benefit from the point of view would be a small reduction of area covered by the reservoir. In summary the reduction from the point of view of environment is not recommended.

11.2.4 Changes of operation

The reduction of dam height would reduce the daily storage volume of the reservoir. And, this would allow to change the operation mode (by reducing generation) in order to increase the water surplus for downstream users.

The surplus of water could released downstream would reduce the effective use of water for generation of electricity. However, the demand of downstream users, taking into account the solutions to provide electricity to the local population, would not require higher riverine releases.

12 COMPENSATION MEASURES

12.1 Compensation of damages to Social Environment

12.1.1 Compensation of damaged private residential houses

A cadastral survey of the land and houses has to be carried out. The inventory of housing facilities will take into account current practice and market rates. All people affected by the Diamer Basha Dam and reservoir and its related works whose residential houses, side-buildings (barns and stables for the straw and corn mostly) and other structures would be damaged or degraded are entitled to be compensated accordingly.

In accordance with the engineering practice in Pakistan, during the Cadastral Survey the additional value for houses has to be determined taking into account additional values such as

- Single-storey, double or triple storey building
- Size and number of bedrooms and bathrooms
- Availability and type of internal or external water supply
- Availability and type of internal latrine, electricity, and telephone,
- Other values.

In case of dispute the village Jirga will be consulted.

As actual reference project the Diamer Basha Dam Project may be chosen. Here the Government of Pakistan announced a minimum compensation of 300,000 Rupees for each house.

Taking into account the totally 48 land holdings potentially affected at least 48 houses have to be removed. Totally this would be at minimum 14,400,000 Rupees (240,000 US Dollars). In accordance with international practice an incentive has to be allotted additionally for each affected house owner.

12.1.2 Compensation of damages to public structures

Any other properties such as foot bridges, mosques, graveyards – if their removal cannot be mitigated - have to be included in the Cadastral Survey and their value to be estimated. A fair compensation for land and building has to be paid in order to allow the immediate restoration.

12.1.3 Compensation of damages to agricultural activities

For the cultivated land required much likely in Pashwa village for the batching plant, crushing plant and other construction facilities the following compensation is to be paid:

Taking into account the mean size of land holdings of 4.6 kanal (2,330 m²) totally approximately 20 households would be affected. The following approach of compensation is focusing only on the cultivated land on the terraces. Due to the situation that during winter the land is not cultivated it only includes the summer crops. Thus maize as grain (for flour) and straw (for fodder) are included. In the estimation in addition was included one walnut tree and one fodder tree per hectare. Table 26 explains the criteria and the overall resulting lost income:

Subjects	Harvest of maize grain	Harvest of maize straw (as fodder)	Harvest of walnut tree	Harvest of fodder tree (10 year age)	Total in Rupees
Harvest (kg/ha/year)	2.500	2.500	200	80	
Market price (Rupees)	12	1	50	2	
Total lost income (Rupees)	30.000	2.500	10.000	160	**42.660**

Table 26 Estimation of lost production and income due to use of land by construction

Source: KKC 2007

In total the lost income for the farmers is 42,260 Rupees (711 US Dollars) per hectare. For the estimated 47,000m² respective 4.7 ha the total lost income per year would be 200,502 Rupees (3,341 US Dollars). For each affected household it would be approximately in average 10,000 Rupees (167 US Dollars) per year for not exploitation of their land holdings of 4.6 kanal.

In order to attract the use of land for construction purposes an incentive of 50% should be paid. This would be a grand total of around 400,000 Rupees (6,680 US Dollars) for the 4.7 ha residential and cultivated land per year.

12.1.4 Compensation of damage to forestry activities

The forest lost for widening or new construction of roads, for dumping of rocks around the windows of the underground water way compensation has to be paid to the community, who is the owner of the land. This compensation will be based upon the volume of timber, which cannot be sold on the local market due to the small size of trees or other circumstances.

Further compensation is to be made for lost trees in these forest areas, which are used for fodder and fuel wood.

In addition there is forest to be re-planted in a ration of 1:4, funded by the Client. That means four times more trees lost due to the construction of HPP facilities, including temporarily locations, have to be reforested.

Reforestation will be done in close cooperation with the Department of Forestry of Kohistan District, the Union Council of the Patan Tehsil and the affected community. The proponent has to prepare the analysis of trees affected (kind, age, state) and to estimate the volume of timber. After proper compensation, including lost income for fuel wood and fodder the total compensation has to be made to the owners.

For the reforestation suitable areas have to be allocated by the Department of Forestry. These locations must be in the Project Area in order to re-establish the ecological function there. Appropriated measures for launching of a nursery in the Keyal Khwar Valley have to be included. Funded by the proponent reforestation will start during the construction period, immediately after cutting of the forest.

For all works on reforestation in first order the farmers, whose land had been taken for construction purposes should be assigned.

12.1.5 Compensation of damage to water supply for irrigation and drinking water

The intakes for the irrigation schemes damaged due to commencing operation, which will lower the average water level, have to be replaced. Reconstruction works aiming adaptation

of water intakes and derivation channels for downstream to the new mean water level will be funded by the Client. Local employees, the residents themselves should be included into these works.

The Department of Agriculture of the Kohistan District and the Union Council of the Patan Tehsil will supervise the works for re-construction of the irrigation schemes, and if there are permanent water intakes for the water supply of the local population also there.

The function of the Patan water pipe has to be continued. This also would be included in the works of reconstruction of the entire water facilities system.

12.1.6 Compensation of damage to electricity supply

As stated in Chapter 11.4 two principal options are available. The one is compensate the loss of generators and supply taking into account the results of the Cadastral Survey.

Present operators or owners of small hydro stations are earning profit or net income per month. Their income has to be compensated for the value of net income foregone for the estimated period of operation of the relevant generator.

And, WAPDA will supply for 20 years electricity to all 1,100 users approximately under the same conditions as present. And, beyond this WAPDA will extend the electricity net for the entire valley and supply to the same conditions electricity. This substantially will improve the living conditions in the valley.

The other option would be to increase the riverine release up to 600 l/s in order to enable the continuation of the present conditions of electricity generation and supply.

12.1.7 Compensation of damage to water milling activities

Under the condition that damages of one or more water mills operation in the downstream reaches of the Keyal Khwar cannot be avoided fair compensation is to be made by the proponent.

Based upon the Cadastral Survey compensation would be required for damage of water mills, for example induced by the road widening. The total costs for re-establishing such water mills plus an incentive have to be paid to the water miller. And, the lost income due to this damage is to be compensated.

Under the condition of the presently designed riverine release of 250 l/s two principal options for continuation of water milling activities would appear:

Under the condition that all three water mills may operate with the amount of water released only reconstruction works of the water intakes would be required. For this case the reconstruction works have to be designed and appropriate funding has to be allocated. For the time that there is gap between operation periods of both water mills the water miller will get compensated for lost income.

In the case the amount of water available for running the water mills does not maintain the stable operation WAPDA has to take actions in order to establish alternative power, presumably based upon electricity. This includes

- Purchase of electrical engine for each mill
- Establishment of all electrical facilities for changing from water to electricity, and
- For a period of 20 years supply of electricity free or charge.

The other option is to increase the guaranteed permanent water release up to 600 l/s, which would allow the present mode of operation.

12.1.8 Compensation of damage of business activities

For the case that mitigation actions to avoid damage of shopping activities might not be feasible the proponent is obliged to compensate both replacement and reconstruction of wooden shops and lost income of the shop keepers and their personnel. In addition there is one water mill, one small hydro power generator and others directly affected by the road widening works.

If the removal of all nay of the 48 wooden shops in Bandlo Bazar and Bairlo wooden shops and the water mill cannot be mitigated during the construction works the Cadastral Survey will investigate size and quality. Compensation is to be paid for the removal. Under certain conditions owners and employees are entitled for lost income compensation.

12.2 Compensation of damages to Physical Environment

12.2.1 Compensation of damages to land and soil

In the case that land has to be used temporarily or permanently compensation has to be paid by the proponent. The cases of the usage of cultivated or forestry land had been addressed (see above Chapters 12.2 and 12.3). In order to compensate additional withdrawal of land (beyond cultivated land, forest land) land, which is now without forest has to be reforested.

It is suggested that the first priority area for reforestation would be Indus River slopes above the power houses location. The ratio should be 1:4, which means for 10 m² at other place 40 m² forest has to be planted and maintained up to a certain stage. This forest activity will also fall into the responsibilities of the Dept of Forestry of Kohistan District.

12.2.2 Compensation of damages to downstream reaches

Damages of downstream subjects such as foot bridges, irrigation intakes, cultivation land, houses or other induced by sediment flushing are to be compensated. After such events an damage analysis and cost estimation has to be prepared by WAPDA. The affected persons or entities have to be compensated accordingly.

12.2.3 Compensation of deterioration of water quality

Under the situation that the water quality of the downstream reaches of the Keyal Khwar due to the essential deduction of discharge might be worsened the proponent has to decide, prepare and fund actions to avoid this water quality change. This may include the funding of an analysis about the pollutants and polluters and appropriate actions for sanitation of the sewage water in the relevant locations.

12.3 Compensation of damages to Biological Environment

For any damages on natural plants, animals including fish stocks the proponent will take care. This will include the funding of analysis, evaluation and working out appropriate compensation. If required national representatives of IUCN or WFF and local Nature Conservation NGO will be incorporated on the expenditures of the proponent.

13 BENEFITS ASSOCIATED WITH THE PROJECT

The construction of the Keyal Khwar HPP would become the most important economic and social measure for the valley. Natural and human environment including traditional tribal rules and customs of NWFP should be respected by the Project. At the same time the natural and human environment should benefit from the Project. Potential benefits of poverty reduction and rural community development would be:

- Access to electricity in the entire catchment
- Improved road and transport conditions in the valley, including bridges
- Improved road access to markets and services, in particular for left bank villages
- Improved irrigation schemes
- Increase of jobs of local workers from the Keyal Khwar valley
- Increase of income and reduction of poverty in the Keyal Khwar valley
- Vocational training and increase of skills of local population
- Support to affected settlements in education, medical services, trade and business
- Support to community development including human rights of women
- Production of high value crops, fruits, vegetables and livestock (as a result of access to markets, agriculture and livestock institutions)
- Decrease in population growth rate as a result of awareness and improved income
- Decrease in population pressure on land and forest due to the employment in new jobs in the valley and in labour markets outside the valley.

14 OUTLINE OF RESETTLEMENT ACTION PLAN

Legal requirements

As referred the “Pakistan Environmental Protection Act, 1997” does not require to prepare a formal Resettlement Action Plan. However, the “Resettlement Ordinance, 2001” stated that in accordance with international requirement a formal Resettlement Action Plan has to be prepared, when the Project meets the concerned conditions.

Overall guidelines for involuntarily resettlement determine World Bank Guidelines such as OP 4.12 and BD 4.12, and the IFC Handbook for Preparation of Resettlement Action Plan set the limit with 200 persons. With other words, a Resettlement Action Plan is to be prepared, when more than 200 people are affected.

The international requirements do not consider whether the resettlement is permanently or temporarily. In the Keyal Khwar HPP it scheduled for 2-3 years to allocate construction facilities on cultivated and residential land in Pashwa Village. Under the conditions that the limit of 200 affected persons will be exceeded lastly EPA Environmental Protection Agency of NWFP will decide.

Preliminarily assessment of scale of resettlement

Currently there is the high probability, if the road widening work and the land acquisition for the batching plant cannot mitigate removal of houses, that the limit of 200 affected people will be exceeded.

For road widening works currently 28 houses in the corridor 0-5 m would be endangered. And, when establishing the batching plant in Pasha Village also some 20 houses have to be (even if only for two or three years) removed. This much likely would affect more than 500 residents.

Scope of Resettlement Action Plan (RAP)

The RAP has to be based upon the detailed analysis of affectees including their economic and social conditions. The socio-economic analysis made in the EIA Study in hand will fulfil the requirement for this analysis. The RAP has to address management principles and actions for implementation of relocation of affected persons. In detail the RAP will consist of

- Legal and institutional framework
- Basic socio-economic data based on census and socio-economic surveys
- Condition of vulnerable groups such as: women; landless people; and ethnic minorities
- Impact analysis including mitigation and compensation measures
- Resettlement principles such as eligibility criteria; compensation entitlements, procedures
- Resettlement management
- Place(s) for relocation of: residential plots, cultivated land, and commercial activities
- Community participation and consultation framework
- Grievance redress mechanism
- Internal and external monitoring procedures
- Estimated funding for compensation, relocation, and other rehabilitation measures
- Administrative requirements including implementation mechanism.

Compensation

Affected persons are entitled to get compensated for lost land, houses and trees. An approach for estimation of lost

Land allocation

Affected persons would be entitled to get plot and house at new places. Under certain circumstances even the income has to be substituted.

15 OUTLINE OF ENVIRONMENTAL MANAGEMENT PLAN

Legal requirements

As explained in Chapter 3, the Pakistan Environmental Protection Act, 1997, and also the Review of IEE and EIA Regulations, 2000 do not require the provision of an Environmental Protection Plan. In contradiction to that the EPA Guideline “Policy and Procedures for the filing, review and approval of environmental assessments” (September 1997) describes in detail what has to be done for preparation of studies. And here the EMP is explained.

Despite this legal condition it is the intention of the Consultant to prepare this obligatory (in Europe) document for implementing of environmental actions during construction.

Subject of EMP

Subject of the EMP Environmental Management Plan is the determination of actions to mitigate or if mitigation is not possible to compensate significant impacts on physical and biological environment.

This EMP will be elaborated when the engineering and tender design documents are under preparation. The approval of the EMP by EPA will allow commencing environmental management works during construction. Following subjects in the EMP have to be addressed at least:

Downstream water release

Decision has to be developed regarding the mandatory water release. Both options have to be discussed. If the 250 l/s riverine release will be confirmed appropriated measures have to be prepared for supply of water to the small power generators and water mills. This would include the determination of electricity supply (costs, access, lines) to the affected people (those who presently get access) and the compensation of the private or community generators and other facilities (such as poles, lines etc.).

Measures have to be developed for ensuring the domestic water needs for humans and animals. As well mitigation measures will be developed in order to guarantee the supply of water to the natural plants, species and most important habitats in the immediate impact area.

Water quality

Actions to avoid a pollution of the downstream water are to be prepared. Under the condition that only less than 20% of water will be released downstream the content of bacteria, but also nitrogen and phosphorus might be raised significantly. Water borne diseases might increase.

Sediment flushing

Mitigation measures have to be determined for the flushing operation of the dam. They have to be focused on the flushing mode and to determine which actions have to be taken in the downstream environment to mitigate damages in human properties or natural values.

Land degradation and loss of forest

Degradation of land and forest will be estimated in the next stage in detail, based upon the detailed design. This will be used for the examination of how much land, natural soil and forest (depending on type, age, natural status)

Fish stock development

The severely reduced downstream water release will impact on the naturally poor fish stocks. Further inventory will focus on to predict the future development of natural fish stocks

based upon the changed natural conditions for development of fish in the stream. Fishery possibilities should be included as well.

Reptiles and birds

Appropriate actions have to be determined to protect the available bird and reptile species and specimens.

16 MONITORING, EVALUATION AND REPORTING

16.1 Environmental Monitoring Programme

The monitoring in the forthcoming Environmental works should include the observation and inventory of following issues:

- Regular water quality monitoring of Pakistan (for assessment of potential threats on water quality caused by construction or operation- for example sewage discharge might increase pollution due to reduced water in Keyal Khwar)
- Regular water discharge, in particular daily minimum flows during low water periods
- Monitoring of water demands for hydro power plants, water mills, irrigation, drinking water
- Analysis of land and property rights for those areas required
- Population data in the potentially affected area, in particular natural growth rate
- Cultivation (crops, areas, average sizes per family/household)
- Inventory of trees endangered by road widening
- Inventory of land and forest needed for access roads to windows, windows and dumping

16.2 Internal Monitoring, evaluation and reporting

Internal monitoring, evaluation and reporting are the responsibility of the project proponent and have to be arranged on regular basis. Overall subjects to be identified in this monitoring, evaluation and reporting process are:

- financial and in-kind compensation associated with loss of access to assets
- financial and in-kind restoration and development associated with the forced removal of the affected households; and
- overall success and ability of the resettlement program to improve living standards of the affected parties.

The programme of monitoring, evaluation and reporting has to be in place with the commencement of first construction works by the Contractor.

Part of the works of next stage, likely Engineering and Tender Design Stage, would be to prepare this programme for both documents for internal monitoring, evaluation and reporting. It would allow permanent review of a process of implementation of Resettlement Action Plan and Environmental Management Plan. Overall performance milestones for the Resettlement Action Plan would be

- Public meetings held in the Project Area
- Census, assets inventories, assessments, and socioeconomic studies completed
- Grievance redress procedures in place and functioning
- Compensation payments disbursed
- Infrastructure of relocation places prepared
- Housing lots allocated
- Housing completed
- Relocation of people completed
- Livelihood development measures implemented
- Income restoration and development activities initiated
- Monitoring and evaluation reports submitted.

Monthly, quarterly and annual Monitoring and Evaluation reports will be submitted to EPA Environmental Protection Agency of NWFP, WAPDA, Kohistan District Administration and concerned Monitoring and Evaluation Committee for scrutiny and clearance.

The Monitoring Programme provided that data would be collected on a predefined basis with the issuance of annual reports to governmental authorities who could then make determinations regarding any corrective measures that may have needed to be taken.

Indicators have to be outlined in the document to demonstrate the change or result of activities, along the above listed milestones.

17 COST ESTIMATE OF ENVIRONMENTAL ELEMENTS

17.1 Overall entitlements

Part of the Resettlement Action Plan will be an entitlement matrix, identifying the various subjects, for which the affected persons in the Keyal Khwar hydro power project are affected.

All private persons are entitled to get compensation for:

- Lost cultivated land, which is private property of the households
- Lost residential land, which is a private property of the households
- Lost private residential houses and side buildings
- Lost trees (both cultivated and fruit trees)
- Lost income due to the fact that the basis for the works is damaged.

The detailed determination of those entitlements will be made when the relocation is to be prepared and other circumstances are known, which would require compensation.

In addition there is the need to estimate further expenditures falling in the area of environmental affairs such as development measures in electricity supply for the entire valley, education, medical care and others. To be included furthermore are cadastral survey, additional research, and administration of resettlement.

17.2 Expenditure elements

17.2.1 General explanation

The following list identifies the most likely expenditures in the Keyal Khwar HPP based upon the present design, which presently is in some subjects due to the Feasibility Study stage vague. In particular the alignment of the road widening has not been completed and the range of impacts on land, trees, houses, and infrastructure by establishing the batching plant and other temporal construction facilities objects are not clear yet.

Annex 7 is listing the most important cost elements. Approaches for estimating the quantities are explained either. There are the most important environmental cost elements:

17.2.2 Private Assets Compensation

- Compensation of private residential houses including side buildings: potentially along road (for widening) and while establishment of batching plant.
- Compensation of private land for residential houses: potentially along road (for widening) and while establishment of batching plant.
- Compensation of private fruit trees: potentially along road (for widening) and while establishment of batching plant.
- Compensation of private facilities: shops along the road, intakes for private household drinking water supply, removal of small hydro power generators including transmission line, water mills
- Compensation of livestock: caused by accidents induced by construction
- Compensation of lost income: lost of harvest when cultivated land exploited during certain period, lost income, when shop, mill, generator due to construction works cannot operate

17.2.3 Community Assets Compensation

- Compensation of lost footbridge, other infrastructure: footbridge down of dam site
- Compensation of communal irrigation water schemes

- Compensation of communal hydro power generators and transmission lines
- Compensation of schools, medical dispensaries, mosques

17.2.4 Cost for acquisition and preparation of alternative land

- Expenditures for land purchase from private owners in the valley (permanently/temporarily)
- Graveyard respective graves removal to new locations
- Tree removal to new locations
- Construction of sediment flushing protection facilities
- Infrastructure: water channel, foot paths, footbridge
- Levelling, terracing, cleaning capital ploughing of sites of alternative land
- Site planning costs

17.2.5 Reforestation

- Reforestation for lost forest: widening road, dam site, windows for underground water way
- Reforestation programme for lost natural objects: trees, valuable bush land, lost habitats of reptiles, birds

17.2.6 Support for Community Development and Poverty Reduction

- Improvement of school facilities and education (including teacher support programmes)
- Improvement of medical facilities in the valley
- Vocational training of local residents in construction, timber manufacturing, handicraft, recreation
- Support to economic activities: timber manufacturing (furniture), agriculture, handicraft, recreation
- Support to community development and public participation programme.

17.2.7 Management Costs and Research

- Cadastral Survey
- Managing costs for Resettlement Authority and Resettlement Action Plan
- Additional research

17.3 Overall Environmental Cost estimate

Annex 8 in detail determines the cost estimate for environmental objects.

Subject	Total in Rupees	Total in Euro
Private assets	30,985,120	387,314
Communal assts	20,068,750	250,859
Managing costs for Resettlement Authority	61,235,000	765,438
Reforestation/Afforestation	150,342,000	1,879,275
Community Development	26,200,000	327,500
Administration	9,040,000	113,000
Total	**297,870,870**	**3,723,386**

Table 27 Environmental Cost Estimate

Source: KKC 2007

The total estimated cost is Rs. 297,870,870.

18 REFERENCES AND BIBLIOGRAPHY

1. Agriculture and Livestock, Economic Survey of Pakistan 2005-06, Ministry of Finance, Government of Pakistan, 2006, Islamabad
2. Area and Production by Districts, Ministry of Food, Government of Pakistan, 2006
3. Agriculture Statistics of NWFP 2002-03, Department of Agriculture, Government of NWFP, 2003, Peshawar
4. Chaudhry, A., Investigations on plants, birds, amphibians, reptiles and mammals, KKC, June 2007
5. District Census Report of Kohistan, Government of Pakistan, Statistics Division, Population Census Organisation, 1999
6. Duber Khwar System Hydropower Project, Final Report for Survey and Mapping, Government of NWFP, Sarhad Hydel Development Organization
7. Environmental Assessment Requirements and Environmental Review Procedure, Asian Development Bank, 2003
8. Feasibility Report Keyal Khwar Hydropower Project, Main Report Volume 1, Pakistan Water and Power Development Authority Hydro Electric Planning Organization, Lahore, September 2003
9. IFC Handbook for Preparing a Resettlement Action Plan, Washington DC, 2002
10. Kreditanstalt für Wiederaufbau (KfW), Environmental Guidelines for Financial Cooperation (FC) by KfW with Developing Countries, October 2001
11. National Environmental Quality Standards (Certification of Environmental Laboratories) Regulations, 2000, Government of Pakistan, Islamabad, in: Ameer, B. U, Manual of Environmental Laws in Pakistan, Khyber Law Publishers, Lahore, 2005, p 47-62
12. NWFP Provincial Conservation Strategy, Government of NWFP and IUCN, Peshawar, 2001
13. Pakistan Environmental Assessment Procedures, Pakistan Environmental Protection Agency, Islamabad, 1997
14. Pakistan Environmental Protection Act, 1997, in: Ameer, B. U, (2005), Manual of Environmental Laws in Pakistan, Khyber Law Publishers, Lahore , pages 1-36
15. Pakistan National Conservation Strategy, Government of Pakistan and IUCN, Islamabad, 1992
16. Palas Conservation and Development Project (PCDP), Website, www.palasvalley.org.
17. Rafique, M., Fish Diversity and Distribution in Indus River and its Drainage system, Pakistan Journal of Zoology, 32(4), p 321-332, 2000
18. Rafique, M., Keyal Khwar Hydropower Project – Environmental Impact Assessment Studies with particular Reference to Fishery, KKC, June 2007
19. Sediment Appraisal of Pakistan Rivers, Surface Water Hydrology Project, Pakistan Water and Power Development Authority, Hydrology and Water Management Organization, Lahore, June 2003

20. Review of IEE and EIA Regulations, 2000, in: Ameer, B. U, Manual of Environmental Laws in Pakistan, Khyber Law Publishers, Lahore, 2005, p 64-84
21. Statutory Notifications (S.R.O.) from October 28, 1998 (about delegation of power and function to the provincial EPA's)
22. World Commission on Dams (WCD) Report, 2000
23. WCD Status Report Keyal Khwar HPP Feasibility Study Phase 2, KKC 2007
24. World Bank - Bank Procedures BP 4.12 Involuntarily Resettlement, Washington DC., 2001
25. World Bank - Operational Policy OP 4.01 Environmental Assessment, Washington DC., 1999
26. World Bank - Operational Policy OP 4.12 Involuntarily Resettlement, March 2007 update
27. World Bank - Operational Policy OP 4.36 Forests, Washington DC

ANNEXES

ANNEX – 1

Annex 1 Stakeholders during EIA Phase

A NGOs/CBOs operating in District Kohistan

- WWF Palas Conservation and Development Project, located at Patan and Jinnah Colony Abbotabad (Mr. Rab Nawaz 0300-8110182).
- BADP Barani Area Development Project (NWFP)
- CRS Catholic Relief Services
- UNICEF Shangla
- Ahmad Nabi President CBO's Kohistan (Tel. 0987-407201)
- SABAWON
- Keyal Conservation and Development Organization (Mr. Saiful Maluk Khan).
- Sangi Development Foundation, 880 Manshera Road Abbotabad (0992-333414 and 334750).

B Administration to be Included

- District Administration Dassu.
- Tehsil Administration Patan
- Union Council Keyal.
- Union Council Chawadara.
- Tehsil Administration Palas.
- Local WAPDA Offices (Dassu and Patan).

C Names of Entities and Persons, Addresses and Telephone Numbers

No.	Organisation, Department	Name of Contact Person	Address	Telephone Numbers
1	District Nasim, District Government	Dr. Saif–ur-Rehman	Dassu	0998-407003
2	District Coordination Officer, District Government	Mr. Sayed Khan Orakzai	Dassu	0998-407002
3	Tehsil Nasim, Tehsil Municipal Administration	Mr. Shahdad Khan	Patan	0998-405104
4	Union Council Nasim Keyal	Mr. Mir Samand	Keyal	
5	Patwari Patan Circle	Mr. Yar Muhammad	Patan	0998-405130
6	Range Forest Officer, Forest Department		Patan	

D Schedule for EIA in Pakistan

Official EPA Information

The EPA NWFP has to issue the Environmental Approval - "*No Objection Certification*" - prior to commencement of project construction. After receipt of conformation for KfW it is better to provide a short brief of the project to the EPA NWFP and information about the start of EIA study.

Public Participation

The scoping sessions with the stakeholders including public representatives, local government departments, NGOs and WAPDA should be started within a week from start of EIA at Keyal Village, Patan and Dassu.

ANNEX – 2

Annex 2 Spellings of Geographical Names

In the IEE Report certain geographical names are used. Regarding the unified spelling herewith the Consultant clarifies the overall approach.

General base for any geographical name is the “1998 District Census Report of Kohistan”, issues by the Government of Pakistan, Islamabad 1999. Geographical names, which are found on the Topographical Map 1:50,000 (issued by the Survey of Pakistan) either, but with different spelling, are written as the above named Census Report. Other local names will be written as the following table explains (in alphabetic order):

Census Report	**Topographical Map 1:50,000**	**Other Spelling**
Asso		
Bach Gay		
Bair		
Bairlo		
Balindrat		
Banda		
Batagram		
Benja		
Besham Qila		
Bandlo	Bandlo Bazar or Bundlo Bazar	Bundlo
Chakdara		
Charto		
Chawadara		
Chor Nala		
Daber		
Dassu		Dasu
Dehro		
Dhope	Dhop Bandu	
Diamer, Diamir		
Darial		
Duber		Duber, Duber, Duber
Dibair Bala		
Gel		
Harian		
Harigah		
Hazara		
Hindukush		
Indus		
Census Report	Topographical Map 1:50,000	Other Spelling
Jabba		
Jalkot		
Jano Bvin		
Jijal		
Kalam		
Karakoram Highway	Karakoram Highway	Karakorum Highway
	Karora	
Keyal Bala, Kayal Bala		
Keyal Village	Gahu	Keyal, Kayal
Keyal Khwar		
Keyun Sero		
Kohistan		
Komila		
	Leo	
Maidan		

Census Report	Topographical Map 1:50,000	Other Spelling
Mandraza		
Nullah		Nala
Palas		
	Patan Banil Khwar	Patan Khwar
Patan	Patan	
Peshwa		Pashwa
Pogalay		
Qillah		
Sanga Khwar	Sanga Khwar	
Sangla		Shangla
		Simu Khwar Village
Sen Steel		Sind Chatal
Serto	Sarto	Sarta
Shahpur		Shah Pur
Sheshal Keyal		Sheshal
Simu Khwar	Simu Nala	Semu, Saimo, Saimoo
Soyan		
Sungai		
Swar Steel		
Tangir		
Yghistan		
Yozal		

ANNEX – 3

Annex 3 Questionnaire for sample survey of affected households

Question	Unit	Description in the interview
settlement	name	
village	name	
Household and tribe		
household head	name	
tribe	name	
sub-tribe	name	
Distances to various locations		
Union Council by road on metal road (Pacca)	km	
Union Council by road on un-metalled road (Kachha)	km	
to nearest market on metal road (Pacca)	km	
to nearest market on un-metalled road (Kachha)	km	
to Patan on metal road (Pacca)	km	
to Patan on un-metalled road (Kachha)	km	
Family structure		
family members	total number	
male	number	
female	number	
children going to school	number	
Age of family members		
below 18 years	number	
18-60 years	number	
above 60 years	number	
Temporary migration for work		
outside district	number	
outside Pakistan	number	

Question	Unit	Description in the interview
Accommodation		
Residential accommodation		
number of rooms	number	
number of bathrooms	number	
toilet	number	
kitchen	number	
Property rights		
own house	own	
rented house	rented	
source of drinking water		
Keyal Khwar stream	yes/no	
natural spring	yes/no	
water supply scheme	yes/no	
others	yes/no	
Household facilities		
refrigerator	yes/no	
television	yes/no	
radio	yes/no	
newspaper	yes/no	
Literacy rate		
person having matriculation	number	
middle education	number	
primary	number	
person who can read newspaper and write a letter	number	
people able to read Quran	number	
Cultural land holdings		
cultivated land irrigated	acres	

Question	Unit	Description in the interview
cultivated land rain-fed	acres	
forest	acres	
Fruit trees		
mulberry	number	
apricot	number	
apple	number	
walnut	number	
Amlook (local berry)	Number	
Livestock		
buffalos and cows	number	
goats and sheep	number	
horses and donkeys	number	
poultry	number	
others	number	
Source of fodder		
grazing in valley	months	
grazing in forest	months	
grazing in upland	months	
Income per annum		
from crops	rupees	
from fruit trees	rupees	
from timber	rupees	
from milk and butter	rupees	
from wool	rupees	
selling live animals	rupees	
Wages received for work in valley	rupees	
Remittance from family members	rupees	
Other sources	rupees	

Question	Unit	Description in the interview
Expenditures per annum on crops & livestock		
purchase of agricultural input such as seed, fertiliser, pesticides, hired labour	rupees	
fodder for animals	rupees	
labour for animals	rupees	
medicine for animals	rupees	
family expenditures	rupees	
food per annum	rupees	
clothes and shoes	rupees	
education	rupees	
health	rupees	
ceremonies	rupees	
construction of house	rupees	
others	rupees	

ANNEX – 4

Annex 4 Meeting with elders, officials, farmers on 22 June 2006 in Keyal Village

Place: Village Keyal

Date: 22 June 2006

Time: 09.30 to 13.30 hours

Present

Local Elders, Officials and Farmers

1 Haji Mirza Khan

2 Haji Gulbar

3 Amir Khan (Medical Technician)

4 Saddar Khan

5 Haji Kar Khan

6 Umar Ayaz Khan

7 Dault Khan

8 Saleem Khan

and other farmers

CBO Keyal

1 Saif ul-Maluk (CBO Keyal Village)

Consultant

1 Muhammad Shafique (Local Socio-Economist)

2 Mumtaz Hussain (Local Environmentalist)

3 Ibrar Hassan Khan (Chief Local Geologist)

4 Dr. Frank. Schrader (Head Environmental Group)

Results

The meeting was arranged on the request of Consultant to Nasim Union Council Keyal and Community Based Organisation Keyal (CBO). The purpose of meeting was to collect data about the socio economic condition in the valley a questionnaire was prepared and objective was to interview individuals and cross check the information in group discussion when met individuals it came that they had very little knowledge about their lands, water rights and other socio economic conditions. Most of the matters in the valley are decided according to customs and traditions. The common man has no liaison with the officials. Elders of the village, sub tribes and tribe keep the liaison among people and officials. Elders are the real decision makers and knowledgeable. In these circumstances it was felt that the most authentic source of information at IEE stage would be group discussion. In the presence of elders the Consultant discussed with the group the social and economic conditions in the valley using a questionnaire as a guideline.

The discussion was started to obtain information about agriculture in the valley. The KKC was informed that nobody exactly knows the size of his plot according to the measurement. They informed that sizes of plots in the valley are very small due to limited land and continuous sub division due to population growth. The group informed that they measure the size of plot in term of quantity of maize grains it produces. The group informed about the following items:

The size of land holdings vary from 5 to 20 maund (40 kg) grain. It was also revealed that the prices of land are very high due to limited supply of land and growing population Consultant was informed that Maize is the main crop in the valley. The crop is planted in

June and harvested in October. About 95% of cropped area is sown under maize in the valley Major source of irrigation in the valley is Keyal Khwar stream The elders also informed the Consultant that water is diverted to the fields from Keyal Khwar through diversion channels. There are six diversion channels in the valley.

The channels were constructed by the people through self help. Community maintains the channels by contributing labour and small cash if required. Local farmers informed that they are planting traditional varieties, as these are very suitable for local bread (nan). On a question that whether local production of maize is sufficient for the population of valley, KKC was informed that the production of maize only meets one third of requirements and due to supply demand gap the prices of local maize are in the range of Rs 500 to 550 per 40 Kg.

On a question about winter crops it was informed that a few plots are sown under wheat. The reason quoted was severe cold weather in the valley from December to February. This discussion revealed that there are no established water rights for winter crops in the valley. Consultant was also informed that there is no shortage of water during summer for maize crop .As the water is in abundance and land in limited supply there are no major conflict on water use. The constraint of irrigation water is generated when the channels cannot be maintained due to topography in the area.

Regarding cultural practices the farmers informed that they use bullock plough to prepare the plot for sowing. Two to three ploughings are done to prepare the plots. These plots are small and carved as terraces .The seed is sown in basins and not on ridges. The animal dung is used as manure and, chemical fertilizers are not applied. Women participate in intercultural and harvesting operation of crops.

KKC was also informed that Keyal people have special skills in cutting timber in forests and also wood work for house construction. As the lands are limited and do not produce enough to support the families, the adult males work in forest with contractor, construction projects in valley and also in Patan. The young men go to Gilgit, Abbotabad and Mansehra, to work as labourer and petty traders. Young people have also gone abroad and remit money to support their families. Women and children also take part in taking care of livestock and harvesting of fruits like mulberry, walnuts etc. The participant of meeting informed to Consultant that a walnut tree produce on average 120 kg of dried fruit harvested in month of November and December. amlook tree (local berry) produces about 200 Kg per tree harvested also in November/December. Three man days are required o harvest walnut tree and 8 to 10 days to harvest an amlook tree. Mulberry and fig are harvested in May and June During summer season there is crop of pumpkin (looki) vegetable on higher altitudes irrigated from spring water.

When asked about influence of tribes in the valley it was informed that there are four Sub-tribes of Keyal, which are Harifkhel, Badekhel, Kunnakhel and Barekhel. There are other tribes settled in the valley such as Sayedkhel, Loharkhel, Nahkhel and Gujarkhel. The sub-tribes of Keyal are in majority. Family size is large having children in the range of 6 to 12.

The literacy rate in the valley is low. When asked that why they do not send their children to school .Consultant was informed that they can not afford to send their children to schools as they are poor people and use the children as earning hands from the very beginning. The poverty rate in the valley was described in the range of 40 to 50%. The other reason they quoted was that teachers are not coming to the schools. Due to little education in the valley the teachers are outsiders and no accommodation is available in the schools particularly for the lady teachers. Due to risky road the transport fare are very high in the valley up to Rs. 50 per person from Patan Tehsil to Keyal Village. Such transport charges are not affordable for daily travel. The local leaders informed that due to poor means of transportation the marketing of local produce is very expensive and due to these reason local perishable commodities such as milk is not transported to Patan. The transport of timber is expensive and its prices are low as compared to Abbotabad .The prices of grains are high as valley is deficit in food needs and transportation cost are high.

The sources of drinking water in the valley are natural springs and Keyal Khwar stream. When asked about the house construction it was informed that houses in the Keyal village where the meeting was held are built of stone and wood as dominant construction material. The village Keyal is located in the foothills of coniferous forests. The local labour is used in the construction. The labour rates are high. The labour charges are Rs 150 to 200 per day. The skilled workers as carpenter charge up to Rs. 300 per day. The civic amenities as latrine are not provided in the houses. The places for discharge of human excreta are agricultural fields and open spaces in the forests. The human excreta discharged this way pollute the water.

There is one dispensary in village Keyal. The incharge of the dispensary is medical technician. He was also present in the meeting. When asked about the common disease he pointed out that most common diseases are malaria, hepatitis, dysentery, gastroenteritis, asthma, scabies and tuberculosis. The first four diseases are due to poor sanitation and pollution of drinking water. The medical technician informed that asthma and tuberculosis are due to poor ventilation in the houses, smoke of burning wood during winter inside houses and keeping cattle in one room of the house during winter. The medical technician informed that he had established a small hydro station of 5 KVA about ten year back at a capital cost of Rs.150,000. He is selling electricity at accost of Rs. 25 per florescent tube and his net income per month is Rs. 4,500.

The livestock is an important component of Keyal valley economy. On a question regarding livestock KKC was informed that families in the valley own cattle on an average of two cows, one donkey and fifteen goat and sheep. The heard of cattle range from 20 to 200 heads, often pooled together for grazing. The cattle are taken to higher altitude for grazing during summer and shifted to the valley during winter. It was also informed that maize in the valley is grown for grain and not used as fodder. The livestock is raised on grasses and fodder trees in the forests. Dried grass is accumulated during summer to feed the cattle during winter .Similarly they accumulate maize, pulses and dry fruit for winter season. There is no custom to use the dried meat during winter. Milk, butter cheese, and lassi are used for family consumption. Consultants were informed that. Maize is staple diet and production of maize in the valley only meet 33% demand, the reaming is bought from the market. Wheat bread and rice are used on special occasion .Fresh fruits and vegetables supply the needed vitamins. Dry fruits such as walnut are sold in the market for cash and also consumed during winter months. Timber is sold for cash and also used in house construction Sub tribes get 80% of share of forest timbers. The share of the tribe is distributed to the families on the basis of numerical strength of family. Labour wages and remittance in country or from abroad are used to meet the basic requirements on food, clothing and housing. Very little is spent on health and education. Saving if any is used on ceremonies and house construction.

ANNEX – 5

Annex 5 Meeting with shopkeepers, owner hydro stations, flour miller on 22 June 2007

Place: Village Keyal

Date: 22 June 2006

Time: 14.00 to 15.00 hrs

Local Participants

1 Gul Dad Khan Naib Nasim (Union Council Keyal)

2 Haji Ghulab

3 Awdood

3 Younis Khan (owner of small hydro power station operator)

4. Meraj Khan

5 R Alhadad

6 Jane Alam

7 Ghazan Khan

8 Farooq Khan

9 Haji Habib

10 Said Fazal

11 Said Kamal

12 Ali Dad

13 Liaqat Ali Khan

Consultant

1 Muhammad Shafique (Local Socio-Economist)

2 Mumtaz Hussain (Local Environmentalist)

3 Ibrar Hassan Khan (Chief Local Geologist)

4 Dr. Frank. Schrader (Head Environmental Group)

CBO Keyal Village

1 Saiful Maluk (CBO Keyal Village)

Results

A meeting was held inside a roadside hotel where local shopkeepers of Bandlo Bazar gathered. Mr. Saif, representative of CBO Keyal Village also participates. The operator of a small hydro station at Bandlo also participated.

The team wanted to count the number of shops, their rental value, property prices and income from the business in the shops. The number of the shops as counted by the team was 33. There are restaurants serving tea and local food and some general provision shops. The income of these shopkeepers is not large and income of the people in the valley to allow them to purchase items of necessity only. When asked about the ownership of the shops Consultant was informed by the shopkeepers in the meeting that they are not the owners of these shops The rent of the shops was described in the range of Rs 600 to 1,200 per month according to the size of shop and location The average price of these shops was estimated by the shopkeepers in the range of Rs 60,000 per shop. The prices of houses near this site were estimated by the participants in the meeting to be in the range of Rs 350,000 per house.

Consultant was under impression that wheat flour in the valley was supplied by NWFP government on subsidized rates .When asked from the shopkeepers about the subsidy they informed that there is no subsidy on wheat flour from the government. The cheap flour is part of aid to earthquake victims.

An operator of small hydro plant was also participating in the meeting apparently he was very happy about the anticipated development of KKH project about the reason he informed Consultant about his reservations. He informed that his father invested capital to install a 20 KW power station about 12 years ago. There are heavy repairs on the machinery, but his monthly income is Rs. 20,000 per month. He is selling electricity at the rate of Rs. 25 per florescent tube. He was of the opinion that he will lose income if his customers are supplied electricity by the WAPDA.

Consultant also interviewed Mr. Sher Dad Khan, a water miller inside his mill down stream of Bandlo Bazar. He informed that he started the water mill with his own capital and learned the operation of mill as on-job-training. He thought that the technology of water mill is simple. He informed that that he is deducting 5 kg of maize flour per 40 kg. He also informed that maize flour is selling in the range of Rs. 550 to 600 per 40 kg.

Consultant asked his reaction on conversion of his mill to electricity. His abrupt reaction was that he will not like to convert his mill to electricity. The reasons he forwarded were:

(i) Water is free but he shall have to pay for electricity

(ii) He will lose his investment in water mill and he will have to investment in electrical wiring equipments and electrical motors.

(iii) He has to learn the technology of electrical equipments.

In the evening the Consultant had a separate meeting with Mr. Saif to know the rough location of villages in the valley. He narrated a very rough location of the villages. The data shall be improved at EIA stage.

ANNEX – 6

Annex 6 Meeting with Tehsil Nasim Patan and others

Place: Village Keyal

Date: 23 June 2006

Time: 09.00-10.00

PARTICIPANTS

Tehsil

1 Shadad Khan, Nasim Tehsil Council Patan

2 Mir Samad, Nasim Union Council Keyal

3 Dost Muhammad, Nasim Union Council Sangou

4 Adadk Khan Nasim Union Council Chawadara

CBO KEYAL

Mr Saif ul-Maluk

Consultant

1 Muhammad Shafique (Local Socio-Economist)

2 Mumtaz Hussain (Local Environmentalist)

3 Dr. Frank. Schrader (Head Environmental Group)

Results

The meeting was arranged on the request of Consultant in the office of Tehsil Nasim Patan. The purpose of meeting was to know the reaction of Tehsil Nasim and Nasim union council Keyal toward the Socio Economic development in Keyal valley as a result of construction of Keyal Khwar project. The salient points of the project were explained to the participants. Tehsil Nasim expressed that he himself and his colleagues are very happy that a development project is expected to be started on the completion of feasibility study in the valley. He viewed that that developments in the valley shall also have positive impact on the surrounding areas and Patan Tehsil. He assured his full cooperation at feasibility stage and during construction of project.

On a question he explained that the administrative set up of Tehsil. He informed that administrative head of Tehsil is Deputy District Revenue Officer. Tehsil Nasim was requested to provide the latest data of population of Keyal valley. The data provided by the Tehsil to Consultant was the same as that of Census Report 1998. Tehsil Nasim confirmed that there are no record of land and property with the Revenue Department. He also informed that the final assessment of the land is made by District Revenue Officer. On a question Tehsil Nazism Patan informed that the land under forests belong to sub tribes of Keyal The forest is managed by forest department and has plan to plant and to cut forest trees. The trees are marked for cutting block-wise and awarded a contract for cutting of these trees to the contractor following the set procedures. The contractors employing the labour cut the earmarked trees and sort out timber in lots. The timber is shared between tribe and department in the ratio of 80:20. The tribes sell the timber in the market usually to the contractors and share the money according to their customs and traditions.

The Team leader thanked the Tehsil Nasim and his colleagues for discussion and their positive attitude for the present project.

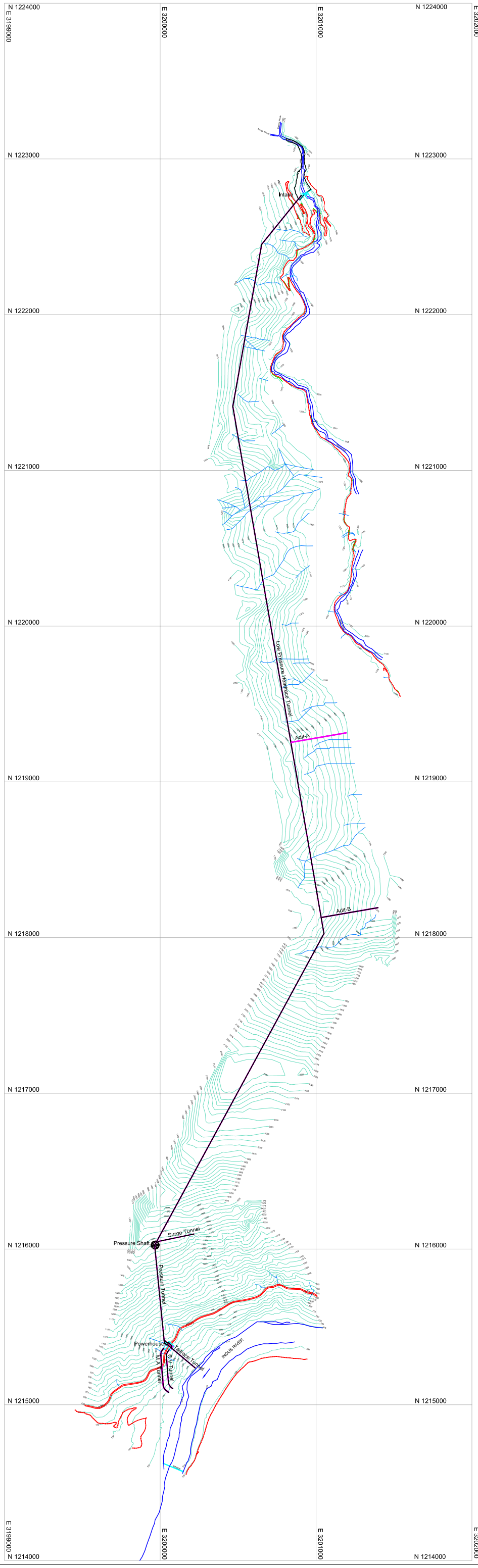
ANNEX – 7

Annex 7
Keyal Khwar Hydropower Project: EIA Environmental Impact Assessment Study 2007
Potential Impacts on socio-economic, physical and biological environment during construction ("*Impact Matrix*")

Stage	Environmental Subjects	Environmental components	Environmental impact	Significant adverse impact	Potentially significant adverse impact, where solutions can be developed	Potentially adverse impact, requiring further studies	Minor or insignificant adverse impact	Significant environmental enhancement
Impacts during construction	Socio-economic Environment	Settlements, houses and population	damage to houses and population by dam, quarries				X	
			damage to houses and population by batching plant		X			
			damage to houses and population by road widening		X			
			damage to houses and population by underground works				X	
		Agricultural activities	deterioration of agricultural activities caused by dam, quarries				X	
			deterioration of agricultural activities caused by batching plant		X			
			deterioration of agricultural activities caused by road widening		X			
			deterioration of agricultural activities caused by underground works				X	
		Forestry activities	deterioration of forestry activities by dam, batching plant, road				X	
			access roads	X				
		Fishery activities	deterioration of fishery activities caused by construction works				X	
		Irrigation and drinking water	construction works				X	
		Electricity generation	works				X	
		Water milling	deterioration of milling activities caused by construction works				X	
		Transportation	deterioration of transportation due to widening of road, heavy		X			
		Business	deterioration of business activities due to road widening,		X			
	Physical Environment	Soil and land	land take due to widening of road and batching plant needs		X			
		Local climate, air noise	threats on local climate (temperature, air moisture, wind)				X	
			threats on air from heavy machines and vehicles		X			
			threats by noise induced from heavy machines and vehicles		X			
		Hydrograph	change of flow				X	
		Water quality	change of water quality due to the chemicals and fluids from vehicles		X			
	Biological Environment	Natural vegetation and ecosystems	degradation of natural plants by all construction works				X	
		Endangered and rare animals	threats on natural plants by all construction works				X	
		Fish stocks	degradation of fish stocks by all construction works				X	
Impacts during operation	Socio-economic Environment	Settlements, houses and population	damage to houses and population during operation				X	
		Agricultural activities	deterioration of agricultural activities caused by operation				X	
		Forestry activities	deterioration of forestry activities by operation				X	
		Fishery activities	deterioration of fishery activities caused by operation				X	
		Irrigation and drinking water	deterioration of irrigation and drinking water supply caused by construction works				X	
		Electricity generation	deterioration of electricity generation caused by operation		X			
		Water milling	deterioration of flour milling activities caused by operation		X			
		Transportation	enhancement of transportation due to widened road, better river					X
		Business	enhancement of business due to improved infrastructure					X
	Physical Environment	Soil and land	land take due to submergence of reservoir area				X	
		Local climate, air noise	change of local climate (temperature, air moisture, wind), air and noise				X	
		Hydrograph	change of flow	X				
		Sediment flushing	change of downstream sedimentation mode and damages		X			
		Water quality	change of water quality due to domestic sewage discharge and		X			
	Biological Environment	Natural vegetation	degradation of natural plants by submergence of reservoir				X	
		Animals	threats on reptiles and birds (during hibernation) by first submergence		X			
		Fish stocks	degradation of fish stocks by operation (only little due to lack of important fish)				X	

Note: the assessment in brackets mean moderate adverse significant impacts

ANNEX – 8



LEGEND

- MATTEL ROAD
- TRACK
- DAM AXIS
- TUNNEL
- RIVER
- DRAIN
- BRIDGE, CULVERT
- 700 INDEX CONTOUR (25m)
- 705 INTERMEDIATE CONTOUR (5m)

1:10,000 0 200 400 600 800 1000 m

KEYAL KHWAR HYDEL PROJECT
REVISION OF FEASIBILITY STUDY

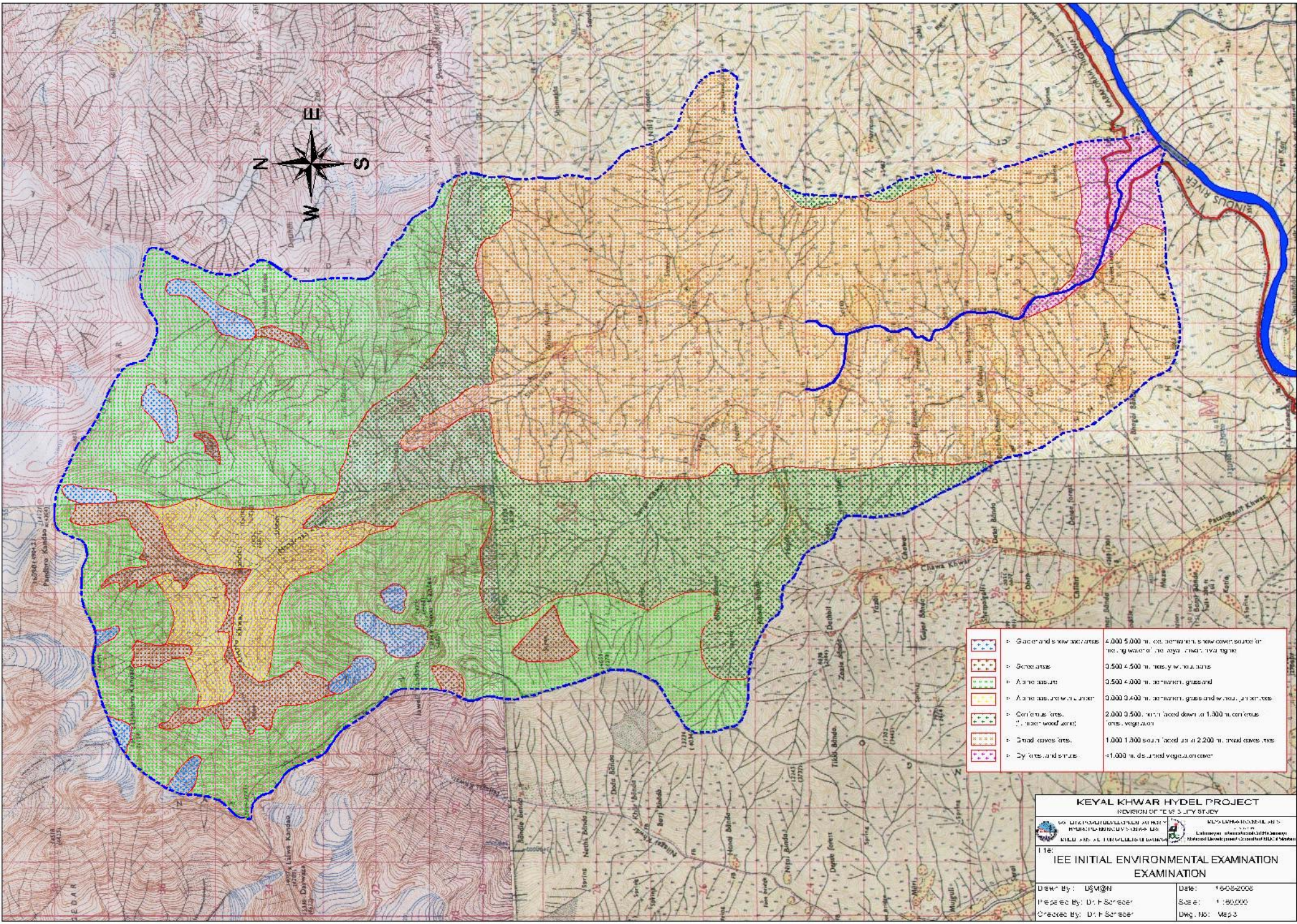
WATER & POWER DEVELOPMENT AUTHORTY
HYDRO PLANNING DIVISION (WATER)
KREDITANSTALT FUR WIEDERAUFBAU (KfW)

KEYAL KHWAR CONSULTANTS
a JV between
Lahmeyer International GmbH (Germany)
National Development Consultant NDC (Pakistan)

Title:
PROJECT LAYOUT

Drawn By : U§M@N	Date: 07-07-2007
Prepared By: R. Gibson	Scale: 1 : 25,000
Checked By: R. Gibson	Dwg. No: KK-SD-II-001

ANNEX – 9


E
N
S
W
INDUS RIVER
Glacier and snow covered areas
4,000-5,000 m. asl, permanent snow cover source for melting water of the Keyal Khwar river regime
Scrub areas
3,500-4,500 m. mostly with scrub
Alpine pasture
3,500-4,000 m. permanent grassland
Alpine pasture with scrub cover
3,000-3,400 m. permanent grassland with scrub cover
Coniferous forest (Chilgoza wood land)
2,000-3,500 m. from wood down to 1,800 m. coniferous forest vegetation
Broad leaves forest
1,000-1,800 m. from wood up to 2,200 m. broad leaves
Dry forest and scrub
<1,000 m. disturbed vegetation cover
KEYAL KHWAR HYDEL PROJECT
REVISION OF FEASIBILITY STUDY
Title:
IEE INITIAL ENVIRONMENTAL EXAMINATION
EXAMINATION
Drawn By: USM@N
Prepared By: Dr. F Sarhadi
Checked By: Dr. F Sarhadi
Date: 16/05/2008
Scale: 1:50,000
Dwg. No: Map 3

ANNEX – 10

Private Assets Compensation

Subject	Description	Quantities			Total in Rupees	Total in Euro
		A	B	C		
houses	widening of road, other construction measures, mostly poor Kacha houses (mud), in Diamer Basha GoP "minimum compensation is Rs 300,000", mean compensation estimated with 400,000 Rupees, A: number of houses, C: Rupees per house	48		400,000	19,200,000	240,000
cultivated land	potentially along road (for widening) per plot: 20 m length, 10 m width totally, A: number of affected plots B: 200 m² for each plot C: Rupees per kanal	18	200	250,000	4,500,000	56,250
fruit trees	trees damaged along road (widening) and while establishment of batching plant: one walnut tree 10 years on one land holding (4.6 kanal land), A: number of trees, C: Rupees per 10 years old fruit trees (walnut)	20		40,000	800,000	10,000
other facilities	shops along the road: in Bandlo Bazar and Bairlo, A: number of shops, C: Rupees per shop	48		60,000	2,880,000	36,000
	generators: privately owned small hydro power generators (purchased, established and operated), A: number of generators, C: Rupees per generator	11		150,000	1,650,000	20,625
	transmission line: estimated 5,000 m transmission line privately owned, A: number of 100 m sections, C: Rupees per 100 m line section	50		5,000	250,000	3,125
	water mills: A: number of mills, C: Rupees per reconstruction of one mill	3		300,000	900,000	11,250
livestock	caused by accidents during construction: A: Number of domestic animals, C: Rupees per animal	20		5,000	100,000	1,250
lost income	lost income from electricity supply to local users, total capacity installed in the valley 16,000 W: A: number of 40 W bulb users, B: number of months, C: Rupees for charge per months	400	6	40	96,000	1,200
	lost of harvest when cultivated land exploited during 3 years: A: number of hectare B: number of years, C: annual lost income from 1 ha	4.7	3	43,200	609,120	7,614
Total					**30,985,120**	**387,314**

Community Assets Compensation

Subject	Description	Quantities			Total in Rupees	Total in Euro
		A	B	C		
irrigation water schemes	adjustment of five irrigation intakes to the lowered water level: A: number of intakes, B: number of working days per unit (5 workers, each five days: 25 days), C: Rupees for daily salary	5	25	250	31,250	391
hydro power generators and transmission lines	SHYDO 225 kW Generator: A: number of generators, C: Rupees for new establishment	1		13,500,000	13,500,000	168,750
public facilities (schools, medical dispensaries, mosques, graves etc.)	school: A: number of schools, C: Rupees for construction of new school	1		4,000,000	4,000,000	50,000
	replacement of concrete footbridge (close to dam site): A: number of footbridge, C: Rupees for construction of footbridge	1		400,000	400,000	5,000
	medical dispensary: A: number of dispensary, C: Rupees for construction/equipment	1		800,000	800,000	10,000
	graves excavation and relocation: A: number of graves, B: number of workers including Imam for excavation and relocation of one grave, C: Rupees per day	50	3	250	37,500	469
	mosque: A: number of mosques, C: Rupees for construction	1		1,300,000	1,300,000	16,250
Total					**20,068,750**	**250,859**

Cost for acquisition and preparation of alternative land

Subject	Description	Quantities			Total in Rupees	Total in Euro
		A	B	C		
land purchase from private owners in the valley for resettlement	land purchase (temporally/permanently) from other land owners for replaced households: A: number of land holdings, B: mean size of land holding in kanal, C: Rupees for one kanal cultivated land	48	4.6	250,000	55,200,000	690,000
land purchase from private owners in the valley for reforestation	land for reforestation (for 2,608 trees): A: number of kanal for reforestation C: Rupees for purchase of barren land per kanal	104.3		50,000	5,215,000	65,188
tree removal	trees to be removed to new locations: A: number of trees to be removed, B: number of workers (5)/machine (in value of 5 workers) per one days, truck (5 workers), C: Rupees per day	200	10	250	500,000	6,250
Site planning costs	Preparation of master planning: A: number of architects/civil engineers, B: number of months, C: Rupees for salary per month	2	2	80,000	320,000	4,000
Total					**61,235,000**	**765,438**

Reforestation/Afforestation

Subject	Description	Quantities			Total in Rupees	Total in Euro
		A	B	C		
reforestation due to loss of forest caused by construction: Forests degraded totally is 13,200 m² (26.1 kanal): a) dumping areas: 8,000 m² b) windows: 200 m² c) 5,000 m²A: Number of trees estimated: 652, (per kanal 25 trees), ratio for reforestation 1:4, Total number of forest trees to be reforested: 2,608.	loss of forest trees due to widening of road, at dam site, quarries, windows for underground water way: A: number kanal to be reforested, B: number of work months for preparation of seedlings, seeding, watering, maintaining of trees for 2 years (20 workers per 104.3 kanal, 24 months C: Rupees per month/worker	104	480	3,000	150,192,000	1,877,400
afforestation of lost natural values: for one case of impact 5 kanal reforestation, 10 cases estimated	trees, valuable bush land, lost habitats of reptiles, birds: A: number of kanal	50	8	3,000	150,000	1,875
Total					**150,342,000**	**1,879,275**

Support of Community Development and Poverty Reduction

Subject	Description	Unit	Quantities			Total in Rupees	Total in Euro
			units	days/others	rate		
Improvement of school facilities and education	beyond new construction of one school other supporting measures including teacher support programmes	lump sum	1		4,000,000	4,000,000	50,000
Improvement of medical facilities in the valley	beyond new construction of one medical dispensary other supporting measures on health such as vaccination of polio, hepatitis, typhus	lump sum	1		800,000	800,000	10,000
Vocational training of local residents	Education/training of local workers (including female) in construction, timber manufacturing, handicraft, recreation: 20 trainings estimated	one training	20		2,000,000	40,000,000	500,000
Support to economic activities: timber manufacturing (furniture), agriculture, handicraft, recreation	purchase of machinery, construction of workshops etc., totally 5 measures	one measure	5		5,000,000	25,000,000	312,500
Support to community development and public participation programme	grant to community/NGO for each affected village (totally 6)	lump sum	6		200,000	1,200,000	15,000
Total						**26,200,000**	**327,500**

Management, administration costs and research

Subject	Description	Quantities			Total in Rupees	Total in Euro
		persons	months	monthly rate		
Cadastral Survey	Personnel for Cadastral Survey: A: number of Revenue Officers, B: number of months, C: Rupees for salary	2	2	80,000	320,000	4,000
Preparation of Resettlement Action Plan	Personnel for Preparation of Resettlement Action Plan: A: number of planners, B: number of months, C: Rupees for salary	2	6	80,000	960,000	12,000
Managing costs for Resettlement Authority	Management Personnel for Resettlement: A: number of officers, B: number of months, C: Rupees for salary	2	36	80,000	5,760,000	72,000
Additional research	Research on plants, animals, fish, flushing, water quality: A: lump sum C: Rupees	1		2,000,000	2,000,000	25,000
Total					**9,040,000**	**113,000**

Grand total of costs

Subject	Total in Rupees	Total in Euro
Private assets	30,985,120	387,314
Communal assts	20,068,750	250,859
Managing costs for Resettlement Authority	61,235,000	765,438
Reforestation/Afforestation	150,342,000	1,879,275
Community Development	26,200,000	327,500
Administration	9,040,000	113,000
Total	**297,870,870**	**3,723,386**