PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

DASU HYDROPOWER PROJECT

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Volume 7: CUMULATIVE AND INDUCED IMPACT ASSESSMENT

General Manager (Hydro) Planning, WAPDA, Sunny View, Lahore, Pakistan

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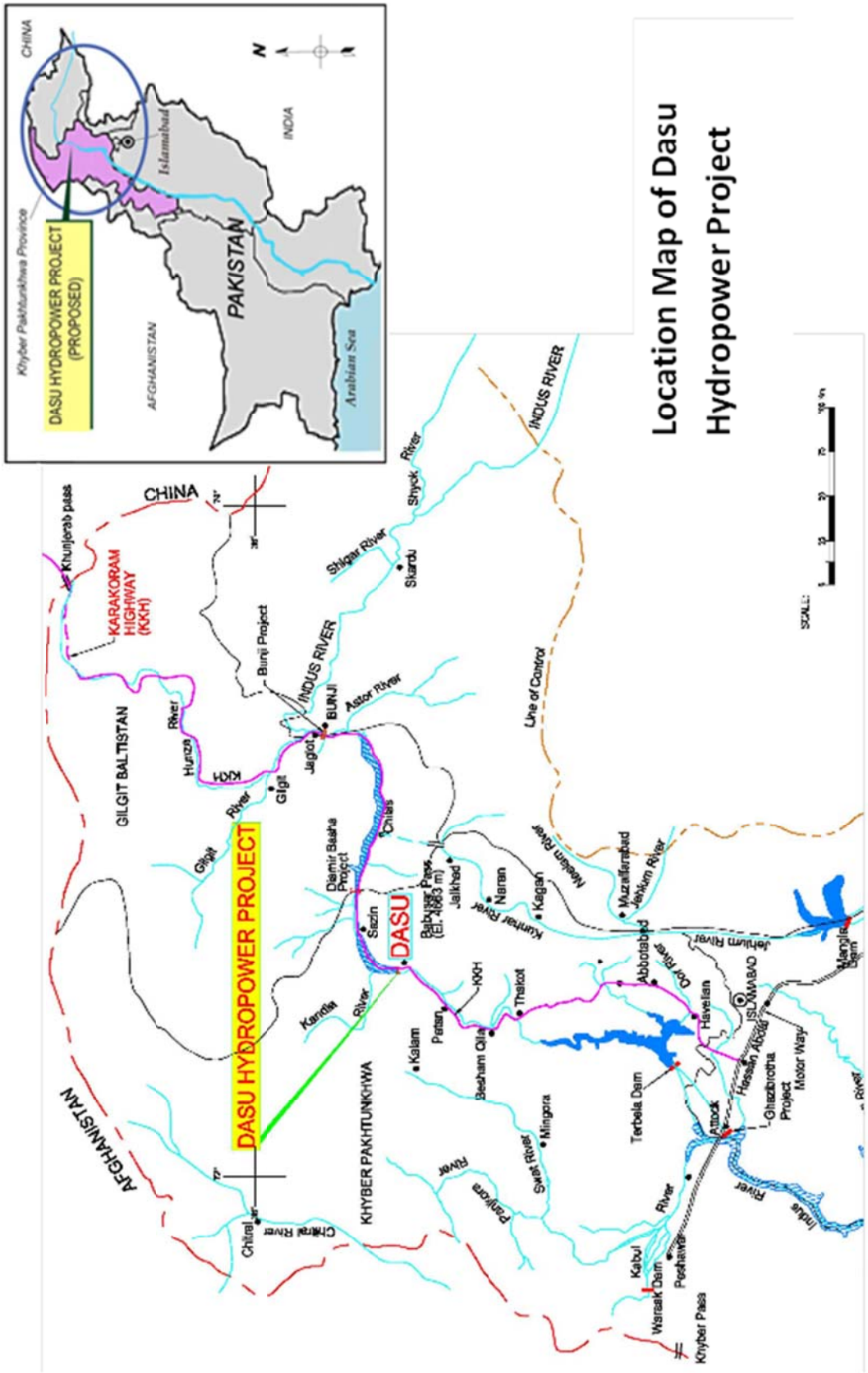
Location Map of Dasu
Hydropower Project
DASU HYDROPOWER PROJECT
(PROPOSED)
PAKISTAN
AFGHANISTAN
INDIA
CHINA
Arabian Sea
Islamabad
Khyber Pakhtunkhwa Province
DASU HYDROPOWER PROJECT
DASU
KARAKORAM HIGHWAY (KKH)
INDUS RIVER
Shigar River
Shyok River
Skardu
Burrii Project
BUNJI
Astor River
Hunza River
Gilgit
Jaglot
Chilas
Diamir Basha Project
Sazin
Babusar Pass (El. 4063 m)
Jalkhad
Naran
Kaghan
Kunhar River
Muzaffarabad
Jehlum River
Mangla Dam
Abbotabad
Dor River
Havelian
ISLAMABAD
Thakot
Besham Qila
Patan
Kalam
Kandia River
Mingora
Swat River
Terbela Dam
Attock
Ghazi Brotha Project
Hasan Abdal
Motor Way
Kabul River
Peshawar
Warsak Dam
Khyber Pass
Chitral
Chitral River
Panjkora River
Indus River
GILGIT BALTISTAN
KHYBER PAKHTUNKHWA
Line of Control
Neelum River
KKH

ENVIRONMENTAL MANAGEMENT ACTION PLAN

Vol 1: Executive Summary

Vol 2: Environmental Impact Assessment

Vol 3: Terrestrial Ecology

Vol 4: Aquatic Ecology

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Vol 7: Cumulative and Induced Impact Assessment

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ABBREVIATIONS

AD	Anno Domini
ADB	Asian Development Bank
ADP	Annual Development Programme
AIS	Air Insulated Substation
AJK	Azad Jammu & Kashmir
AKC	Allai Khwar Consultants
AKRSP	Agha Khan Rural Support Program
AR4	Fourth Assessment Report of IPCC
ARSO	Abaseen Rural Support Organization
BC	Before Christ
BCJV	Bunji Consultants Joint Venture
BCM	Billion Cubic Meter
BDF	Basic Design Flood
BHC	Bunji Hydro Consultants
BHP	Bunji Hydropower Project
BHPP	Bunji Hydropower Project
BP	Bank Procedure
CCRF	Code of Conduct for Responsible Fisheries
CDM	Clean Development Mechanism
CEA/CFFC	Chief Engineering Advisor / Chairman Federal Flood Commission
CESSD	Communication for Effective Social Services Delivery
CFRD	Concrete Face Rockfill Dam
CIIA	Cumulative and Induced Impact Assessment
CITES	Convention on International Trade in Endangered Species
CNA	Capacity Needs Assessment
CPPA	Central Power Purchasing Agency
CRPEA	Contract Register and Power Exchange Administrator
CRS	Catholic Relief Services
CWS	Church World Services
DAO	District Agriculture Officer
DBC	Diamer Basha Consultant
DBD	Daimer Basha Dam
DBDP	Diamer Basha Dam Project
DBHP	Daimer Basha Hydropower Project
DCO	District Coordination Officer
DD	Dasu Dam
DDMA	District Disaster Management Authority
DEPO	District Environment Protection Officer
DFID	Department for International Development
DFO	Divisional Forest Officer
DHP	Dasu Hydropower Project
DIM	District Industries Magistrate
DISCOs	Distribution Companies
DRM	Digital Rights Management
DSO	Dam Safety Organization
DTM	District Transport Magistrate
EA	Environmental Assessment
EAD	Economic Affairs Division

EC	Electrical Conductivity
ECC	Economic Coordination Committee
ECP	Environment Construction Plan
EHV	Extra High Voltage
EIA	Environmental Impact Assessment
El	Elevation above mean sea level
EMMP	Environment Monitoring and Management Plan
EMP	Environment Management Plan
EMS	Environmental Management System
ENERCON	Energy Conservation Centre of Pakistan
EPA	Environmental Protection Agency of Pakistan
ES	Executive Summary
ESIA	Environmental and Social Impact Assessment
FAO	Food and Agriculture Organization (UN)
FFD	Flood Forecasting Division of PMD
FPSP	Flood Protection Sector Project
FRL	Full Reservoir Level
FSL	Full Supply Level
Ft	Feet
g	acceleration due to gravity (taken as 9.81 m/s^2)
GB	Gilgit Baltistan
GBTI	Ghazi Barotha Taraqiati Idara
GCISC	Global Change Impact Studies Centre
GDP	Gross Domestic Product
GENCOs	Generation Companies
GHG	Greenhouse Gas
GIS	Geographical Information System
GLOF	Glacial Lake Outburst Flood
GoP	Government of Pakistan
GT Road	Grand Trunk Road
GTZ	German Technical Cooperation
GWh/a	Gigawatt hour/annum
GWP	Global Water Partnership
ha	hectare = 10,000 m^2
HASH	Heidelberg Academy of Science and Humanities
HEPO	Hydroelectric Planning Organization
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HK	Hindu Kush-Karakoram
HKH	Hindu Kush-Karakoram-Himalayan
Hr	Hour
HVAC	High Voltage Alternating Current
I&P	Irrigation and Power Department
IBIS	Indus Basin Irrigation System
IBP	Indus Basin Project
ICOLD	International Commission of Large Dams
IEE	Initial Environmental Examination
ILRP	Income and Livelihood Restoration Program
INGO	International Non-Governmental Organization
IPCC	Intergovernmental Panel on Climate Change
IPECC	Indonesia – Pakistan Economic and Cultural Cooperation
IPOE	International Panel of Expert
IPPs	Independent Power Producers

IRS	Indus River System
IRSA	Indus River System Authority
ISO	International Standard Organisation
ISWDO	Indus Social Welfare and Development Organization
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated
JICA	Japan International Cooperation Agency
KANA	Kashmir Affairs and Northern Areas
KDO	Karakoram Development Organization
KKH	Karakoram Highway
km²	Square kilometers
KNP	Khunjerab National Park
KP	Khyber Pakhtunkhwa
Kt	Knots (nautical miles per hour)
kV	Kilovolt
kWh	Kilowatt Hours
LLOs	Low Level Outlets
LLTA	Loan Liability Transfer Agreement
M	Million
m	Metre
m²	Square metres
m³	Cubic metres
m³/s	Cubic metres per second (cumecs)
MAF	Million Acre Feet
mg/l	Milligram per litre
mg/m³	Miligram per cubic meter
MINFAL	Ministry of Food Agriculture and Livestock
Mm³	Million cubic meter
MMP	Mitigation Management Plan
MMT	Main Mantle Thrust
MoC	Ministry of Communication of Pakistan
MoCC	Ministry of Climate Change (Environment) of Pakistan
MoH	Ministry of Health of Pakistan
MoI	Ministry of Industries of Pakistan
MoIP	Ministry of Industries & Production of Pakistan
MOL	Minimum Operation Level
MoRA	Ministry of Religious Affairs of Pakistan
MoWP	Ministry of Water and Power of Pakistan
MWh	Megawatt hours
NA	Northern Areas of Pakistan
NADP	Northern Area Development Project
NASSD	Northern Area Strategy for Sustainable Development – IUCN
NATCO	Northern Areas Transport Corporation
NCCW	National Council for Conservation of Wildlife
NCS	National Conservation Strategy
NDMA	National Disaster Management Authority
NDMC	National Disaster Management Commission
NEAP	National Environmental Action Plan
NEOC	National Emergency Operations Centre
NEQS	National Environmental Quality Standards
NESPAK	National Engineering Services Pakistan
NGOs	Non-Governmental Organizations

NIDA	National Integrated Development of Pakistan
NTDC	National Transmission and Dispatch Company
NTFPs	Non-timber Forest Products
O&M	Operation and Maintenance
OP/BP	Operational Policy / Bank Procedure
P&D	Planning and Development
PAD	Provincial Agriculture Department
PAPs	Project Affected Persons
PC	Planning Commission
PCR	Physical and Cultural Resources
PDA	Palas Development Association
PDD	Project Design Document
PDMA	Provincial Disaster Management Authority
PEPA	Pakistan Environmental Protection Act
PEPAC	Pakistan Environmental Planning and Architectural Consultants Limited
PEPC	Pakistan Environmental Protection Council
PEPCO	Pakistan Electric Power Company
PEPO	Pakistan Environmental Protection Ordinance
PESMU	Project environment and social management unit
PFD	Provincial Forest Department
PFI	Pakistan Forest Institute
PKR	Pakistani rupees
PM	Project Management
PMD	Pakistan Meteorological Department
PMF	Probable Maximum Flood
PMNH	Pakistan Museum of Natural History
PO	Plan Objective
PoE	Panel of Experts
PPIB	Private Power Infrastructure Board, GoP
Ppm	Parts per million (same as mg/l)
PRO	Project Resettlement Office
PS	Performance Standards
PTD	Provincial Transport Department
PTDC	Pakistan Tourism Development Corporation
PWD	Public Works Department of Gilgit Baltistan
QMMB	Quid-i-Azam Mazar Management Board
R&D	Research and Development
RADO	Rural Area Development Organization
RAP	Resettlement Action Plan
RCC	Roller Compacted Concrete
RIM	Remote Inflow Measurements
SADO	Social Awareness and Development Organization
SAR	Sodium Adsorption Ratio
SCF	Safety Check Flood
SDF	Social Development Fund
SDF	Salik Development Foundation
SHYDO	Sarhad Hydel Development Organization
SMO	Scarp Monitoring Organization
SPCS	Sarhad Provincial Conservation Strategy
SRSP	Sarhad Rural Support Program
SSESA	Strategic / Sectoral Environmental and Social Assessment of Indus Basin
STIs	Sexually Transmitted Infections

SVP	Sutlej Valley Project
SWDO	Indus Social Welfare and Development Organization
SWH	Surface Water Hydrology
T4HP	Tarbela-IV Hydropower Project
TDP	Tarbela Dam Project
TDS	Total Dissolved Solids
ToR	Terms of Reference
UIB	Upper River Indus Basin
UK	United Kingdom
UNCED	United Nations Conference on Environment and Development
UNDP	United National Development Program
UNEP	United National Environment Program
UU	Unreported and Unregulated
VECs	Vocational Training Centres
VHF	Very High Frequency
WAA	Water Apportionment Accord (1991)
WAPDA	Pakistan Water and Power Development Authority
WASA	Water and Sanitation Authority
WASO	Water and Sanitation Officer
WB	World Bank
WCAP	Water Sector Capacity Building and Advisory Services Project
WCD	World Commission on dams
WEC	WAPDA Environmental Cell
WHO	World Health Organization
WWF	World Wildlife Fund
ZSD	Zoological Survey Department

Volume 7
CUMULATIVE AND INDUCED IMPACT ASSESSMENT

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EXECUTIVE SUMMARY

Objective

Dasu Hydropower Project (DHP) is one of several hydropower projects planned in Upper Indus Basin (UIB) as part of Pakistan Water and Power Development Authority (WAPDA) Vision 2025. DHP in combination with other proposed hydropower and storage projects has potential to cause significant cumulative and induced impacts on physical, ecological and social resources in the UIB. This cumulative and induced impact assessment (CIIA) examines the incremental environmental/ecological impacts of hydropower projects and storage development in the UIB between 2013-2022 in relation to DHP, including potential effects on biodiversity and ecological integrity of the riverine ecosystem and surrounding areas, environmental vulnerability of the river system and water availability for agriculture and other uses in the system. The CIIA is a step beyond the EIA (Volume 2), as it incorporates an integrated approach to assess the incremental impacts due to developments in hydropower projects including DHP over the next 10 years.

DHP is a run-of-river project planned for development on the Indus River near Dasu, Kohistan district of Khyber Pakhtunkhwa (KP) province, located about 350 km north of Islamabad. DHP will be comprised of a 242 m high concrete gravity dam and 74 km long reservoir behind the dam. The reservoir will have average width of 365 m and, at full supply level (FSL) of elevation 950 m, an area of about 24 km^2. The project will have an underground powerhouse housing 12 turbines, each of which will produce 360 MW power, and a total maximum capacity to produce 4320 MW.

The current study was prepared over approximately two months as the project EIA was being finalized, by a two-member core-team supported by specialists drawn from the Project Design Team (hydrologist), Environmental Impact Assessment team (forestry and biodiversity) and parallel Social Impact Assessment team (social specialist). The study was undertaken over a short time-period in order to meet decision-making deadlines of WAPDA and World Bank, as part of the Bank funding-approval process. A comprehensive study under Water Sector Capacity Building and Advisory Services Project (WCAP) has been planned on Strategic/Sectoral Environmental and Social Assessment of the Indus Basin (SSESA). In the absence of the SSESA the CIIA is intended to provide an indicative and framework assessment of potential cumulative and induced impacts of DHP in the UIB.

Assessment Scope and Assessment

The CIIA has followed basic EIA steps: scoping of spatial and temporal boundaries and valued environmental components; identification of baseline conditions; assessment of potential effects; identification of mitigation measures and assessment of significance; identification of summary recommendations and follow-up information needs. Two types of impact are considered:

- Incremental effects of DHP on the type and magnitude of other (recent and future) developments in the area – Incremental project impacts.
- Effects of development in other sectors that are induced by DHP activities and components - Induced impacts.

Also two development scenarios are assessed: Scenario A reflects hydropower development as ‘business as usual’; and, Scenario B reflects hydropower development ‘best practices’.

The geographical area of the CIIA is the Indus River basin between the Pakistan-India line of control and Tarbela Dam (Tarbela catchment area in Pakistan). The CIIA

examines recent development trends and the existing condition of the basin, and potential impacts over the next 10 years (2013-2022).

Broad topics considered to be important at the outset and itemized in the Terms of Reference are: i) water-hydrology, water use and quality; ii) vulnerability to flooding, flood management aspects; iii) forestry and bio-diversity; iv) agriculture and livelihood; v) social issues (i.e., involuntary resettlement, loss of income, ethnic minorities, cultural impacts considering religious and cultural values associated with Indus and health risks including risk of HIV/AIDS); vi) fisheries; transport; vii) water supply and irrigation; vii) urban development; viii) power transmission and industry; ix) institutional issues and capacity.

External issues such as climate change that are having important effects on basin development also are addressed.

CIIA key issues were the topic of review at the final two of four public consultation workshops held as part of the DHP ESIA process (Karachi and Islamabad). Recommendations brought forward during stakeholder consultations in specific reference to CIIA were used to guide the CIIA.

Baseline conditions were identified based on information available from secondary sources. Existing conditions, trends in sector developments and environmental issues and anticipated future-state conditions (2022 and beyond) were examined; for the latter policies and strategic planning documents were reviewed and used to aid interpretation of likely future conditions.

Impact analyses considered incremental addition of effects of DHP on important ecological/environmental, social and economic components in the UIB to effects of other projects/actions in the basin. Analyses examined trends of those components and potential effects of anticipated future hydropower projects/actions planned for implementation by 2022, and potential effects induced by planned hydropower and storage development in relation to DHP.

Incremental effects of DHP were assessed for two development scenarios: Scenario A – ‘business as usual’; and Scenario B – ‘best practices’. For best practice context, considered input from stakeholder workshops, documented guidance from institutions such as the World Bank Group which identify considerations for broader hydropower development goals (World Bank 2007): Responsible environmental management; Poverty alleviation and sustainable development; Integrated water and energy management; Institutional development. Further, at project level, best practices apply to the array of individual issues that are specific to each project. The CIIA has considered ‘Best’ and ‘Good’ practice elements presented in the Hydropower Sustainability Assessment Protocol (International Hydropower Association 2010).

To the extent practicable risks to important environmental, social and economic components were assessed for the two development scenarios considering the pattern and level of development.

Given variability in environmental, social and economic components along the Indus River, potential impacts were assessed within three zones (Figure ES.1), governed mainly by biophysical variations (e.g., Tarbela Reservoir differs from most of the remainder of the basin; the upper portion of GB is at higher elevation and has lower flows than the Indus River in lower portions of the study area).

Administrative and legal Framework

Detailed information on the legal and policy framework in Pakistan for environmental assessment and World Bank policies for environmental assessment are given in Section 2 of Volume 2: EIA. A summary of these frameworks, including assessment of cumulative impacts, is provided in this section.

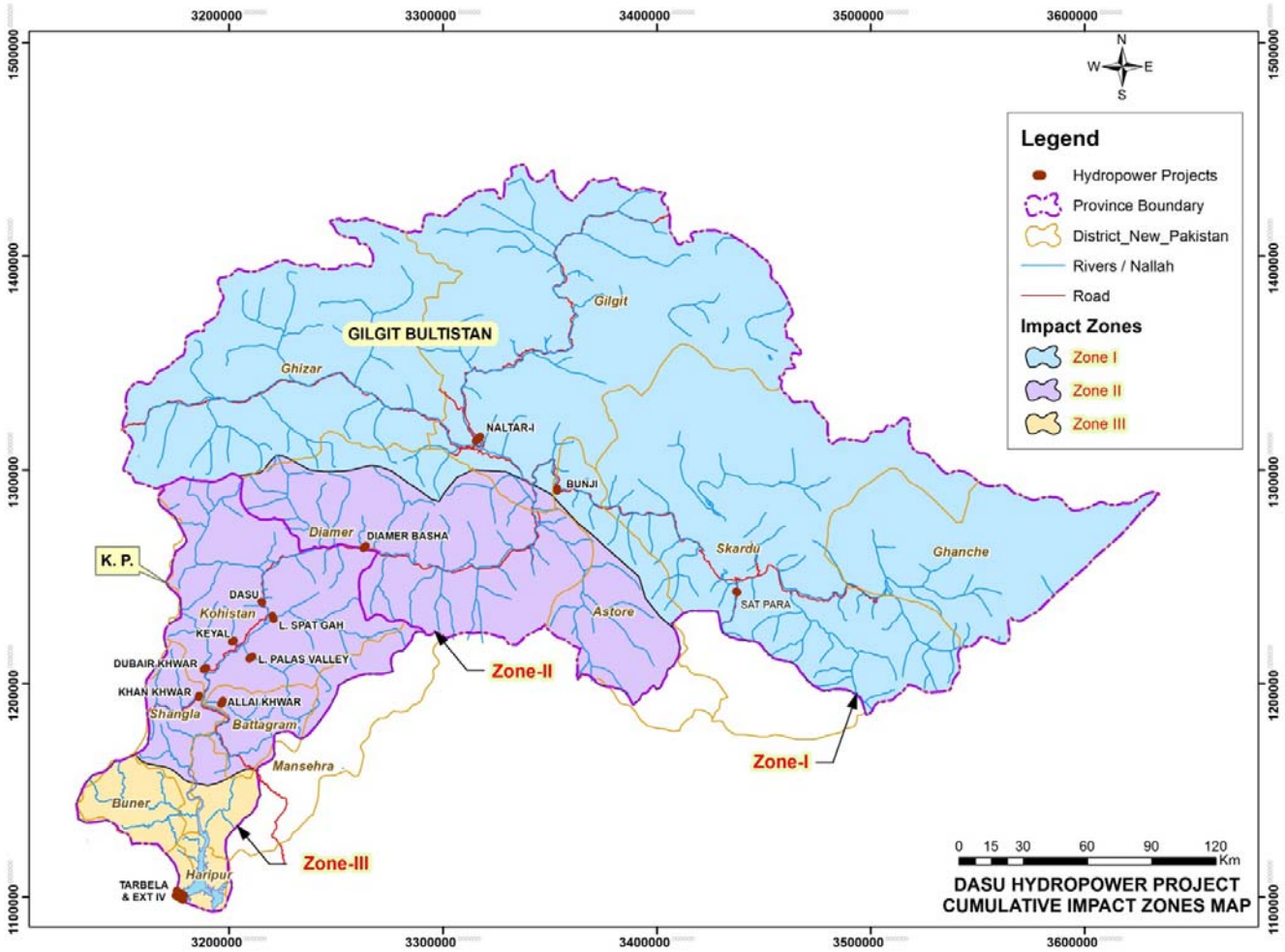


Figure ES.1: Cumulative Imapct Assessment Study Area and Zones

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help and ensure that those are environmentally sound and sustainable, thus to improve decision making. OP/BP 4.01 Environmental Assessment provides the framework for World Bank environmental safeguard policies and describes requirements for environmental assessment, including in relation to cumulative impacts, particularly in relation to sectoral and regional EA. World Bank Group expectations for assessment of cumulative impacts of individual projects are outlined in International Finance Corporation (World Bank Group) Performance Standard (PS 1); assessment of project environmental and social risks and impacts must encompass ccumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

Hydropower Projects

The proposed hydropower projects expected to be implemented up to 2022 are listed in **Error! Reference source not found.** indicating status: i) existing / in operation; ii) under construction; iii) ready for implementation; and, iv) detailed engineering design and tender documents in hand. A description of each project is presented in Appendix 4.2.

Table ES.1: Hydropower Development Plan in Upper Indus Basin (up to 2022)

Sr. No.	Name of Project	River	Location (District)	Storage (MAF)	Installed Capacity (MW)	Expected Completion Date
IMPACT ZONE – I						
1.	Satpara*	Indus	Skardu	RoR	17	2012
2.	Bunji****	Indus	Astore	RoR	7100	2022
3.	Naltar*	Naltar	Gilgit		27	2012
IMPACT ZONE – II						
4.	Diamer Basha*** (KP+GB)	Indus	Diamer / Kohistan	8.10	4500	2020-21
5.	Dasu*** (KP+GB)	Indus	Kohistan / Diamer	RoR (0.67)	4320	2019
6.	Keyal Khawar****	Indus	Besham	RoR	122	2016
7.	Dubair Khawar**	Indus	Besham		130	April, 2013
8.	Khan Khawar*	Indus	Besham		72	2011
9.	Allai Khawar*	Indus	Besham		121	Oct. 2012
10.	Lower Spat Gah****	Indus	Kohistan	RoR	496	2017
11.	Lower Palas Valley****	Indus	Kohistan	RoR	665	2017
IMPACT ZONE – III						
12.	Tarbela*	Indus	Tabela	7.00	3478	1976
13.	Tarbela Ext-IV***	Indus	Topi	-	1410	2019
			Total	**15.77**	**18743 (Additional)**	

Status: * Existing / in Operation (3,715 MW) **** Under Construction (130 MW)
******* Ready for Construction (10,230 MW) ******** Detailed Engineering Design and Tender Documents in hand (8383 MW)

Baseline Conditions

Baseline conditions in the CIIA study area are summarized in Table ES.2.

Table ES.2. Summary of Baseline Conditions in the UIB

Hydrology: The Indus river originates from a spring called Singikabad near Mansarowar Lake on the north side of the Great Himalayan range in Kailash mountain in Tibet at an altitude of 5,494m asl. The river flows south towards the Arabian Sea, linking two large natural water reservoirs, the snow and glaciers in the mountains and groundwater contained in the alluvium of the Indus Plain of Sindh and Punjab provinces.

Floods: Flooding in rivers is generally caused by heavy concentrated rainfall in the catchments during the monsoon season, which is sometimes augmented by snowmelt flows. However, exceptionally high floods have occasionally been caused by the formation of temporary natural dams by landslides or glacier movement and their subsequent collapse. Flooding of the major rivers causes human and financial losses by inundating areas along their banks, by damaging irrigation and communication facilities across or adjacent to their banks, and by erosion of land along the riverbanks.

Climate change: the projected temperature increases in 2080s in Northern and Southern Pakistan are 4.67°C based on IPCC AR4 2007, the glacier melting in the Himalayas is expected to increase flooding of Indus and its tributaries for the next two to three decades which will be followed by decreased river flows as the glaciers recede.

Sedimentation: The sediments in the river water are comprised of suspended solid and moving bed load. The Indus River carries heavy sediment load due to the ruggedness of catchment terrains and lack of vegetation cover in the catchment.

Water quality: Water quality, in general, is in compliance with National Environmental Quality Standards (NEQS) on environmental outlay.

Water Use: Irrigated agriculture is the dominant user of Indus river tributaries. Other important uses are Municipal, Industry and environmental

Biodiversity: The Indus Basin contains a very diverse and highly enriched ecosystem GB and KP harbor some of the richest plant communities in the Indus Basin region.

Agriculture: The KP and GB provinces possess 14.79 million hectares of land, of which the cultivable area is 2.75 million hectares. Out of cultivable area only 1.8 million hectares are cultivated mostly in KP. An estimate of the present land use of GB is only 1% of cultivable area.

Forestry: The northern Pakistan's natural forests are amongst the most important forests in Pakistan. They play a vital role in protecting the watershed of the Indus River; support a rich diversity of flora and fauna; serve as an important source of forage and pasture for the livestock population; contribute to the national supply of softwood; provide critical supplies of timber and firewood to local communities; supply an important array of non-timber forest products (NTFPs), including medicinal plants, spices, honey and mushrooms; and have tremendous potential for recreation and the development of ecotourism.

Fisheries: Areas upstream of Tarbela Reservoir are characterized by mainly small-scale fish capture of riverine cold water fish species (principally snow carp) by communities to supplement domestic protein consumption and for occasional sale to local purchasers. Tarbela Reservoir has an organized contract-based fishery managed by the KP government and focused on mainly warm waters fish species (principally introduced carp species) in the southern portion of the reservoir.

Transport: The Karakoram Highway (KKH) connects Islamabad to China, Gilgit and Skardu. Northern Areas. At present 2590 vehicles are passing every day.

Urban development: Urban development trends in the local context are concerned with population increase, mainly due to in-migration from rural areas or from outside of the Project area to the towns: Dasu/Komila 6,992; Besham 57,739; Chilas 28,953.

Along with urbanisation come the challenges of town planning, water supply and sanitation.

Industry: There exist a few wood industries in the area. These wood industries prepare small wood logs and stock the timber in lots. Industry as a sector is concentrated in towns, where there are a number of light industries established. Wood processing is the most important industry in Khyber Pakhtunkhwa and Gigit Baltistan Provinces. Potential industries

being developed are textiles, canning and construction materials.

Power Transmission: a majority of residents of the districts of all three zones are connected with power through the national grid system and/or micro hydel.

Social Development Livelihoods – mainly agriculture and livestock based. Poverty incidence and trends in KP show 44% rural population living below poverty line, and declining job opportunities and a range of natural resource problems. In Diamer area-of-influence, the main tribes are local and non-local tribes. Local tribes are Sheen and Yashkun while, non-local tribes are Soniwals, Kohistani, Kashmiri, Gujar, Pattan, and Swati. In Dasu area-of-influence, the major tribes in the area are Afghan; Gujar/Ajar; Syed; Main and Qureshi while in Battagram area most of inhabitants are Swati. The health facilities are limited in the study area. People are compelled to go to Abbottabad and Rawalpindi to avail medical facilities. The health services are extremely poor due to the lack of medical facilities and doctors, in particular female doctors in all districts of three zones, and often partly functional or totally closed due to various reasons. Gender issues are gaining importance in development projects because female members of the community are generally neglected while designing, assessing and implementing such projects. Females are generally more vulnerable than male members of the society and the Project is no exception to this.

Rock Carvings: About 30,000 petroglyphs and 5,000 inscriptions, spread over 30 sites stretching over 100 km from Shatial to the Raikot Bridge are located in the study area. This is one of the world's largest and impressive complexes of rock art, which date from 5,000 BC to 8th Century AD.

Impact Assessment

DHP will contribute incrementally to effects of other existing and planned hydropower projects in the UIB; potential cumulative and induced impacts are summarized in Table ES.3. Sector or topic specific best practices identified during assessment of potential cumulative and induced impacts are summarized in Table ES.4.

Table ES.3: Summary of Potential Cumulative and Induced Impacts

Sr. No.	Potential Impacts
1.	**River Hydrology and Water Quality** ***Hydrology:*** Total annual flow at Tarbela is 78.92 BCM. About 19.77 BCM of water (25%) will be retained in the reservoirs of the proposed projects (including the existing Tarbela). Operation of reservoirs (storage and release of water from reservoirs, either for irrigational purposes at Basha or peaking operations at Dasu) will alter the natural flow pattern. Presently high flows in Indus occur in summer and low flows occur in winter season. Downstream of Tarbela, a considerable increase of 42 % can be seen in low flow season for scenario 2 and 3 (Table 6.2) when storage capacity of Basha is released into the system. With Basha, flows between Dasu and Tarbela will not change considerably due to possible peaking operation and overall effect will be negligible. However, during peaking a few hours surge will occur. No flow change is anticipated between Basha and Tarbela during regular operation. ***Floods:*** Storage of water in the reservoirs will attenuate the floods and save the downstream communities properties and lives. GLOFs are a serious threat and these are to be better managed to protect the hydropower infrastructure and community. Currently there is no early flood warning telemetry network available on the upstream of Dasu. In 2010 there was a huge landslide in the Hunza Valley, which blocked Hunza River and eroded away a considerable length of Karakoram Highway (KKH) near Attabad and also created a lake. Efforts are in progress to lower down the water level. With conjunctive operation of Tarbela, Diamer Basha and Dasu reservoirs, combined flood regulating capability of these dams will significantly increase. For individual 10-daily flows it was assessed that a maximum of about 60% reduction could be expected downstream of Tarbela. ***Water quality:*** Degradation of downstream of the dams is expected to increase

Sr. No.	Potential Impacts
	due to release of sediment free water (sediment laden water has less potential for erosion). Water quality in the reservoirs is going to change due to thermal stratification and dissolved oxygen content in the lower parts of the reservoir. The water released from the reservoirs will be an altered water quality due to changes in temperature, oxygen and sediment content. The river water quality relatively remains in permissible limits even in low flows in river Indus (Kotri Barrage). ***Sedimentation*:** Annually reservoir entrapment of sediment will be significant. Sediment trap efficiency values calculated for DHP were approximately 60 %. Life of Tarbela will be increased by 50 years due to retention of sediments in Dasu (15 years) and Basha (35 years).
2.	**Water Use** Downstream of Tarbela, there will be increased water availability during the low flow season and transition period of Early Kharif. The enhanced supplies downstream of Tarbela reservoir, in tandem operation with Basha and Dasu reservoirs, in low flow period is expected to increase irrigation supplies by 14% on average. Upstream of Tarbela, community drinking water and irrigation supplies are expected not to be affected since they are drawn mainly from tributaries, but may be affected by smaller tributary projects.
3.	**Biodiversity** DHP will contribute to change in aquatic habitat. Reservoirs will convert riverine ecosystems to lake-like ecosystems; segments of the Indus River and tributaries downstream of each dam will be subject to altered flows and water quality. DHP is not anticipated to have direct impacts on the forests and other terrestrial biodiversity. Most wildlife in DHP area is out of project footprints and is situated in the higher altitudes away from human settlements and the Indus river; poaching and illegal trapping of wild animals such as Musk deer, Markhor and various migratory bird species refuging in these mountainous habitats may increase. Indirect negative effects could result from habitat loss, increased access along new corridors and access roads to wildlife habitat and wilderness areas. Development of transmission lines will have a potential impact on the migratory birds due to collision and electrocution. There is a potential of natural intrusion in to natural habitat and exploitation of flora and fauna due to relocation of 150 km of KKH into higher elevations; and construction workers. Reservoirs are expected to increase the population of migratory birds as they serve as artificial staging grounds.
4.	**Agriculture** About 1388 ha of agriculture land will be affected (excluding Tarbela, which affected 17,300 ha of land) due to all the projects. 1220 ha of acquisition occurs from Basha and Dasu. Irrigation supplies on the downstream of Tarbela will increase by 14%.
5.	**Forestry** Mega hydropower projects including DHP are expected to affect community fuel-wood selling activities and through induced urban and industrial growth would increase demand for local wood products.
6.	**Fisheries** Existing and proposed hydropower projects have potential to adversely affect snow carp and other fish species and fishing activity. There is risk that DHP incrementally will contribute to reduction in population sizes of snow carp and other fish species and amounts of fish caught by local fishermen. There will potential effect on aquatic habitat due to submergence of river on the upstream and the release of altered water quality on downstream. Fish movement on the mainstream Indus will be disturbed.

Sr. No.	Potential Impacts
	Fish movement from the tributaries to Indus is common during low flow season in winter. Due to release of high water flows from reservoirs in winter, there will be a potential effect on the fish movement patterns between tributaries and the Indus. This will also affect the availability of fish for local consumption. Risks to fish habitat will increase as a result of project-induced increases on urban development, agriculture, transport, forestry and industrial activity. Project-induced increases in human populations, especially during the construction stage will increase demand for fish and pressure on fish stocks. Reservoir fisheries development is possible in the larger reservoirs.
7.	**Transport** Construction of the large dams is expected to create a substantial increase in construction-related traffic and realignment of portions of the KKH. Current heavy vehicles traffic on KKH is about 400 daily. About 1200 vehicles (200-300 for Dasu and 900-1000 for Basha) will use KKH during construction. This increase in heavy vehicle traffic on KKH is expected to cause traffic congestion, safety hazards, air and noise pollution. Besides this gradual increase in local traffic will also occur due to economic development in the region.
8.	**Urban Development** As with DHP, other hydropower developments, particularly larger ones such as Basha and Bunji, likely will lead to "boom town" development in nearby communities, at least over the construction stages. Overlap in construction timing could lead to large population influxes at multiple locations along the Indus River. Large scale urban development is expected around the hydropower projects due to employment and business opportunities. This may create changes in the existing land use, mostly conversion of existing farm land into residential and commercial area. This will also lead to accelerated and unplanned urban development as seen from the development of urban areas like Haripur after Tarbela Dam Project.
9.	**Power Transmission** Environmental assessment has not yet been undertaken for the Basha power transmission line or completed for DHP. Environmental and social issues include: i) health and biological impacts due to electro-magnetic fields; ii) loss to scenic beauty; iii) collision and electrocution of migratory birds; iv) loss of agricultural land; v) life safety issues; and vi) avalanche damage to the poles. Indus valley is a narrow gorge with limited place for development. There are already 2 existing transmission lines (132 KV and 220 KV) along Indus valley on the downstream of Pattan. There will be two transmission lines of 500 KV for Dasu along Indus up to Manshera (and then to Islamabad). There will be one more transmission line for Basha (765 KV) probably along Indus on the same narrow corridor.
10.	**Industry** Potential environmental and social effects will be associated with the types and size of industries that expand or are newly attracted to project-affected areas. Local industrial growth has potential to affect water demand, water quality, air quality, ecological services and resource use activities such as fishing and social factors such as workers and community health.
11.	**Resettlement, Livelihoods and Income** Cumulatively, substantial land acquisition and resettlement will be required. DHP will require relocation of 6,953 people. Already 96,000 people were relocated for Tarbela. Another 50,000 people are expected to be relocated by Bunji and Basha. There are still about 400 unresolved court cases on compensation for Tarbela. Relocation of people will often lead to adverse impacts on their livelihood. Large presence of immigrant workforce will lead to community related impacts. In both near and long-term, considerable development is anticipated in and will benefit local populations and improve their income and standards of living significantly.

Sr. No.	Potential Impacts
12.	**Other Social Effects** ***Population Growth:*** Population booms are expected during construction, for example Diamer Basha Dam is a mega project and an estimated 11,000 people will be hired for the construction activities for the period of 10 years. Some in-migrants will possibly permanently settle in the areas. ***Health:*** At present the health facilities in the project area area is are not adequate. It is anticipated that the health conditions in project-affected communities might deteriorate. ***Ethnic Minorities:*** Ethnic minorities like Soniwal in the DHP and Basha project areas likely will be severely affected due to reservoir inundation as they will have to shift themselves to new places for their livelihood. ***Social Disparity:*** The presence of construction workers with rather good salaries and other habits than the local population, and their followers, as well as easier access, may cause a change of attitude and behavior regarding alcohol and substance abuse. The long-term outlook appears beneficial to the communities affected.
13.	***Rock Carvings:*** The rock art complex in KP and GB, which is spread over 100 km distance from Shatial to Raikot, consists of more than 30,000 petroglyphs. Most of them will be flooded by the proposed reservoir of the Diamer-Basha dam. The natural weathering process and vandalism are threats to the rock carvings. The potential for vandalism may increase due to increase of traffic along KKH due to construction traffic of the Project.

Table ES.4: Summary of best practices for each sector or topic assessed

Sector/Topic	Recommended Best Practices
Hydrology and Water Quality	Comprehensive examination of downstream flow changes (including both minimum flows and surge flows) resulting from all existing/planned main-stem and tributary hydropower and storage projects and opportunities to coordinate operational releases to minimize potential combined effects of flow and water quality changes on in-stream and riparian resources and human activities. Presently the flood management through reservoirs in Pakistan is limited to the safety of the dam structures and does not include specified provision to attenuate in-coming flood peak. Inclusion of this aspect in the Operation Manual would improve current practice. Glacier monitoring program and establishment of flood telemetry network is required for management of GLOFs.
Water Use	Put in place broad-area processes to anticipate and respond to emerging risks and opportunities related to water use especially in Zone 2 and, engagement with potentially affected stakeholders in upper basin areas in an inclusive and participatory manner with thorough and timely feedback on water use issues.
Biodiversity	Principles of responsible environmental stewardship; integrated resource management, poverty alleviation and institutional capacity development. In the current circumstances; the overall leadership of one institution such as WAPDA. Capacity of resource agencies, such as forest and fisheries departments, is low with respect to natural resource management and would need enhanced capacity and institutional resources to meet expectations of integrated resource management and community up-gradation along with responsible energy development. A commission or team should be considered to plan and execute a robust natural

Sector/Topic	Recommended Best Practices
	resource management strategy. Consistent involvement and interest of all sectors of local communities/ stakeholders. Apart from the role of forests and fisheries departments, an improved role will have to be played by the WEC and its associated agencies.
Agriculture	Put in place broad-area processes: to reduce risks associated with potential cumulative and induced encroachment on agricultural land and effects of agricultural practices (including possible increased use of pesticides); and, anticipate and respond to emerging issues and opportunities related to agriculture especially in Zone 2. Engage directly stakeholders in the broadly affected areas, possibly including representation of adjacent districts and provinces, in an inclusive and participatory manner with thorough and timely feedback on agriculture issues. The downstream Tarbela agriculture supplies will enhance to overcome water shortages and more area under cultivation.
Forestry	Principles of responsible environmental stewardship; integrated resource management, poverty alleviation and institutional capacity development should be adopted preferably under the overall leadership of one institution such as WAPDA. Capacity of forest departments is low in natural resource management; and would need enhanced capacity and institutional resources to meet expectations of integrated resource management and community up-gradation. Ideally, the natural resource management elements of hydropower project development should be guided by formation of a commission to plan and execute a basin natural resource management strategy. This would require a consistent involvement and interest of all forestry-sector stakeholders. Apart from the role of forest departments, WEC and its associated agencies would require an improved role and capacity.
Urban Development	Work with affected districts and communities within their broader community planning frameworks as they apply to urban and economic development, and including integrated mechanisms for sharing project benefits and anticipating and managing induced environmental/ecological and social effects; this may require provision of financial and technical support to agencies responsible for community and economic planning and engagement of stakeholders on a multi-district basis where multiple projects exist or are planned in close proximity (e.g., Zone 2).
Power Transmission	Basin-wide assessment of corridors and routes; and, putting in place processes to anticipate and respond to emerging risks and opportunities related to power transmission issues and induced development, especially where hydropower projects are concentrated. Broad-area engagement of affected stakeholders in an inclusive and participatory manner, with thorough and timely feedback on issues related to power transmission including induced effects. Design of transmission lines should consider morphometric features of the large birds, behavior of birds and electromagnetic radiations from the transmission lines.
Fisheries	Support development and implementation of an integrated basin-wide framework to assist assessment and management of wild-capture

Sector/Topic	Recommended Best Practices
	fisheries, including identification of long-term strategies to assist fisheries management institutions to address potential effects of multiple hydropower developments in their jurisdictions and engage community stakeholders (especially in Zone 2, where hydropower projects are concentrated). Define and support capacity-building in fisheries management institutions to strengthen capabilities related to both fisheries ecology and management. Support community/stakeholder-awareness programmes that highlight: interaction between hydropower facilities and fisheries resources; life cycle needs/habitat and protection requirements of fish species in the upper Indus River basin; good practices and opportunities for capture-fisheries in the basin area. Support broad-area inventory and analysis of ecological components and fishing activities based on a long-term perspective and, within the basin-wide framework, identification of high priority needs to enable assessment of planned hydropower development over the next 10 years and projects under consideration beyond 10 years.
Transport	Put in place processes: to reduce transport related risks, including traffic safety issues and induced effect of increased roads and traffic on other environmental/social components; and, anticipate and respond to emerging risks and opportunities related to traffic and other transport issues especially for locations where hydropower projects are in close proximity (e.g., Zone 2). Engage directly affected stakeholders over a broadly affected area in an inclusive and participatory manner, with thorough and timely feedback on transport-related issues.
Industry	Put in place processes to anticipate and respond to emerging risks and opportunities associated with growth of local industries. Engage directly affected stakeholders in more than one jurisdiction to ensure environmental and social safeguards are adequately anticipated and applied, and with thorough and timely feedback on issues related to industry growth. Integrate with community development and economic planning initiatives.
Resettlement, Livelihoods and Incomes	A Social Development Fund (SDF) has been recommended for establishment by DHP to support the long-term livelihood development activities. During the operation of the DHP it is expected that SDF will receive funds from the benefit sharing mechanism proposed for the project. This concept could be broadened to incorporate and coordinate long-term livelihood development activities on a basin or sub-basin basis, particularly in Zone 2 (where a cluster of hydropower projects are located) over the near term. Engage economic planning agencies and community stakeholders in planning and execution of community development activities within a framework integrating provincial/district policies, community aspirations and hydropower project compensation and benefit sharing.
Other Social Effects	Put in place broad-area processes, in addition to initial project-specific mitigation and compensation planning, to anticipate and respond to emerging risks and opportunities related to social issues especially in Zone 2 where two large projects have overlapping areas-of-influence (Diamer Basha, and DHP). This would include: coordinated engagement with directly affected stakeholders in

Sector/Topic	Recommended Best Practices
	overlapping affected areas in an inclusive and participatory manner with thorough and timely feedback on social issues; and, adequate planning to ensure increased demands, especially near-term during construction, are met for factors such as power, food supplies and transport/infrastructure.
Rock Carvings	A museum will be established at Chilas, by Diamer Basha Dam Project, to relocate the Rock carvings (if feasible) that will be submerged by Basha project. 3D replica models for all submerged carvings will also be placed in the museum The development and security of the Shatial site is more important as it will be the only site portraying the original and authentic specimens of rock art in the face of the fact that all such petroglyphs at the Basha Dam would be submerged in water leaving no trace of genuine antiquity at that site.

Summary of Recommendations

A recommended best practice mechanism to reduce risks of cumulative and induced impacts of DHP and other hydropower and storage projects on affected environmental/social components is to undertake coordinated and integrated basin-wide research, mitigation-measure development, and monitoring by means of a single coordinating body. Consideration should be given to:

i. development of guidelines on best practices that will be applied to hydropower and storage projects basin-wide and will be developed through stakeholder engagement

ii. following best practices approach in planning and design of future hydropower projects and associated facilities such as transmission lines, quarry sites, etc.

iii. formation of an upper-basin impact management/compensation program similar to such basin-management programs elsewhere where multiple hydropower and storage development exists;

iv. consultations with affected community and relevant stakeholders for planning and design of future project facilities;

v. creation of a steering committee or board to guide design and execution of the program environmental and social effects-management activities, in concept comprised of WAPDA, government regulatory and resource management agencies, and representatives of affected communities;

vi. development of a broad-area monitoring and adaptive management framework to be applied to hydropower and storage development in the upper-basin;

vii. development of guidelines on best practices that will be applied to hydropower and storage projects basin-wide and will be developed through stakeholder engagement;

viii. basin wide studies on aquatic biodiversity; in particular, comprehensive examination of combined effects and adequacy of environmental flows planned for main-stem and tributary hydropower projects in Zone 2 – based on bottom-up understanding of the aquatic resources at risk;

ix. Management of floods through glacier monitoring program and development of flood monitoring network;

x. integrated watershed management studies for control of erosion and sedimentation;

xi. development of long term benefit sharing mechanism, both monetary and nom-monetary, with the affected community;

xii. examination of entities elsewhere to develop a program-management modality and composition appropriate for the social, political and jurisdictional setting in the Indus River upper-basin; and

xiii. institutional strengthening and capacity development of the implementing and executing agencies in social and environmental management.

1. INTRODUCTION

DHP is one of several hydropower projects planned in Upper Indus Basin (UIB) as part of Pakistan Water and Power Development Authority (WAPDA) Vision 2025. DHP in combination with other proposed hydropower and storage projects has potential to cause significant cumulative and induced impacts on physical, ecological and social resources in the UIB. This cumulative and induced impact assessment (CIIA) examines the incremental environmental/ecological impacts of hydropower projects and storage development in the UIB between 2013-2022 in relation to DHP, including potential effects on biodiversity and ecological integrity of the riverine ecosystem and surrounding areas, environmental vulnerability of the river system and water availability for agriculture and other uses in the system. The CIIA is a step beyond the DHP EIA (Volume 2), as it incorporates an integrated approach to assess the incremental impacts due to developments in hydropower projects including DHP over the next 10 years. The catchment area of upper Indus River and study area from Tarbela up to the Line of Control between Pakistan-India is shown in Figure 1.1. Study terms of reference are provided in Appendix 1.1.

Dasu Hydropower Project (DHP) is a run-of-river project planned for development on the Indus River near Dasu, Kohistan district of Khyber Pakhtunkhwa (KP) province, located about 350 km north of Islamabad. DHP will be comprised of a 242 m high concrete gravity dam and 74 km long reservoir behind the dam. The reservoir will have average width of 365 m and, at full supply level (FSL) of elevation 950 m, an area of about 24 km^2. The project will have an underground powerhouse housing 12 turbines, each of which will produce 360 MW power, and a total maximum capacity to produce 4320 MW.

1.1 BACKGROUND

Pakistan is suffering from an acute power and energy crisis which is primarily caused by insufficient energy supply and increasing demand. The total installed capacity of the country was 24,173 MW, yet only a peak demand of 19,924 MW could be served in 2011, needing significant demand to be un-served. Power shortages resulted in long hours of load shedding, impacting households, industrial and commercial activity. Power shortages coupled with fuel shortages impacted export performance and economic growth. Pakistan per capita energy consumption is one of the lowest in the world with 450 kWh compared to the world average of 2,730 kWh. WAPDA has prepared Vision 2025 program for improving hydropower generation capacity to cope with the increasing water and power demands of the country.

WAPDA conducted a study[1] in 1981 to identify potential hydropower and storage development projects in the UIB. The study recommended 25 major potential sites (9 on Indus and 16 on tributaries) each having an installed capacity of more than 100MW. In addition to the existing Tarbela Dam, three more dams are being planned for placement along the Indus River main-stem between Tarbela Dam and the border with India, including DHP, over the next 10 years (2013-2022). Four new dams are under construction or planned for placement on tributaries of the UIB over the same period, in addition to five dams already in place on tributaries.

1.2 OBJECTIVE OF THE STUDY

Cumulative impact assessment has gained prominence over the last several decades as an important tool for overcoming shortcomings of project-specific assessments and enabling broader assessment of combined effects of multiple projects within the same

[1] MONENCO 1981. Inventory and ranking study of the potential water storage and hydropower generation sites along the upper reaches of Indus and its tributaries.

sector and effects of a project within the context of development trends of different sectors in a region. As such, cumulative impact assessment now forms part of and overlaps with other assessment protocols that go beyond single project environmental assessments, notably strategic, sectoral and regional environmental assessments.

A separate and comprehensive strategic/sectoral assessment of environmental and social issues associated with hydropower and storage development options in the Indus Basin is being undertaken by WAPDA (*Strategic/Sectoral Environmental and Social Assessment of Indus Basin* – SSESA). Terms of reference (ToRs) for SSESA Study are given as Appendix 1.2. That assessment will examine cumulative impacts in a broad-area perspective and will overlap with the assessment presented in this report. An important difference will be the focus of this report on incremental environmental and social effects of DHP in relation to other hydropower and storage developments in the upper basin. This CIIA study was prepared in advance of the SSESA and will assist with formulation of the SSESA cumulative impact assessment.

The CIIA study was undertaken over approximately two months as the project EIA was being finalized, by a two-member core-team supported by specialists drawn from the Project Design Team (hydrologist), Environmental Impact Assessment team (forestry and biodiversity) and parallel Social Impact Assessment team (social specialist). The study was undertaken over a short time-period in order to meet decision-making deadlines of WAPDA and World Bank, as part of the Bank funding-approval process. In the absence of the SSESA the CIIA is intended to provide an indicative and framework assessment of potential cumulative and induced impacts of DHP in the UIB.

1.3 HYDROPOWER PROJECTS IN UPPER INDUS BASIN

The existing and planned hydropower projects in the Upper Indus Basin upto 2022 in the three identified impact zones (Figure ES.1) are 13 as indicated in Table 1.1.

Table 1.1: Zone-wise Hydropower Projects in UIB

Zone-I	Zone-II	Zone-III
1. Satpara*****	1. Diamer Basha*******	1. Tarbela*****
2. Bunji********	2. Dasu*******	2. Tarbela Ext-IV*******
3. Naltar*****	3. Keyal Khawar********	
	4. Duber Khawar******	
	5. Khan Khawar*****	
	6. Allai Khawar*****	
	7. Lower Spat Gah********	
	8. Lower Palas Valley********	

Status: * Existing / in Operation ****** Under Construction ******* Ready for Construction
******** Detailed Engineering Design and Tender Documents in hand

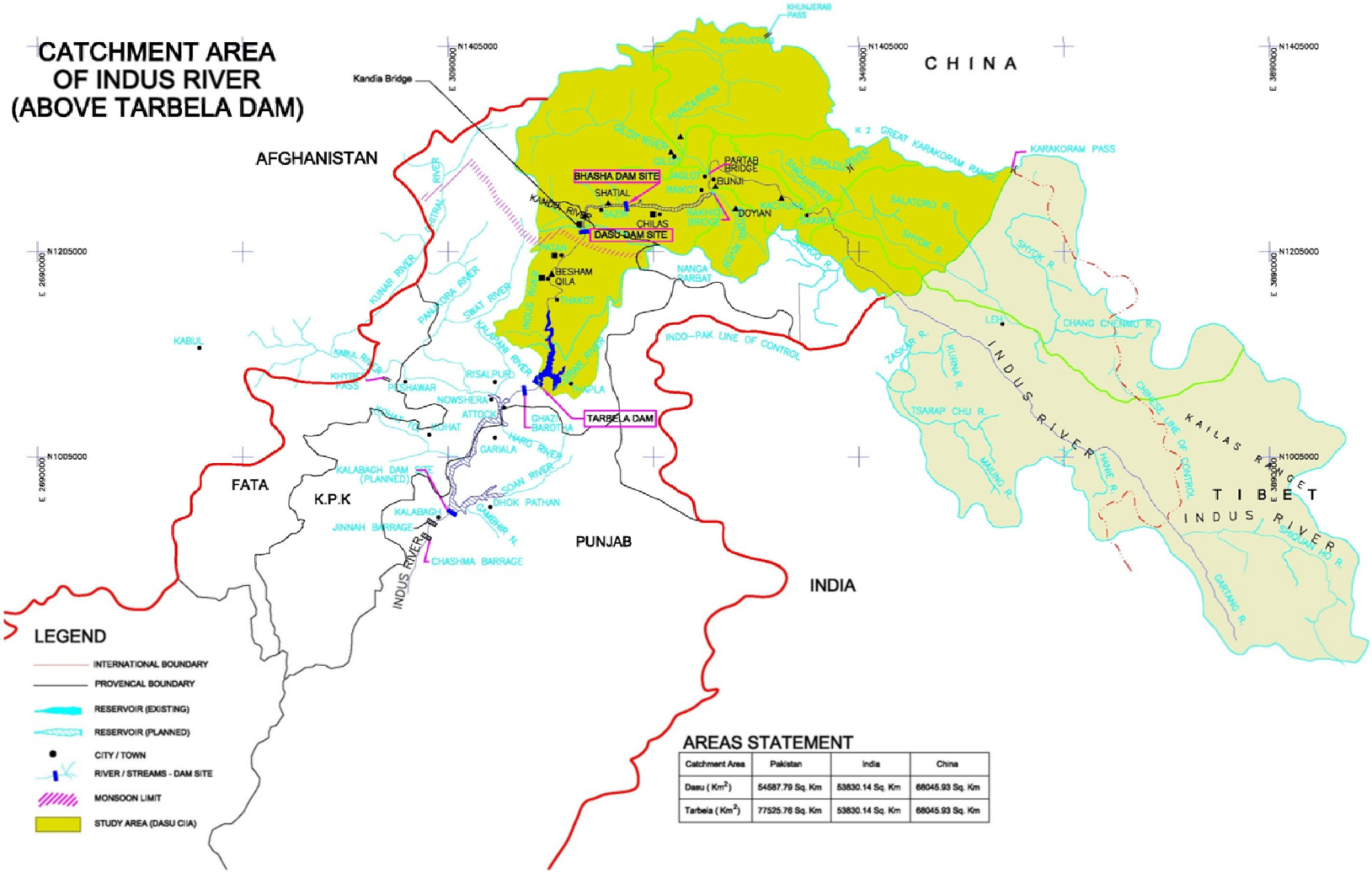


Figure 1.1: Catchment Area of Upper River Indus

2. ASSESSMENT FRAMEWORK

The CIIA has followed basic EIA steps: scoping of spatial and temporal boundaries and valued environmental components; identification of baseline conditions; assessment of potential effects; identification of mitigation measures and assessment of significance; identification of summary recommendations and follow-up information needs. Two types of impact are considered:

- Incremental effects of DHP on the type and magnitude of other (recent and future) developments in the area – Incremental project impacts.
- Effects of development in other sectors that are induced by DHP activities and components - Induced impacts.

Also two development scenarios are assessed: Scenario A, reflects hydropower development, 'business as usual'; and, Scenario B, reflects hydropower development 'best practices'.

2.1 ASSESSMENT SCOPE

2.1.1 Spatial and Temporal Boundaries

The geographical area of the CIIA is the Indus River basin between the Pakistan-India Line of Control and Tarbela Dam (Tarbela catchment area in Pakistan).

The CIIA examines recent development trends and the existing conditions of the basin, and potential impacts over the next 10 years (2013-2022).

2.1.2 Environmental and Social Components

Valued environmental and social components for inclusion in the assessment were based on a preliminary list of issues presented in the terms of reference, important components identified in the DHP EIA (Appendix 2.1) and results of stakeholder consultations.

2.1.2.1 Preliminary List of Key Issues

Broad topics considered to be important at the outset and itemized in the Terms of Reference are:

(i) water-hydrology, water use and quality
(ii) vulnerability to flooding, flood management aspects
(iii) forestry and bio-diversity
(iv) agriculture and livelihood
(v) social issues (i.e., involuntary resettlement, loss of income, ethnic minorities, cultural impacts considering religious and cultural values associated with Indus and health risks including risk of HIV/AIDS)
(vi) fisheries
(vii) transport
(viii) water supply and irrigation
(ix) urban development
(x) power transmission & industry
(xi) institutional issues and capacity

External issues such as climate change that are having important effects on basin development also are addressed.

2.1.2.2 Public Consultation workshops

CIIA key issues were the topic of review at four public consultation workshops held as part of the DHP environment assessment process in Peshawar, Lahore, Karachi and Islamabad. The final two workshops contained modules to elicit feedback regarding

proposed CIIA activities; in Islamabad workshop participants were divided into three work groups and were asked to discuss and provide feedback on topics presented in Appendix 2.2 (feedback from each work group was presented to all workshop participants by a work group spokesperson). Comments related to the DHP EIA are summarized in Appendix 2.2; comments directed specifically at the CIIA are summarized below.

(1) Social Issues

Items recommended for consideration within the CIIA are:

(i) Long term benefits to affected populations
(ii) Displaced communities – needs must be considered in order to provide basic facilities
(iii) a. Involvement of community in planning and development processes
b. Timely and frequent stakeholder meetings for suggestions and feedback
(iv) Proper compensation of affected communities – need to be clearer with proper guidance to affectees
(v) Increase capacity of WAPDA in terms of human resources – low human resources has meant affected communities have suffered

(2) Environmental Issues

Items recommended for consideration within the CIIA are:

(i) Integrated watershed management approach
(ii) Management/governance mechanism to transfer long-term strategy (environmental and social)
(iii) Cumulative impact on river geomorphology and biodiversity
(iv) In Kohistan, potential livelihood and income generation activities must be started early for people resettled at higher elevations to reduce pressure on forests

2.2 ASSESSMENT OF POTENTIAL EFFECTS

Within the time available for execution of the CIIA work involved:

- creation of baseline to assess effects on environmental and social components;
- assessment of cumulative and induced impacts based on two development scenarios using a risk assessment approach; and
- preparation of summary recommendations.

2.2.1 Baseline conditions

Baseline conditions were identified based on information available from secondary sources. Existing conditions, trends in sector developments and environmental issues and anticipated future-state conditions (2022 and beyond) were examined; for the latter policies and strategic planning documents were reviewed and used to aid interpretation of likely future conditions. Mandates of ministries and agencies responsible for key sectors are described in Appendix 2.3.

2.2.2 Impact analyses

Impact analyses considered incremental addition of effects of DHP on important ecological/environmental, social and economic components in the UIB to effects of other projects/actions in the basin. Analyses examined trends of those components and potential effects of anticipated future hydropower projects/actions planned for implementation by 2022, and potential effects induced by planned hydropower and storage development in relation to DHP.

2.2.2.1 Development Scenarios

Incremental effects of DHP were assessed for two development scenarios: Scenario A – 'business as usual'; and Scenario B – 'best practices'.

(1) Development Scenario A - Business as Usual

This scenario reflects a "business as usual" development pattern given the aggregate view of all the proposed developments with special emphasis on cascade hydro development (keeping in view the projects awarded and in progress already).

(2) Development Scenario B - Best Practices

This scenario reflects "best practices" with broad policy support for environmentally and socially sensitive development. In this context, institutions such as the World Bank Group identify need for cautious development in context of broader development goals (World Bank 2007):

(i) Responsible environmental management
(ii) Poverty alleviation and sustainable development
(iii) Integrated water and energy management
(iv) Institutional development

At a project level, best practices apply to the array of individual issues that are specific to each project. To provide a context for best practices, the CIIA has considered 'Best' and 'Good' practice elements presented in the Hydropower Sustainability Assessment Protocol (international Hydropower Association 2010). The Protocol was developed by means of a forum comprised of representatives of organisations from diverse sectors with differing views and policies on sustainability issues related to hydropower development and operation. Forum members included representatives of governments of developed and developing countries, commercial and development banks, social and environmental NGOs, and the hydropower sector. The Protocol includes detailed descriptions of practices that can be used for scoring projects at four stages of development (Early Stage; Preparation; Implementation; Operation) and a five level scoring system (ranging from practices having significant gaps – Level 1, to best practices – Level 5). General characteristics of 'Best Practice' and 'Good Practice' scoring levels are summarized in Table 2.1.

Recommendations brought forward during stakeholder CIIA consultations in specific reference to CIIA were grouped under the main headings shown in the Protocol table (Table 2.2) and were referred to during assessment of Scenario B.

Table 2.1: Best Practice and Good Practice characteristics described for scoring levels to assess criteria used in the Hydropower Sustainability Assessment Protocol

Level	Assessment	Management	Stakeholder Engagement	Stakeholder Support	Outcomes	Conformance / Compliance
5 **[Best]**	Suitable, adequate and effective assessment with no significant opportunities for improvement. In addition to basic good practice (Level 3), the assessment is likely to take a relatively broad, external or regional view or perspective; emphasise opportunities; and show a high level examination of interrelationships amongst relevant sustainability issues.	Suitable, adequate and effective management processes with no significant opportunities for improvement. In addition to basic good practice (Level 3), management plans and processes are likely to show excellent anticipation of, and response to, emerging issues or opportunities; senior management and/or executive decisions are likely to be timely, efficient and effective in response to monitoring data, investigations and issues arising; and, in cases, commitments in plans are public, formal and legally enforceable.	Suitable, adequate and effective stakeholder engagement processes with no significant opportunities for improvement. In addition to basic good practice (Level 3), the engagement is likely to be inclusive and participatory with the directly affected stakeholders; thorough feedback is likely to be available on how directly affected stakeholder issues are taken in to consideration; in cases, there is likely to be directly affected stakeholder involvement in decision-making; and information identified through engagement processes to be of high interest to stakeholders is released publicly in a timely and easily accessible manner.	There is support of nearly all directly affected stakeholder groups for the assessment, planning or implementation measures for that topic, or no opposition by these stakeholders. In cases formal agreements or consent with the directly affected stakeholder groups have been reached for management measures for that topic.	In addition to basic good practice (Level 3), there may be exhibited enhancements to preproject conditions; contributions to addressing issues beyond those impacts caused by the project; leveraging of opportunities; or significant contribution to capacity building.	No non-compliances or non-conformances.
3 **[Good]**	Suitable adequate and effective assessment with no significant gaps. This would typically encompass (as appropriate to the topic and life cycle stage) identification of the baseline condition including	Suitable, adequate and effective management processes with no significant gaps. These would typically encompass (as appropriate to the topic and life cycle stage)	Suitable, adequate and effective stakeholder engagement processes with no significant gaps. These would typically encompass (as appropriate to the topic and life cycle stage): Identification of	There is general support amongst directly affected stakeholder groups for the assessment, planning or implementation	As appropriate to the topic and the life cycle stage, there may be exhibited avoidance of harm,	No significant non-compliances and nonconformances.

Level	Assessment	Management	Stakeholder Engagement	Stakeholder Support	Outcomes	Conformance / Compliance
	relevant issues, appropriate geographic coverage, and appropriate data collection and analytical methodologies; identification of relevant organisational roles and responsibilities, and legal, policy and other requirements; appropriate utilization of expertise and local knowledge; and appropriate budget and time span. At level 3 the assessment encompasses the considerations most relevant to that topic, but tends to have a predominantly project focused view or perspective and to give stronger emphasis to impacts and risks than it does to opportunities.	development and implementation of plans that: integrate relevant assessment or monitoring findings; are underpinned by policies; describe measures that will be taken to address the considerations most relevant to that topic; establish objectives and targets; assign roles, responsibilities and accountabilities; utilise expertise appropriate to that topic; allocate finances to cover implementation requirements with some contingency; outline processes for monitoring, review and reporting; and are periodically reviewed and improved as required.	directly affected stakeholders; Appropriate forms, timing, frequency and locations of stakeholder engagement, often two-way; Freedom for affected stakeholders to participate; Attention to special stakeholder engagement considerations relating to gender, minorities, cultural sensitivities, level of literacy, and those who might require particular assistance; Mechanisms by which stakeholders can see that their issues are recognised and acknowledged, and how they have been or are being responded to; and disclosure of information on significant sustainability topics (in cases, this may be on request).	measures for that topic, or no significant ongoing opposition by these stakeholders.	minimization and mitigation of negative impacts; fair and just compensation; fulfillment of obligations; or effectiveness of implementation plans.	

Table 2.2: Recommendations brought forward during stakeholder CIIA consultations

Assessment and Management		Stakeholder Engagement
Environmental Issues	**Social Issues**	
• Integrated watershed management approach • Management/governance mechanism to transfer long-term strategy (environmental and social) • Cumulative impact on river geomorphology and biodiversity • In Kohistan, potential livelihood and income generation activities must be started early for people resettled at higher elevations to reduce pressure on forests	• Long term benefits to affected populations • Displaced communities – needs must be considered in order to provide basic facilities • Proper compensation of affected communities – need to be clearer with proper guidance to affectees • Increase capacity of WAPDA in terms of human resources – low human resources has meant affected communities have suffered	• Involvement of community in planning and development processes • Timely and frequent stakeholder meetings for suggestions and feedback

2.2.2.2 Identification of risks and opportunities

To the extent practicable risks to important environmental, social and economic components were assessed for the two development scenarios considering the pattern and level of development which would lead to cumulative effects that are either significant or acceptably insignificant. Exposure or vulnerability of key receptors to project actions/stressors was considered together with probable magnitude of effects and likelihood of occurrence.

2.2.2.3 Zones of potential impact

Given variability in environmental, social and economic components along the Indus River, potential impacts were assessed within three zones (Figure 2.1), governed mainly by biophysical differences (e.g., Tarbela Reservoir differs from most of the remainder of the basin; the upper portion of G-B is at higher elevation and has lower flows than the Indus River in lower portions of the study area).

2.2.2.4 Other considerations

To the extent practicable within the time available for conducting the study, the assessment included discussion of: benefits (including allocation among groups and geographic areas), constraints; and implementation and financing options.

2.2.3 Mitigation and Significance of Potential Effects

2.2.3.1 Identification of Mitigation Measures

Measures to mitigate potential incremental effects on basin environmental, economic and social components were identified, focusing on: measures applicable to overall sustainable development in the basin; business solutions for effective environmental management through stakeholder engagement; project-specific recommendations for environmental management.

2.2.3.2 Determination of Significance

Significance of residual effects after assumed implementation of recommended mitigation measures was assessed subjectively for those important environmental, social and economic components for which residual effects were identified.

2.2.3.3 Summary Recommendations

As appropriate measures were recommended for:

- Overall development of the UIB, including all hydropower and storage projects in the basin over the next ten years, with respect to managing environmental and social issues in a sustainable manner.
- Business solutions for effective environment management in the UIB.
- Project-specific recommendations on environmental management.

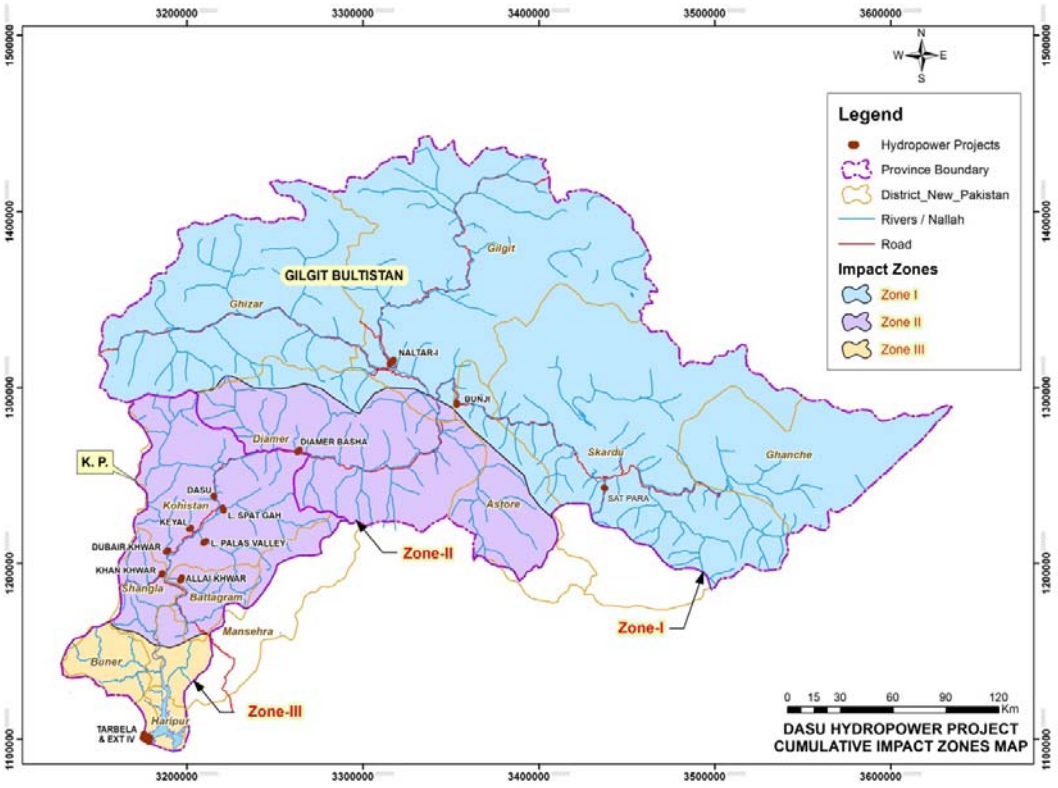


Figure 2.1: Impact Zones for CIIA

3. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

Detailed information on the legal and policy framework in Pakistan for environmental assessment and World Bank policies for environmental assessment are given in Section 2 of Volume 2: EIA. A summary of these frameworks, including assessment of cumulative impacts, is provided in this section.

3.1 NATIONAL FRAMEWORK

3.1.1 National Legal Framework

The Pakistan Environmental Protection Ordinance, 1983 was the first piece of legislation designed specifically for the protection of the environment. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards were established in 1993. The Pakistan Environmental Protection Act (PEPA) was enacted in 1997, conferring broad-based enforcement powers to the environmental protection agencies. Publication of the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations (IEE-EIA Regulations), 2000, provided the necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA).

3.1.1.1 Environmental Protection Act

PEPA, 1997 is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, soil, marine, and noise pollution, as well as to the handling of hazardous wastes.

3.1.1.2 Other Relevant Laws

In addition to the PEPA, 1997, a number of other laws have clauses concerning the regulation and protection of the environment (examples are listed in Table 3.1).

Table 3.1: Additional Laws having Provisions Relevant to Environmental Protection

• Pakistan Penal Code, 1860 • Pakistan Explosives Act, 1884 • Land Acquisition Act, 1894 • Telegraphy Act, 1910 • Forest Act, 1927 • Factories Act, 1934 (as amended to 1997) • Protection of Trees Act, 1949 • Pakistan Water and Power Development Authority Act, 1958 • Labour Laws	• Motor Vehicle Ordinance, 1965 and Rules, 1969 • Antiquity Act, 1975 • KP Wildlife Protection, Preservation, Conservation and Management Act, 1975 • Employment of Child Act, 1977 • Highway Safety Ordinance, 2000 • Local Government Ordinance, 2001 • Project Implementation and Resettlement Ordinance, 2001

3.1.2 National Policy Framework

The main Federal Government safeguard policy documents that are directly applicable to the proposed project are the National Conservation Strategy and the Resettlement Policy. The Ministry of Environment is responsible at the Federal level for policy, planning and implementation in respect of environmental aspects in Pakistan. The Pakistan Environmental Protection Council (PEPC) headed by the Chief Executive of Pakistan is the highest inter-ministerial and multi-stakeholders decision making body for such matters.

3.1.2.1 The Pakistan National Conservation Strategy (NCS)

The Pakistan National Conservation Strategy (NCS) is the principal policy document for environmental issues in the country and was developed and approved by the Government of Pakistan on March 1, 1992. The NCS works on a ten-year planning and implementation cycle. The NCS deals with 14 core areas which are;

i. maintaining soils in cropland;
ii. increasing irrigation efficiency;
iii. protecting watersheds;
iv. supporting forestry and plantations;
v. restoring rangelands and improving livestock;
vi. protecting water bodies and sustaining fisheries;
vii. conserving biodiversity;
viii. increasing energy efficiency;
ix. developing and deploying material for renewable energy;
x. preventing/abating pollution;
xi. managing urban wastes;
xii. supporting institutions for common resources;
xiii. integrating population and environmental programmes; and
xiv. preserving the cultural heritage.

3.1.2.2 Resettlement Policy in Pakistan

An important aspect of EIA is consideration of the displacement and relocation of the project affected population. A new resettlement policy is currently in draft form with the Pakistan Environmental Protection Agency. The policy has been formulated to ensure an equitable and uniform treatment of resettlement issues throughout Pakistan. This policy will apply to all development projects involving adverse social impacts, including land acquisition, loss of assets, loss of income, loss of business and other possible losses. The draft Resettlement Policy addresses those areas which are not taken care of in the Land Acquisition Act of 1894 and will be applicable wherever any public sector or private development project affects people, families or communities, even when there is no displacement of population.

The Government has proclaimed an ordinance entitled "*Project Implementation and Resettlement of the Affected Persons Ordinance 2001*", later referred to as the "*Resettlement Ordinance*". This ordinance will be used to safeguard the interests of persons/groups having to be involuntarily resettled due to land acquisition caused by a proposed project. This Ordinance establishes that the resettlement of the involuntarily displaced persons is done as a matter of right and not by way of charity or any such sentiment. In addition Affected Persons shall be accepted as special groups who in the supreme interest of the country have accepted/undergone involuntary displacement. The proposed Ordinance shall be supplementary to the Land Acquisition Act of 1894, as well as other Laws of Pakistan, and wherever items are included in the Draft Resettlement Policy.

3.1.2.3 National Environment Policy

This policy was implemented in 2005 to provide an overarching framework for addressing the environmental issues facing Pakistan. It gives directions for addressing sectoral issues and provides means for promoting conservation and environmental protection in water, air and waste management, forestry, and transport. The policy aims to promote protection of the environment, the honoring of international obligations, sustainable management of resources and economic growth.

3.1.2.4 Associated Guidelines Procedures and Standards

Guidelines, procedures and standards that pertain to environmental assessment and protection include:

- Guidelines for the Preparation and Review of Environmental Reports, 1997
- Policy and Procedures for Filing, Review and Approval of Environmental Assessments, 2000
- Guidelines for Public Consultation, 1997
- Guidelines for Sensitive and Critical Areas, 1997
- National Environmental Quality Standards, 2000 (amended to 2010)

3.1.3 Water Apportionment Accord

In 1991, the Water Apportionment Accord was signed between the representatives of all the four provinces of Pakistan to allocate supplies to the existing projects and future developments of the Indus River System. The need for storage wherever feasible on the Indus and other rivers was also recognised for planning future agricultural developments. The Water Apportionment Accord also included the following provision for Indus Delta:

> *"The need for certain minimum water escape to the sea below Kotri Barrage to check sea intrusion was recognized. An optimum level of 10 MAF was discussed. It was decided that further studies would be undertaken to establish the minimal escapage needs downstream of Kotri Barrage."*

An Indus River System Authority was to be established to implement the Water Apportionment Accord with representation from all four provinces and the Federal Government. The system-wise allocations would also be worked out on a 10-day basis with actual average system uses for the post-Tarbela period 1977-82 providing guidelines for developing future regulation pattern.

3.1.4 Environment Regulatory Authorities

The PEPO 1983 was the first legislation in Pakistan designed specifically for the protection of the environment. The promulgation of this Ordinance was followed in 1984 by the creation of:

- Pakistan Environmental Protection Council
- Ministry of Climate Change
- Pakistan Environmental Protection Agency (PAK-EPA)
- KP Environment Protection Agency

3.1.5 Khyber Pakhtunkhwa Province

The Government of KP Province functions under the provisions of the Constitution of Pakistan (1973). The Provincial Assembly elects the Chief Minister of the Province who forms a Cabinet of Ministers to look after various Departments. The Chief Minister is the Chief Executive of the Province. The Federal Government appoints a Governor for the Province. Amendment XVIII (the Eighteenth Amendment) of the Constitution of Pakistan was passed by the National Assembly of Pakistan on April 8, 2010. According to this amendment, the Ministry of Environment has been dissolved and the provinces have been authorized to make the laws and regulations regarding environment. The powers of Pak-EPA have now become the powers of Provincial EPAs. Every province is making its own environment protection act. Although, work on this has initiated however, to date law has not be enacted in KP and PEPA 1997 continues to be the prime legal instrument for environmental protection.

3.1.6 Government of Gilgit Baltistan (formerly Northern Areas)

The Federal Ministry of Kashmir Affairs and Northern Areas (KANA) administers the Gilgit Baltistan area of Pakistan. Major projects will not be implemented without the involvement of the said Ministry. The Government of the Northern Areas has its own legislative council. The Chief Secretary of the Gilgit Baltistan is the administrative

head. On the 23rd October 2007, the President of Pakistan unveiled a package of political, administrative and development reforms for the Northern Areas, now named Gilgit Baltistan.

3.2 WORLD BANK POLICIES

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. Developers seeking financing from the World Bank are required to comply with the applicable environmental and social safeguards, Operational Policies (OPs) and Bank Procedures (BPs).

OP/BP 4.01 Environmental Assessment provides the framework for World Bank environmental safeguard policies and describes requirements for environmental assessment, including in relation to cumulative impacts, particularly in relation to sectoral and regional EA. Guidance identified in OP 4.01 (Annex A- Definitions) is:

- *Regional EA*: Regional EA pays particular attention to potential cumulative impacts of multiple activities.
- *Sectoral EA*: Sectoral EA pays particular attention to potential cumulative impacts of multiple activities.

World Bank Group expectations for assessment of cumulative impacts of individual projects are outlined in International Finance Corporation (World Bank Group) Performance Standard (PS 1); assessment of project environmental and social risks and impacts must encompass:

- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted;

PS 1 notes that cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities. Examples of cumulative impacts include: incremental contribution of gaseous emissions to an airshed; reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed; interference with migratory routes or wildlife movement; or more traffic congestion and accidents due to increases in vehicular traffic on community roadways.

OP 4.04 Natural Habitats outlines the World Bank policy on biodiversity conservation taking into account ecosystem services and natural resource management and use by project affected people. Projects must assess potential impacts on biodiversity and the policy strictly limits circumstances under which conversion or degradation of natural habitats can occur as well as prohibiting projects which are likely to result in significant loss of critical natural habitats. If changes in river flows, by the hydropower projects, have the potential to cause significant loss or degradation of natural habitats, borrows must comply with this policy.

4. EXISTING AND PLANNED HYDROPOWER PROJECTS

Pakistan is endowed with a very large renewable energy resource in the form of hydropower with a conservatively estimated potential of around 46,000 MW. Out of this, only about 6,516 MW has been exploited to date. Hydro energy has grown at an average annual rate of 3.96% over the period 1980-2010, this growth dampened to 1.85% in the last 10 years and to 1.05% during the last 5 years. Hydro energy as percent of total energy declined from about 72% in 1980 to about 31% in 2010.

To cope with the increasing water and power demands of the country (Section 5 of Volume 2 EIA), WAPDA prepared "Water Resources and Hydropower Development - Vision 2025 Program", which was approved by the Government in 2001. This program is a US$25 to 33 billion development program with projects that could generate over 18,700 MW of additional hydropower plants. It was focused on the development of water storage projects to strengthen the economy by reinforcing agriculture, by optimizing water resources and by enhancing hydropower generation with an aim of establishing the Indus Basin Irrigation System in future. Locations of all hydropower and storage projects proposed in Vision 2025 are shown in Appendix 4.1.

The proposed hydropower projects expected to be implemented up to 2022 are listed in Table 4.1 and shown in Figure 4.1 indicating status: i) existing / in operation; ii) under construction; iii) ready for implementation; and, iv) detailed engineering design and tender documents in hand. A description of each project is presented in Appendix 4.2.

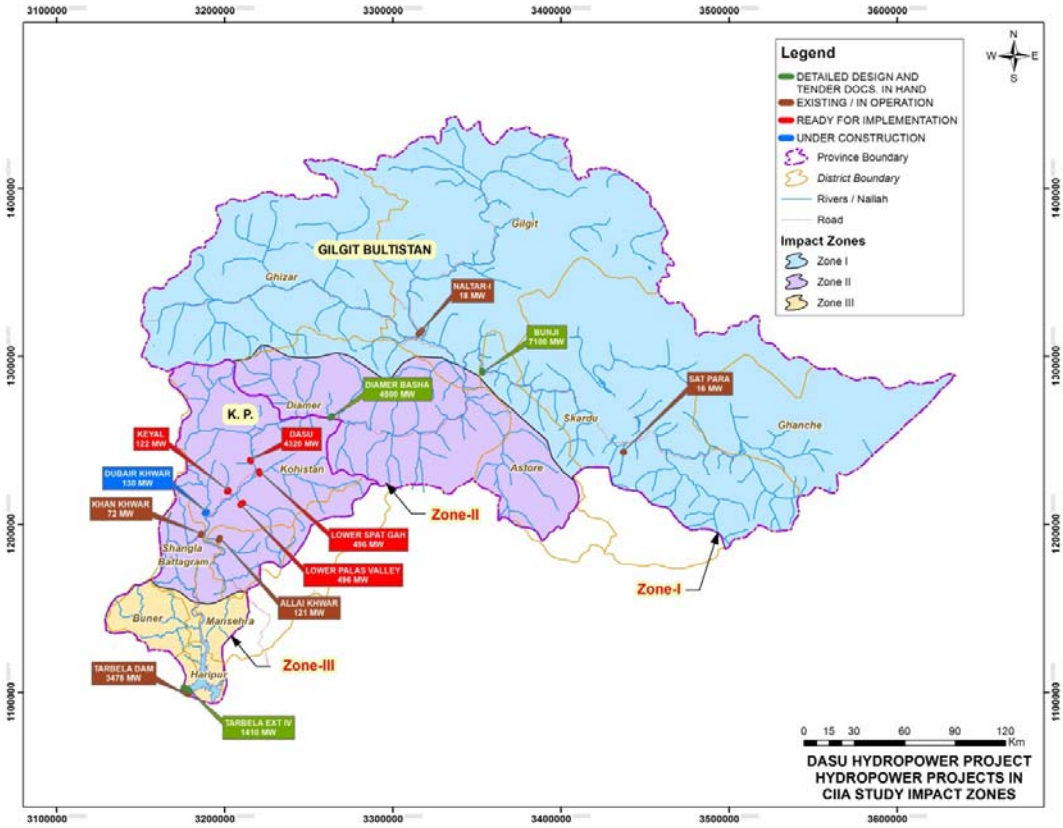


Figure 4.1: Hydropower Development Projects in Upper Indus Basin (up to 2022)

Table 4.1: Hydropower Development Plan in Upper Indus Basin (up to 2022)

Sr. No.	Name of Project	River	Location (District)	Storage (MAF)	Installed Capacity (MW)	Expected Completion Date	Status as on Oct. 2012			
							Existing / in operation	Under Construc-tion	Ready for Construc-tion	Detailed Engg. Design and Tender Documents in hand
IMPACT ZONE – I										
1.	Satpara	Indus	Skardu	RoR	17	2012	✓			
2.	Bunji	Indus	Astore	RoR	7100	2022				✓
3.	Naltar	Naltar	Gilgit		27	2012	✓			
IMPACT ZONE – II										
4.	Diamer Basha (KP+GB)	Indus	Diamer / Kohistan	8.10	4500	2020-21			✓	
5.	Dasu (KP+GB)	Indus	Kohistan / Diamer	RoR (1.14)	4320	2019			✓	
6.	Keyal Khawar	Indus	Besham	RoR	122	2016				✓
7.	Dubair Khawar	Indus	Besham		130	April, 2013		✓		
8.	Khan Khawar	Indus	Besham		72	2011	✓			
9.	Allai Khawar	Indus	Besham		121	Oct. 2012	✓			
10.	Lower Spat Gah	Indus	Kohistan	RoR	496	2017				✓
11.	Lower Palas Valley	Indus	Kohistan	RoR	665	2017				✓
IMPACT ZONE – III										
12.	Tarbela	Indus	Tabela	7.00	3478	1976	✓			
13.	Tarbela Ext-IV	Indus	Topi	-	1410	2019			✓	
			Total	**16.24**	**18743 (Additional)**		**3715**	**130**	**10230**	**8383**

5. BASELINE CONDITIONS

5.1 ENVIRONMENTAL CONDITIONS

5.1.1 Hydrology

The Indus river originates from a spring called Singikabad near Mansarowar Lake on the north side of the Great Himalayan range in Kailash mountain in Tibet at an altitude of 5,494m asl. The river flows south towards the Arabian Sea, linking two large natural water reservoirs, the snow and glaciers in the mountains and groundwater contained in the alluvium of the Indus Plain of Sindh and Punjab provinces.

Climate in UIB varies from monsoonal (from Tarbela – Besham), dry subtropical to temperate (above Dasu and upstream) and to alpine in the mountainous areas. Annual rainfall in monsoon influence area is generally more than 1,000 mm, while it is less than 300 mm in other areas. Mountains tops are covered with snow during winter. Glacial studies above 5000 m suggest precipitation in the order of 2,000 mm annually in the form of snow.

The Indus Basin comprises the Indus River, its five major left bank tributaries, the Jhelum, Chenab, Ravi, Beas and Sutlej rivers, and one major right bank tributary, the Kabul. The *Indus Waters Treaty of 1960* apportioned the flows of three main rivers to Pakistan the Indus, Jhelum, and Chenab Rivers, and the remaining three to India - Ravi, Beas and Sutlej.

As a source document, WAPDA's Report titled "Hydrologic Study of Diamer Basha Dam for Utilization Pattern of Stored Water and Additional Power Generation at Tarbela, Ghazi-Barotha and Chashma", March 2012 (hereafter referred as Hydrologic Study of Basha Dam) was extensively used as a source of relevant and latest post hydropower development / impact assessment data, including baseline conditions. The combined inflow of three western rivers: Indus at Kalabagh (including Kabul); Chenab at Marala and Jhelum at Mangla, is shown in Table 5.1.

Table 5.1: Inflow of Indus River at Kalabagh, Chenab River and Jhelum River

BCM (MAF)

Description	Low Flows / Rabi	High Flow / Kharif	Annual
Average	28,629 (23.2)	140,306 (113.7)	168,935 (136.9)
Maximum	31,590 (25.6)	187,198 (151.7)	218,665 (177.2)
Minimum	21,348 (17.3)	99,831 (80.9)	121,179 (98.2)

The hydrographs of Indus river flow at Basha, Dasu and Tarbela are shown in Figure 5.1; the average annual flow of the Indus River at Tarbela is approximately 2500 m^3/s.

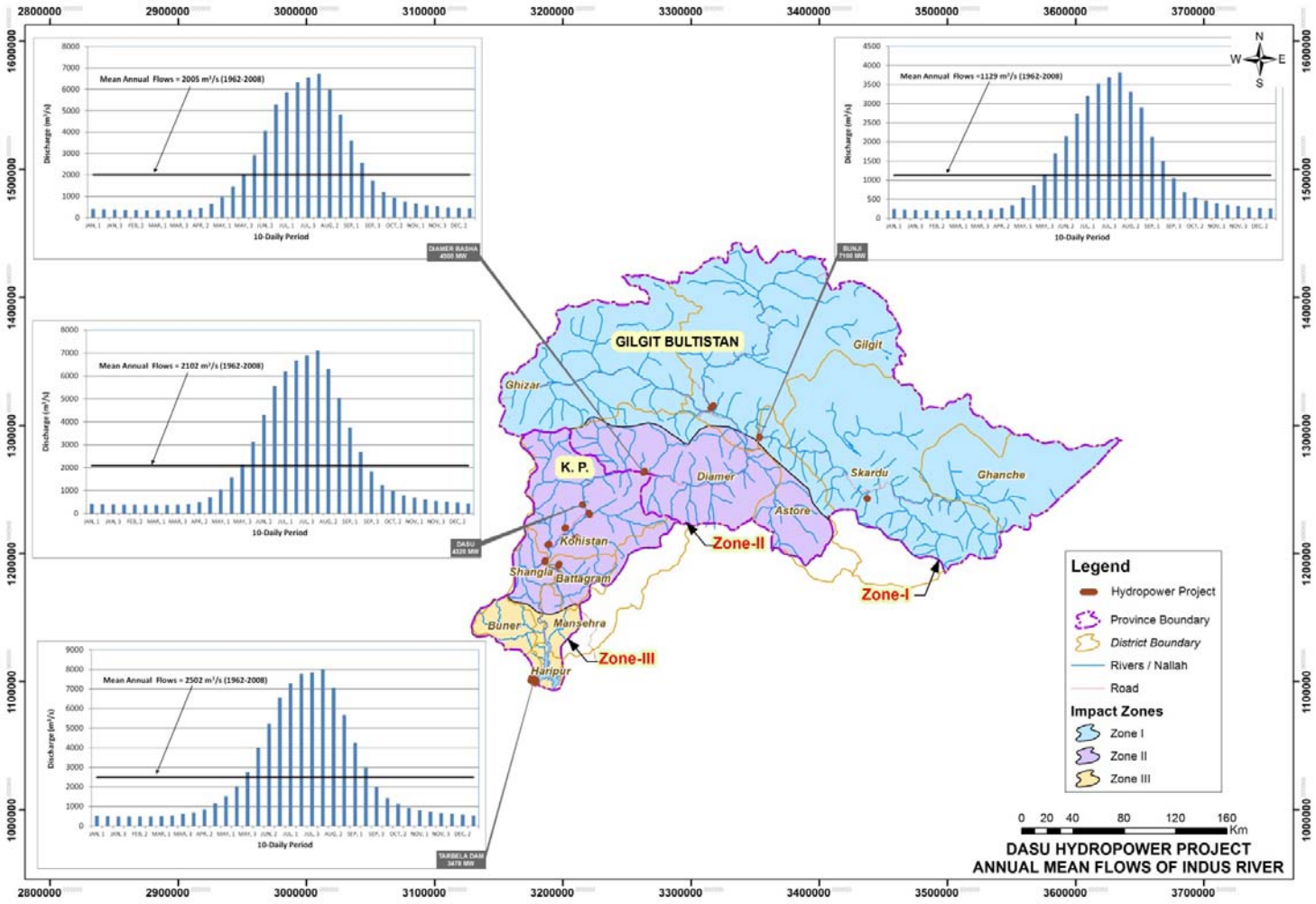


Figure 5.1: Hydrographs for Indus River at Bunji, Diamer Basha, Dasu and Tarbela

The post-Tarbela excess or system outflows to the sea were about 38,691 BCM (31.354 MAF) on the average. Out of the 169,384 BCM (137.246 MAF) of water which was withdrawn in the year 2000, 96% were used for agricultural purposes, leaving 2% for domestic and another 2% for industrial use (Asian Water Development Outlook, 2007 – ADB). By far most water is used for irrigated agriculture, emphasizing the particular significance of agriculture in the country. The sector contributes about 21% of the Pakistan's Gross National Product (GNP) (2009-2010). The country still has the world's largest contiguous irrigation system. In 2010-2011, the total irrigated area in Pakistan was 181,000 km² (18.1 million ha). Water is also essential for power generation. Presently Pakistan has about 31% generation through hydropower.

Floods: Flooding in rivers is generally caused by heavy concentrated rainfall in the catchments during the monsoon season, which is sometimes augmented by snowmelt flows. Monsoon currents originating in the Bay of Bengal and resultant depressions often cause heavy downpour in the Himalayan foothills. These are additionally affected by weather systems from the Arabian Sea (by seasonal lows) and from the Mediterranean Sea (through westerly waves) which occasionally produce destructive floods in one or more of the main rivers of the Indus system. Mean annual precipitation has been recorded as 1098mm (Besham) during 1970-2009, 1272mm (Pattan) during 2005-2010, 332mm (Kandia) during 2006-2010 and 196mm (Chilas) during 1953-2010. The average annual rainfall in the Upper Indus Basin, towards north of Besham continuously decreases. The annual mean rainfall in the Dasu Project area is accordingly small because the rainfall source in the area is westerly winds originating from Mediterranean Sea. Summer monsoons are unable to contribute because Himalaya acts as a barrier to monsoon movement. Monsoons limit is south of Besham. However, exceptionally high floods have occasionally been caused by the formation of temporary natural dams by landslides or glacier movement and their subsequent collapse. There are, large seasonal variations in almost all the river discharges, which further change the river course and morphology.

Flooding of the major rivers causes human and financial losses by inundating areas along their banks, by damaging irrigation and communication facilities across or adjacent to their banks, and by erosion of land along the riverbanks. In the upper part of the Indus Basin System, flood water spilling over the riverbanks generally returns to the river. However, in the lower Indus Basin, where the Indus primarily flows at a higher elevation than adjoining lands, spills do not return to the river. This phenomenon extends the period of inundation, resulting in even greater damages. Although embankments built along almost the entire length of the river in Sindh and at locations in the upper Indus Basin (there are only few embankments in UIB, most of which are natural) have provided some protection against floods, poor maintenance of the bunds causes breaches. Such breaches often cause great damage because of their unexpected nature and intensification of land use following the provision of flood protection.

In July 2010 unprecedented catastrophic floods occurred, followed by abnormally heavy monsoon rains, causing the Indus River and its major right bank tributary of Kabul River to rise above their banks and flood extensively. In early August, the heaviest flooding moved southward along the Indus River from severely affected regions in KP toward western Punjab, where at least 0.57 mha (1.4 million acres) of cropland was destroyed, and the southern province of Sindh. The rains that continued for two months were above normal which devastated large areas of Pakistan, making it an international natural disaster zone. As of September 2010, over two thousand people had lost their lives and over a million homes had been destroyed since the flooding began.

The 2011 Sindh floods began during the Pakistani monsoon season in mid-August 2011, resulting from heavy monsoon rains in Sindh, eastern Balochistan, and southern

Punjab. The floods caused considerable damage; an estimated 434 civilians were killed, with 5.3 million people and 1,524,773 homes affected. Sindh is a fertile region and often called the "breadbasket" of the country; the damage and toll of the floods on the local agrarian economy was extensive. At least 0.69 mha (1.7 million acres) of arable land was inundated as a result of the flooding.

Vulnerability to Flooding: Flood is defined as a situation when water reaching any point of the stream is greater than its carrying capacity at bank-full stage. In other words, the flood is said to have occurred when the river gauge exceeds a certain higher limit or the flow exceeds a certain discharge limit. The limit depends upon many factors and is different for various reaches even on the same stream. In Pakistan, the flood stages have been categorized as low, medium, high very high and exceptionally high. Their limits for Indus Basin Rivers are listed in Table 5.2.

Table 5.2: Flood Limits

(All figures in 000 m³/s)

S.No.	Rivers	Site	Low	Medium	High	Very High	Exceptionally High
1.	**Indus**						
		Tarbela D/S	250	375	500	650	800
		Attock Bridge	250	375	500	650	800
		Kalabagh Barrage	250	375	500	650	800
		Chashma Barrage	250	375	500	650	800
		Taunsa Barrage	250	375	500	650	800
		Guddu Barrage	200	350	500	700	900
		Sukkur Barrage	200	350	500	700	900
		Kotri Barrage	200	300	450	650	800
2.	**Kabul**						
		Warsak	30	45	100	200	400
		Nowshera	45	47	100	200	400

Historical Floods in Project Area: There is a long history of floods in Pakistan. Flood peaks are usually measured at specified points generally at Remote Inflow Measurements (RIM) Stations and at the Hydraulic Structures Barrages, Head-works, Dams etc. Historic flood Peaks recorded at various points along River Indus and its tributaries are shown in Table 5.3.

Table 5.3: Historical Flood Peaks in Study Area

Station	River	Discharge m³/s (ft³/s)	Year
Bunji	Indus	12372.7 (437,000)	1963
Besham	Indus	14037.4 (495,800)	1992
Tarbela	Indus	22650.2 (800,000)	1929

The floods in the upper Indus catchment area occur due to natural dam formation and then their failure. Natural dam formations are of two types. One form blocks the passage of Indus River / Tributary / Tributaries due to: landslide (s), while other causes creation of lake behind the glacier and sudden and large river flow caused due to overtopping or bursting of an ice dam is known as glacial lake outburst flood (GLOF). Nearly 60 GLOF events have been reported since 1830. Such dam-break floods are characterized by a very rapid flood rise. Dams created by massive landslides are rare but glacier dams are numerous. Other causes of floods are storm runoff and glacier and snowmelt. Important and well recorded events are presented in the following paragraphs.

a. 1841 Flood - The landslide dam[1] burst flood of June 1841 resulted from the sudden failure of a dam in the main stem of Indus River near Raikot. The landslide occurred on left bank of Indus River at Lichar Gah below Bunji and close to the head of the proposed periphery of the proposed Diamer Basha reservoir. The Indus river is about 75m wide at this location and a landslide dam of some 200m height totally blocked the river for six to seven months. There was another landslide, a few km upstream of the previous landslide after about seven months, but on the right side of Indus River. The landslide dam therefore failed due to high velocity wave and over topping in such a way that it drained the entire contents of the lake within 24 hours. The volume of the lake behind the landslide dam was estimated as 4.6 BCM. This brought lot of sediments into reaches downstream.

b. 1858 Flood - The flood of August 1858 is the flood event that resulted from the failure of a landslide dam above Baltit in Hunza Valley. This landslide dam blocked the Hunza River for some seven months before it suddenly failed. This dam break produced a flood wave with a peak flow of 17,000 m^3/s and an estimated volume of 1.85 BCM and brought lot of sediments downstream.

c. 1929 Flood - In August 1929 there was a glacial lake outburst flood (GLOF) in Shyok River, a tributary of Indus River. This had a peak discharge of 23,710 m^3/s with base flow of 5350 m^3/s and a 2 days' volume of 2.3 BCM constituted at Partab Bridge and the same value was assumed as Basic Design Flood (BDF) to occur at Diamer Basha Dam Site.

d. 1974 Flood - In 1974 Hunza River was obstructed by a huge landslide which blocked the river and resulted in creation of lake about 8 km x 10 km behind the blockage. The bursting of this lake left significant sediments on the valley floor and caused severe erosion of the downstream valley.

e. Recent Flood of 2010 - In 2010 there was a huge landslide in the Hunza Valley, which blocked Hunza River and eroded away a considerable length of Karakoram Highway (KKH) near Attabad and also created a lake which is still existing and causing great hurdles and problems for the locals and is affecting trade with China. On 27 February 2012 the artificial blockage was blasted to release 50,000 ft^3/s (about 1416 m^3/s) to lower down the lake water level and ease the situation to some extent. Efforts are in progress to lower down the water level. It resulted in a rise of about 2.44 meter (8 feet) at gauge–II near the proposed Dasu Damsite on 29 February 2012.

5.1.2 Climate Change

Temperature: The 4th Assessment Report (AR4) by three working groups of the Intergovernmental Panel on Climate Change (IPCC) projects average global surface temperature will increase by approximately 3°C during the 21st century. The following information is derived for Pakistan (for two IPCC scenarios, A1B – very rapid economic growth, population growth peaking mid-century and balanced use of energy sources; A2 – fragmented and slow economic growth and continuous population growth):

- The temperature increase in Northern Pakistan is larger than that in Southern Pakistan, in line with the IPCC global scenarios which show higher temperature increase over Central Asia than that over South Asia.
- The temperature increase in both Northern and Southern Pakistan in each scenario is higher than the corresponding globally averaged temperature increase (for A2 scenario, the projected temperature increases in 2080s in Northern and Southern Pakistan are 4.67°C and 4.22°C, respectively (Figure 5.2).

[1] A landslide dam, debris dam, or barrier lake is a natural damming of a river by some kind of mass wasting: landslide, debris flow, rock avalanche or volcano. If it is caused by earthquake, it may also be called a quake lake.

- The current annual average temperatures for Northern and Southern Pakistan are about 19°C and 24°C, respectively).

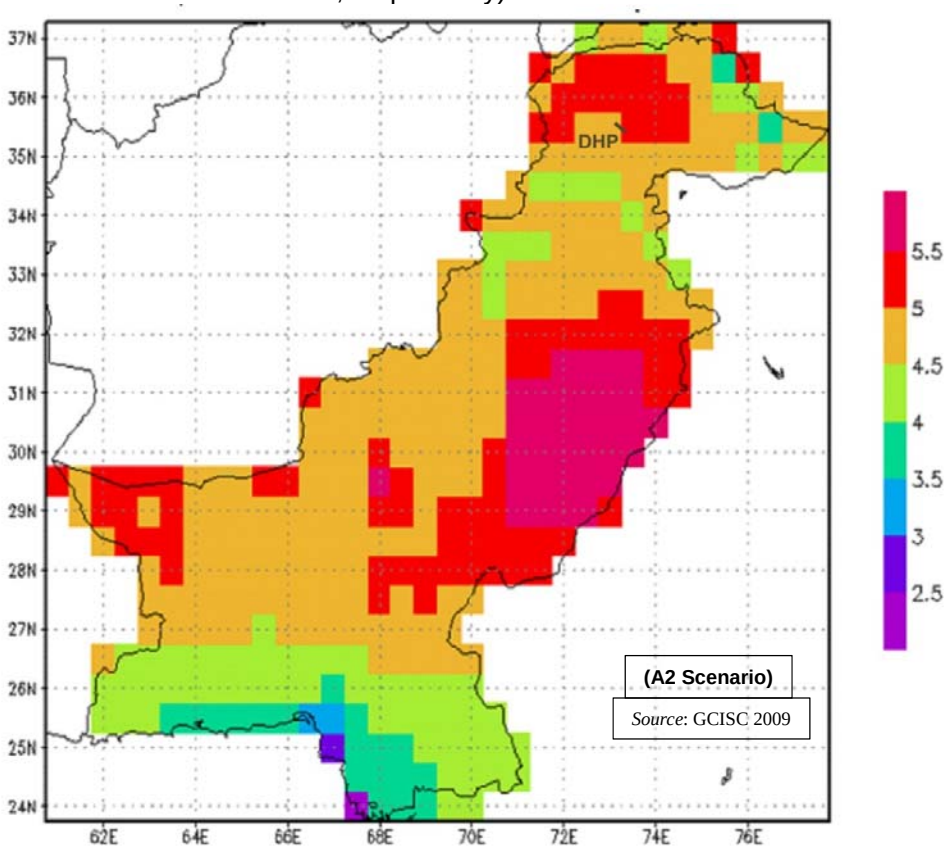


Figure 5.2: Projected Temperature Change (°C) for 2080s (PRECIS)

For Pakistan as a whole projected temperature increases are: in 2020s - 1.3-1.4°C; 2050s - 2.5-2.7°C; and 2080s - 3.9-4.4°C. In northern Pakistan, where the DHP is located, the change in temperature in the year 2080 is projected to be 4.1-4.7°C (Figure 5.3).

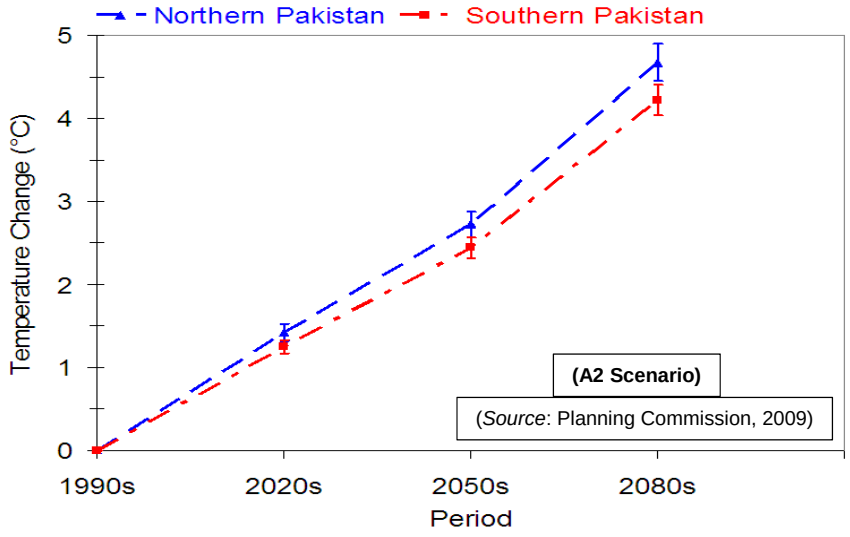
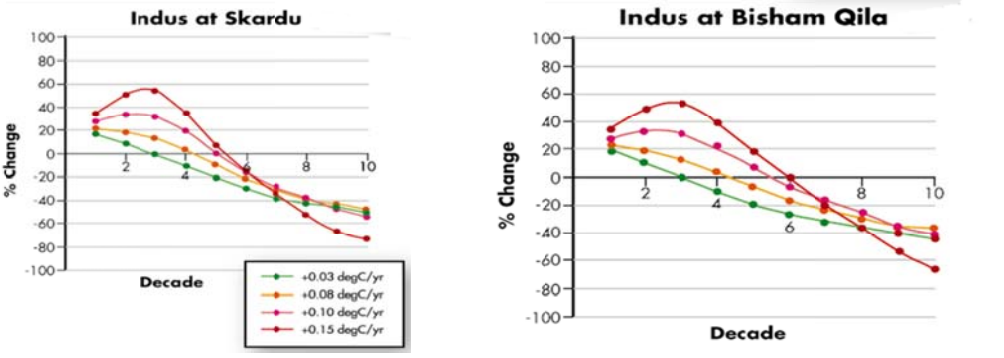


Figure 5.3: Projected changes in average temperature of Northern and Southern Pakistan

Melting of Glaciers: About 50-80% of the 174 BCM (141 MAF), average river inflows in the Indus River System (IRS) is fed by snow and glacier melt in the Hindu Kush-Karakoram (HK) part of the Hindu Kush-Karakoram-Himalayan (HKH) mountain ranges. After the Arctic/Greenland and Antarctic glaciers, the HKH represent the third largest ice mass on earth. These glaciers constitute about 2,700 cubic km of stored volume of ice (Roohi, 2005), equivalent to about 14 years of average IRS inflows.

Over the past century, glaciers worldwide have exhibited a receding trend; the HKH glaciers are receding faster than in any other part of the world and it is expected that if the present rate of recession continues, the HKH glaciers might disappear by 2035 (Rees, G. and D.N. Collins, 2004). The thermal regime of HKH glaciated region has in general warmed up and the frequency of occurrence of moderate as well as severe heat waves have also increased significantly (PMD, 2009). Preliminary analysis of the time series data on flows of the Indus and its tributary rivers has not indicated any large melting of glaciers so far (GCISC, 2009). Based on the studies available, it looks likely that the HKH glaciers are receding under the influence of global warming and that melting will increase with increase in summer temperature.

Based on IPCC AR4 2007, the glacier melting in the Himalayas is expected to increase flooding of Indus and its tributaries for the next two to three decades which will be followed by decreased river flows as the glaciers recede. It is expected that the river flows will decrease after a few decades due to reduced glacier mass to a level that would be determined by the precipitation input at that time. A three-year modeling study by the Centre for Ecology and Hydrology, Wallingford, UK and Alpine Glacier Project, University of Salford, UK covering the 100-year time horizon starting from 1991 reports that in the Upper Indus the mean river flow will increase between 14% and 90% followed by flow decreasing to between 30% and 90% of baseline by the last decade of the 21st century (Figure 5.4) (Rees, G. and D.N. Collins, 2004).



(Source: Rees and Collins, 2004)

Figure 5.4: Predicted Changes in Indus Flow

Recent simulation modelling conducted by GCISC on Indus flows for a scenario where temperature will rise by 3^{o}C and glaciers shrink to half their present size, indicates overall annual flow would reduce by about 15% and the monthly flow pattern would also change considerably, with more water coming in spring and early summer and less water in the later part of summer (Figure 5.5). The scenario used in that model (3^{o}C and 50% glacier recession) is believed to represent the future scenario of DHP, whose minimum life time will be up to 2060, and was considered in planning and design of the DHP.

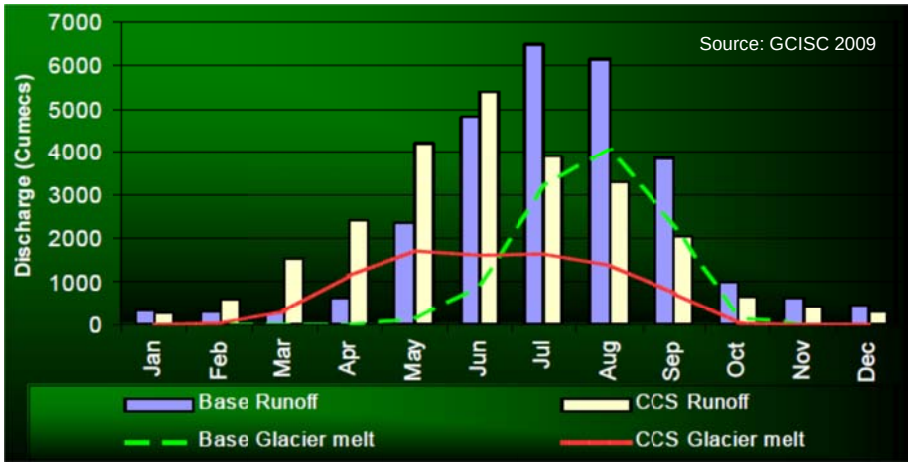


Figure 5.5: Present Base Flows (1995-2004) and Future Flows in Indus at Besham Qila for a scenario of 50% glacier recession and 3°C of temperature increase

5.1.3 Sedimentation

The sediments in the river water are comprised of suspended solid and moving bed load. The Indus River carries heavy sediment load due to the ruggedness of catchment terrains and lack of vegetation cover in the catchment. The annual runoff at DHP is 66.7 BCM with 78.6 % occurring from June to September; sediment load including both suspended sediment and bed load at the Dasu dam site was computed by transposing sediment values from those at Partab/Bunji Bridge plus Doyian and Besham Qila. Total annual sediment load entering Dasu Damsite works out to be 200 million tons.

The graph in Figure 5.6 shows the average monthly inflow discharge and monthly sediment inflow. For soil erosion, provincial department of soil conservation take care of watershed management, regulation and river morphology from time to time. Federal Flood Commission in association of provinces also takes care of river morphology and flood control structures.

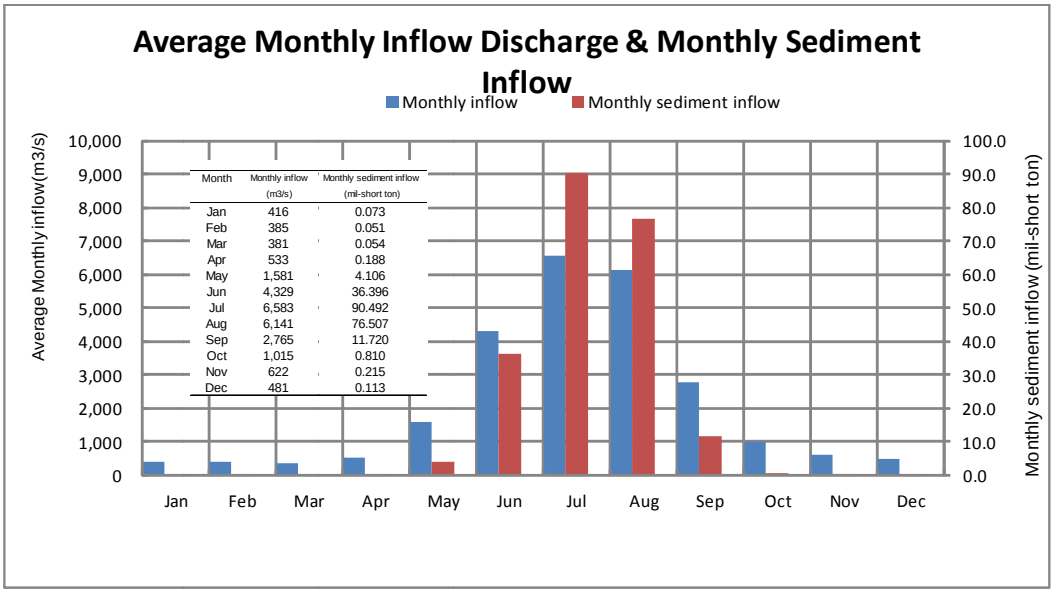


Figure 5.6: Sediment Load at Dasu Dam Site

Particle size distribution entering Dasu reservoir is assumed to be the same as at Partab/Bunji Bridge and is shown in Table 5.4.

Table 5.4: Particle Size Distribution of Total Sediment Load at Dasu Dam site

Sediment Type	Percent			Total (%)
	Sand	Silt	Clay	
Suspended	40.0	44.0	16.0	100
Unmeasured (Bed Load)	10.6	0.2	0.0	10.8
Total	50.6	44.2	16.0	110.8
Percentage	45.7	39.9	14.4	100

(Ref. Table 9-12 of DHP-FR 2009, on page 9-11 of Volume – 3, Hydrology)

5.1.4 Water Quality

Water quality of Indus and its tributaries in the DHP project area was collected during high flow season (July/Aug 2012) and low flow season (Nov/ Dec 2012) from fifteen sampling/analysis locations: i) Komila facing Jalkot, ii) Segloo, iii) Dam Axis, iv) Uchar Nullah, v) Barseen Gah/ Nullah, vi) Kandia River, vii) Lutar Nullah, viii) Churi Nullah, ix) Summer Nullah, x) Tangir River, xi) Darel River, xii) Harban Das, xiii) 5km d/s of Jalkot nullah, xiv) upstream of pattan and xv) Dasu Nullah (about 3 km from Dasu Bridge upstream.

Water quality results of Indus (from Basha to Tarbela) and its tributaries during high flow season (summer 2012) are given in Table 5.5. Water quality, in general, is in compliance with National Environmental Quality Standards (NEQS) on drinking water. In situ water quality tests were also conducted by the project fisheries team during August-September, 2012 (Table 5.6).

Table 5.5: Summary of Water Quality Results (Samples Collected on July 12- August 2, 2012)

Sr. No	Parameter	Indus		Tributaries	
		U/S	D/S	U/S	D/S
1	Water Temperature (ºC)	18-21	17-18.3	15.5-21	15.6
2	Taste	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
3	Odour	Non-Objectionable	Non-Objectionable	Non-Objectionable	Non-Objectionable
4	pH	7.03-8.07	7.50-8.11	7.12-7.82	7.65
5	Dissolved Oxygen (mg/l)	8.2-9.3	8-12	7.7-8.9	11.89
6	Conductivity (µs/cm)	61.9-69.3	40-96.3	11.9-37.1	63
7	Turbidity (NTU)	3-45	57.5-70.5	1-8.45	0.55
8	Total Hardness as $CaCO_3$ (mg/l)	8-62.6	30-65	10-23.4	40.2
9	BOD_5 (mg/l)	2.5-10	4.2-12	2-6.1	2.0
10	COD (mg/l)	3-21.3	7-19.3	3.5-12.3	5.0
11	Total Dissolved Solids (mg/l)	72.2-105	75.5-115.8	14-63	56
12	Total Suspended Solids (mg/l)	84-127	16-245	ND-17	ND
13	Chloride (mg/l)	9-10	7-12	2.5-22	1.0
14	Chlorine (mg/l)	ND-0.38	0.01-0.15	0.02-0.20	0.03
15	Sodium (mg/l)	3.94-5.95	2.29-7.13	1.44-3.36	3.80
16	Fluoride (mg/l)	ND-1.12	0.547-0.90	ND-0.75	0.09
17	Iodine (mg/l)	ND-0.90	0.14-0.33	0.1-0.75	0.16
18	Sulphate (mg/l)	ND-37	3.9-35.5	0.5-4.0	0.18
19	Sulphide (mg/l)	0.54-1.18	0.05-0.64	0.09-0.45	0.23
20	Nitrogen ammonia (mg/l)	0.95-2.53	0.73-2.53	ND-1.02	0.85

Sr. No	Parameter	Indus		Tributaries	
		U/S	D/S	U/S	D/S
21	Nitrate (mg/l)	1.90-3.50	0.02-230	0.09-2.90	0.60
22	Cyanide (mg/l)	0.008-0.045	0.02-0.035	0.003-0.045	0.005
23	Copper (mg/l)	0.006-0.012	0.008-0.029	0.001-0.006	0.006
24	Cadmium (mg/l)	ND	ND	ND	ND
25	Chromium (mg/l)	0.013-0.016	0.004-0.033	0.006-0.020	0.009
26	Lead (mg/l)	ND	ND	ND	0.010
27	Silver (mg/l)	ND-0.00037	ND-0.0004	ND-0.0002	ND
28	Zinc (mg/l)	0.044-1.439	0.182-1.295	0.01-1.042	0.616
29	Nickel (mg/l)	0.016-0.022	0.013-0.021	0.005-0.018	0.010
30	Arsenic (mg/l)	0.002-0.007	0.005-0.032	ND-0.003	0.001
31	Selenium (mg/l)	ND-0.008	ND-0.009	ND-0.009	ND
32	Manganese (mg/l)	0.044-0.121	0.072-0.373	0.002-0.012	0.005
33	Iron (mg/l)	2.045-4.298	0.562-15.941	0.066-0.403	0.071
34	Barium (mg/l)	ND-0.21	0.016-0.229	ND-0.034	0.120
35	Boron (mg/l)	0.21-1.90	0.20-2.10	ND-0.90	0.22
36	Mercury (mg/l)	ND-0.0006	ND-0.0020	ND-0.002	ND
37	Magnesium (mg/l)	3.73-9.29	1.20-10.40	0.71-2.51	3.42
38	Phenolic Compounds (mg/l)	ND	ND	ND	ND

ND= Not Detected U/S=Upstream D/S=Downstream

Table 5.6: In Situ Water Quality Tests

Sr. No	Parameter	Indus		Tributaries	
		U/S	D/S	U/S	D/S
1	Air temperature (ºC)	31-35	22-35	30-38	26-37
2	Water Temperature (ºC)	15-24	15-19	14-21	16-21
3	H_2O depth (ft)	18-50	15-70	1.5-2.5	1.5-3.5
4	Secchi Disc Depth (m)	0.15-0.5	0.3-0.5	0.15-1.0	1.0-2.5
5	H_2O colour	Muddy	Muddy/Sandy	Colorless-Greenish	Colorless
6	Dissolved Oxygen (mg/l)	4.8-7.4	5.5-7.4	5-10	6-70
7	Dissolved Carbon dioxide (mg/l)	10-16	10-12.5	0-50	13-29
8	NO_3 (mg/l)	0.41-1.20	0.20-0.84	0.34-1.70	0.40-1.70

5.1.5 Biodiversity

The UIB contains a very diverse ecosystem spread over northern mountain side of Pakistan to the Indus delta in the south to the Arabian Sea. The concentration of high mountains formed by convergence of three mountain ranges, the Hindu Kush, Karakoram and Himalayas, at the confluence of the Indus and Gilgit rivers, provides a unique ecosystem with various floral and faunal species.

Biological diversity in the Indus Basin has not been investigated systematically, although floral and faunal diversity of some areas has been explored and a partial picture of biodiversity exists. Based on literature review (Roberts 1991 & 1992, Roberts 1997, Sheikh, 2001, Rafiq 1999, and Baig 2001), estimated numbers of species of some major taxon groups are provided in Table 5.7.

Table 5.7: Biodiversity Reported from the UIB

Taxon / Groups	Reported from Pakistan	Reported from UIB
Mammals	196	55 plus
Birds	668	255 plus
Reptiles/Amphibians	177/22	23/6
Freshwater fishes	198	20
Insects	>5000	?
Plants	>5000	?

Sources: GoP, IUCN and WWF (2000); Roberts (1997); Virk, Sheikh & Marwat (2003); Sheikh & Molur (2005) and Sheikh et al (2012)

Plant Biodiversity: About 5,700 species of flowering plants have been reported from Pakistan, and almost 400 of these are endemic species (Nasir and Ali 1970) and around 1,000 species of vascular plants are known to occur in northern mountain regions of Pakistan. Most of the endemic plants are found in the northern and western mountains of Pakistan (Ali and Qaiser 1986). GB and KP harbor some of the richest plant communities in the Indus Basin region.

Plant diversity in the Upper Indus Basin is yet to be explored fully. The people of the Basin largely depend on wild plants for fuel, as food supplements, medicine, construction material, farm nutrients and livestock feed. Many of these plants are now threatened by a number of factors. Most pervasive one is loss or degradation of habitat due to overgrazing of fragile alpine meadows and collection of firewood and shrubs to meet the fuel wood requirement. Collection of medicinal plants with commercial value and for local use has also pushed some populations of rare plants into threatened category. Out of about 5,700 plant species in Pakistan, 400-600 species are considered to have medicinal uses. Out of these, 300-400 species are used in traditional medicines. These medicines are prescribed by Hakims, which provide healthcare for the most people in rural areas. Plants of ethno-botanical importance in the upper basin are listed in Table 5.8. A number of plants found in the upper Indus Basin are listed on the appendices of the CITES, such as *Saussurea lappa* (Kuth), a plant of commercial and medicinal value.

Table 5.8: Plants of Ethno-botanical Importance in the Upper Indus Basin

Scientific Name	Local Name
Artemisia maritima	Afsantin
Saussria lappa	Kuth
Picrorhiza kurroa	Karru (Katki)
Podophyllum emodi	Bankakri
Glycyrrhiza glabra	Mulathi
Aconitum heterophyllum	Atees
Ferula foetida	Hing
Onosma spp.	Goazaban (Ratanjot)
Rheum emodi	Revand-chini
Thymus serpyllum	Tumuro
Valeriana wallichi	Mushbala
Hippophae rhamnoides	Buru (Sea Buckthorn)
Ephedra spp. Som	Asmani buti
Carum spp.	*Zeera* Saffed Rattu
Cumium cyminum	Kamsal Zeera
Cannabis sativa L.	Bhang
Ajuga parviflora	Kauri buti
Mentha longifolia	Feeru
Olea ferruginea	Kao

Ethno-botanical surveys are needed to identify plants of medicinal and commercial importance and to determine the status of key species of medicinal plants which have been over-exploited. Medicinal plants are threatened by: (1) habitat degradation due to increased human activities (grazing of domestic livestock, farm encroachment), (2) over-exploitation of rare and endangered species, and (3) loss of regeneration potential of degraded forests. Forest areas are the main source of medicinal plants, particularly the undisturbed natural forests. These forests are under increasing pressure from increased human population. Unless concrete steps are taken for promoting in-situ conservation of medicinal plants, many important species of economic value may be lost.

Animal Biodiversity:

Mammals: More than 55 species of mammals are estimated for UIB on the basis of published information and the distribution maps and discussion contained in Roberts (1997). Only one species is endemic to the Indus Basin, the woolly flying squirrel, while Astore Markhor (flare-horned Markhor) can be considered near endemic, as its distribution is restricted to a few valleys mainly by rugged terrain and geographic barriers like rivers. Distribution of many small mammal species is patchy and restricted to certain watersheds due to physical barriers like high mountains and rivers. The most diverse groups are carnivores and rodents. Rodents have a high breeding capacity and constitute the food base for many carnivores. Species like shrews provide food base to foxes, weasels and stone Mortens (Z.B. Mirza, 2001 and 2002). Upper Hunza and the triangle between Indus River and Astore rivers are "hot spot" for large mammal diversity. Most of these species require large habitat areas to maintain viable populations. Particularly, species like markhor and Ladakh urial constitute much of the remaining global populations. Both of these species are considered as endangered and are listed in Appendix – F of CITES. A list of threatened mammals in the Indus basin is given in the Table 5.9.

Table 5.9: List of Threatened Mammals in the Indus Basin

Common Name	Scientific Name
Snow leopard	*Uncia uncial*
Himalayan lynx	*Felix lynx*
Indian wolf	*Canis lupus*
Himalayan black bear	*Ursus thibetanus*
Himalayan brown bear	*Ursus arctos*
Musk deer	*Moschus chrysogaster*
Flare-horned Markhor	*Capra falconeri felconeri*
Ladakh urial	*Ovis vignei vignei*
Marcopolo sheep	*Ovis ammon poli*
Blue sheep	*Pseudois nayaur*
Wooly Flying Squirrel	*Hylopetes cinereus*
Kashmir Flying Squirrel	*Hylopetes fimbiratus*

Source: Sheikh & Molur (2004): Status and Red List of Pakistan Mammals

Avifauna/ Birds: The Indus Basin has one of the most diverse avifauna of the mountain regions of the world, but unfortunately little information is available on the distribution, status and ecology of many bird species. The comprehensive account on the avifauna of Pakistan comes from Roberts (1991 and 1992) and Sheikh (2001). Some researchers have documented details of bird diversity such as avifauna of Khunjerab National Park (WWF 1996, Blumsetin 1995), Deosai Plateau in Baltistan (Woods et al. 1997, Khan and Rafiq 1998) and in Naltar Wildlife Sanctuary (Sheikh 2001).

The Karakoram and Himalayan ranges separate the uplands of Central Asia from the Indian Sub-continent, thereby forming an effective barrier between two large areas of Asia which are different climatically: cold high Asia and tropical south and Southeast Asia. The area serves as staging, transitory, breeding, migratory and otherwise native

grounds for many bird species. In total, about 255 species of birds have been estimated for the Indus Basin. These include passage migrants, vagrant, resident, breeding and irregular visitors. Many of these species breed in various locations of the Indus Basin over a large range. The lack of reliable and consistent published data on the avifauna of GB and KP indicates the need for long-term ornithological studies to determine the distribution and abundance of the bird species. A list of threatened species is given the Table 5.10. These species have small and fragmented populations and are threatened by loss and fragmentation of their habitat.

Table 5.10: Threatened Bird Species Found in the Indus Basin

Common Name	Scientific Name
Western-horned Tragopan	*Tragopan Melaoncephalus*
Himalayan Monal pheasant	*Lophorous impejanus*
Lesser Kestrel	*Falco naummani*
Snow partridge	*Lerwa lerwa*
Ferruginous duck	*Aythya nyroca*
Kashmir flycatcher	*Ficedula subrubra*
Long-billed bush warbler	*Bradypterus major*
Tytler's Warbler	*Phylloscupos tytleri*
Indian skimmer	*Rhynchops allicollis*
Sociable lapwing	*Vanelllus gregarius*

Source: Virk, Sheikh and Marwat, 2003

Threats to the avifauna include habitat loss, habitat alteration, (especially breeding habitat), loss of edges, especially forest edges, deforestation, expansion of agriculture, use of pesticides and direct persecution by human. Direct persecution involves hunting, trapping, shooting from agriculture fields and poisoning. Use of pesticides on crops and fruit trees has reduced the population of many species, particularly of magpies, crows, yellow-billed chough and rock dove.

Reptiles and Amphibians: Herpetofauna in northern Pakistan is represented by 3 families of amphibians (Ranidae, Bufonidae & Megaphrydae) and 8 families of reptiles (Gekkonidae, Agamidae, Scincidae, Varanidae, Boidae, Colubidae, Elaphidae and Viperidae). About 23 species of reptiles and 6 of amphibians have been reported from northern Pakistan. Among reptiles 9 species are of lizards and 14 of snakes, while among amphibians 2 species of frogs and 4 of toads (estimated from Baig 2001). Despite efforts of some early herpetologists, herpetofauna remained largely un-described. Most of the herpetological explorations are concentrated in and around protected areas (e.g KNP and Deosai national parks). A number of reptilian species are either endemic to the region or have restricted range distribution. These species include 2 amphibians and 4 lizards (Table 5.11). Most of these species are restricted to their type locality; more detailed work is needed to understand composition of herpetofauna in northern Pakistan. Lower herpetofauna diversity is probably due to extreme climatic conditions, rugged terrain, and rapid rivers, which have acted as barrier to species like turtles and tortoises.

Table 5.11: Endemic Species of Herpetofauna of the Indus Basin

Species	Scientific Name
Amphibians	
Deosai Frog	*Scutiger occidentalis*
Batura toad	*Bufo pseudoraddi batuae*
Reptiles	
Pakistani Rock Agama	*Laudakia pakistanica pakistanica*
Auffenberg's Rock Agama	*Laudakia pakistanica auffenbergi*
Khan's Rock Agama	*Laudakia pakistanica khani*
Batura Bent-toed Gecko	*Crytodactylus baturensis*

Source: Virk, Sheikh and Marwat, 2003

Insect and Butterflies Diversity: In Pakistan, more than 5000 species (BAP, 2000) of insects are reported. Though Pakistan Forest Institute, Peshawar has good collection of insects, including those from Indus Basin region, still very little information is available on the insect diversity. Pakistan Museum of Natural History (PMNH) and the Oxford University Museum have been studying insect diversity from Gilgit along the Karakoram Highway to the Sino-Pakistan border on Khunjerab Pass and several selected valleys. They have recorded about100 species of butterflies, with new taxa being added on each visit. For example, about 40 butterfly species were recorded during the Hunza 2000 expedition; four of these were new records to Pakistan. The beneficial and harmful roles that insects play in the human environment are well recognized. However, the present level of information on insect biodiversity remains very low and the scope for new discoveries and useful knowledge regarding insect diversity remains very high, particularly to find out endemic species of insects. There is need to document invertebrate fauna of the Indus Basin, for which local expertise can be developed by involving local research institutions who can facilitate collection of samples. Recent increase in use of pesticides on agriculture crops and orchids may have negative impact on many useful insects which help in pollination of fruit trees.

Agro-biodiversity: Agro-biodiversity refers to genetic variability in cultivated plants and domesticated animals including their closely related wild species growing and evolving under natural conditions. Agro-biodiversity not only directly contributes to national economies, but it also provides employment and livelihood to a large section of the society. There are growing concerns that modern commercial agriculture has had a direct negative impact on biodiversity at all levels: ecosystem, species and genes, and on both natural and domestic diversity (UNEP 1995).

The Upper Indus Basin lies in close proximity to the two major centers of agro-biodiversity — Central Asia and China. Moreover, diversity in agro-ecological zones, crops, fruit, domestic animals, farming systems and cultural diversity make this area rich in agriculture biodiversity. Particularly, northern Pakistan is considered the center of diversity for several nut fruits. Over the centuries, local communities have evolved strategies for harnessing local agro-biodiversity for food and nutrition. Livestock biodiversity in the upper basin is shown in Table 5.12.

Table 5.12: Status of Livestock Biodiversity in the Upper Indus Basin

Species	Total Breeds in Pakistan	Breeds in the Indus Basin
Yak	1	1
Cattle	12	1
Goats	32	7
Sheep	37	4
Horses	4	2
Donkeys	4	1
Camel	?	1
Chicken	3	1

Source: Virk, Sheikh and Marwat, 2003

Wetland Biodiversity: Wetlands are very important for ecological stability and have great value for humans. They regulate water levels within watersheds, improve water quality, reduce flood and storm damage, provide important fish and wildlife habitat, and support hunting, fishing and other recreational activities. There are about 25-33 wetlands of different size in the upper Indus Basin; important wetlands are listed in Table 5.13. These wetlands are mainly freshwater and glacial lakes, which are fed by streams, snowmelt, glacial and spring water. Most of the alpine wetlands exist between 2800 and 4000m of elevation. Sheikh (1999) has studied the Naltar wetland complex for its ecology and as a habitat for breeding birds. Species of leaf warblers, bush warblers, tits and buntings breed at the edges of these wetlands at the height of 2,800 to 3,100 meters. Pakistan once supported enormous waterbird populations,

especially in winter, but these declined dramatically during the twentieth century. Many natural wetlands disappeared as a result of irrigation and drainage projects to provide more land for agriculture and habitation, although at the same time new lakes and marshes were created upstream of dams and barrages, or as a result of faulty drainage systems or overspill from irrigation canals. Although this overall loss of habitat was undoubtedly a factor in waterbird declines, the main cause was probably the high levels of hunting and disturbance throughout much of the Indus watershed (mostly Indus Basin downstream of Tarbela). These pressures continue to depress waterbird numbers, but if they could be controlled there is potential for population recoveries.

Table 5.13: Significant Wetlands in the Upper Indus Basin

Sr. No.	Wetland	Status
1	Deosai Plateau Wetland Complex/ Sheosar Lake	National park
2	Naltar Wetland Complex	Not Protected
3	Borith Lake	Not Protected
4	Shimshal Lake	Not Protected
5	Satpara Lake	Wildlife Sanctuary
6	Kachura Lake	Not Protected
7	Rama Lake	Not Protected
8	Jutial lake	Not Protected

Source: Virk, Sheikh and Marwat, 2003

Major issues noted with wetlands in the Indus Basin are dams and irrigation; siltation; disturbance; pollution; poaching and excessive hunting; inadequate data on bird population and migratory trends.

5.2 LAND AND RESOURCE USE

5.2.1 Water Use

Pakistan's population was 173.5 million in 2010 and is expected to reach 242 million by the year 2030. Population rise, rapid urbanization and better socio-economic conditions, will bring about increasing pressure on water resources. Future water requirements for all sectors are given in Table 5.14.

Table 5.14: Future Water Requirements at Farm Gate – BCM (MAF)

Sector	YEAR					
	2000*	**2010****	**2015****	**2020****	**2025***	**2030****
Water Supply & Sanitation	5.55 (4.5)	7.4 (6.0)	9.25 (7.5)	11.10 (9.0)	12.95 (10.5)	14.8 (12.0)
Industry	4.32 (3.5)	4.69 (3.8)	5.06 (4.1)	5.55 (4.5)	5.92 (4.8)	6.29 (5.1)
Agriculture	122.07 (99.0)	128.23 (104.0)	134.4 (109.0)	140.56 (114.0)	146.73 (119.0)	152.89 (124.0)
Environmental Protection	1.6 (1.3)	1.73 (1.4)	1.85 (1.5)	1.97 (1.6)	2.1 (1.7)	2.22 (1.8)
Total:-	**133.54 (108.3)**	**142.05 (115.2)**	**150.56 (122.1)**	**159.18 (129.1)**	**167.7 (136.0)**	**176.2 (142.9)**

Source: **For Year 2000 & 2025 National Water Policy Vol II, January 2003*
***For years 2010, 2015, 2020 & 2030 computed on proportional basis.*

Main water uses are:

- ***Agriculture*** - The total area of the country is 79.61 Million hectares (Mha) of which 23 Mha is designated as cultivated area. About 19.6 Mha cultivated land is served by irrigated water, while the remaining 3.4 Mha is rain fed. Almost 90 percent of water resources are being used to meet crop water demand. Increases in agricultural production to meet the needs of a rising population, will require additional water. Based on population growth projections, by 2030

an estimated additional 24.66 BCM (20 MAF) over year 2010 will be needed for agriculture at the farm gate (assuming a 50 percent increase in crop yields from non-water inputs).

- ***Municipal*** – In 2000 total water uses for domestic and municipal purposes in both urban and rural areas are estimated at 5.55 BCM (4.5 MAF). By 2030 requirements for water supply, rural potable water and sanitation requirements are estimated to be 14.80 BCM (12.0 MAF) resulting in shortfall of 9.25 BCM (7.5 MAF).
- ***Industry*** - There are over half a million large and small industrial units in the country, of which nearly 120,000 are engaged in textile, chemical, fertilizer, tanneries and other manufacturing and processing activities. The water in year 2000 use by all industries and mines is estimated to be 3.5 MAF. This is expected to rise to 6.29 BCM (5.1 MAF) by 2030, i.e. an additional requirement of 4.23 BCM (1.6 MAF).
- ***Environment*** - In order to ensure adequate water throughout Pakistan for wetlands, environmental protection and increased irrigated forestry, about 2.22 BCM (1.8 MAF) water will be required by the year 2030. The equivalent water requirement for 2010-11 is about 1.73 BCM (1.4 MAF). Thus 0.49 BCM (0.4 MAF) more water will be needed for environmental protection.

Water availability in Pakistan is 1,030 m^3 per capita/year (2010); this is already well below the 1,700 m^3 per capita/year threshold for water stressed conditions. Thus Pakistan is already fast moving into a condition of 'water scarcity'. This situation is likely to deteriorate in future as the gap between supply and demand widens. However, the gross additional water demand (at the farmgate[2]) for all sectors by 2030 over year 2010 will be about 34.15 BCM (27.7 MAF) (24.66 BCM (20 MAF) for agriculture and 9.49 BCM (7.7 MAF) for municipal water supply, rural potable and sanitation, industry and the environment). The corresponding requirement at the canal head (including provision for system losses where applicable) would be nearly 48.09 BCM (39 MAF). Water available for future development is about 38.22 BCM (31 MAF) including 27.13 BCM (22 MAF) of river flow, 7.89 BCM (6.4 MAF) from groundwater and 3.70 BCM (3 MAF) from rainfall harvesting.

This shortfall of about 48.09 BCM (39 MAF) of water by the year 2030 is to be met through creating storage facilities and diverting 27.13 BCM (22 MAF) to canals which at present is flowing to sea after allowing 10.6 BCM (8.6 MAF) for environmental flows. This additional diversion of 27.13 (22 MAF) at canal head would add about 19.24 BCM (15.6 MAF) at farm gate. Taping a potential of 7.89 BCM (6.4 MAF) pumpage from groundwater and 3.7 BCM (3 MAF) from rain water harvesting will add to this making additional water availability at farmgate upto 30.83 BCM (25 MAF). A planned program of water course improvement by 2030 will cover all the water courses of country enhancing water course efficiency upto 92% and will save wastage of about 12.33 BCM (10 MAF) in the irrigation system and thus the total water availability at farmgate would be about 176.32 BCM (143 MAF). The future water requirement of about 176.32 BCM (143 MAF) for all sectors by 2030 would be safely met mainly through construction of large storages to overcome storage loss due to sedimentation and improve water regulation.

Irrigation: Irrigated agriculture is the dominant user of Indus waters. The irrigation network is the largest one of its kind in the world. Irrigation in this system started as early as 100 BC when lands were irrigated in the Indus Plain by flood water. Inundation canal system of irrigation started during Mughal Empire, when river stages became high in summer. The system that exists today started in middle of the 19th

[2] *Farmgate: Final Outlet from Canal system to Farmer land.*

century under British rule. Barrage controlled irrigation systems were constructed during the period 1908 to 1982. Important projects were constructed from 1920 to1947, notably: Sukkur Barrage; Sutlej Valley Project (SVP) consisting of 4 weirs on Sutlej River; and Haveli Canal including a barrage at Trimmu. Another major development in early twentieth century was Triple Canal Project comprising Upper Jhelum, Upper Chenab and Lower Bari Doab canals.

After independence in 1947 Kotri, Taunsa and Guddu barrages were constructed to convert Indus Inundation Canals to weir control. A major addition between 1960 and 1977 was Indus Basin Project (IBP) comprising Mangla Dam, Tarbela Dam and a system of barrages and link Canals for transferring waters from Western to Eastern Rivers.

Existing Indus Basin Irrigation System (IBIS) is schematically shown in Figure 5.7.

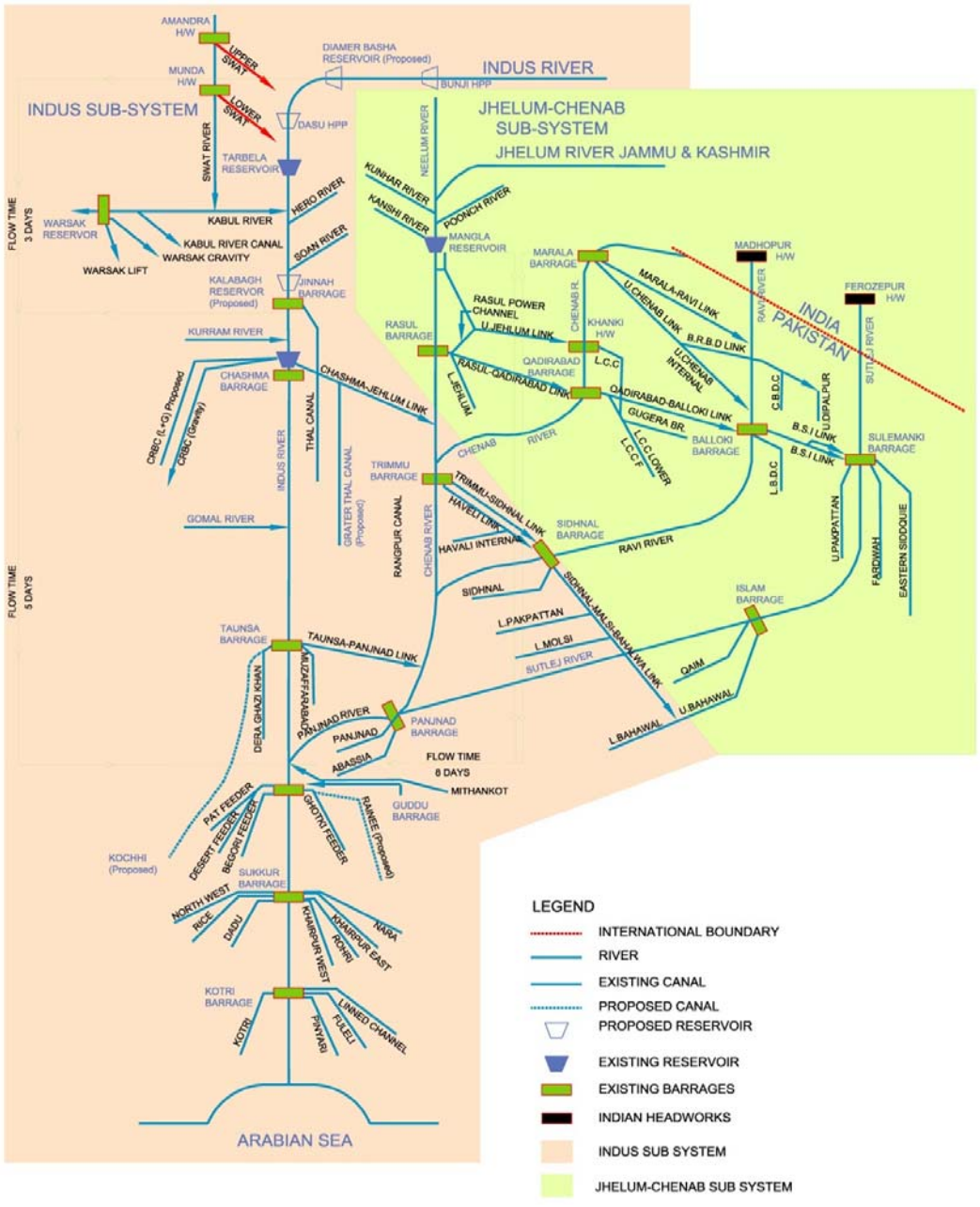


Figure 5.7: Schematic Diagram – Indus Basin Irrigation System

IBIS consists of two Sub-systems namely: Jhelum Chenab also known as Mangla Command; and Indus known as Tarbela Command. J-C Sub-system comprises Jhelum, Chenab, Ravi and Sutlej Rivers and Mangla dam on Jhelum River, a network of barrages and off-taking link and irrigation canals. Indus Sub-system includes: Indus and Kabul rivers with its tributaries; Tarbela Dam on Indus River; and Warsak Dam on Kabul River.

Other works in Indus Sub-system include a network of barrages consisting of: Jinnah, Chashma, Taunsa, Guddu, Sukkur and Kotri on the Main Indus River; Trimmu on Chenab River; Sidhnai on Ravi River; and Panjnad on Panjnad River.

In the wake of implementation of IBP, the Government of Pakistan (GoP) appointed various committees and commissions to resolve the water allocation issues between the provinces. However, no settlement could be reached and GOP resorted to adhoc distribution of waters to the provinces after completion of IBP.

Adhoc distribution arrangements continued till resolution of the water dispute among provinces through Water Apportionment Accord (WAA) of 1991. WAA also envisaged establishment of an Indus River System Authority (IRSA) for implementation of its provisions among four provinces. Under an act of the Parliament, IRSA was established in January 1992 and soon assumed the basic responsibility of overseeing the distribution of Indus River waters among the co-sharers in accordance with WAA. The allocations agreed by the provinces as per WAA 1991 were, in essence, based on the historic concept of:

i. Protecting the prescriptive rights of the provinces acquired through actual canal withdrawals under various projects.
ii. Apportioning the surplus water equitably to afford greater development opportunity to relatively backward areas.

These demands, by the time of assumed commissioning of Diamer Basha (2017), have been projected as per entitlements of Water Apportionment Accord (WAA) by considering; (i) Existing commitments (ii) New projects under construction / completed (iii) Ecological requirements below Kotri.

5.2.2 Forestry

According to constitution of Pakistan, forestry is a provincial mandate and the provinces can make and implement their own forest policies within the framework of the national forest policy. Participation of local communities, promotion of private sector investment, and recommendations for the revision of the forestry legislation has been included. Illegal harvesting and the local need for fuel wood and construction timber have been recognized as core problems. The policy for the first time not only addressed the traditional forests but also the management of rangelands, wastelands, watersheds and farm forestry (Shahbaz et al 2002). The Pakistan National Forest Policy (2001) dictates that Mountain forests are critically important to Pakistan. They provide a carbon sink to mitigate global warming, are repositories of invaluable biodiversity, safeguard water supplies, retard loss of soil and water from watersheds thereby reducing the siltation of waterways and water storage reservoirs, and afford sustenance to large human communities and their livestock.

The northern Pakistan's natural forests are amongst the most important forests in Pakistan. They play a vital role in protecting the watershed of the Indus River; support a rich diversity of flora and fauna; serve as an important source of forage and pasture for the livestock population; contribute to the national supply of softwood; provide critical supplies of timber and firewood to local communities; supply an important array of non-timber forest products (NTFPs), including medicinal plants, spices, honey and mushrooms; and have tremendous potential for recreation and the development of ecotourism. The management of these forests is thus of local, national and

international concern. These forests fall under two broad legal classifications. “Protected forests” are state-owned forests, designated under the Pakistan Forest Act (1927). Although none of the GB’s protected forests has been commercially exploited, virtually all have been significantly degraded. “Private forests” are owned by local communities, under the terms of the Gilgit Private Forests Regulation of 1970 and the subsequent Rules framed in 1975. The GB’s private forests cover an area of approximately 217,088 ha. They are owned by the tribal communities of Chilas, Darel and Tangir, but managed by the Northern Areas Forest Department, which is responsible for overseeing commercial timber extraction and timber sales (GoP and IUCN, 2003).

Securing a sustainable future for the forests of the GB will require action on many different fronts, and at many different levels. The principal objectives at this point in time will be to conserve all remaining natural forest areas, and to initiate a process of rehabilitation at priority sites.

It is absolutely clear that forests and non-timber forestry products are playing a key role in the life of mountain people. They serve needs for fuel wood, home construction, furniture and trading to Gilgit Baltistan (GB) trade centers and the down country to meet commercial and business objectives. Throughout the Indus Basin, there are remarkable forests on both sides of the river; however, the main density of forests is in the upper reaches of the valleys and mountain ecosystems. The chief marketable product is timber. Local demand for Fuel/firewood exists in Shigar, Skardu, Gilgit, Bunji, Komila-Dasu, Pattan, Dubair and adjoining areas.

5.2.3 Agriculture

Gilgit-Baltistan

Gilgit-Baltistan (GB): Land-use in the GB is dominated by subsistence cultivation, fruit growing, livestock raring, forestry and protected areas. There is a small but growing service sector, particularly in transportation, tourism and trading, as well as a significant military presence. Although the GB’s mineral and fisheries resources appear to be considerable, this potential has remained largely untapped to date.

The GB’s high altitudes, rugged mountains and sweeping glaciers make much of the region uninhabitable. Only two per cent of the Northern Areas is believed to be cultivable. Of this area, just over one per cent is already in use for the production of grain crops, vegetables and fruits. Approximately nine per cent of the Northern Areas is occupied by natural forests and scrub, and 22 per cent by rangelands (primarily alpine pasture).

A majority of the population (approximately 80 per cent) is engaged in subsistence agriculture. Human settlements are concentrated along the valley floors, where glacial melt provides sufficient water for cultivation. Agricultural systems vary significantly with altitude. Between 1,200 and 2,000 metres, both summer and winter crops are grown; wheat is typically produced after harvesting maize. Between 2,000 and 3,000 metres, only summer crops (either maize or wheat) are grown. Beyond 3,000 metres, cultivation ends and high forests and alpine pastures begin. Accordingly the agro-ecological zones of Northern area are indicated in Table 5.15.

Irrigated land consists primarily of small terraces, on which wheat, maize, barley, potatoes and vegetables are grown. The raising of fruit trees is another important use of land, particularly in the valleys of Baltistan, Hunza and Yasin. Common fruits include apricots, almonds, pomegranate, grapes, peaches and mulberries. Trees are planted along fields or in small groups in the fields, as well as in courtyards. They are not only a source of food, but also play an important role in the cash economy; many people have now started to export dry and fresh fruit to earn income.

Table 5.15: Agro-Ecological Zones (AEZ) of the GB

AEZ	Location	Settlement Type	Elevation (m)	Characteristics
I	At the base of valleys, near the Indus river.	Compact winter villages.	1,200-2,000	Double cropping zone. Wheat is typically grown in the winter crop and maize in the summer. Approximately one-third of the total cultivated area is found in this zone.
II	In the middle and higher reaches of the valleys.	Usually dispersed settlements.	2,000-3,000	Single cropping zone, snow in winter. Approximately two-thirds of the total cultivated area is found in this zone.
III	High pasture and forest land.	Scattered summer shelters.	3,000+	No cultivation; snow-bound in winter.

Livestock are an integral component of the agricultural system. In 1996, the total livestock population of the GB was estimated to exceed two million animals, including 397,957 cattle, 1,047,285 goats and 518,052 sheep.

The economic conditions of people of GB can be improved by growing cash crops, and replacing low value crops with high value crops. Promotion of economically important and health wise beneficial medicinal plants be carried out. As GB exists in isolation, day temperatures are high, night temperatures are low, humidity contents are also low, oil seed crops produce maximum oil contents under such conditions. Likewise, because of above environmental parameters GB is extremely useful for seed production of number of cereal and vegetable crops.

Due to dwindling sources of forests, agro-forestry needs to be promoted and a number of trees have been identified that can go for this enterprise. Added with the propagation of mulberry trees is the industry of sericulture. One of the stakeholders, makes all these activities possible, is the banking system that loans out money for in time execution of all the farming practices. An estimate of the present land use of GB is only 1% of GB that is cultivable. About 4% is occupied by forest and 23% are rangelands mainly alpine pasture. Table 5.16 shows land use statistics and crops in GB.

Table 5.16: District-wise land use in GB (Northern Areas)

Sr. No.	District	No. of Farm	Farm Area (ha)	Cultivated Land (ha)	Farm Area uncultivated (ha)		
					Cultivable Waste	Forests	Total
1	Gilgit	17573	21624	11900	18073	17028	35101
2	Ghizar	11302	15223	7800	7896	7740	15636
3	Diamer	16008	16583	14900	32000	249784 (218784 Private)	281744
4	Sakardu	22746	22127	15200	20859	9288	30147
5	Ghanche	11351	25557	7900	11636	100	11736
Grand Total		**78980**	**101114**	**57700**	**90464**	**283900**	**374364**

Source: Northern Areas Strategy for Sustainable Development – IUCN (2002)

Khyber Pakhtunkhwa: KP Province has a population of more than 20 million people. Approximately 83% of this population lives in rural areas putting a tremendous pressure on land resources. The province possesses 10.17 million hectares of land, of which the cultivable area is 2.75 million hectares. Out of cultivable area only 1.8 million hectares is cultivated whereas 1.08 million hectares is cultivable waste. The major chunk of cultivated land is rain fed which constitute 49% of the cultivated area.

This scenario resulted in a situation where 94% farms are now below the range of 12.5 acres, which is a subsistence farm level. The land tenure system in KP can be classified into three categories: 58% farm area is operated by owners; 27% is

cultivated by owners-cum-tenants; and 15% is cultivated by tenants. Due to great diversity in climate and soils, KP grows over 42 crops; the major ones being wheat, rice, barley, maize, sugarcane, tobacco, rape & mustard, groundnut, pulses, vegetables and fruits. The major crops occupy nearly 90% of the total cropped area and play an important role in sustaining the living of the rural population. Livestock farming is also a dominant occupation of the farming community with more than 15 million animal heads and about 22 million poultry birds' habituating in the province. However, this occupation is mostly to supplement family nutritional and cash requirement. The capitalist trend in this sector is still lacking resulting in weak & non-descriptive breeds with low level of milk and meat productivity.

The major crops grown in the project area are Maize, Wheat, and Rice while Pulses like Mot, Kot, Red Beans and vegetables. The traditional subsistence farming system is widely practiced since generations in the area. It is the predominant economic system, which in general supplies the people with most of their daily needs.

Agricultural products are not generally sold in the local markets. Selling in the markets or to neighbors is resorted to only in two cases. Firstly; when the plot size or the yield of harvest exceeds the family food demands and secondly; when families are forced to sell their food products in order to get some cash (for marriage, purchasing of products such as wheat flour, salt, tea, Sugar, clothes, shoes, medical service, transport, education etc.)

All kinds of vegetables are grown in the area only for their domestic purpose but before flood in the entire Kandia valley where the farmers usually grew peas at commercial scale and supply the produce to other areas of the country. This remained the big contribution in their household finance.

In some areas of Sazin Valley, where the progressive farmers grow Potato for their domestic and commercial purpose, the yield of potato is very high due to the absence of viral disease. The cardinal variety of potato recorded high yield. The common and very famous vegetable of the area is Samchal (Wild Spinach) which is commonly grown in every kitchen garden by each household. The vegetable are being usually brought from Swat & Mansehra which are non-perishable.

The main source of fodder is the residual of Maize & Wheat and natural grass from the rangeland. Especially in summer, at the lower altitudes, there is a lack of fodder for domestic animals. That is why majority of the people migrate to their rangelands and forests at higher elevations in the spring to spend summer with their animals in the meadows. This is due to the factor that the extreme scarcity of cultivated land results in insufficient provision of fodder (dominating crop is maize) during the winter period. Around 80 % of the cultivated land in summer is covered by maize, which is also used for flour production including fodder stock for their domestic animals during winter.

At present, traditional and very unscientific methods are used to get fodder production. For example, more seed is put to get the thick stand of crops (wheat, maize). Later on, some of the plants are uprooted / cut and fed to the livestock, which is a good practice for getting fodder but at the expense of reduced yields. Probably, the farmers cannot afford to put sufficient areas under fodder due to requirements of the staple crops of wheat and maize.

In winter season the people use the leaves of Bani & Wild Olive as a fodder for their Cows, Goats & sheep which are common on the bank of rivers. In Project area, there is a big problem of fodder because agriculture fields are less and the population is increasing day by day which cannot meet with this fodder deficiency. This is the main reason; the people keep only Goats, Cows & Sheep which can easily graze openly in the hilly areas. To overcome the fodder deficiency, Barani Area Development Project-II and Kohistan Development Project Introduced mot grass practices in the area which is still applicable in some areas. Area under different crops is given in Table 5.17.

Table 5.17: District-wise Crop Area of KP

District	Area under different crops (000 hectares)							
	Wheat	Maize	Vege-tables	Tobacco	Sugar-cane	Fruits	Soya-bean	Sun-flower*
Abbottabad	14.55	14.29	0.21	-	-	0.69	-	-
Bannu	10.11	4.91	0.51	-	0.84	1.88	0.89	2.79
Battagram	6.16	16.03	0.03	-	-	0.28	-	-
Buner	48.90	52.38	0.53	2.94	0.72	0.44	0.79	-
Charsadda	27.22	17.43	2.71	3.43	32.10	1.65	0.87	1.32
Chitral	7.81	5.67	1.19	-	-	0.56	-	-
D.I.Khan	43.69	1.19	1.25	-	12.90	3.10	2.76	7.90
Hangu	12.01	8.04	0.18	-	-	0.08	0.12	0.20
Haripur	37.26	39.59	1.19	-	0.11	1.33	0.12	0.20
Karak	23.92	0.07	0.01	-	-	-	0.17	0.20
Kohat	32.79	2.20	0.72	-	0.18	1.79	0.16	0.30
Kohistan	1.36	26.64	0.09	-	-	0.11	-	-
Lakki	24.13	0.65	0.13	-	0.11	1.95	0.85	2.41
Lower Dir	25.75	9.29	1.12	0.04	0.21	0.99	-	-
Malakand	28.78	5.43	1.64	1.49	4.85	1.27	0.30	-
Mansehra	29.20	60.05	1.38	2.24	0.01	1.22	-	-
Mardan	46.01	31.04	2.24	5.43	29.49	2.36	0.94	2.78
Nowshera	23.35	10.86	1.59	1.51	5.15	1.79	1.27	0.80
Peshawar	34.53	16.60	2.01	-	11.88	1.31	0.71	0.50
Shangla	22.49	37.04	0.35	-	-	0.32	-	-
Swabi	44.82	32.71	0.77	15.86	4.42	1.15	1.14	2.85
Swat	61.0	62.31	10.24	0.41	-	13.12	0.30	0.19
Tank	4.39	0.14	1.01	-	0.30	0.36	0.85	2.20
Upper Dir	20.38	7.28	0.54	-	-	1.18	-	-

Source: Field Surveys, Env.& Soc. Safeguards Study, Detailed Design 2012, DHC

Duber Khwar: Agriculture and other livelihood in the project area is from both irrigated and rainwater farming. The important crops consist of wheat, maize and some vegetable. As the rainfall is low, rain water farming is given less attention. Most of cultivable lands which fall in rain fed (Barani) areas are unused. Agriculture Department is presently encouraging the people to grow apple and Japanese fruit. Pastures are utilized to raise herds, which is one of the major sources of revenue for the people. People, who have small land holdings, move down the country after they cultivate their lands where they work as labourers. Their women and children look after these farms during their absence. The estimated cultivable land available is 9212 hectares out of which only 1943 hectares are irrigated. On about 91% of the area, corn is grown whereas only 7% area is under wheat. Other crops, vegetable etc., take up about 2% of the cultivable land. Agriculture, livestock and timber are the major income generating means. A large number of healthy male folks work mostly outside as labourers on roads, forests etc.

Allai Khwar: Livestock and crop production characterizes the agriculture of the project area. Crop production takes place on a very small farm size averaging 0.5 to 0.75 ha. In the affected areas, the only large holding is the grassland owned by the Khan of Telus. Most owners and farmers hold and work on land in both rain-fed (maize intercropped with gourds) and irrigated (winter wheat and summer rice) areas. Farmers prefer to work on irrigated areas and contract tenancy on rain-fed land to augment their income. In terms of land use, the cultivated area is about 20%, of which 10% is irrigated. Pasture and grassland together constitute about 38%, while forest covers less than 30%. Fallow land and embankments are about 7%, while uncultivable land is 5% of the arable total.

Zone-III

Tarbela: The land use and cropping pattern in Zone-III districts is shown in Table 5.18. The population for Buner, Haripur and Mansehra districts is 715,000, 847,000 and 1,458,000 respectively. In this zone winter and summer season crops can be easily grown. The productivity in this zone is better than zone-I and II.

Table 5.18: District-wise Land Use in Zone-III (ha)

Crops	Buner	Haripur	Mansehra
Cultivated Area	**55000**	**77000**	**81000**
Wheat	4890	3726	2978
Maize	5238	3959	6005
Sugarcane	72	11	1
Tabaco	294	-	224
Fruits	44	133	122
Vegetables	53	119	138
Soyabean	79	12	-
Sunflower	-	200	-
Rice	338	12	2261
Barley	259	587	691
Gram	-	101	-
Cotton	-	-	-
Jowar	-	793	-
Bajra	-	83	-
Rape seed & Mustard	334	463	229

Source: District-wise Agriculture Statistics KP (2007-08)

5.2.4 Fishing

Fisheries Resources and Activities: Areas upstream of Tarbela Reservoir are characterized by mainly small-scale fish capture of riverine cold water fish species (principally snow carp) by communities to supplement domestic protein consumption and for occasional sale to local purchasers. Tarbela Reservoir has an organized contract-based fishery managed by the KP government and focused on mainly warm waters fish species (principally introduced carp species) in the southern portion of the reservoir.

Fish communities and associated fishing activity is influenced by biophysical conditions along the Indus River in the CIIA study area. The river passes through rugged mountainous terrain from the border with India to the upper limit of Tarbela Reservoir; habitat conditions in the main-stem and tributaries are dominated by steep gradient and fast flowing, turbid, cool water. Fish species have morphological adaptations such as features to enable clinging to rocky bottoms which allow them to survive in relatively turbulent conditions. In contrast habitat, in Tarbela Reservoir is lake-like and in the southeastern basin (Khalabat Bay) is relatively shallow and warm, providing suitable conditions for production of the introduced carp species.

Data in EIA documents (Volume 4 of this EIA and the DBHP EIA, DBHP 2010) suggest that species diversity and abundance along the gorge between Pattan and Shatial, roughly centring on Dasu, is low relative to locations downstream between Pattan and Tarbela Reservoir and upstream of the approximate upper limit of the planned DHP reservoir Shatial for at least the upper limit of the DBHP study area (approximately 110 km upstream from the upper limit of the DHP reservoir). Fish diversity and fishing activity is reported to be relatively in other gorge areas upstream DBHP such as the area in which the Bunji project is proposed (BHP 2010).

The snow carp *Schizothorax plagiostomus* is the most common species reported in fish catches for both domestic consumption and sale along the Indus River main-stem and tributaries. The endangered golden mahaseer, *Tor putitora*, a valued sport fish in Tarbela Reservoir (and areas downstream of Tarbela Dam) is reported to spawn upstream in Allai Khwar and possibly other locations near Besham.

Fisheries Management: Fisheries in KP are managed by the provincial government and in GB by the autonomous administration authority. Apart from the organized contract fishery in Tarbela Reservoir data on fish capture activities are not readily available for much of the study area catchment mainly on account of limited government resources to conduct systematic data collection. For areas upstream of Tarbela Reservoir data are available on numbers of licences issued and production from fish ponds but not on numbers and species of fish caught in different localities along the river. Annual data for 2005-06 to 2008-09 on KP district-wise fish production and numbers of fishing licences is presented in Appendix 5.1.

Resource management throughout the catchment area is constrained by lack of information on fish abundance, fish catch and effects of illegal fishing methods (e.g., use of poisons and explosives) on fish abundance and catch quantities. The latter indicates a demand for fish from the area and without quantification makes estimation of fish abundance and potential sustainable harvests challenging for local fisheries managers.

Fisheries production in recent decades has relied on development of aquaculture and reservoir fisheries and, in both cases, emphasis on use of exotic species; this appears to be the current management focus of provincial agencies. Objectives and conservation measures of the KP Fisheries Department are provided in Table 5.19.

Table 5.19: KP Department of Fisheries Objectives and Conservation Measures

KP Fisheries Department Objectives

The mandate of the Fisheries Department, KP is to make fish production available to the masses on a sustainable basis. To achieve this goal, the development has the following main objectives:

- Development of farm fisheries both in public and private sector.
- Conservation of fisheries resources in the Province.
- Introduction improved variety of exotic fishes.
- Development of fisheries resources for promotion of tourism.
- Provision of information and training to private sector for development of farm fisheries.

KP Fisheries Department Conservation Measures

- Fisheries Department KP has adopted strong measures/policy to conserve the depleting fish in natural waters.
- Regularly stock fish seeds in the aquatic resources to replenish the fisheries resources.
- Implement close seasons for fishing during the breeding season form:-

  a)1st October to 9th March for cold water.

  b) 1st June to 31st August for warm water fishes.
- Implement fisheries Ordinance, 1961 and Fisheries Rules 1976 that aims to .
  - Judicially manage fisheries resources by issuing the licenses.
  - Prevent illegal fishing
  - Controls mesh size of fishing nets.
- Department has established 46 Nos. of “Fish Protection Committees”.
- To promote awareness, The Department Regularly organizes “Hujra Talks”.

Source: Government of Phaktunkwha, Fisheries Department website, accessed November 25, 2012

Similarly, in G-B, although the administrative structure and mandate is different, fishing activity is regulated and controlled by the Department of Fishery, which is part of the Department of Agriculture of Gilgit-Baltistan. Statute for this is the 'Fishery Resources, its Regulation and Development Planning and Enforcement of Fisheries Act, 1962', which among other things regulates control of fish stocks, and enables enactment of fishing rules and regulations for conservation. The Department of Fishery responsibilities include mobilization of fishery resources, enhancement of fish production, development of infrastructure and staff capacity building, promotion of fish culture and aqua-cultural activities, and conservation measures to protect the endemic species.

Sector Plans and Anticipated State in 2022: Aquaculture production will likely increase modestly over the next decade but protection and growth of the capture fishery faces severe challenges mainly related to lack of information on the resource base and fishing activity. National and provincial level strategies and policies are directed at improving the state of capture fisheries but will require sustained and meaningful financial support for sustainable production.

Although management of fisheries is the responsibility of provincial governments, the national government has prepared a national policy for fisheries to guide the sector. The national strategy was developed over several years and was based in part on engagement of provincial fisheries agencies and other entities in strategy workshops and provides a perspective on the vision for fisheries over the next ten and more years. Policy objectives and strategies for inland capture fisheries are summarized in Table 5.20.

Table 5.20: Policy goals, strategies and objectives for inland capture fisheries of Pakistan

Policy goals (overall fishing policy and strategy)	1. Contribution to national economic growth 2. Poverty alleviation 3. Food security
Strategy objective	Increase national fish supply based on sustainable production and improved marketing of aquatic products
Capture fishery objective	Sustainable increase in capture fisheries production
Plan Objectives - Inland Capture Fishery	*PO 2B.1: Rehabilitate inland aquatic habitats damaged by pollution and environmental degradation.* *PO 2B.2: Control over-exploitation of inland fisheries resources.* *PO 2B.3: Promote sustainable management of inland aquatic resources.* *PO 2B.4: Establish sustainable exploitation of untapped inland resources.* *PO 2B.5: Promote sport fishing activities in inland water bodies*

Source: *National Policy and Strategy for Fisheries and Aquaculture Development in Pakistan, 2006*

The KP Comprehensive Development Strategy 2010 states "The strategy for the fisheries sector aims to facilitate conservation, protection, development and management of fisheries resources in the province for the sustainable provision of food, income, sports and health values." The Northern Areas (GB) Strategy for Sustainable Development (IUCN 2003) is now 10 years old but basic elements still apply in relation to capture-fisheries, such as adoption of measures to enhance baseline information on area biodiversity, build associated management capacity, promote community-based conservation and sustainable-use programmes and develop comprehensive awareness programmes.

Policy and strategic objectives for the study area imply that knowledge of fisheries resources and fishing activity and fisheries management should improve by 2022. That assumption is highly dependent on application of adequate resources for data collection and fisheries management; for the purpose of this CIIA baseline fisheries conditions in 2022 are assumed to be comparable to current baseline conditions (2012).

5.2.5 Transport

Prior to 1978, GB was cut off from Pakistan due to the harsh terrain and lack of access roads. All of the roads to the south opened towards the Pakistani-administered state of Azad Jammu and Kashmir (AJK) and to the southeast towards the Indian-administered state of Jammu and Kashmir. The fastest way to travel was by air, but air travel was accessible by few local people. The Karakoram Highway (KKH) connects Islamabad to Gilgit and Skardu. Northern Areas Transport Corporation (NATCO) offers bus and jeep transport service to the two hubs and several other popular destinations, lakes, and glaciers in the area. A railway through the region has been proposed, to Khunjerab.

KKH was constructed over an 11 year period (1968-1978) by the Pakistan Army;s Frontier Works Organization (FWO), with Chinese assistance. This asphalt road stretches some 840 km, and provides the Northern areas with a vital link to the rest of the country. Beginning in Hassan Abdal, the road winds through Haripur, Abbottabad, Mansehra, Batagram, Thakot, Besham, Pattan, Dasu, Sazin, Shatial, Chilas, Gilgit and Hunza; it the crosses the Khunjerab pass at an altitude of 4,733 m, to reach the Chinese frontier. Apart from its strategic importance, the Karakoram Highway is also historically significant, since it follows closely that segment of the ancient Silk Route which once passed through the Northern areas. The completion of the Karakoram Highway opened up the Northern areas to an unprecedented influx of developers, immigrants and tourists. Perhaps more than any other factor, the Karakoram Highway is responsible for the GB's accelerating rate of social, economic, cultural and environmental change.

KKH, with many rock overhangs and sharp bends, runs along Indus right from its crossing on Indus at Thakot. During rainy season, the traffic is susceptible to occasional disruptions due to landslides. Many of the bridges are insufficient to carry the expected traffic load. The traffic is counted at ten different locations including Dasu, Komila Bazar, Pattan, Besham and Thakot. At present 2590 vehicles are passing every day, as indicated in Figure 5.8. KKH, is also not sufficiently wide for movement of long trucks/vehicles carrying heavy machinery is very risky.

In Khyber Pakhtunkhwa; demand for transport has been exceeding GDP growth rates. At present 20% of people have no access to an all-weather road (compared with 15% in all Pakistan) and 40% have no access to any form of passenger services (compared with 30% for the country as a whole. Poor households are more likely to live in areas with no access to transport, seriously limiting their prospects for improving their livelihoods and their access to key social services. Road construction typically receives between 10% and 15% of the development budget, which is relatively low by international standards. There are about 25,000 km of roads in KP, with 2,173 km of national roads, 1,450 km of provincial roads, 18,711 km of district roads and 2,624 km of other roads. About 44% of the roads maintained by the province are in poor condition and 78% of the roads maintained by the districts are in poor or bad condition. This has arisen as a result of inadequate funding for road maintenance over many years and because of a failure to enforce rules on axle-loads. The role of railways and air transport in KP is limited and does not need priority attention in the short or medium term. KP at present contains over 700,000 vehicles and construction of proposed hydropower projects in the area will increase four folds.

The main transportation link between Khyber Pakhtunkhwa and Gilgit-Baltistan upto Skardu is shown in Figure 5.8.

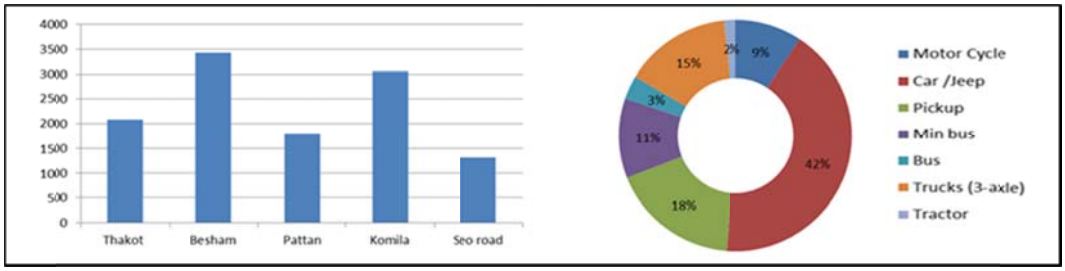


Figure 5.8: Average Daily Traffic on KKH, Dasu (Komila & Seo Road) to Thakot

5.2.6 Urban Development

The district-wise population in districts of GB and KP provinces is shown in Table 5.21 and Figure 5.9. In GB the current rate of urbanization is reported to be 8%.

Table 5.21: Population and Density in Districts of Gilgit-Baltistan and Khyber Pakhtunkhwa for Cumulative Impact Zones

District	Population	Area (km²)	Density (people/km²)
Gilgit Baltistan Province			
Ghanche	88366	9400	9
Sakardu	214,848	18,000	12
Astore	71,666	8,657	8
Gilgit	383324	39300	10
Diamer	207,107	11,936	17
i. Chilas (town)	*(28953)*	*(2982)*	*(10)*
Ghizar	120218	9635	12
Total (GB)	**1,085,529**	**96,928**	**(Avg) 11**
Khyber Pakhtunkhwa Province			
Kohistan	472,570	7,492	63
i. Dasu/Komila (town)	*(6,992)*	-	-
Battagram	307,278	1,301	236
Mansehra	1152839	4579	252
Shangla	434,563	1,586	274
i. Besham (town)	*(57739)*	*(184)*	*(313)*
Buner	506048	1865	271
Haripur	692,228	1,725	401
Total (KP)	**2,942,526**	**18,548**	**(Avg) 159**

Source: District Census Reports, 1998.

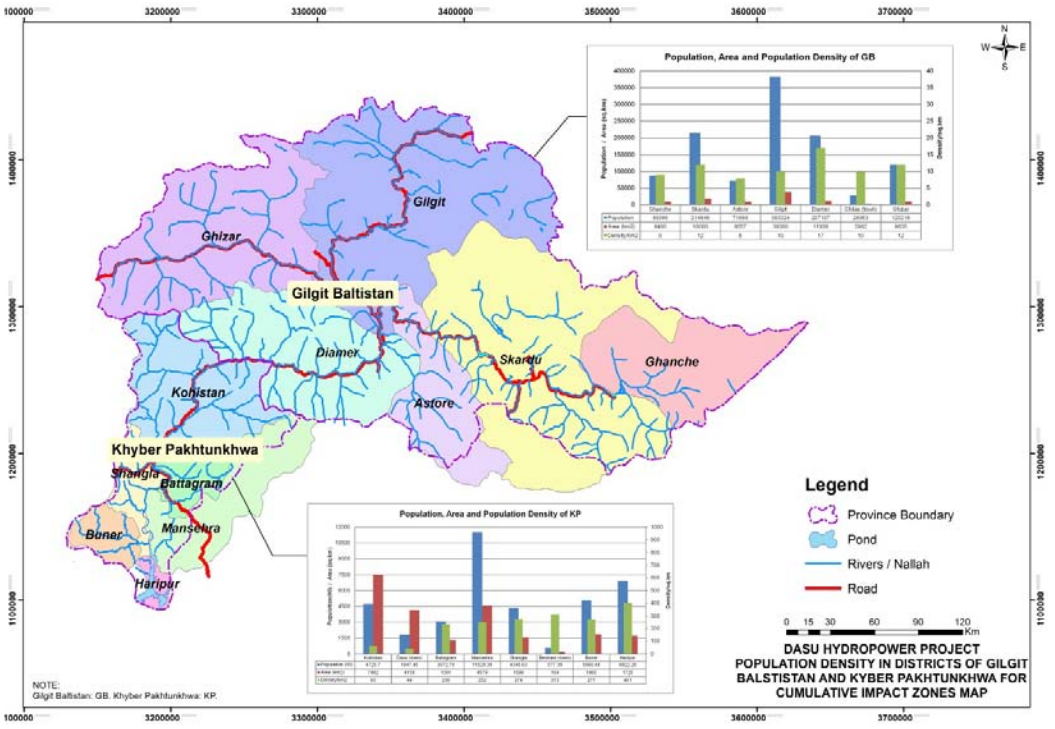


Figure 5.9: District-wise Population, Density and Main Transportation Road of GB & KP

5.2.7 Industry

It is quite understandable that the industrial developments will also grow with provision of cheap energy. There exist a few wood industries in the area. These wood industries prepare small wood logs and stock the timber in lots. These wood lots are sold to wood contractors to supply it to markets in main towns spread over the country. In Diamer and Kohistan areas there is no industry available. Some fine embroidery is being done by women folk. It is mostly done on items of personal use i.e. chadders, shirts and pillows. Shangla and Battagram are not industrially developed areas like other districts of the province. There is only, one flour mill namely Duber Flour Mill situated at Besham.

An industrial estate established in 1988 is situated at Gadoon in the Swabi district. However, with the withdrawal of incentives available to the industrial estate, a large number of industries have been abandoned. The main industries remaining are cement, cigarette, tanneries and flour mills. There are no industries of major importance within the Project area. In Haripur district, Hattian Industrial Estate was established in 1985. Industrialization has brought favourable job opportunities in the district, while establishing of a large number of chemical, cotton fiber, textiles, and telephone industries of Pakistan and brick plants which are functioning now in the district.

5.2.8 Power Transmission

As for as availability of electricity is concerned, a majority residents of the districts of all three zones are connected with power through the national grid system and/or micro hydropower. Injection of power generated at Dasu Hydropower to the National grid requires construction of extra high voltage transmission lines for which possibility of feasible line route corridor has to be explored in detail. The two existing transmission lines (132 KV and 220 KV) along Indus valley downstream of Pattan pass through the corridor. Two 500 kv transmission lines of 300 km length are planned from Dasu to

Pattar Garh, near Hassan Abdal along Indus. A transmission line of 765 KV for Basha will probably be installed along Indus in the same corridor.

5.3 SOCIOECONOMIC CONDITIONS

Detailed and comprehensive description of baseline situations is available in Appendix-5.2.

5.3.1 People in the Indus River Basin

The inhabitants of the regions through which the Indus River passes and forms a major natural feature and resource are diverse in ethnicity, religion, national and linguistic backgrounds. On the northern course of the river in the state of Jammu and Kashmir in India, live the Buddhist people of Ladakh, of Tibetan stock, and the Dards of Indo-Aryan or Dardic stock and practicing Buddhism and Islam. Then it descends into Baltistan, northern Pakistan passing the main Balti city of Skardu. On its course river from Duber Bala also drains into it at Duber Bazar.

As it continues through Pakistan, the Indus river forms a distinctive boundary of ethnicity and cultures upon the western banks the population is largely Pashtun, Baloch, and of other Iranic stock, with close cultural, economic and ethnic ties to eastern Afghanistan and parts of Iran. The eastern banks are largely populated by peoples of Indo-Aryan stock, such as the Punjabis and the Sindhis. In northern Punjab and the Khyber Pakhtunkhwa, ethnic Pashtun tribes live alongside Dardic people in the hills (Khowar, Kalash, Shina, etc.), Burushos (in Hunza), and people.

5.3.2 Demographics Features

According to the latest available District Census Reports (1998), the district falling with the zones have the populations as: in Diamer (207,107), Kohistan (472,570), Shangla (434,563), Battagram (307,278), Haripur (692,228), and Swabi (1,026,804) with varying density from 12 in Diamer to 666 in Swabi per sq km. In the areas-of-influence of the three main hydropower projects in the southern portion of the CIIA study area (Figure 5.10), the populations are almost entirely Muslim and most of the people belong to Hanfi Sunni Sect. Religious leaders, as compared to other areas in Pakistan, have gripping influence on the local population.

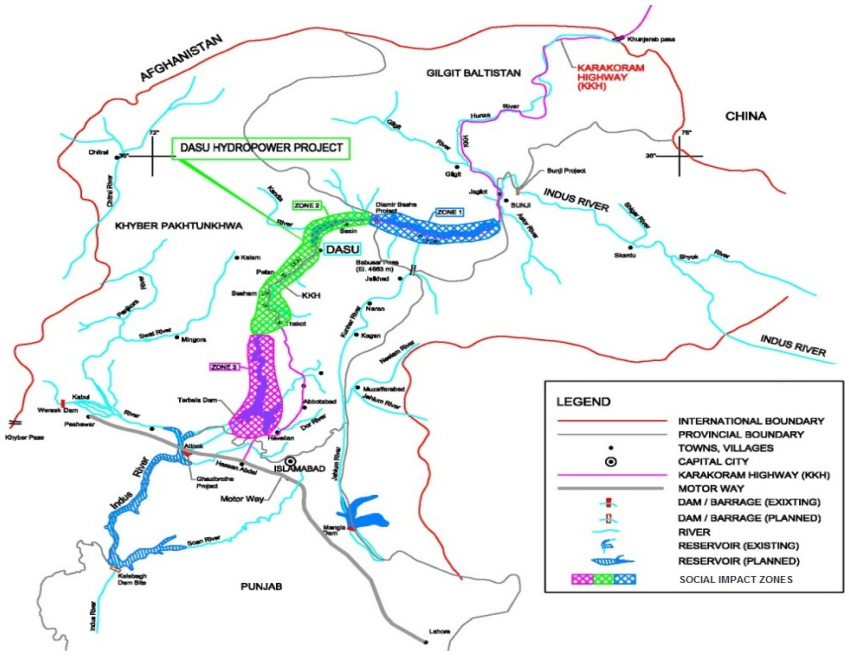


Figure 5.10: Social impact Areas

5.3.3 Livelihood

In Diamer area-of-influence, the traditional subsistence farming system and animal husbandry is widely practiced since generations. It is the predominant economic system, which in general supplies the people with most of the daily needs. Majority of the affected households are having land for growing crops and fruits as well as feeding the livestock. Most of the daily consumer goods such as wheat, maize, potatoes, vegetables, fruits, milk, butter, eggs and meat are being produced for self-consumption. In other words, agricultural farming is the prevailing livelihood system of self-reliance and sustainability in the Districts area.

In Dasu area-of-influence, majority of people earn living by farming, while many locals are farming as tenants on the land owned by the land lords of the districts. In the Tarbela reservoir area, the main occupation of the inhabitants of the Swabi district is agriculture and people are mostly landless tenants. However, a few educated people are engaged in Government or private service. The livelihood of the local population of the district mainly depends on agriculture and livestock rearing. The livestock serves as an income source which they sell to meet their needs. The people of the district live a simple life including the standard of their clothing and their diet. Unemployment, lack of potable water, basic health and education facilities, electricity and roads are the major issues for the people of the district. Similarly, in Haripur district agriculture remains the main occupation of its inhabitants. The proportion of people serving in the Government sector is higher due to the existence of the Pakistan Telecommunication Industry in Haripur as well as the Hazara Fertilizer Factory. There are also a large number of people serving in the Armed Forces. Most of the people in this district are dependent upon labor. They work in nearby cities, Gadoon industrial estate, Karachi and abroad.

5.3.4 Income and Poverty Trends

An example of annual average income per household in Satpara Valley is given in Table 5.22, the lowest 9% have Rs. 20,000 to Rs. 30,000 annually, and the maximum 30 % have Rs. 5000. The average income per household is Rs. 16,500 per annum.

Table 5.22: Annual Income of Population of Satpara Valley

% of Population	Annual Income (Rs.)
17	30000
9	20000-30000
11	15000-20000
9	10000-15000
24	5000-10000
30	Upto 5000
Total 100%	**Average 16500**

Poverty incidence and trends in **KP** show 44% rural population living below poverty line, and declining job opportunities and a range of natural resource problems. The perceived causes of these high poverty levels included a variety of factors such as low level of agricultural yields and livestock productivity due to use of obsolete technology, drought and geographic isolation. The development challenges for the KP, therefore demand achieving sustainable economic growth particularly in rural areas through the development of agriculture and livestock sectors along with exploiting other opportunities. With special reference to agriculture sector, the areas of grave concern for KP are rainfed cultivated land, cultivable wasteland, fragmented and un-economical land holdings, weak coordination amongst various tiers of the Agriculture department, weak organizational trends amongst farming community, in-efficient utilization of water resources, non-availability of good quality seed, high cost of fertilizers and pesticides, inadequate technical capacity of the department coupled with obsolete extension

methodologies, lack of agricultural marketing infrastructure, lack of gender mainstreaming, absence of rural based agricultural processing units, lack of health & management coverage for animals, low productivity of livestock, burden of multiple agricultural taxes and absence of an enabling environment for private sector investment.

5.3.5 Main Tribes

Being on the route of the conquerors of Central India, the tribes and castes of the districts are a multitude of various races from the north. In Diamer area-of-influence, the main tribes are local and non-local tribes. Local tribes are Sheen and Yashkun while non-local tribes are Soniwals, Kohistani, Kashmiri, Gujar, Pattan, and Swati. Both local and non-local tribes are further subdivided in clans. As for Kohistan District, on the Swat side the tribes are divided into two groups: Manzar and Money. They are two brothers, sons of Nafria. Tribes of Duber, Kandia and Ronolia belong to Manzar group, those of Bankad, Jijal, Pattan, Kayal and Seo belong to Money group. Both main tribes are further subdivided in clans.

In Dasu area-of-influence, the major tribes in the area are Afghan; Gujar/Ajar; Syed; Main and Qureshi while in Battagram area most of inhabitants are Swati. The major tribes in the area are: Swati, Gujar, Akhunkhel, Syed and Qureshi. In Tarbela reservoir area, the key tribe in the Swabi district is Yousafzai, an off-shoot of Pathans. Resident in the District Razarsare: Rajars; Utman; Jadoon; Gadoon; and Khatak. In the Haripur district the Punjabis and Kashmiris are in the majority as compared to Pathans.The key tribes and castes include: Tareen; Dilazak;Tarkheli; Gujar; Awan; Mishwani; Pathan; Gakhar; Jdoon; Sayyed; Tanoli; and Turks.The majority of the people in the study area are Pakhtun with the other key tribes, castes in the Project area being: Awan; Yousafzai; Syed; Mughal; Mashwani; Bafanda; and some working classes (artisans).

5.3.6 Language

In Diamer area-of-influence, Shina is the most common language spoken by all the affected peoples while Kohistani, Shina and Pashto are spoken by the majority of populations in Kohistan. In Dasu area-of-influence, Pashto is the predominant language being spoken in Shangla and Battagram districts. In Tarbela reservoir area, Pashto is the dominant language spoken in the Swabi district spoken by 96% of the population. The mother tongue spoken in the Haripur district is predominately “Hindko” with the other languages spoken being similar to the Swabi district.

5.3.7 Social Infrastructure and Services

Health Status: The health facilities are limited in the study area. People have to go to Abbottabad and Rawalpindi to avail medical facilities. The health services are extremely poor due to the lack of medical facilities and doctors, in particular female doctors in all districts of three zones, and often partly functional or totally closed due to various reasons. Even the functioning health facilities lack adequate staff and medicines. In particular, women for any medical treatment have to travel sometime more than 20- 40 km to avail appropriate health facilities. Due to poor and unhygienic living conditions and a lack of potable water, ill health is prevalent. The most common diseases in the study area are malaria, diarrhea, hepatitis and skin diseases.

Education Facilities: Like health facilities, education facilities in districts of all zones are not considered satisfactory. The study area, especially in rural area in most cases has only primary schools, which due to the tradition in this area, are only for boys. The girls are almost excluded from any education. Most of the parents, particularly men in the study area are not convinced about sending their daughters to the school. Therefore, the illiteracy rate is high. The Census Data of 1998 reported that the overall illiteracy rate was higher with women.

Electricity, Drinking Water and Communication: As for as availability of electricity is concerned, a majority residents of the districts of all three areas-of-influence are connected with power through the national grid system and/or micro hydel. Diamer, Kohistan, Shangla, Battagram Haripur and Swabi have access to drinking water sources both through household connection and street taps. As such the availability/ access to drinking water within their houses for families in various districts is; Diamer (13.89 %), Kohistan (12.45 %), Shangla (12.7 %), Battagram (24.36 %), Haripur (55.2 %) and Swabi (79.4 %). The rest collect water from street taps sources. Districts of the Diamer and Dasu areas-of-influence are linked directly through construction of KKH, while upper valleys of said areas are linked with districts headquarters through paved and unpaved roads and bridges. In districts of the Tarbela area, there is a chain of national, district and rural roads available. The telecommunication services are available in and around the districts. The services of all the mobile providers are available. Pakistan Telecommunication Company Ltd. is providing land lines and wireless telephone services in all districts of study area.

Gender issues: Gender issues are gaining importance in development projects because female members of the community are generally neglected while designing, assessing and implementing such projects. Women are generally more vulnerable than men of the society and the Project area is no exception to this. In Diamer and Dasu Project Areas, health status of women is the poorest of all groups of local population. They are exposed especially to: poor nutrition; air pollution from internal cooking procedures; early marriage; and frequent childbirths. Gender discrimination is very prominent in study area. Girls are deprived of school education. The gender situation is further complicated due to:

i) Early marriage of girls.
ii) Restriction on women's mobility.
iii) Poor domestic sanitation conditions.
iv) Long working hours (both for girls and women) including working on the farms.
v) Preference to sons over daughters.

They do not allow even any interaction between women of their area and women from outside their village. Traditional laws regulate the relationship between men and women, giving men a dominant position. Due to these social taboos the allocation of resources, education, health and skills favor men.

In Tarbela project area, gender situation is better as compared to the other two zones. According to one sources[3], 51.2% of those participated in the study were involved in the decision making process relating to important issues such as the sale and purchase of property and the schooling and marriages of their children. However, a vast majority of women (83.3%) were of the view that, despite all the discussions around making a decision, the final decision power lies with the male head of the family. A small number of respondents (5.2%) had the right of ownership of the property. Women were asked about the most common diseases prevalent in the Project area, the common most diseases prevalent in the Project area were: Diarrhea (32.7%); Typhoid (27.3%); Hepatitis (9.2%); Measles (6.4%); and Malaria (5%).

Social Issues: People have various disputes and conflicts on different issues, like other parts of the country. However, they resolve their minor disputes through the heads of families while major disputes are resolved through the *jirga* (a tribal assembly of elders that make decisions by consensus). In case of serious matters, local influential politicians intervene to settle the dispute. Police and the court of law is the last option.

[3] EIA Tarbela 4th Extension Project, 2010.

5.4 ROCK CARVINGS

Shortly after the construction of the Karakorum Highway connecting Pakistan and China through the Himalayan and Karakorum mountains, in 1978, Prof. Karl Jettmar (Heidelberg, Germany) and Prof. A.H. Dani (Quaid-i-Azam University Islamabad, Pakistan) discovered thousands of petroglyphs and inscriptions along the Indus valley. These are mainly concentrated in the area east and west of the village of Chilas (Diamer District). A joint Pakistani-German research project was founded and started its first surveys in 1979. Since 1982 the project is maintained as a research cell by the Heidelberg Academy for the Humanities and Sciences. The systematic documentation and publication of this material has been executed since 1989 under the directorate of Prof. Harald Hauptmann. The project keeps a close collaboration with scholars from Pakistan, England, France and Germany.

The aim of this research is a complete documentation and publication of all major rock art sites in this region. An archive of the collected material is installed in the Heidelberg Academy. A duplicate of it will be built up in Pakistan, e.g. in Gilgit.

The publications are presented in two series: *Antiquities of Northern Pakistan* (ANP), providing selected specialized articles on the subject, and *Materialien zur Archäologie der Nordgebiete Pakistans* (Materials for the Archaeology of the Northern Regions of Pakistan - MANP) which is devoted to the publication of complete rock art sites in monographs.

Up to now about 30 sites are registered on a stretch of 100 km to both sides of the Indus bearing 30,000 petroglyphs and 5,000 inscriptions in more than 10 writing systems. The carvings are pecked or chiseled into the dark brown varnished surface of the boulders scattered on the river banks and the terraces of the valley.

The earliest examples of Indus valley rock art are dating back to prehistoric times. The most recent (besides modern ones) belong to the period before the Islamization of the region in the 14th to 15th cent. AD. The prehistoric carvings in general show animals, hunting scenes and demon-like creatures in different styles.

The Buddhist phase starts around the 1st cent. AD and lasts until the 9th or 10th cent AD. The main subjects represented in the carvings are stupas, Buddhas and other Buddhistic symbols. Another important element of this period is inscriptions, mostly consisting of personal names and dedicational phrases. The majority of the inscriptions are executed in Indian scripts like Brahmi, Kharosthi and Proto-Sarada. Of special interest are those in Sogdian (700), Chinese (13) and Hebrew (1).

The old paths along the Indus valley constituted a branch of the Silk Road system. Many of the carvings of this period were therefore executed by travellers like merchants and pilgrims from Central Asia, China and India. But there are a lot of carvings obviously made by the inhabitants of the region as well.

During the 9th or 10th century AD, the Buddhist belief was replaced by a new socio-religious movement. Axes and sun-symbols are the new signs of this last major phase of the Indus valley rock art.

The complex of rock carvings and inscriptions in the upper Indus valley provide a remarkable source for the study of the cultural history of Central and South Asia.

6. IMPACT ASSESSMENT

6.1 HYDROLOGY AND WATER QUALITY

6.1.1 Effect of DHP

Operation of DHP as a run-of-river facility will mean no change in hydrology downstream of the powerhouse discharge point. Downstream flows will be reduced temporarily during first-filling of the reservoir and periodic flushing events. Flushing may not be required until 15 years of operation and Diamer Basha Dam is constructed by that time, flushing may not be required for another 30 years. In Detailed Design Report various sedimentation studies of no flushing, every year flushing and start of flushing after 15 years have been presented. Final mode of reservoir operation for sediment management shall be decided after due diligence of WAPDA, DHC, IPOE and WB.

The first impounding is planned to start on 15th June, starter dam crest elevation of 798 masl (there will be already a water pool below 798 m and river bed level of 765 m at dam site – refer Section 3 of Volume 2: EIA) to LLOs inlet sill elevation of 833 masl in a few hours. Afterwards from 17 June, a filling rate of 2 m/day will be adopted to raise the reservoir level gradually from 833 to 950 masl in two months and the excess flow will be released downstream through low level outlet facilities. The expected change in flow during the two months from 17th June to 15th August will be around –1,301 MCM. The first Wet Test for generating equipment will commence around 15th September. After first impounding year the normal drawdown flushing and filling events would start after 15 years. The flow changes during regular flushing and filling events are expected to be around 24 and –8% respectively.

Sedimentation is projected to reduce the reservoir length from 73 km to approximately 15 km over the first 10 years of operation, and 9 km after 15 years of operation. Stratification is not expected to occur in the reservoir due to relatively short water retention times and high water velocities. River temperature data suggest that vertical mixing in the future reservoir would likely occur in spring and autumn; mixing likely would be aided by the relatively high water velocities that will be present in the reservoir. Low oxygen conditions are also likely not to develop in the reservoir due to the short water retention times. However, deeper portions of the reservoir may develop low oxygen conditions during low flow season. Anoxic or low oxygen conditions may not be present at the time flushing events are planned (May-June) if spring mixing occurs. If low oxygen conditions are evident during monitoring prior to flushing a lead-in period may be required whereby the lower-level outlets are used to draw out low oxygen-concentration lower-elevation water in combination with spillway releases to provide adequate oxygen concentrations in water downstream of the plunge pool.

Substantial sedimentation will occur in the reservoir. Model simulations carried out for flushing scenario at Dam site show that in the initial years larger particles of the sand class will be negligible as those will be trapped in the upper reaches of the reservoir. Silt and clay particles will be flushed out in far greater quantities due to flushing efficiency. The advancement of the delta will increase sediment outflow at the Dam site and the change will gradually tend to be negligible after 30 years of operation. Year-wise progressive change on the sediment classes flushed out of Dasu Reservoir is shown in Table 6.1.

Table 6.1: Year-wise Progressive Sedimentation in Dasu Reservoir

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Clay%	132	115	110	127	92	101	99	101	97	83	69	52	83	56	56	37	37	38	32	40
Silt%	68	68	67	68	63	65	64	66	60	58	51	39	51	39	41	26	28	25	24	31
Sand%	-100	-96	-95	-99	-87	-90	-89	-92	-85	-80	-69	-53	-72	-54	-56	-35	-38	-35	-33	-42
Year	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Clay%	45	37	12	20	16	19	11	7	2	3	4	-10	5	0	-2	-3	-5	1	-6	-10
Silt%	36	33	15	20	16	20	13	13	8	8	7	-3	6	-1	0	0	-2	2	-4	-5
Sand%	-48	-44	-19	-26	-21	-26	-16	-16	-10	-10	-9	5	-8	1	1	0	3	-2	5	7

Change in particle-size composition of sediment discharged at the damsite is graphically shown in Figure 6.1.

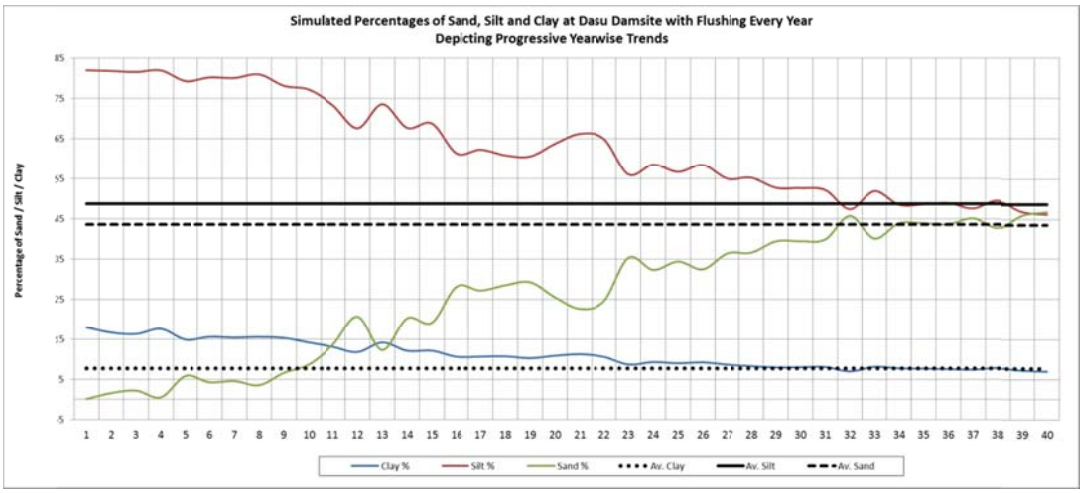


Figure 6.1: Year-wise Sedimentation Change in Dasu Reservoir

6.1.2 Scenario A: Business as Usual

Hydrology: Potential effects on river hydrology downstream of Tarbela Dam were assessed analyzing system operations under varying hydrologic and hydropower development scenarios by the year 2022. Using information on baseline conditions in an earlier Hydrologic Study of Basha Dam (*WAPDA* 2012); three scenarios were examined. Percentage changes from baseline conditions are summarized in Table 6.2.

Table 6.2: Percent Change in River Hydrology downstream of Tarbela under Different Hydropower / Storage Development Scenarios

Hydropower / Storage Development Scenarios	Low Flow (Oct - March)	Early Kharif (Apr-May)	High Flow (Jun-Sep)
1. Dasu + Tarbela	0	10	-1
2. Basha + Tarbela	42	9	-11
3. Basha + Dasu + Tarbela	42	19	-12

With Basha, flows between Dasu and Tarbela will not change considerably due to possible peaking operation and overall effect will be negligible. However, during peaking a few hours surge will occur. Downstream of Tarbela, a considerable increase of 42 % can be seen in low flow season for scenario 2 and 3 (Table 6.2) when storage capacity of Basha is released into the system. As for Early Kharif - the transition and critical period between low and high flow seasons, increases of 10, 9 and 19 percent for scenarios 1, 2, 3 respectively, are also appreciable when Dasu storage during its flushing-drawdown (after the first 15 years of operation) in Early Kharif is released downstream of Tarbela. As for the high flow period, filling up of Basha (6.39 MAF) and Dasu storage from 842 to 950 masl of about 1.034 MAF

reduces the high flows from 1 to 12 % on average for different scenarios. Multiple small hydropower projects in Zone 2 will not have a considerable impact on hydrology between Dasu and Tarbela due to their small head water ponds.

No flow change is anticipated between Basha and Tarbela during regular operation. The flow pattern between Bunji and Basha during high flow (August – September) will increase by 0.1 MAF and will decrease during the same period due to impoundment of the same volume.

Downstream of Bunji, for short-time, during peaking hours (4 hours daily from 1800 to 2200 hrs in summer) a surge wave with a maximum height of 5 to 6m will travel from the tailrace channel along the river to Basha reservoir. The maximum level of the surge will always be lower than the level usually reached during the summer period; the raising time will be approximately half an hour.

Flood Management: During monsoon season when there are high floods in Jhelum, Chenab and Eastern Rivers, Indus flows would be impounded in the main stem storages of Tarbela, Diamer Basha and Dasu. Besides attenuation of flood peaks and corresponding lessening of flood magnitude on Indus River, this would also enable maximum utilization of the flows of Jhelum and Chenab Rivers.

With conjunctive operation of Tarbela, Diamer Basha and Dasu reservoirs, combined flood regulating capability of these dams will significantly increase. However, effective utilization of this capability will be dependent on the reliability and timely rim-station flood forecasting by Flood Forecasting Division (FFD) of Pakistan Meteorology Department (PMD).

Another related aspect of flood management is the recently added capability of Mangla Dam through its dam height-raising project. This would enable almost all the floods in Jhelum River to be absorbed. This may particularly help in effective management of concurrent high flood peaks on Chenab as well as the Eastern Rivers of Ravi and Sutlej through conjunctive operation of proposed Upper Indus reservoirs.

Through assessment of snapshots of only wet, average and dry years out of the historic hydrological series, the average 10-daily effect on flood flows is shown in Table 6.3.

Table 6.3: Percent Effect on 10-Daily Flood Flows downstream Tarbela under Different Hydropower / Storage Development Scenarios

Hydropower / Storage Development Scenarios	Range of Effect on Average 10-Daily Flood Flows
1. Dasu + Tarbela	---> -2 to - 4 <---
2. Basha + Tarbela	---> -10 to - 22 <---
3. Basha + Dasu + Tarbela	---> -12 to - 26 <---

These results show that flood-flows decrease for all scenarios, which would greatly help in mitigating the already immense effects of this natural occurring calamity annually. The more hydropower schemes are in place on upper Indus, the more is the possibility of flood reduction. For individual 10-daily flows it was assessed that a maximum of about 60% reduction could be expected downstream of Tarbela.

The estimates are preliminary and present a somewhat upper level of flood vulnerability range that the system may encounter. They are to be treated as tentative and indicative.

Water Quality: The water quality in the river system from Basha to Tarbela, in terms of sediment content, will vary significantly with the development of the different hydrologic scenarios shown above. The entrapment of sediment annually, for scenarios 1 & 2 will be significant. Sediment trap efficiency values calculated for DHP in November 2012 were approximately 60 %. As for scenario 3 (Basha + Dasu +

Tarbela) the total sediment entrapment will be even more pronounced and hence will reduce the sediment regime below Dasu more markedly than scenarios 1 & 2. In terms of reservoir life of Tarbela there will an addition of at least 35 years due to reduced sediments in the river.

6.1.3 Scenario B: Best Practices

Best practice approaches would include: comprehensive examination of downstream flow changes (including both minimum flows and surge flows) resulting from all existing/planned main-stem and tributary hydropower and storage projects and opportunities to coordinate operational releases to minimize potential combined effects of flow and water quality changes on in-stream and riparian resources and human activities.

Presently the flood management through reservoirs in Pakistan is limited to the safety of the dam structures. According to the Standard Operating Procedures of these reservoirs, using Tarbela Dam as an example, the existing reservoir operation is purely based on dam safety against various hydrological considerations and does not include specified provision to attenuate in-coming flood peak. Historic operation of Tarbela Dam reveals that the attenuation of Flood Peaks are available when the floods are encountered with the water level in the reservoir below the maximum conservation level and the flood peaks are reduced but there is no provision available in the operation manual. Inclusion in the Operation Manual would improve current practice.

6.2 WATER USE

Water use, as stated in baseline section, is predominantly irrigated agriculture downstream of Tarbela, which is already stressed with chronic shortages in low flow and Early Kharif periods. The enhanced flows into the river system in the supply deficit periods shall considerably increase water availability for that sector during low flows. There will also be a similar increase, during deficit periods, in ecology releases downstream of Kotri Barrage, as they are to be treated as part of the overall water demand.

6.2.1 Effects of DHP

A system integrated study to assess the potential impact of different hydropower development scenarios, with respect to baseline conditions, on irrigation supply and ecological releases was conducted for a range of hydrologic conditions. The results are summarized in Table 6.4.

Table 6.4: Percent Average Impact on Irrigation Service & Ecological Releases (downstream Kotri) under Different Hydropower / Storage Development Scenarios

Hydropower / Storage Development Scenarios	Low Flow (Oct - March)	Early Kharif (Apr-May)
1. Dasu + Tarbela	0	1
2. Basha + Tarbela	14	1
3. Basha + Dasu + Tarbela	14	2

DHP alone will have no effect on water available for use downstream of DHP powerhouse outlets or downstream of Tarbela during the winter low flow period and will increase water availability slightly during early Kharif for the years when flushing takes place.

6.2.2 Scenario A: Business as Usual

Downstream of Tarbela, as expected the outcome of Scenarios 2 and 3 show increased water availability during the low flow season and transition period of Early Kharif. The enhanced supplies downstream of Tarbela reservoir, in tandem operation with Basha and Dasu reservoirs, in low flow period is expected to increase irrigation

supplies by 14% on average. The important winter crops grown in that period would benefit considerably including Wheat.

A small but noteworthy increase is expected for the critical Early Kharif irrigation supplies of about 1% on average and oscillating between 1 to 5% with varying hydrologic conditions. This release of about 1 MAF would be incidentally from Dasu reservoir during its annual drawdown for flushing operations (after the first 15 years of operation). Annual flushing operations would be necessary to evacuate massive sediments and prolong the life of the relatively small Dasu reservoir; with Basha flushing will be necessary only after 45 years. It would, however, provide relief to satisfy Early Kharif irrigation demands to some extent.

The available surplus flow for future development downstream Kotri Barrage, in spite of the development scenarios on Upper Indus, may range between 6 – 11 MAF in an average year. The surplus as indicated would be a major quantity and could be utilized to add up to the ever diminishing system storage capacity.

Allocation of Water for Irrigation: The resultant provincial / project-wise break-down of irrigation demands under post-Diamer Basha scenario as outlined in *Hydrologic Study of Basha Dam* is shown in Table 6.5.

Table 6.5: Province-wise Projected Water Demands under Post-Diamer Basha / Dasu Scenario

Province	Irrigation Demands As per Water Apportionment Accord (MAF)[c]			
	Para 2	Para 4	Para 7	Total
Punjab	55.942	0.620	-	56.562
Sindh	48.763	1.094	-	49.857
Balochistan	3.870	1.671	-	5.541
NWFP (Khyber Pakhtunkhwa)	8.781 [a]	0.492	-	9.273
Kotri Below For Seawater Intrusion and Environment [b]	-	-	3.620	3.620
Total Indus Basin Irrigation System	117.356	3.877	3.620	124.853

a) Including 6.560 MAF for the canals located above the rim-station of Kalabagh.
b) As per GoP Consultant's report duly reviewed by IPoE on Water Escapages Below Kotri, November, 2005.
c) Para 2 – existing commitments; Para 4 – new projects under construction/completed; Para 7 – ecological requirements below Kotri

WAA 1991 is a reflection of the dynamism of water resources policies in Pakistan. The recognition of environmental protection as a demand on the water resources confirmed environment as a priority area of concern. The freedom to change the water allocations within its different canal systems within the provinces is a step in the direction of allocation rationalisation for agricultural productivity. It obviously does not cover the entire process of demand-driven operation but indicates a movement from the rigidity of the historical withdrawals of each canal system to at least a sub-basin level.

In the *Hydrologic Study of Basha Dam* overall system irrigation service was also assessed under varying wet, average and dry hydrologic conditions for pre and post Basha scenarios. As a baseline input, Tarbela alone (or Pre Basha / Dasu), depiction of System Irrigation Service is summarized in Table 6.6. The system irrigation services shown in Table 6.6 indicate an improvement in post scenario (Basha+Dasu+Tarbela) in Rabi crops season for wet, average and dry conditions from 92 to 100%, 83 to 98% and 78 to 91% respectively. Similarly in Kharif crops season for dry conditions from 97 to 100%. Whereas, the ecological release service scenario the flow conditions for delta improvements will also get enhanced for wet, average and dry contexts from 93 to 100%, 83 to 99% and 79 to 90% respectively. Similarly such flows in Kharif crops

season in dry condition will be increased by 97 to 99%. Thus it could be realized that cumulative impact of storage reservoir will facilitate in regulating both irrigation water supplies, LBOD and delta requirements below Kotri. Surplus water downstream of Kotri Barrage for future development is shown in Table 6.7.

Table 6.6: System Irrigation Service and Ecological Releases Service under Pre-Basha/Dasu and Post-Basha/Dasu Scenarios (%age)

Season	Inflow Condition	Pre- Basha/Dasu		Post- Basha/Dasu	
		System Irrigation Service	Ecological Releases Service	System Irrigation Service	Ecological Releases Service
Rabi	Wet	92	93	100	100
	Average	83	83	98	99
	Dry	78	79	91	90
Kharif	Wet	100	100	100	100
	Average	100	100	100	100
	Dry	98	97	99	99
Annual	Wet	97	96	100	100
	Average	96	92	100	100
	Dry	92	88	97	95

Table 6.7: Surplus Water Downstream of Kotri Barrage for Future Development under Wet, Average and Dry Conditions for Pre Basha/Dasu and Post- Basha/Dasu Scenarios – BCM (MAF)

Inflow Condition	Pre- Basha/Dasu	Post- Basha/Dasu
Wet Year	22.98 (18.64)	21.97 (17.82)
Average Year	13.09 (10.62)	7.41 (6.01)
Dry Year	10.46 (8.48)	1.86 (1.51)

6.2.3 Scenario B: Best Practices

Best practices to improve water available for use include: putting in place broad-area processes to anticipate and respond to emerging risks and opportunities related to water use especially in Zone 2 and, engagement with potentially affected stakeholders in upper basin areas in an inclusive and participatory manner with thorough and timely feedback on water use issues.

6.3 BIODIVERSITY

6.3.1 Effects of DHP

Potential impacts of the Project on the terrestrial ecosystem are low and insignificant due to limited biodiversity in the Project impact area (up to 1,000 masl above reservoir area). While, there was a significant biodiversity on the higher altitudes (with location of forests above 2,000 masl and location of wildlife habitat above 3,000masl) away from the project impact area. Construction activities such as drilling and blasting create high noise and vibrations, which may have potential to disturb the birds and wildlife on higher elevations. The flora in DHP area is diverse and scattered throughout the impact area. There are no threatened, endemic or rare plants species recorded during field surveys or were reported in the secondary resources. The key impacts on vegetation are: loss of about 21,000 trees and shrubs, and loss of about 280 ha of grazing land consisting of various grasses and herbs.

6.3.2 Scenario A: Business as Usual

Zone 1: Upstream of Gilgit-Indus confluence

This region comprises of a high-mountain environment with mainly Indus flowing from the Baltistan region along the northern tip of Himalayas to the west joining with Gilgit

river from the Karakorums. There is a variety of ecological habitats occurring in this zone. This area has montane dry sub-tropical scrub, dry-alpine permanent snow fields; alpine meadows; sub-alpine scrub and dry-temperate conifers mixing with dry temperate ever green oak forests in the Kohistan region in the south. The dry sub-tropical scrub exists along the main Indus River up to Raikot and Bunji. The alpine zone and snow fields occur in most of the upper Hunza and the northern parts of Baltistan. The landscape is characterized by the vast glaciers, a desolate waste of boulders and sheer cliffs. Moist areas are found beneath glaciers and snowfields and along stream banks. The vegetation is largely xerophytic. The sub-alpine scrub zone is also widespread throughout higher mountains of Himalayas-Hindu Kush- Karakoram, including Gilgit (Naltar), Skardu, Ghizer and Astore regions, but often confined to small ravines on upper slopes. Sub-alpine scrub is important for both livestock and mountain ungulate species like markhor, Himalayan ibex and is considered important summer grazing grounds for these species. The dry temperate conifers are characterized by much fewer deciduous tree species and are mainly single species stands of conifers. These forests occur in parts of Gilgit, Diamer, and Skardu districts. In Gilgit region it occurs in patches of both Karakoram and Hindukush mountains in valleys like Naltar (Sheikh, 2002), Bagrot, Haramosh, Minapin, Chaprot, Jutial Nullahs, while in Skardu District mainly in Basho Valley of Randu Tehsil (Schickhoff 1993). Diamer District is rich in these forests, where they occur in many valleys of Darel, Tangir, Chilas and Astore tehsils. Typical tree species found in these forests are *Picea smithiana, Cedrus deodara* and *Pinus willichiana* as predominant tree canopy with under story of Quercus ilex and Junglus regia and scattered shrubs of *Artimesia maritima, Ephedra intermedia*, *Indigofera gerardiana*, *Sambucus ebulus, Sorbaria tomentosa*, and *Plectranthus rugosus*.

Risks associated with hydropower development in this region include increased human in-migrant populations, development of new and improved roads and housing, improved infrastructure facilities and urban/ suburban expansion induced by hydropower projects. These developments may have a small indirect effect on ecological resources both upstream and downstream of hydropower projects in Zone 1. However, at this stage, there are not many hydropower projects in operation/ planning in the Zone 1 that would be linked incrementally to ecological components affected by DHP. The current hydropower projects include Satpara, Naltar and Bunji.

Satpara hosts a wetland of considerable capacity. This wetland is of significant importance for the migratory birds. As such the location of Satpara is far from DHP. DHP will not have any direct impact on the existing structures and functions of the Satpara dam. Naltar is located north west of the Karakorum mountains and has a very small capacity reservoir. It receives most of the flow from the Naltar and Ishkoman glaciers that melt into the Naltar River which further feeds into Hunza River in the south. Hunza feeds into Gilgit and Gilgit becomes part of the Indus downstream of Bunji in the GB province. Another important aspect is that Naltar is located in a side valley and not on a major river and have no big infrastructure dependency on its operation. It basically supplies to the local villages and few month power generation to the ski hills base.

Naltar and Satpara are not likely to have any impact on the efficacy and functioning of the DHP VEC's. However, Bunji is in proximity to the DHP. The southern access to Bunji will also be through the DHP. Wooly Flying Squirrel *Eupetaurus cinereus* is considered an endangered species (Sheikh & Molur 2004) in Pakistan and has known populations in Chilas and neighboring regions including Bunji. This animal is known to be captured or hunted for various local beliefs. The appropriate conservation and management authorities participating in the energy development projects should strongly consider this species. Other known important wildlife species from the area include Markhor (*Capra falconeri).*.

Another potential induced impact may be through the commercial exploitation of the local medicinal and aromatic plants because the interest and knowledge of the area will increase and areas in Bunji may have increased visitation pressure induced through DHP. Naltar and Satpara are too far from DHP to give or take any adverse direct or indirect impact. Since the key wildlife species are not in the DHP footprints but only exist in the higher altitudes; the probability and potential of these impacts is considered very low.

Zone 2: Top of Tarbela Reservoir to Gilgit-Indus confluence

This zone has some representation of the same ecological zones as in the zone 1 but is dominated by dry temperate evergreen oak scrub includes an intermediate zone passing behind the moist temperate zone, which covers lower valleys of Diamer district mainly areas adjacent to Kohsitan District of KP. Dry Oak forest (*Quercus ilex*) dominates the vegetation of this area. Other plant species include *Daphne oleoides, Sophora griffithii*, *Cotoneaster numularia, Artimesia martima* and *Berberis lycium*. Occasionally individual stands of *Pinus gerardiana, Pinus wallichiana, Cedrus deodara* and *Juniperus spp*. Large mammal species found in this zone are flare-horned markhor, black bear, Himalayan lynx, stone martin and forest dormouse. Common game birds are chukar partridge, koklas pheasant, and rufous turtle dove. Other bird species include golden eagle, lammergier, common kestrel, and alpine chough.

In this zone, apart from DHP, Diamer-Basha is the other major HP development in the planning stage. Other HP projects include Pattan, Duber Khawr, Keyal Khawr, Khan Khawr, Spatg Gah and few others. Diamer-Basha is situated north of DHP and shares its southern boundary with the DHP; all others are in the south. The ecology and diversity of Diamer-Basha is comparatively similar to DHP. When these projects will be in full operation the local ecology of DHP is likely going to have some impacts as well. However, it is not anticipated to have direct impacts on the forests and other biodiversity e.g. indirect negative impacts on the forests through habitat loss, increased accessibility through new corridors and access roads to wildlife habitat and wilderness areas. Forests are situated in the higher slopes as most of the lower downstream mountains are devoid of soil and are barren rocky in nature. No significant impact is anticipated on the forests in the Zone 2.

The main access to Diamer-Basha and Bunji will also go through the DHP. If the water will be stored and released in Diamer-Basha then that may trigger some changes to the aquatic habitat downstream at DHP; however, minimal affects are anticipated to the terrestrial habitat of DHP. Similarly, there may be an increased demand on the forests use during construction activities in the whole region. Though most of wildlife in DHP is out of project footprints and is situated in the higher altitudes away from human settlements and the Indus river; there may be increased opportunities for poaching and illegal trapping of wild animals such as Musk deer, Markhor and various migratory bird species refuging in these mountainous habitats. When DHP becomes fully operational, the water management system will also change on the Indus and that may trigger some impacts downstream. Generally, the impacts would be low level because there will be a consistent flow of water from the DHP and the downstream ecology will sustain. The aquatic ecology diversity is low and vegetation is very scanty in the riparian zones. However, the downstream projects can experience flooding during extreme situations which may influence fisheries activities in the downstream. When local and regional human and road traffic will increase on the KKH the pressure can double or triple on the natural resources. Another potential impact may be through the commercial exploitation of the local medicinal and aromatic plants. Since the key wildlife species are not in the DHP footprints so the probability and potential of these impacts are considered low. Similarly the populations of significant species such as Western Tragopan, Musk deer are found only in the upper reaches of various

downstream valleys such as Pattan and Palas so no significant impacts are anticipated.

Zone 3: Tarbela Reservoir.

Scenario A: None of the significant impacts are anticipated for forests in this region unless there is a flooding situation.

Potential operation of DHP as storage release for peaking operation may affect the downstream flows and downstream aquatic biodiversity. However, it is not certain whether these impacts will reach up to Tarbela reservoir. The terrestrial biodiversity of zone 3 has no representation of endangered or threatened fauna and flora, and no impact are envisaged.

6.3.3 Scenario B: Best Practices

Zone 1: Generally, hydropower development in the zone 1 will offer increased access and opportunities to the local resident populations and these developments can be propagated in a positive way for the wise use of natural resources in the northern wilderness. According to the best practice model, the principles of responsible environmental stewardship; integrated resource management, poverty alleviation and institutional capacity development should lead the way. In the current circumstances; the overall leadership of one institution such as WAPDA seems okay. However, the forestry and biodiversity in the GB are with the Forest Department and their capacity is very low in natural resource management. GB's PWD (Power and Works Department) would also need enhanced capacity and institutional resources to come up to the expectations of integrated resource management and community upgradation along with responsible energy development. In the absence of appropriate training, capacity enhancement and poverty eradication programs; the success of these infrastructure projects can be undermined. Ideally, the natural resource management of Bunji, Diamer-Basha and DHP should participate in a commission to plan and execute a robust natural resource management formula.

Zone 2: According to the best practice model, the engineering planning of Diamer-Basha and downstream reservoirs/ dams should be in close coordination with DHP. The principles of responsible environmental stewardship; integrated resource management, poverty alleviation and institutional capacity development are important considerations. In the current circumstances; the overall leadership of one institution such as WAPDA seems okay. However, the forestry and biodiversity in the GB are with the Forest Department and their capacity is very low in natural resource management. On the other hand the KP Forest Department is much more experienced and has international exposure. It is important that both KP and GB forest and biodiversity strategies (NASSD and SPCS) should be kept in mind during the planning/ management processes. In the absence of suitable training, institutional capacity enrichment and poverty extinction programs; the long-term success of these major infrastructure projects can be undermined. Ideally, the natural resource management of Diamer-Basha, Pattan, Duber Khawr, Keyal Khawr and DHP should participate in a team to plan and implement a strong natural resource use/ access strategy. This will require a consistent involvement and interest of all sectors of local communities/ stakeholders. This is especially true for forestry industry.

Zone 3: An integrated approach with shared responsibilities and effective participation of the local communities/ stakeholders will ensure long-term success and health of these large scale energy projects and their associated biodiversity. Apart from the role of forests and wildlife department in KP, an improved role will have to be played by the WEC and its associated agencies.

6.4 AGRICULTURE

Construction of hydropower projects will create land use changes in each project area. The land affected by construction of the proposed hydropower projects is summarized in Table 6.8 and Figure 6.2. Table 6.8 also provides the command area for future irrigation development. It could be noted that the total command area of 5,016,320 ha, only 54,786 ha (1.1%) would be affected as cultivated 18,688 ha (0.4%) and uncultivated 36098 ha (0.7%). There are many issues and constraints confronting / effecting agriculture mostly in Zones 1 & 2 which include:

- Lack of cultivable land;
- Lack of awareness about improved agricultural management practices;
- Lack of quality seeds;
- Crop diseases and insect pests;
- Poor storage and processing;
- Weak marketing and poor access to markets;
- Weak extension services;
- Insufficient assess to micro-credit
- Insufficient public sector investment and insufficient involvement of the private sector;
- Insufficient and inappropriate research.

Table 6.8: Area Affected by Hydropower Projects in Study Area

Sr. No.	Name of Project	Command Area for Irri. Dev. (Ha)	Affected Area (Ha)				Status as on Oct. 2012			
			Cultivated	Non-cultivated	Total	Rank Order	Existing / in operation	Under Construc-tion	Ready for Construc-tion	Detailed Engg. Design and Tender Documents in hand
IMPACT ZONE – I										
1.	Satpara	4724	04	22	26	8	✓			
2.	Bunji	-	51	1421	1472	4				✓
3.	Naltar	-	02	23	25	9	✓			
IMPACT ZONE – II										
4.	Diamer Basha (KP+GB)	2600000	1077	14066	15143	2			✓	
5.	Dasu (KP+GB)	-	143	4500	4643	3			✓	
6.	Keyal Khawar	-	20	-	20	11				✓
7.	Dubair Khawar	9212	06	10	16	12		✓		
8.	Khan Khawar	2384	03	18	21	10	✓			
9.	Allai Khawar	-	07	61	68	7	✓			
10.	Lower Spat Gah	-	45	32	77	5				✓
11.	Lower Palas Valley	-	30	45	75	6				✓
IMPACT ZONE – III										
12.	Tarbela	2400000	17300	15900	33200	1	✓			
13.	Tarbela Ext-IV	-	-	-	-	-			✓	
	TOTAL	**5016320 (100%)**	**18688 (0.4%)**	**36098 (0.7%)**	**54786 (1.1%)**					

Source: Projects Feasibility and Environmental Assessment Reports.

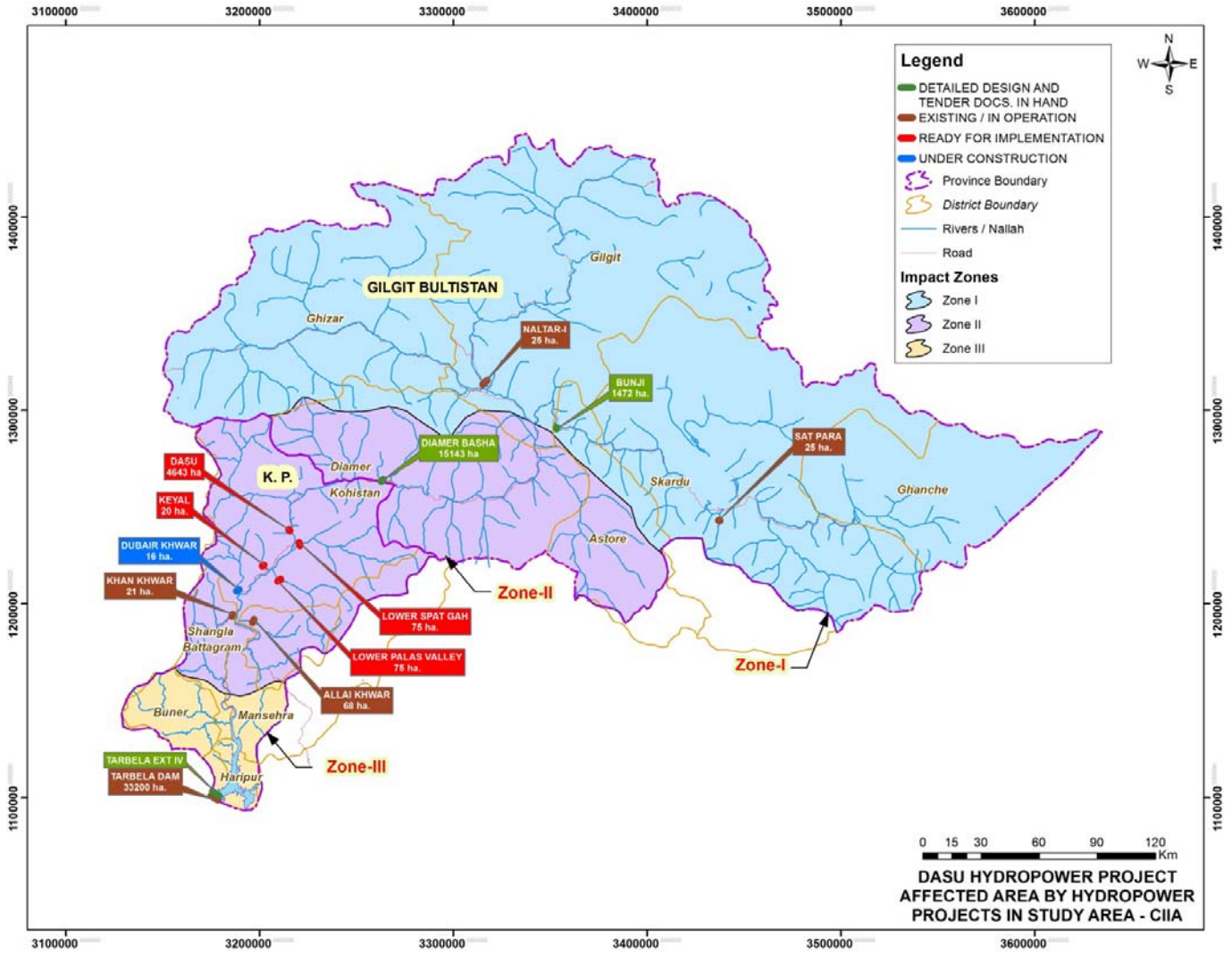


Figure 6.2: Area Affected by Hydropower Projects in Study Area

6.4.1 Effects of DHP

DHP will affect 143 ha of cultivable land and 4,500 ha of non-cultivable land (Table 6.8). Development of hill slopes for agriculture requires lot of time for construction of agricultural terraces and accumulation of top soils. Agricultural areas are mainly farmed by land owners (68%) and sharecroppers (24%). The loss of agriculture land will be compensated by livelihood restoration programs and development of agricultural terraces at the resettlement villages.

6.4.2 Scenario A: Business as Usual

The Diamer Basha Project will affect a relatively large amount of cultivated and currently uncultivated agricultural land (15,134 Ha in total) representing a fairly large cumulative loss of agricultural land in Zone 2 (each small hydropower project situated on tributaries in that zone will affect additional smaller amounts of agricultural land). The affected agricultural land in Zone 1, predominantly within the Bunji project area, will be small in comparison to the affected area around Tarbela in Zone 3. As with DHP, measures will be taken as part of the resettlement action plans to compensate project-affected people for loss of agricultural land and associated livelihoods.

Additional demand for agricultural goods will likely be induced from increased population during the construction phase in all areas and as a result of expanded urban development as communities become supplied with local power transmission lines. Project-induced urban and industrial development could encroach on agricultural land in project-affected areas.

6.4.3 Scenario B: Best Practices

Risks associated with potential cumulative and induced encroachment on agricultural land and effects of agricultural practices (including possible increased use of pesticides) can be reduced by putting in place broad-area processes to anticipate and respond to emerging issues and opportunities related to agriculture especially in Zone 2. Best practice approaches would include engaging directly stakeholders in the broadly affected areas, possibly including representation of adjacent districts and provinces, in an inclusive and participatory manner with thorough and timely feedback on agriculture issues.

6.5 FORESTRY

6.5.1 Effects of DHP

Forests, though essentially located on high elevation, are the most important natural resource of the area. DHP will potentially affect fuel wood selling activities of project-affected people, notably loss of business linked to loss of fuel wood selling locations. Selling of fuel wood is an important business in the project area and a common practice on main KKH in winter season as well as in summer season. People harvest Oak Tree, Wild Olive and other fuel wood trees from hill sides and store in the form of wood toll on main KKH. The daily sale of fuel wood is very high and the people earning a large amount; the local selling rate of the fuel wood is Rs.260/- per 50 Kg at different spots.

Additional risks to forest resources associated with DHP include increased human in-migrant populations, development of new and improved roads and housing, improved infrastructure facilities and urban/ suburban expansion induced by hydropower projects. Forests are quite a significant source of income for area communities as: private owners; woodchoppers; and timber cutting thereby selling through government leasing. The forest royalty ratio is 80:20 i.e. eighty (80%) share is of community while 20% shares go to the provincial treasury of Khyber Pakhtunkhwa Province.

Collection of pine nut is also an important seasonal business of the area; demand for pine nuts will likely increase as the numbers of in-migrants increases during the construction stage.

Project construction is expected to increase the population size of local communities and activity of local small-scale industries. Regular supply of electricity by the proposed hydroelectric project will likely attract new industries or induce expansion of existing, mainly wood-based, industries. The general economic and social conditions are expected to improve with construction and operation of the projects and will promote conditions conducive to growth of local industries. Small scale industries/business like furniture making, timber wood industry, are likely to slowly increase due to hydropower development occurring in the DHP project area.

6.5.2 Scenario A: Business as Usual

Zone 1: Hydropower projects in operation/ planning in Zone 1 would not have incremental effects on forestry activities affected by DHP (in Zone 2). Hydropower development in the zone would present similar risks to nearby forest resources as those noted above for DHP; these include increased human in-migrant populations, development of new and improved roads and housing, improved infrastructure facilities and induced urban/ suburban expansion.

Zone 2: In this zone, apart from DHP, Diamer-Basha is the other major HP development in the planning stage. The six other hydropower projects are smaller projects existing or planned for construction on tributaries. Diamer-Basha is situated north of DHP and shares its southern boundary with the DHP; all others are in south of DHP. Forest conditions of Diamer-Basha are similar to DHP; Diamer Basha is not anticipated to have direct impacts on the forests but may have similar effects as DHP on community fuel-wood selling activities. Forests are situated in the higher slopes as most of the lower downstream mountains are devoid of soil and are barren rocky in nature. Overall, no significant impact is anticipated on the forests in Zone 2.

Zone 3: No significant impacts are anticipated for forests in this region unless there is a flooding situation.

For all zones, project-induced urban development will increase use of natural resources including forest products.

6.5.3 Scenario B: Best Practices

Generally, hydropower development will offer increased access and opportunities to local residents for proper use of forestry resources Principles of responsible environmental stewardship; integrated resource management, poverty alleviation and institutional capacity development should be adopted preferably under the overall leadership of one institution such as WAPDA. However, forestry management is the responsibility of provincial forest departments. Capacity of the GB Forest Department is very low in natural resource management; KP Forest department is much more experienced and has international exposure. It is important that both provincial forest and biodiversity strategies (NASSD and SPCS) should be kept in mind during the planning/ management processes. Other agencies, such as GB's PWD (Power and Works Department) would also need enhanced capacity and institutional resources to meet expectations of integrated resource management and community up-gradation along with responsible energy development. In the absence of appropriate training, capacity enhancement and poverty eradication programs; the success of these infrastructure projects could be undermined. Ideally, the natural resource management elements of hydropower project development should be guided by formation of a commission to plan and execute a basin natural resource management strategy.

This would require a consistent involvement and interest of all forestry-sector stakeholders. Apart from the role of forest departments, WEC and its associated agencies would require an improved role and capacity.

6.6 FISHERIES

6.6.1 Effects of DHP

DHP has potential to adversely affect populations of fish (mainly snow carp) currently harvested by individuals in communities along the Indus River and tributaries due to formation of the reservoir and submergence of tributary spawning and rearing areas. During run of river operations of DHP, potential adverse impacts on the downstream fisheries are low due to no alternations in downstream water flows. DHP has a potential to be operated as a peaking plant after commissioning of Diamer Basha Project. If DHP is operated as peaking plant, there could reduction in the productive capacity of downstream habitat through alteration of downstream flows, sediment deposition, and water quality changes. However, peaking operations are not foreseen for DHP due to 1,000 GWh of lesser power generation compared to run of river (base load) operations. :

Fish yield in the upstream and downstream of the dam can be increased by hatchery development with native snow water species and stocking the fingerlings in the affected areas, and maintaining the spawning areas. Development of a reservoir fishery is also possible but current plans for reservoir run-of-river operation indicate rapid sedimentation will quickly reduce the reservoir water dimensions; projections suggest the distance from the reservoir inflow delta to the dam will be reduced from 73 km to approximately 10 km in 15 years. Reservoir volume will be reduced by 87 percent over that period. Also water velocities will be high and will reflect river-like conditions; projections indicate surface water velocity will range from approximately 0.2-0.5 m/s near the dam to 3-5 m/s at the head of the reservoir, placing limits on types of fisheries activity that can be adopted.

Project induced activities such as increased human population in Dasu and nearby communities could put additional pressure on currently harvested species either through direct capture by in-migrants or by increasing demand in local restaurants or markets. Fish habitat including water quality could be adversely affected by project-induced urban development, industry, agriculture, forestry and road development / traffic.

6.6.2 Scenario A: Business as Usual

Zone 1: Zone 1 is located at a substantial distance upstream of DHP. Potential effects of existing and planned hydropower projects in Zone 1 are summarized in Table 6.9.

Table 6.9: Potential adverse effects on fisheries resources identified in EIA documents for existing and planned hydropower projects in Zone 1

Project	Source	Potential Adverse Effects Identified in EIA Documents
Bunji	Wapda 2010	Water quality effects during construction; poaching by construction staff; entrainment of fish into intakes
Satpara	Wapda 1989	Potential construction effects related to increased sediment on phytoplankton, invertebrates, macrophytes, juvenile fish and fish feeding. Potential loss of stream habitat for juveniles
Naltar III	GTZ-HEPO 2000	Fish population will be fragmented into a population above weir and one below weir due to weir acting as a barrier to migration; low flow of water in the stream from weir to location of power house especially during low flow season, i.e. January to April; and discharge of sediment beyond weir, from silt and sand traps

The existing and proposed hydropower projects in Zone 1 have potential to affect snow carp, other fish species and dependent fisheries in that zone. Risk of DHP incrementally affecting the same populations of snow carp and other fish species in or making use of habitat in Zone 1 is low given the distance between DHP and Bunji and the two smaller projects on tributaries in that zone. Construction of Basha dam immediately upstream of DHP would place a barrier between fish in Dasu reservoir and locations upstream of Basha. In the absence of Basha, fish species or populations upstream of Dasu dam would be exposed to possible effects from the three projects in Zone 1 if those facilities affect the productive capability of habitat far enough downstream that effects occur in locations used by fish populations that occur in the vicinity of DHP (Bunji is expected to affect downstream habitat; for example, a 5 to 6m high surge is expected downstream of Bunji during each peaking start-up, traveling as far as Basha).

Zone 2: In addition to DHP and Basha on the main-stem in Zone 2, six dams are in place on or are planned for tributaries in that zone over the next ten years. Potential adverse effects on fisheries resources of the proposed Basha project and existing and planned hydropower projects on tributaries in Zone 2 are summarized in Table 6.10.

Table 6.10: Potential adverse effects on fisheries resources identified in EIA documents for existing and planned hydropower projects in Zone 2

Project	Source	Potential Adverse Effects Identified in EIA Documents
Diamer Basha	Diamer Basha Consultants	Fish migration: low significance of natural fish stock and preference of cold-water fish only in the upper river courses of above 1,200 masl. Minor changes of coldwater fish spectrum. Loss of spawning areas due to submergence of lower nullah sections in the reservoir. Damage at facility for safe passage through various dam outlets Predation exposure to fish and birds insignificant due to low numbers
Keyal Khwar	Lahmeyer International and National Development Consultants 2007	Effects on fish in Keyal Khwar (*Glyptosternum reticulatum* and *Schizothorax plagiostomus*) possible at rock quarries and dam construction site; no adverse effect during operation because no fishing activity in the stream.
Dubair Khwar	Sarhad Hydel Development Organization 1999	No effect on natural/capture fisheries.
Khan Khwar	Sarhad Hydel Development Organization 1996	Decrease in fish catch resulting from impaired migration of valuable species; loss of downstream habitat due to flow changes
Allai Khwar	Wapda 2000	Not specified Mitigation calls for monitoring of possible effects on fisheries of pollution and arrested migration, and encouragement of private sector for expansion of existing hatchery
Lower Spat Gah	Lahmeyer International and Knight Piesold 1997	No information is presented on baseline or impact assessment related to fish resources
Lower Palas Valley	Lahmeyer International and Knight Piesold 1998	No information on potential effects on fish resources

In Zone 2, the existing and proposed hydropower projects have potential to have a serious additive effect on snow carp and other fish species and fishing activity in that zone. There is risk that DHP incrementally will contribute to reduction in population sizes of snow carp and other fish species and amounts of fish caught by local fishermen.

Six of the existing or planned hydropower projects are located on tributary streams; as noted for Zone 1, tributaries often provide spawning habitat for snow carp – hydropower projects likely will affect spawning populations in some of the associated tributary systems. All of Zone 2 tributary projects are located downstream of DHP. If the projects in Zone 2 operate as peaking facilities, there could be potential negative impact on mahaseer habitat on the downstream of Allai Khwar due to alteration of downstream flows in the Indus River.

Zone 3: Operation of hydropower projects in Zone 2 as peaking facilities might have an adverse impact on Tarbela fisheries. The amount of effect on fisheries resources that could occur under those conditions, mainly from daily reductions in flow downstream of projects in Zone 2, is uncertain but likely would not be high given the distance downstream and anticipated adoption of conservative minimum flow releases. The projected change in downstream conditions indicates low vulnerability of fish populations harvested in the Tarbela commercial fishery. Risk would be greatest for species such as mahaseer in Tarbela Reservoir that depend on upstream areas along the Indus River main-stem for completion of their life-cycle and whose movement or habitat use in upstream locations could be impaired by altered habitat conditions.

Other Factors: Other current and proposed developments and human activities and natural events in the CIIA study area are believed to be having negative effects on fisheries resources; these include:

1. Illegal fishing using explosives, poisons and electricity which are believed by local fisheries managers to be causing large-scale damage to fish populations throughout the area but for which firm data do not exist
2. Fishing by acceptable means, again for which data do not exist, believed to be causing reduced population sizes through overfishing.
3. Other human activities along riversides in towns and smaller communities throughout the area likely contributing to degradation of water quality and physical habitat features and resultant impaired fish production
4. Natural events such as landslides causing severe habitat loss in some areas.

Risks to fish habitat will increase as a result of project-induced increases on urban development, agriculture, transport, forestry and industrial activity. Project-induced increases in human populations, especially during the construction stage will increase demand for fish and pressure on fish stocks.

6.6.3 Scenario B: Best Practices

Recommendations for best practices to reduce potential cumulative and induced effects on fisheries include:

1. Support development and implementation of an integrated basin-wide framework to assist assessment and management of wild-capture fisheries, including identification of long-term strategies to assist fisheries management institutions to address potential effects of multiple hydropower developments in their jurisdictions and engage community stakeholders (especially in Zone 2, where hydropower projects are concentrated).
2. Within the framework above, define and support capacity-building in fisheries management institutions to strengthen capabilities related to both fisheries ecology and management.
3. Support community/stakeholder-awareness programmes that highlight:

interaction between hydropower facilities and fisheries resources; life cycle needs/habitat and protection requirements of fish species in the upper Indus River basin; good practices and opportunities for capture-fisheries in the basin area.

4. Support broad-area inventory and analysis of ecological components and fishing activities based on a long-term perspective and, within the basin-wide framework, identification of high priority needs to enable assessment of planned hydropower development over the next 10 years and projects under consideration beyond 10 years.

Adoption of a best practice approach would yield: baseline fisheries data and assessment on a broad, regional basis; high-level examination of interrelated topics such as sustainability of fisheries, aquatic biodiversity and water use; long-term appraisal of sector management issues; and, a rigorous mechanisms for stakeholder engagement and monitoring (at all project stages, but importantly during operation) to enable adaptive management. Anticipated outcomes through application of best practice measures are:

Zone 1: Application of best practices to hydropower development likely would eliminate risk of projects in Zone 1 exerting additional effects on fishing activity in the DHP area-of-influence. Best practices would elucidate fisheries ecological and resource-use linkages and enable identification of measures to protect potentially affected fisheries resources and fishermen.

Zone 2: Application of best practices should reduce risks to fisheries of incremental adverse effects from DHP in relation to construction of Basha and the six existing or planned hydropower projects on tributaries.

Zone 3: Risk of projects in Zone 2 affecting fisheries in Tarbela Reservoir is already low and likely would be eliminated by adoption of best practices.

6.7 TRANSPORT

6.7.1 Effects of DHP

Due to construction of the Dasu dam and the impounding of the reservoir 46 km of the KKH will be inundated along the left bank of the Indus river valley. Relocation of that 46 km of KKH to higher level will be required along the rim of the Dasu reservoir because of its submergence. Inundation and rebuilding of the KKH will be a permanent change. Two suspension bridges on Indus, connecting both the banks, will also be affected due to project interventions. It is estimated that traffic will increase by 200-300 construction vehicles daily due to DHP.

6.7.2 Scenario A: Business as Usual

Construction of the other large dams (like Diamer Basha – 900 to 1000 vehicles) is expected to have similar effects on associated roads and bridges. A traffic congestion will occur frequently due to construction vehicles, however normal traffic will also gradually increase. For example, construction of the Bunji Dam means loss of existing roads, bridges and access to the Right bank areas including the Upper Valleys. Such impacts include:

1. Large segment (about 95 km) of the existing Karakorum Highway (KKH) on left bank will be inundated (from dam site to Raikot Bridge)
2. All other link roads to KKH, mostly in the lower parts of side valleys, will be submerged as well.
3. Six existing suspension bridges linking existing KKH to the right bank settlements will be drowned.
4. Raikot Bridge, though with a deck elevation of 1,180 masl, will not be physically submerged but the relocation of KKH may render it redundant.

Further, access conditions for the left bank upper villages will substantially improve via the relocated KKH. On the other hand, impoundment of the reservoir will adversely affect access to villages on the right bank. Besides directly impacting 12 villages close to the river (9 fully and 3 partially), 77 villages in the upper valleys of Khanbari, Hodar, Kiner, and Shing Nullahs will totally lose access to markets and services. The reservoir would completely inundate the lower parts of the side valleys and significant stretches of the related link roads. Thus, their existing access roads to Chilas over the suspension bridges will terminate near reservoir edge of 1,160 masl totally isolating the right bank. This is proposed to be compensated through construction of a 'Right Bank Periphery Road' connecting the dam site to the upper part of relocated KKH near Draing close to Raikot Bridge. The largest and most important impact will be submergence of the existing KKH over a length of about 95 km. Most of the service and business facilities are located along this left bank main road, the affected population on this side is almost three times that on the right bank.

6.7.3 Scenario B: Best Practices

Transport related risks can be reduced by addressing traffic safety issues and induced effect of increased roads and traffic on other environmental/social components by putting in place processes to anticipate and respond to emerging risks and opportunities related to traffic and other transport issues especially for locations where hydropower projects are in close proximity (e.g., Zone 2). An objective would be to engage directly affected stakeholders over a broadly affected area in an inclusive and participatory manner, with thorough and timely feedback on transport-related issues. On a project level, contractors will have to restrict movement of construction vehicles during the peak traffic hours.

6.8 URBAN DEVELOPMENT

6.8.1 Effects of DHP

Dasu and Komila are expected to experience an Increase in population especially during construction, with in-migrants attracted to work and business opportunities. Indirectly the project is expected to increase urban development through provision of more power via local transmission lines.

6.8.2 Scenario A: Business as Usual

As with DHP, other hydropower developments, particularly larger ones such as Basha and Bunji, likely will lead to "boom town" development in nearby communities, at least over the construction stages. Overlap in construction timing could lead to large population influxes at multiple locations along the Indus River. Over a longer time-frame the hydropower developments in the study area will provide opportunity for social uplift and income generation. The projects will create localized land use changes, potentially leading to accelerated and unplanned urbanization. Urban development will exert pressure on cultivated and range lands. Socio-economic improvement in the project areas will occur and more social facilities will be needed in those areas. Projections of urban development of the amount and spatial extent are difficult, but some form of urban development due to construction and operation of the proposed hydropower projects is anticipated.

Urban development will induce effects on environmental components such as demand for water, water quality, use of natural resources (forests, fisheries, agriculture) and biodiversity and on social elements such as health services.

6.8.3 Scenario B: Best Practices

Risks of urban development affecting environmental and social components can be reduced by working with affected districts and communities within their broader community planning frameworks as they apply to urban and economic development,

and including integrated mechanisms for sharing project benefits and anticipating and managing induced environmental/ecological and social effects. This may require provision of financial and technical support to agencies responsible for community and economic planning and engagement of stakeholders on a multi-district basis where multiple projects exist or are planned in close proximity (e.g., Zone 2).

6.9 POWER TRANSMISSION

6.9.1 Effects of DHP

Injection of power generated at Dasu Hydropower to the National grid requires construction of extra high voltage transmission lines for which a feasible line route corridor has yet to be explored in detail. The construction cost in this area is expected to be very high compared to line construction cost in plain areas. The environmental assessment of a transmission route is being carried out through a separate study by National Transmission and Dispatch Company (NTDC). Two 500 kv transmission lines of 300 km length are planned from Dasu to Pattar Garh, near Hassan Abdal.

Although the transmission lines are necessary to convey electricity to businesses in southern areas, environmental and social issues include: i) health and biological impacts due to electro-magnetic fields; ii) loss to scenic beauty; iii) collision and electrocution of migratory birds; iv) loss of agricultural land; v) life safety issues; and vi) avalanche damage to the poles. These potential effects and risks may be outweighed by the benefits of the power transmission lines to the urban and industrial centers of country.

6.9.2 Scenario A: Business as Usual

The two existing transmission lines (132 KV and 220 KV) along Indus valley downstream of Pattan pass along a corridor close to the Indus River. Two transmission line of 500 KV for Dasu is planned for construction and also is expected to pass along the Indus from Dasu to Pattar Garh near Hasan Abdal. A transmission line of 765 kV for Basha is probably to be installed along the Indus in the same corridor as the DHP line. The existing power transmission lines layout is shown in Figures 6.3.

Indus valley is flyway for migratory birds from Central Asia to Indian Subcontinent. Thousands of birds will travel through this for wintering grounds in sub-continent. Development of many transmission lines along Indus will affect the birds through collision and electrocution. Electromagnetic waves from the transmission lines may also affect the health of nearby population. In addition, environmental and social issues outlined above for DHP would apply to transmission lines for all planned hydroelectric projects. Smaller lines that supply power to communities near the projects would likely induce urban and industrial development and increase risk of environmental and social effects from such development.

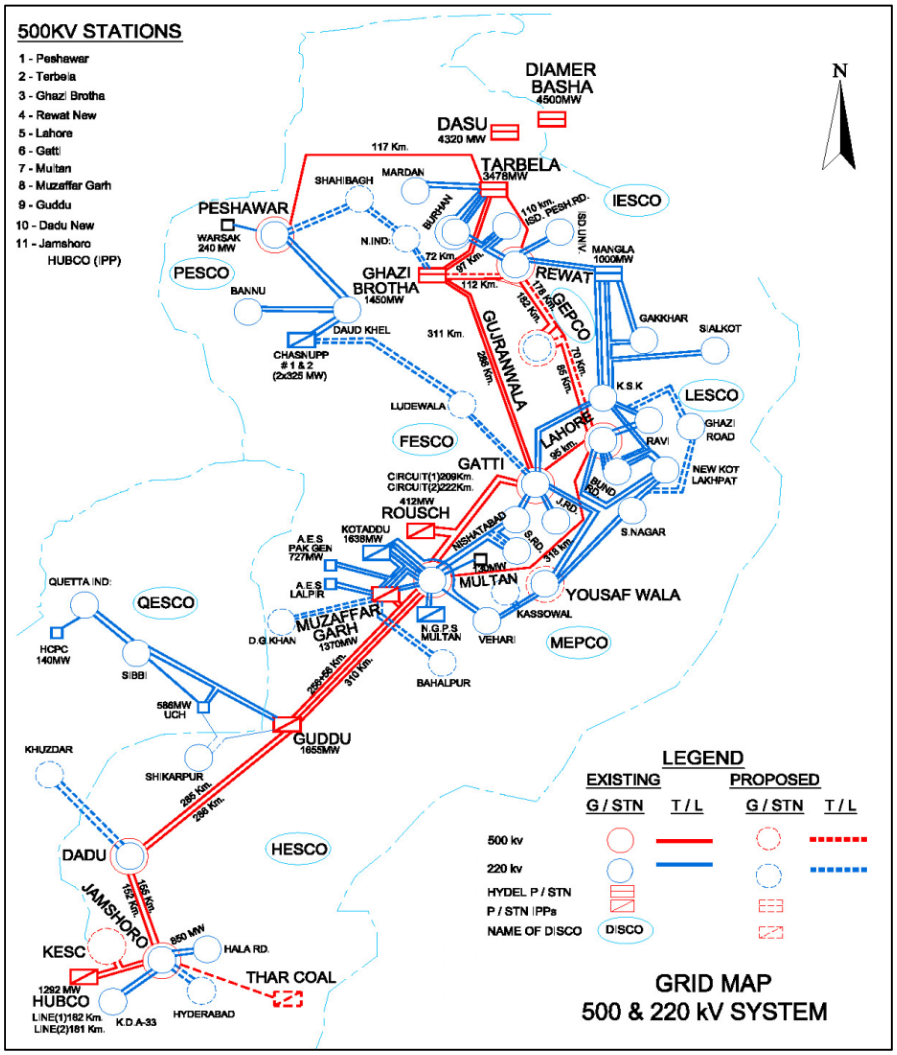


Figure 6.3: Transmission Lines and Grid Stations

6.9.3 Scenario B: Best Practices

Risks of cumulative environmental and social effects resulting from power transmission lines can be reduced by: basin-wide assessment of corridors and routes; and, putting in place processes to anticipate and respond to emerging risks and opportunities related to power transmission issues and induced development, especially where hydropower projects are concentrated. Best practice calls for broad-area engagement of affected stakeholders in an inclusive and participatory manner, with thorough and timely feedback on issues related to power transmission including induced effects. Design of transmission lines shall consider morphometric features and behavior of the large birds, and electromagnetic radiations from the transmission lines.

6.10 INDUSTRY

6.10.1 Effects of DHP

Project construction is expected to increase the population size of local communities and activity of local small-scale industries. Regular supply of electricity will likely attract new industries or induce expansion of existing, mainly wood-based, industries. The general economic and social conditions are expected to improve with the construction and operation of the projects and will promote conditions conducive to growth of local industries. Professionals like doctors (medical clinics) and teachers would be

encouraged to live in the area and, hence, the provision of social sector services is likely to improve. The small scale industries/business like hotels/restaurants, furniture making, timber wood industry, agriculture, light engineering workshops, stone crushing, petrol pumps, banks, estates enterprises, shops/craftsmanship, stone handicrafts, jewelry and tailoring are likely to slowly increase due to hydropower development occurring in the DHP project area.

The construction of DHP and other hydropower projects would attract cement industry as cement would be required in large quantities. Moreover, there exists a lot of base material required for cement industry in the area. This situation will improve living standards of the communities while, providing job opportunities as well.

6.10.2 Scenario A: Business as Usual

Small-scale industries such as those outlined above likely will develop in each community located close to the larger projects within the Indus river upper-basin according to local resources, product-demand and availability of new power from project transmission lines.

Potential environmental and social effects will be associated with the types and size of industries that expand or are newly attracted to project-affected areas. Local industrial growth has potential to affect water demand, water quality, air quality, ecological services and resource use activities such as fishing and social factors such as worker and community health.

6.10.3 Scenario B: Best Practices

Environmental and social risks associated with cumulative and induced industrial growth can be reduced by putting in place processes to anticipate and respond to emerging risks and opportunities associated with growth of local industries. This will require engagement of directly affected stakeholders in more than one jurisdiction to ensure environmental and social safeguards are adequately anticipated and applied, and with thorough and timely feedback on issues related to industry growth. These activities should be integrated with community development and economic planning initiatives.

6.11 RESETTLEMENT, LIVELIHOODS AND INCOMES

To facilitate the assessment, areas-of-influence (Impact Areas) were identified for each of three hydropower projects (Diamer Basha, Dasu and Tarbela) and included upstream, downstream and immediate reservoir locations (Table 6.11). Secondary sources used in preparing the report include government census/surveys as well as project materials.[1] Background information is presented in Appendix 5.2.

Table 6.11: Impact Areas of Selected Hydropower Projects

Project	Impact Areas
Diamer Basha Dam	Area 1 - upstream Dasu Hydropower Project from Dodishal to Raikot Bridge
Dasu Hydro Project	Area 2 - upstream and downstream area under Dasu Hydropower Project
Tarbela 4th Extension Project	Area 3 - upstream and downstream area of Tarbela 4th Extension project

Table 6.12 provides a comprehensive list of impacts by the three hydro projects.

[1] The sources include(i) Districts Census Reports of Diamer, Kohistan, Shangla, Battagram, Haripur and Swabi Districts (1998); (ii) Land Acquisition, Resettlement and Development Plan for Basha Dam Project (July 2010); (iii) Tarbela 4th Extension Project, ESA Final Report (May 2011); (iv) Revised Action Plan for Legacy Issues, Tarbela 4th Extension Project (May 2011); (v) Social Impact Management Framework for Tarbela 4th Extension Project (2011); and (vi) Resettlement Action Plan for Dasu Hydropower Project (Nov, 2012).

Table 6.12: Social and Cultural Impacts of the Selected Projects

Indicators	Basha Dam Project	Dasu Hydropower Project	Tarbela 4TH Extension
Location	Diamer and Kohistan Districts	Kohistan and Diamer Districts	Haripur and Swabi Districts
Affected Population	28,650 people will be affected due to project interventions.	6,953 affected persons will be dislocated requiring relocation	No displacement by 4th Extension. However, some claims and issues still remain from earlier phase of Tarbela Dam.
Households	4,310 from 31 villages	767 from 34 villages	4,387 in 11 villages around the Project area, but not affected
Acquisition of Land for project construction	Total estimated land acquisition of 15,150 ha (37,419 acres), up to the land acquisition zone of 1170 masl, comprising: (i) Private agricultural land: 1138 ha (2811 acres); (ii) Area under housing/infrastructure: 29 ha (72 acres); (iii) Area under commercial objects: 10 ha (24 acres); (iv) Barren / other land: 6,493 ha (16,036 acres)) ; and (v) Government land: 7,480 ha (18,476 acres)	A total of 3312 ha of land will be affected in the Left bank while 1331 ha will be affected in the Right bank. Of the total land affected, the majority of land affected is on the Left bank comprising 70% of the total land to be acquired.	WAPDA owns the land where the Tunnel 4 activities will take place and the infrastructure to be built. The land is currently uninhabited and has low productivity value. The land required for expanding the switchyard and upgrading the access roads. No land acquisition and resettlement impacts for the main construction site are anticipated.
Trees	Loss of estimated 525,775 trees both fruit (283964) and non-fruit (241811) varieties.	An estimated 21,000 trees of various species and sizes will be lost due to project interventions	An estimated 80 to 90 trees of various species will be affected near power house site.
Commercial activities	453 commercial units/objects comprising of governmental buildings, areas and objects such as schools, police stations, medical dispensaries, and others.	197 commercial structures will be affected due to project interventions.	All project construction activities will be carried out in already acquired land, so there will be no impact on any commercial activities.
Vulnerable	A total of 100 people by virtue of their socio-economic realities are considered socially vulnerable and thus in need of special consideration so that they can benefit from the development activities project. These groups include: (a) Hard core poor households; (b) Female-headed households (FHH) and (c) Households headed by differently-abled persons.	There are 10 families of Soniwal tribe living in project area. They extract gold from sand of River Indus. Others include female-headed households, and persons with disability.	No vulnerable people identified
KKH	Submergence of about 94 km of existing Karakorum Highway (KKH) on the left bank	Submergence of about 46 km of existing Karakorum Highway (KKH) on the left bank	Not applicable
Suspension Bridges	7 suspension bridges are being affected.	2 suspension bridges are being affected.	Not applicable
Indigenous People	IPs, as it is defined for operational purposes (i.e., only Kalash people are	As per WB IP definition for Pakistan, no IPs live in the project area. The affected	No IPs in the Project area

Indicators	Basha Dam Project	Dasu Hydropower Project	Tarbela 4TH Extension
	considered IPs) do not live in the project area; however, generally the people affected are "tribal."	peoples are tribal and of course marginal – socially and culturally.	
Ethnic Minorities	There are 500 families of Soniwal tribe living in project area. They migrate along the Indus banks for extracting gold from sand of River Indus	There are 13 families of Soniwals living in project area. They are extracting gold from sand of River Indus	No ethnic minority in the project area
Cultural heritage	Submergence of 30,367 rock carvings forming part of the cultural heritage	A 400-year old mosque at Seer Gayal village on Right Bank would require relocation	No identified cultural heritage in the project area
In-migrants and social Issues	Several thousands in-migrants and construction workers will move in creating cultural conflict and disruptions in community life	Deterioration of social and community life due to in-migration from other areas of Pakistan and foreign construction workers	Not applicable
Gender impacts	Women have lower status, very limited access to education and health due to seclusion. The poor suffer even more from malnutrition. Many pregnancy related death occur in the valley due to lack of access to medical centers. The construction of the dam will further disrupt their life due to loss of land access to resources.	Women have a lower status and publicly "invisible." As a result, mobility is restricted and limited to occasions such as weddings, deaths, Eid and for medical services. The loss of land, houses and forests due to the project will have significant impacts on the women despite the predominant culture of seclusion in the project area.	Since Tarbela 4th Extension is near semi-urban area, the situations of women are much better. A survey indicated that 49.6% of the respondent visit local hospitals and clinics demonstrating higher mobility of women in the project area.

6.11.1 Effects of DHP

DHP will require relocation of 6,953 people. Relocation of people will more often than not lead to adverse impacts on the assets and livelihood resources of the relocated communities. The field surveys have revealed that livelihood resources of 767 households will be adversely affected by relocation. Thus, restoration of income of these affected communities to pre-project level or more is one of the most important tasks in resettlement planning and management. Therefore, the RAP has included programs for income restoration, capacity building and social capital building of eligible communities.

Within the project affected area the affected livelihood means and resources are land-based activities as agriculture and animal feed collection and wages from timber transportation. The income from selling produce from fruit and nut trees and a few home based small shops was a supplementation. A few PAPs in the downstream areas earn income from being involved in the transportation industry while some PAPs in the upstream villages were engaged in looking after the cultivation and livestock of Maliks. As per findings of the field surveys the effect on livelihood sources of PAPs are mainly due to: i) Loss of agricultural/cultivation activities; ii) Loss of businesses including small shops, hotels and fuel wood selling spots; iii) Loss of range / grazing lands; iv) Loss of mature fruit / non-fruit trees; v) Loss of traditional fishing activities (though very limited); and, vi) Loss of gold washing sites of traditional Soniwal families. Different types of affected persons, numbers and sources of livelihood are shown in the Table 6.13.

Table 6.13: Categories of Affectees and Sources of Livelihood

Categories	Number of Households	Livelihood Source
Farmers	600	Agriculture and Livestock rearing
Entrepreneurs/Small shops	197	income from shops at residence
Government employees	25	Monthly salary
Wage workers	137	
Total	959*	

***** The total of households as 959 is more as compared to 767 due to multiple sources of livelihood.

Approach to Income and Livelihood Restoration: The DHP income and livelihood restoration program (ILRP) has been developed with the aim of improving or at the least restoring to the earlier level the livelihood of all displaced persons. In preparing the program the impact of dislocation on livelihoods and adversely affected income was given due consideration. In addition to income restoration capacity building of affectees and enhancing social capital of the affected communities are major objectives of the ILRP. Hence, training and skills development and measures for income and livelihood restoration of those affected have been included in addition to compensation and resettlement benefits. In the income and livelihood restoration a two pronged approach has been adopted for the estimated project period of 09 years. A short-term livelihood restoration program followed by a long term development plan which has been prepared to be implemented by the PRO and guidance of an organization experienced in long term sustainable livelihood development (contracted organization).

Poverty Alleviation: In both near and long-term, considerable development is anticipated in Dasu and Kohistan that will benefit local populations and improve their income and standards of living significantly. With the hydro power project, new industrialization and opportunities of trade and business will also improve. Dasu will turn into an important business and trade centre in KP in the next 20 years benefitting the local people, particularly those affected by the project.

6.11.2 Scenario A: Business as Usual

Similar effects are anticipated within the areas-of-influence of each of the larger hydropower projects (Diamer Basha, Tarbela and Bunji).

Poverty Alleviation and Improvements in Standards of Living: In 5 year perspective, there should be considerable improvement on District Diamer, Basha Dam area with regard to the levels of poverty. There will be more jobs and business opportunity for local population. It is expected that in the 20-year perspective the rural population of the Diamer District will experience a considerable improvement in the living standards. In Diamer Basha area the topography is gently sloping and access to right bank of Indus River is quite difficult and cumbersome for easy mobility of the local communities and their development is handicapped which requires attention. This can be summarized as:

i. Increased food security (but still reliant on rice supplements)
ii. Improved health and education services
iii. Improved market access for vegetables and other agricultural products
iv. Improved transportation, communications (market access) and electricity
v. Employment for some during the construction period

Induced Effects: Hydropower project-induced urban and industry development will potentially have a positive effect on livelihoods and income, though local benefits could be eroded by a likely surge in in-migrants, at least initially during the construction stages.

6.11.3 Scenario B: Best Practices

A Social Development Fund (SDF) has been recommended for establishment by DHP to support the long-term livelihood development activities. During the operation of the DHP it is expected that SDF will receive funds from the benefit sharing mechanism proposed for the project where a designated part of the income from selling power will be diverted to a separate account established for funding Social and Environmental Enhancement Programs of the District. This concept could be broadened to incorporate and coordinate long-term livelihood development activities on a basin or sub-basin basis, particularly in Zone 2 (where a cluster of hydropower projects are located) over the near term.

A best practice approach would involve engaging economic planning agencies and community stakeholders in planning and execution of community development activities within a framework integrating provincial/district policies, community aspirations and hydropower project compensation and benefit sharing.

6.12 OTHER SOCIAL EFFECTS

6.12.1 Effects of DHP

Population Increase - A "Boom town" Scenario: The project construction will bring significant changes in the lives and livelihoods of the local people, including new opportunities for wage-earning employment. Yet these benefits – with promises for more development in the future – will literally attract thousands of new in-migrants to the project area with potential negative impacts on social and cultural aspects such as increases in crimes – including potential conflicts between the local and the in-migrant groups – and additional pressures and stresses on the already poor infrastructure and social/civic amenities available in Dasu area.

Dasu and Komila together have 7140 inhabitants (Table 6.14). In 2007, population of Dasu was under 1,600. Dasu has now 1602 (estimates) while Komila on the right bank has 5,538 persons. The construction of the dam project will require a significant number of migrant laborers to overcome the shortfall in the local labor market. Thus, the population will likely double or even triple during the construction of the project as the demand for construction workers will peak to 2,700/day. Thus, this small Dasu settlement on the Karakoram Highway will turn into a "boom town" with the influx of new in-migrants during the project construction and the operation of the dam.

Table 6.14: Populations of Dasu and Komila

Settlement	1898 Census	2007 Feasibility Study of Dasu	2012 Estimates*
Dasu	1569	1590	1602
Komila	5423	5497	5538

*Vol. 9 Public Health Action Plan, Sept 2012, Dasu HPP.

The project can expect to attract a diverse range of in-migrants groups – Table 6.15 provides further details with regards to in-migrants types.

Table 6.15: Typical In-Migrant Groups

Types	In-migrants Group
Laborers and their families	Laborers, close family members/followers, move to project sites for employment and other opportunities
Traders/entrepreneurs	Migrant traders/entrepreneurs will move in to project sites to benefit from business opportunities associated with the construction of the project
Small business/shop owners	Many outsiders will move in and establish small business/shops to serve the growing populations

Types	In-migrants Group
Suppliers of construction-related materials	Suppliers of construction materials will open new businesses to benefit from
Various service providers	"Hidden" sex trade network may likely emerge to cater to male workers without their families

The migration and resettlement of laborers/construction workers and their families will introduce a wide range of concerns into the project area of operation – for instance, adequacy of public infrastructure, religious and civic amenities, local transport, housing, food security, health and safety and security issues. Migrant entrepreneurs will also arrive on the scene to benefit from the business opportunities associated with the project. There will be increased demand for goods and services as the local people will have higher level of disposable income. This will also lead to the growth of small businesses/shops in the Dasu and in Komila bazaar on the right bank. Many small business owners will likely open *chhapar* hotel (tea shop) and *khokha* (small eatery) on both banks of the river and closer to construction sites, colonies and campsites. A migration management plan has been developed to deal with the adverse impacts and to integrate the new-comers to the project area.

Health Status: In 5 year perspective, construction of Dasu project would cause higher frequencies of waterborne diseases such as malaria and dengue fever and influx of workers with followers may have health effects, such as higher frequencies of HIV/AIDS, sexually transmitted infections (STIs) in the local population. For the 20 year perspective considerable improvement is expected in District Kohistan with regard to health once construction of the District Hospital in Dasu town is completed. It is planned as a category B hospital with: 208 beds in total; outpatient facilities; and specialists in internal medicine, surgery, gynaecology and paediatrics.

Ethnic Minorities: In the 5 year perspective ethnic minorities like Soniwal 13 households on right bank of Indus River of project area likely will be affected by reservoir inundation as they will have to move to new places for their livelihood. This will severely impact their livelihood; these families have little choice but to seek alternative employment opportunities and occupation, including employment in the project.

Social Disparity: There are already gaps and tribal differences among the local residents. The influx of outsiders, employment and opportunities to earn cash and the flow of investments and trade in the project area may lead to further inequity and disparity in income. The influx of new in-migrants and construction workers to the project site may place considerable pressure on the traditional Kohistani socio-cultural systems as well as resources. The new comers to the project area are likely to have 2 to 3 times more salaries and income putting considerable pressure on existing resources – for example, housing/shelter, land, water, power, food supplies, jobs, transport/infrastructure etc. – on households and communities, threatening their general well-being and welfare.

6.12.2 Scenario A: Business as usual

6.12.2.1 Social Impact Area 1 – Diamer Basha

Population Growth: Diamer Basha Dam is a mega project and an estimated 11, 361 people will be hired for the construction activities for the period of 10 years. Some in-migrants will possibly permanently settle in the areas. This, in addition to families of in-migrants, new businesses and shop owners, will lead to increase in population by about 50% over the first five years of construction. In some 20 years, the population of the project area will likely increase by 100%. This will have a huge impact on the existing infrastructures and social amenities within the project area.

Health: At present the health facilities in the project area is not adequate. Within a 5-year perspective, it is anticipated that the health conditions might deteriorate. Cases of malaria and dengue may be on the rise due to the establishment of large reservoir. In 20 year perspective, the improvement in public water supply systems, the use of latrines and improvement in providing medical facilities will reduce the number of illness caused by water or food-borne diseases.

WHO estimates show that Pakistan has enjoyed a low prevalence of less than 0.1% for Human Immunodeficiency Virus (HIV) in general population. However, there will be influx of migrant workers from different geographic areas with variable prevalence rates of HIV. This poses a potential risk for spread of HIV and other sexually transmitted infections (STIs) in the local community. Therefore, it seems imperative to screen all prospective workers to determine prevalence of such communicable diseases. It is recommended to carry out screening of all the prospective employees (locals and foreign) any candidate tested positive, would be automatically screened out. The district hospital should be up graded with modern equipment.

Ethnic Minorities: In the 5-year perspective as with DHP ethnic minorities like Soniwal in the project area likely will be severely affected due to reservoir inundation as they will have to shift themselves to new places for their livelihood. Within the next 20 years, this particular ethnic group will perhaps move into alternative occupations for livelihoods. They are exposed to the greatest risks.

Social Disparity: The presence of construction workers with rather good salaries and other habits than the local population, and their followers, as well as easier access, may cause a change of attitude and behavior regarding alcohol and substance abuse. Another problem is the possible disruption of traditional networks, dismantling rules and customs of family and community life. People who must resettle will also suffer from various kinds of stress and stress related diseases such as duodenal ulcer, hypertension etc. A sense of helplessness and depression may result from displacement and migration.

Similar social impacts in **Area 2** (Dasu) will also take place as mentioned above.

6.12.2.2 Social Impact Area 3 - Tarbela 4th Extension

No major projects are likely to be undertaken at or around the TDP site concurrent to the T4HP. Therefore, no construction related cumulative impacts are likely to take place in the area. WAPDA is planning to undertake other hydroelectric projects on Indus River upstream of Tarbela, including Dasu and Basha dams. The construction of these projects, if carried out concurrent to the T4HP, could potentially have the following adverse cumulative impacts: i) cumulative vehicular traffic on the approach roads; ii) cumulative demand on construction materials and borrow areas; iii) cumulative demand on construction labor; and iv) cumulative safety hazards and restricted movement for the local population. However, none of these impacts are likely to take place since the sites and approach routes of these future projects are well away from Tarbela, and the country has enough resources/infrastructure catering to the construction material needs of these projects.

6.12.2.3 Conclusions

In the short run, Dasu, Diamer Basha and Tarbela hydropower projects will obviously have adverse social impacts in their respective areas-of-influence along the Indus River, particularly for affected-people losing their land and assets. The availability of land is scarce and would be difficult to mitigate this issue in DHP. Similarly, it is more acute problem in Diamer Basha as there gently sloping areas exist for the expansion of irrigated agriculture and cultivable land. Besides this, certain urbanization and few industrial developments will create more pressure on land and water usage. The access on right bank of River Indus and villages beyond the river bank is an important

issue for the mobility of the local people. This issue needs immediate attention for their uplift of social life. For this purpose, benefit sharing process could provide a solution.

Mitigation measures for compensation and social development programs, if implemented properly, will outweigh the impacts in the long-run. The three projects will also trigger new urbanization in the project area leading to further development of the quality of life. In sum, the long-term outlook appears beneficial to the communities affected and at large.

6.12.3 Scenario B: Best Practices

A best practice approach would put in place broad-area processes, in addition to initial project-specific mitigation and compensation planning, to anticipate and respond to emerging risks and opportunities related to social issues especially in Zone 2 where two large projects have overlapping areas-of-influence (Diamer Basha, and DHP). This would include: coordinated engagement with directly affected stakeholders in overlapping affected areas in an inclusive and participatory manner with thorough and timely feedback on social issues; and, adequate planning to ensure increased demands, especially near-term during construction, are met for factors such as power, food supplies and transport/infrastructure.

6.13 ROCK CARVINGS

6.13.1 Effects of DHP

Though 46 carvings located near Shatihal on the river bank on the upstream side of the proposed Dasu dam site, none of them will be submerged under the proposed reservoir. The natural weathering process and vandalism are threats to the rock carving. Shatihal rock carvings are located in a private land and not protected with fencing and hence it is easily exposed to an increased activity of human vandalism, littering or undesired scribing on the rocks. The potential for vandalism may increase due to increase of traffic along KKH due to construction traffic.

6.13.2 Scenario A: Business as Usual

Most of 30,000 plus rock carvings will be submerged under Basha reservoir.

6.13.3 Scenario B: Best Practices

It is proposed in Diamer Basha Project to set up a museum at Chilas with three dimensional life size replicas and documentation of important petroglyphs, and relocation carvings (subjected to feasibility). Hence it is important to note that rock are complex at Shatial is the only art complex left in its original position in Pakistan after completion of Diamer-Basha Project.

Hence it is important to protect the rock carving-cluster of Shatial in their original condition without any compromise with their authenticity. This can be done by procurement of the land from the private owners, fencing the area, treatment of the weathered carvings and protection from further weathering, and development of tourism facilities. This may provide a good opportunity to expand business and commercial activities and to promote tourism and hotel accommodation. These activities will also stimulate local employment in an area with few economic activities.

Department of Archaeology and Museum (DOAM) of KP has designated about 10 ha (25 acres) of land for procurement and protection of the rock carving site under Antiquities Act, 1975. DOAM has submitted an application to local government in Dasu for purchase of this land. However, non-availability of funds with DOAM has hindered any progress in this direction. DOAM has officially requested the DHP for its support in funding the amount for land acquisition. An estimate of US$ 1.4 million (Vol-5 of EMAP – DHP 2013) for protection of rock carvings and development of tourism facilities is proposed.

6.14 INSTITUTIONAL ISSUES AND CAPACITIES

6.14.1 WAPDA

A Capacity Needs Assessment (CNA) study of WAPDA was recently undertaken by Euro – consultants (2010), encompassing (i) organization review and analysis for suggesting essential organizational changes for effective and efficient functioning of the organizations and (ii) training to widen the knowledge base of the institution.

Organization Review and Analysis: The CNA study recommended institutional strengthening of WAPDA organizations like WAPDA Environmental Cell (WEC), Dam Safety Organization (DSO), Flood Protection / Monitoring and Research Institutes. A Separate General Manager (Research and Monitoring) now may be created to provide guidance and vision to the above stated organizations for required capacity and institution building.

Organizational strengthening of WEC & DSO was recommended in order to enhance performance and ability to evaluate environmental issues and required functions of safety inspections and monitoring of the existing and newly constructed dams of WAPDA.

Need Assessment of WAPDA Environment Cell (WEC): The capability of WEC has been kept at bare minimum just to handle the environmental issues according to as the need be. WEC is still being run on ad-hoc basis by picking the engineers and scientists from existing WAPDA hierarchy. The existing staff strength of WEC is shown in Table 6.16. The CNA recommended that the WEC Team be strengthened with inclusion of Environmentalists, Gender Specialists, Anthropologists, Wildlife Specialists, Botanists, Taxonomists and Economists. Personnel are needed having proper environmental academic background and must be provided logistical support to carry out environmental studies and subsequent monitoring of environmental and social parameters.

Table 6.16: Existing Staff Strength of WEC

S. No.	Designation	Status of Posts		
		Sanction	Working	Vacant
1.	Director General	1	-	1
2.	Director*	1	1	-
3.	Dy. Director (Civil)	1	1	-
4.	SRO (Economics)	1	-	1
5.	SRO (Ecology)	1	1	-
6.	SRO (Geology)	1	1	-
7.	RO (Ecology)	1	1	-
8.	RO (Soil Chemist)	2	1	1
9.	RO (Ecology)	1	-	1
10.	RO (Agriculture)	1	-	1
11.	RO (Environment)	1	-	1
12.	Jr. Engineer (Civil)	1	1	-
	TOTAL	**13**	**7**	**6**

*[The post of Director was also vacant at the assessment time of consultants]

Institutional strengthening and capacity building for the technical implementation of EMMP for Dasu Hydropower Project and future hydropower projects by WEC Headquarter (Lahore) is an important and essential task, so that it can provide in-house support to WAPDA's effort to expand the hydropower development program in a sustainable way, addressing the environmental and social safeguard issues that often hamper the development of hydropower projects.

During the implementation of Dasu Hydropower Project, WEC will provide the following expertise to the project authorities of Dasu HPP:

- Supervision and provision of technical assistance & training of the environmental and social staff working at Dasu Project at site for effective implementation regarding Environmental Monitoring and Management Plan (EMMP).
- Environmental Auditing of the Project on quarterly basis.

Resources Required: The Logistical Support includes procurement of logistical and technical equipment, including transport, to meet the additional load of environmental studies, Environmental Monitoring of Dasu and other Future Hydropower Projects. The equipment, utilities and provision of funds for frequent traveling and lodging between Lahore & Dasu be considered.

The CNA consultants recommended organizational strengthening and proposed the essential organizational changes by additional posts shown in tables 6.17 and 6.18 for Wapda WEC & DSO.

Table 6.17: Additional Posts proposed for WAPDA Environmental Cell (WEC)

S. No.	Designation	No. of Posts
1.	Director General	1
2.	Director	1
3.	Jr. Economist	1
4.	Jr. Sociologist	2
5.	Jr. Environmentalists	2
6.	Legal Officer/ AD Legal	1
	TOTAL	**8**

Source: Capacity Needs Assessment (CNA) Study under WCAP by ECPAK – 2010

Table 6.18: Posts to be added to Dam Safety Organisation (DSO)

S. No.	Designation	No. of Posts
1.	Director (Civil)	1
2.	Director (Geology)	1
3.	Dy. Director (Civil)	2
4.	Jr. Engineer (Civil)	2
5.	Asstt. Director (HRM)	1
	TOTAL	**7**

Source: Capacity Needs Assessment (CNA) Study under WCAP by ECPAK – 2010

Training: Training topics, for both local and foreign components, have been suggested which focus on the latest technology of water and hydropower resource management. These topics include; (i) Hydrodynamic River Flow Simulation Model of Indus Basin (SOBEK Software), (ii) Roller Compacted Concrete, (iii) Tunneling, (iv) International Water Laws (Law of Inter Transboundary Water Resources), (v) Foreign Interaction of Infrastructural Development on River Morphology, (vi) Water Flow Measurement System to improve Water Auditing, Transparency and Communication in Water Distribution, (vii) Telemetry System of Indus Basin (to insure transparency and equitable water distribution to all provinces), (viii) Digitization of Data on Flood Protection Schemes using GIS Database system leading to Interpretation of Satellite Images for Flood Forecasting, Warning and Flood Damages, (ix) Integrated Water Resource Management (IWRM) and (x) Snow Melting and Glaciology Modeling.

6.14.2 Other Institutions

Management of resource sectors such as forestry and fisheries is the responsibility of provincial authorities and guided by national policies. These agencies prepare

provincial policies and objectives and administer management at district level. Resources for effective management at district level are often very limited. For example, in Kohistan District, fisheries personnel do not have sufficient resource to collect basic inventory data on in-river fishing activities and important fish habitat locations. District and community level agencies have limited ability to supply decision-making information and potentially are easily overwhelmed by requirements to provide information to support management of environmental/ecological and social effects of project developments. Engagement of these entities to participate in a meaningful way in stakeholder engagements will require support to enable adequate provision of human and logistic resources.

Mandates of agencies responsible for management and development of sectors potentially affected by hydropower development in KP and GB are described in Appendix 2.3. These are agencies that should be considered in basin-wide and integrated measures to reduce cumulative and induced risks associated with hydropower and storage development in the UIB.

7. SUMMARY CONCLUSIONS AND RECOMMENDATIONS

7.1 MANAGEMENT OF SOCIAL AND ENVIRONMENTAL ISSUES FOR SUSTAINABLE DEVELOPMENT OF THE UIB

7.1.1 Risks and Challenges

a) DHP potentially will contribute to significant adverse cumulative and induced effects of 12 hydropower and storage projects expected to be in place or under construction in the Upper Indus Basin (UIB) by 2022 (Table 7.1); these projects include four on the Indus River main-stem and eight on tributaries.

Table 7.1: Environmental and social components potentially subject to incremental adverse effects of DHP in relation to other hydropower/storage projects

Environmental or Social Component	Cumulative Effect*	Induced Effect
Hydrology	✓ (25% retention of water flows in Indus; 60% reduction of flood peaks; changes in natural flows in winter)	✓ (Climate change[1] may affect river flows)
Water quality	✓ (changes in sediment and oxygen concentrations; 50 years of Increased life of Tarbela due to sediment trap)	✓ (increased urban development, agriculture, forestry, traffic and industry)
Water use	✓ (14% increase of irrigation supplies)	✓ (increased urban development, agriculture, traffic and industry)
Biodiversity	✓ (intrusion into natural habitat due to access roads)	✓ (changes in water hydrology, quality, or habitat from increased urban development, agriculture, forestry, traffic and industry)
Forestry	✓ (demand for forest products from construction workers and in-migrants)	✓ (increased urban development, agriculture, forestry, and industry)
Agriculture	✓ (loss of 1388 ha agriculture land)	✓ (increased urban development, forestry, and industry)
Fisheries	✓ (barrier effect fish movement; habitat loss; reservoir fishery development)	✓ (changes in populations available for harvest resulting from overfishing attributed to increased urban development)
Transport	✓ (Traffic Safety due to construction traffic)	✓ (increased urban development, traffic and industry)

[1] Climate change is shown in this table because it is expected to have an important effect on Indus River upper basin hydrology over the long-term; upper basin hydroelectric development is not directly linked to climate-change induced effects on river flows.

Environmental or Social Component	Cumulative Effect*	Induced Effect
Livelihood and Income	✓ (land acquisition and resettlement);	✓ (increased in-migrants during urban and industry expansion)
Other Social Issues	✓ (in-migrants ,boom-town; health)	✓ (increased urban development, traffic and industry)
Rock Carvings	✓ (Submergence of about 30,000 rock carvings)	✓ (vandalism by construction workers, urban and industrial development)

* Detailed summary of potential cumulative effects are shown in Table ES.3 (Executive Summary – CIIA).

In addition to direct cumulative effects, DHP is expected to contribute to increased power transmission to local communities, urban development, new or expanded industries, increased forestry and agricultural activity and increased road use. These induced activities could lead to an array of environmental and social effects: unplanned urban development, increased deforestation, reduction of agricultural land, air and water pollution, traffic congestion and safety issues, increased demand for water for local use, effects on aquatic and terrestrial biodiversity and local fishing activity, demand for community health services, and social conflicts.

b) Additional best practice measures can be applied to the current business as usual approach to greatly reduce risks of cumulative and induced adverse effects. Opportunity exists for planning and development interventions through coordinated actions by the hydropower implementing agency, environmental protection and economic planning agencies, and community entities.

c) Multiple new main-stem projects such as DHP and Basha in addition to the existing Tarbela project will improve water regulation/availability for irrigation and other uses over the winter low flow period and reduce flood flows and damages downstream of Tarbela Dam.

d) Best practice approaches to management of cumulative and induced effects in the Indus upper-basin suggest possible synergies could be achieved through collaboration of WAPDA with: knowledgeable specialists in environmental/resource-management agencies, academia and NGOs for addressing broad considerations related to biodiversity, especially aquatic biodiversity and fisheries and induced effects on environmental factors such as water and air quality and resource use; and, provincial/district economic planning and development agencies and community groups for addressing issues related to induced community growth and social issues. (An example of best practice approach is: Columbia Fish and Wildlife Compensation Program - it addresses needs related to three large and several small HP projects on the Canadian portion of the Columbia River http://www.fwcpcolumbia.ca/).

e) Within the CIIA study area, a relatively high concentration of hydropower projects (existing, under construction or planned) is evident in in the vicinity of DHP (Zone 2), representing a relatively high risk of adverse cumulative effects on environmental and social components and requiring priority attention.

f) Risks are particularly high for aquatic biodiversity and fisheries resources in Zone 2 – main-stem hydropower projects will potentially impair longitudinal movement of fish to tributary spawning areas and tributary hydropower projects will potentially affect spawning habitat and/or fish movement in associated tributaries. Tributaries are important spawning locations of snow carp and other fish species. In combination with main-stem projects those projects likely will

significantly impair ecosystem function and reduce fish populations in that portion of the Indus River basin.

7.1.2 Recommendations

a) A recommended best practice mechanism to reduce risks of cumulative and induced impacts of DHP and other hydropower and storage projects on affected environmental/social components is to undertake coordinated and integrated basin-wide research, mitigation-measure development, and monitoring by means of a single coordinating body.

b) Consideration should be given to:

   i. formation of an upper-basin monitoring and impact management/ compensation program similar to such basin-management programs elsewhere where multiple hydropower and storage development exists;
   ii. creation of a steering committee or board to guide design and execution of the program environmental and social effects-management activities, in concept comprised of WAPDA, government regulatory and resource management agencies, and representatives of affected communities;
   iii. examination of entities elsewhere to develop a program-management modality and composition appropriate for the social, political and jurisdictional setting in the Indus River upper-basin;
   iv. supplementation of the steering committee or board with technical/topic advisory committees that include technical specialists in prioritized topic areas;

c) Priority actions to address sustainable management of environmental and social issues within or in the absence of the program framework outlined above include:

   i. immediate efforts on aquatic biodiversity research; in particular, comprehensive examination of combined effects and adequacy of environmental flows planned for main-stem and tributary hydropower projects in Zone 2 – based on bottom-up understanding of the aquatic resources at risk;
   ii. development of guidelines on best practices that will be applied to hydropower and storage projects basin-wide and will be developed through stakeholder engagement;
   iii. development of a broad-area monitoring and adaptive management framework to be applied to hydropower and storage development in the upper-basin.

7.2 BUSINESS SOLUTIONS FOR EFFECTIVE ENVIRONMENT MANAGEMENT IN THE UIB

7.2.1 Challenges

a) Development of an effective basin-wide program for management of cumulative and induced effects related to DHP and other hydropower projects will require broad-area multi-stakeholder engagement and collaboration in addition to fomentation of a basin-wide approach and perspective within WAPDA.

b) Implementation of such a program will require: examination of a suitable institutional arrangements; and, capacity-building in areas of integrated and basin planning.

c) Capacity needs-assessments also would be required for specific agencies that would be partners in program development and execution, such as those

dealing with fisheries, forestry and economic development and planning. Resource-sector agencies such as fisheries and forestry departments have very weak capacity at local level to collect basic resource management data and to provide information to support environmental assessments. These entities require assessment of their current resource management capability and needs and ability to participate effectively in environmental assessments and management planning.

7.2.2 Recommendations

a) Recommended actions to support effective environmental management in the upper Indus River basin are:

i. Creation of an upper-basin environmental/social impact management and compensation program with a governance structure based on a core steering committee or board and technical sub-committees as already recommended above;
ii. The choice and features of the initial program delivery model would be subject to stakeholder input, and after implementation be subject to evaluation of performance and effectiveness; evaluation outcomes could lead to refinement of governance structure;
iii. Program activities would be based on ecosystem-based approaches directed mainly at populations of species and human communities affected by WAPDA planned, constructed or operated facilities and adaptive-management to address outcomes of program monitoring activities and unforeseen issues that arise.
iv. The core steering committee and technical sub-committees would be expected to prepare well designed issue-specific action plans. Action plan preparation and implementation-monitoring by sub-committees are expected to lead to synergies among a variety of environmental, resource management, economic/development planning and community/non-governmental entities (Possible sub-committees are: Hydrology and Water quality; Biodiversity; Social Development; Economic Development; Monitoring and Evaluation; Communication and Consultation).
v. Development of a Basin committee communication and consultation mechanism; approaches and spatial coverage will vary among issues/affected-groups, likely being geographically broadest for aquatic ecology and fisheries issues.
vi. Preparation and conduct of capacity building programs for steering committee partner agencies to address hydropower impact issues within the framework of broad-area natural-resource management, community and economic-development priorities/goals.
vii. Preparation of a funding mechanism linked to revenues from hydropower projects and to support integrated/coordinated basin-wide environmental and social management actions associated with hydropower and storage projects in the upper-basin.
viii. Funding leading universities (e.g., Ghulam Ishaq Khan University, which is located near Tarbela) in the country for research fellowships in key environmental and social aspects associated with hydropower projects. Also, assisting in establishing separate faculties in leading universities for integrated management of UIB.
ix. Integrated watershed management studies for control of erosion and sedimentation
x. Management of floods through glacier monitoring program and development of flood monitoring network.
xi. Development of long term benefit sharing mechanism, both monetary and nom-monetary, with the affected community

xii. Consultations with affected community and relevant stakeholders for planning and design of future project facilities

b) Structure, composition and governance procedures should be developed through input of stakeholders and may involve consideration of impact-issues that extend beyond those related to DHP, the focus of this CIIA (pending projects at locations distant from DHP may have to address environmental or social issues that differ from those encountered in the DHP area-of-influence). An indicative initial list of stakeholders and their roles and responsibilities is provided in Table 7.2.

Table 7.2: Indicative list of Roles and Responsibilities among Environmental/Social Management Program Stakeholders

Stakeholder	Role	Responsibility
WAPDA	Core Partner – Hydropower planner and proponent; Member – Steering Committee	Provide leadership, arrange funding and technical support related to sustainable development of hydropower and storage facilities
Ministry of Climate Change	Core Partner – Environment, Ecology, Human Settlement and Forests	Provide guidance, arrange funding and technical support related to sustainable environmental, ecological management in the development projects
Provincial Department of Archeology and Museum, DOAM (KP and GB	Core Partner – Rock Carvings	Provide protection to the rock carvings from vandalism, and development of tourism facilities.
Environmental Agencies [KP and GB]	Core Partners – Environmental Protection; Members – Steering Committee	Provide guidance on provincial policies related to environmental protection and execution of technical studies
Provincial Resource Management and Economic Planning and Development Agencies	Core Partners – Resource Management and Economic Planning and Development; Members – Steering Committee	Provide guidance on provincial policies related to protection of affected resources, plans for resource development and execution of technical studies and economic policies and planning
District Agencies	Members of Steering Committee	Provide guidance on sustainable development of natural resources in project-affected districts
Community groups	Members of Steering Committee	Participation in decision-making regarding sustainable development of community resources for their benefit and ownership.
Technical specialists – Academia/ NGOs/ Agencies	Members of Technical Advisory Committees	Provision of specialist knowledge to support decision-making regarding protection and sustainable development of basin resources on long term basis.

Interaction facilitated through formation and function of the program committees outlined above are anticipated to build synergies among stakeholders, including government and community-based organizations to effectively manage cumulative effects of DHP and other hydropower and storage projects on environmental and social components.

c) The outlined recommendations for environmental management of hydropower development of the upper basin should be considered in anticipation of and may be superseded by findings and recommendations in the planned comprehensive '*Strategic/Sectoral Environmental and Social Assessment of Indus Basin*' (SSESA) being funded separately through WCAP. Tentatively, findings of this CIIA could be used to initiate stakeholder discussion on:

- structure and elements of an environmental management and social development programs for hydropower and storage projects in the Indus River upper basin, by engaging community-level, provincial/district-level, and central-level stakeholders;
- Formation of a Program Steering Committee and topic-specific Sub-committees;
- Prioritization of environmental/social items to be addressed;
- Formulation of issue-specific basin-wide action plans;
- Mechanisms for ongoing review of emerging issues, committee membership, inclusivity/representation, sub-committees or stakeholder-groups, and committee/sub-committee effectiveness and improvement;
- Responsive communication and consultation mechanism to reach a broader stakeholder audience.

d) Costs for the recommended program would be dependent on stakeholder decisions regarding composition and functions of committees in the program and annual workplans and action items. Based on similar programs elsewhere, indicative annual costs could range from USD 0.5 million to USD1.0 million.

7.3 PROJECT-SPECIFIC RECOMMENDATIONS ON ENVIRONMENTAL MANAGEMENT

7.3.1 Challenges

Quality and topic-coverage varied greatly among environmental assessments of hydropower projects examined during this CIIA. Although key agencies such as the provincial environmental protection agencies and WEC have and are in a continual process of improving environmental assessment skills, this is likely not the case for other provincial and district level agencies which already display weak capacity in their own sectors.

7.3.2 Recommendations

a) Consideration should be given at the start of the EA process for each hydropower project to possible needs of sector agencies that are expected to be effectively engaged as stakeholders in EA and provision of support if needed. Areas of need include provision of support to enable supply of local sector-information to facilitate EA studies, including initial issue-scoping, and participation in associated public consultation activities.

b) Each new hydropower project entering the development pipeline after DHP should be required to elaborate in the respective EIA what incremental effects the new project is expected to have on cumulative and induced effects in the upper-basin, building upon elements of this DHP-CIIA and forthcoming SSESA.

c) New projects may bring forward project-related effects not outlined in this CIIA or alter conclusions herein. The Program Steering Committee described above should anticipate need to adapt program initiatives and interventions to any new issues brought forward.

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Appendix – 1.1

TOR FOR THE CUMULATIVE AND INDUCED IMPACT ASSESSMENT

The Project

Dasu Hydropower Project (DHP) is a proposed run of the river power project on Indus River. Water and Power Development Authority (WAPDA) is the implementing agency of the Project on behalf of Government of Pakistan. This project forms the part of WAPDA's vision-2025 program. The aim of vision 2025 is to improve hydropower generation capacity, the revival of the country's economy and above all meet the future needs of Indus Basin Irrigation System.

The DHP is proposed to be located on Indus River, about 8 km upstream of Dasu Bridge near Dasu town, in Kohistan District of KP province, Pakistan. Geographically it is located 74 Km downstream of Diamer-Basha Dam Project measured along the river. The Dasudamsite is a mountainous region. The Project site is accessible from Islamabad by GT Road and Kara Kurram Highway (KKH) via Abbotabad-Mansehra-Besham-Pattan-Dasu. There is no rail link or airport to Dasu. River transport also does not exist.

The implementation of the project would include construction of about 230m high Roller Compacted Concrete (RCC) gravity dam on Indus river at a site about 8 km upstream of Dasu bridge. Impoundment of the dam will create a reservoir about 74 km long with an average width of 290m and having a surface area of about 21.5 km^2 at conservation reservoir level of 950m. The maximum flood level will be 957m. The Project is planned to have an installed generating capacity of 4,280 MW without any loss of downstream flow in the Indus river. An elevation of 957m has been adopted as the limit of reservoir submergence for potential impacts.

Objectives of the Study

The study is aimed at assessing the incremental environmental/ecological impacts of HP and storage development in the Indus river between 2013-2022 in relation to Dasu HPP on aquatic fauna and flora, biodiversity of the riverine ecosystem of the river and surrounding areas and ecological integrity and environmental vulnerability of the river system while specifically analyzing the impact on water availability for agriculture and other uses in the system. This study is a step beyond the EIA, as it incorporates an integrated approach to assess the incremental impacts due to developments in HP in relation to DHPP over next 10 years (2013-2022). The specific objectives of the study are:

(i) To characterize and understand the potential cumulative impacts arising from the construction and operation of all (in sequence and in total) the current and proposed projects on the Indus river over the next 10 years,
(ii) To assess the cumulative impact of hydropower and storage development on water availability for agriculture and other uses in the Indus river system,
(iii) To identify areas where planning and development interventions are required over and above single project mitigation/management responsibility and capacity to deal with identified cumulative impacts. Also, identify development opportunities and develop synergies arising from the hydro development scheme.
(iv) To recommend specific measures, that could be implemented by the implementing agency on the Indus river, so as to provide guidance on integrated planning and development for addressing the cumulative impacts issues over and above the mitigation and/or management measures developed for each individual project.

Scope of Study

The study should cover spatial and temporal dimensions relevant to cumulative and induced impacts and take into account medium- and long-term strategic planning on Indus river.

(i) **Spatial coverage**. The cumulative and induced impacts will assess impacts within the Indus river basin when it enters into Pakistan from India down to Tarbela. External issues (such as climate change) identified as having a significant impact on basin development will also be addressed.

(ii) **Temporal coverage**. The cumulative impact assessment will evaluate recent trends and the existing condition of the basin, as well as potential impacts over next 10 years. The study should also provide, when possible, quantitative longer-term projections based on anticipated longer term impacts.

The study will be predominantly based on information available from **secondary sources**, including the available project documents (feasibility study, detailed engineering reports, evaluation reports, etc., of the current and proposed hydropower projects), Consultants will determine, if any primary survey is required to augment available information, and will conduct such survey to address the objectives and scope of study appropriately.

Community and stakeholders' consultations shall be considered as integral part of each stage of the study, and shall be undertaken for each of the tasks listed below. It is paramount for the Consultants to document each of the consultations sessions, and describe how the assessment and recommendations from the cumulative impact is aligned with the concerns expressed by the communities and the different stakeholders. Community/stakeholders consultations conducted for Dasu project could also be used to supplement this assessment.

Key issues and questions The study will assess the cumulative impacts on Indus river basin including, but not limited to, (i) water-hydrology, water use and quality (ii) vulnerability to flooding, flood management aspects (iii) forestry and bio-diversity (iv) agriculture and livelihood (v) social issues (i.e., involuntary resettlement, loss of income, ethnic minorities, cultural impacts considering religious and cultural values associated with Indus and health risks including risk of HIV/AIDS), (vi) fisheries (vii) transport (viii) water supply and irrigation(ix) urban development (x) power transmission & industry (xi) institutional issues and capacity.

Development Scenarios: Two development scenarios are anticipated – (a) a scenario which represents the "business as usual" development pattern given the aggregate view of all the proposed developments with special emphasis on cascade hydro development (keeping in view the projects awarded and in progress already), and (b) a scenario that reflects "best practices" with broad policy support for environmentally and socially sensitive development. A risk assessment approach will be employed in examining the two scenarios considering the pattern and level of development which would lead to cumulative effects that are either significant or acceptably insignificant.

Task 1: Project Initiation

The consultant shall identify all relevant stakeholders for the cumulative impact assessment study. These would include, but not limited to the government (national and provincial both)Ministries/departments of power, forestry, environment, agriculture and livestock, water supply, fisheries, urban development; the universities and research institutions; non-government organizations and community based organizations; and other experts.

The consultant, with endorsement from the government , will convene a study initiation event (meeting, focus group, etc.) with the identified stakeholders in Islamabad (and at least one consultation each in Lahore and Karachi) to discuss (i) the methodology to be used for the study, (ii) the study plan and schedule, (iii) identification of all relevant documents to be reviewed as part of the baseline for the study, (iv) the scope of the cumulative impact assessment, and (v) the approaches to consultation with various stakeholders including focus groups identification, interaction protocols, and documentation. These consultations could be integrated into the consultation program for Dasu HPP. The output from the event must include the key issues and development

scenarios for the study. A project initiation report will be prepared by the consultant and shared with the client as well as with the Bank.

Task 2: Prepare Baseline
The baseline study will be predominantly based on information available from secondary sources however primary data will be used where it can readily be collected particularly from three on-going projects, ie., Tarbela 4th HP project, Dasu HP project and Diamir-Bhasha Project on the Indus river.

The consultant shall prepare an environmental, socio-economic and resource baseline for the Indus river basin. The baseline will focus on the key issues identified in Task 1.

The baselineinformation should also be clearly presented in tables and maps of adequate scale. The consultant shall present the best available information in these maps, images, and land use assessments summaries. *It is recommended that these maps are based on elementary GIS, so that these could be used in future*. It is important to locate all the current, ongoing and the proposed projects in these maps.

The development of the baseline shall include desk reviews and evaluation of existing studies which have addressed environmental and social impacts and strategic developmental planning issues.

An institutional review of key policy, legal, and regulatory framework for environmental and social management in the basin will also be required as part of the baseline information.

Task 3: Impact Assessment
The consultant with undertake an assessment of potential economic, environmental or ecological, and social trends including those potentially induced by the hydropower and storage development program for Indus river basin in relation to DHPP. The study shall undertake an assessment of development scenarios in the basin as identified in Task 1, specifying: benefits (including allocation among groups and geographic areas), constraints; implementation and financing options; and costs. It will specify the role of hydropower development in the development scenarios.

Task 4: Summary Recommendations
Based on the outcome of the previous tasks (to be documented as part of final Report), the cumulative impact assessment study will outline the following as part of the recommendations in the final Report:

(i) Recommendations for overall development of the Indus basin, including all hydropower and storage projects in the Basin over the next 10 years, with respect to managing the social and environmental issues in a sustainable manner. If required, recommendations for individual projects particularly Dasu should be specifically stated.
(ii) Business solutions for effective Environment Management in the Indus Basin, with a description of roles and responsibilities among the different stakeholders, and a plan to build synergies among all the stakeholders, the government and the community-based organizations.
(iii) Project specific recommendations on environmental management based on the study analysis by clearly identifying the rational for their inclusion in the project specific EIAs.

OUTPUTS
Consultants are expected to provide the draft report on cumulative and induced impacts and the final report once both the client and the Bank has reviewed and provided their comments on the draft report.

Appendix – 1.2

TOR FOR STRATEGIC/SECTORAL ENVIRONMENTAL AND SOCIAL ASSESSMENT OF INDUS BASIN

WATER SECTOR CAPACITY BUILDING AND ADVISORY SERVICES PROJECT (WCAP)

(COMPONENT A1, ACTIVITY 3)

STUDY TITLE: Strategic/Sectoral Environmental and Social Assessment of Indus Basin

DRAFT TERMS OF REFERENCE (TOR) FOR PROCUREMENT OF CONSULTANTS

1. Background

Pakistan's Indus Basin Irrigation System (IBIS) is the strong heart of the country's economy and provides country's basic food security (90% of food production). Agriculture contributes about 25% to Pakistan's GDP but the sustainability of this production is subject to environmental threats. In last 64 years, Pakistan has added new dams, barrages, link and branch canals, and is modernizing and maintaining the world's most complex and extensive irrigation system. The major issues being faced in the Indus Basin include soil and water salinity, environmental degradation of lower river reaches, vulnerability to drought and supply, inefficiency and low productivity. Prospects of climate change further complicate the management of these issues. Pakistan needs to, at least, double its storage capacity by 2025, in order to meet the projected domestic, industrial and irrigation/agriculture water requirements in the context of growth and urbanization. At present Pakistan is also suffering from severe energy shortages because of limited supplies and inadequate infrastructure development. Therefore, storage is also required to generate hydropower which is a key economic component of the country's energy system and on which reliance is increased due to high fuel cost.

In Pakistan, power generation is mainly in the public sector with two vertically integrated (in generation, transmission and distribution) utilities. Water and Power Development Authority (WAPDA) has prepared a twenty-five (25) years development plan *"Water Resources and Hydro Power Development - Vision 2025 Program"*. This program envisages short, medium and long term development of water storage and hydropower projects to meet the irrigation and power demands. The *"Policy for Power Generation 2002"* is the major power policy that aims to provide sufficient capacity for power generation at the least cost, to encourage and ensure exploitation of indigenous resources, and to ensure that all stakeholders are looked after in the process. The *"Energy Security Action Plan 2005-2030"* was approved in 2005 to meet the requirements of Pakistan's Vision 2030 for reliable and quality energy supplies. It enhances energy supply through an optimal mix of all resources including hydropower, oil, gas, coal, nuclear and renewable energy such as wind and solar. Also the *"National Energy Conservation Policy 2005"* is trying to promote energy conservation practices and effective energy saving of observable magnitude at the national level. Further, in 2006 the *"Policy for Development of Renewable Energy for power Generation"* (Small Hydro, Wind & Solar Technology) was approved to provide additional power supplies to meet increasing national demand.

Pakistan's hydropower expansion program to meet its current and future energy demands needs a process of examining potential environmental and social implications of all or most of the potential projects proposed for expansion. Strategic Sectoral Environmental and Social Assessment (SSESA) of the whole Indus Basin offers an opportunity for sector wide environmental and social considerations including cumulative impacts, impacts that result when the effects of implementing the proposal are added to analogous effects of other past, present and future projects, before investment priorities are determined. The SSESA of Indus Basin will also promote the inclusion of environmental and social considerations in

the country's energy policy and sector growth and for screening out environmentally damaging water resources development and management projects at an early stage.

2. Assessment Rational

To meet country's energy requirements Pakistan has extensive portfolio of hydropower projects which are either under preparations or under implementation in Indus Basin including Diamer-Bhasha Dam, Kurram Tangi Dam, Munda Dam, Kohala Dam, Golen-Gol hydropower, Dasu hydropower, Bunji hydropower, Neelum Jhelum hydropower, etc. and needs large investment for development of such multi-purpose water infrastructure projects. Furthermore, these multi-purpose water infrastructure development projects encounter risk of serious problems, due to environmental and social aspects which include resettlement of residents, restoration of their livelihoods, adverse impacts on downstream river flows, environmental health and social use of the river. Therefore, for making country's hydropower expansion program successful, there is a strong need to credibly address the cumulative environmental and social risks of storage and hydropower development projects in Indus Basin in order to minimize the impact of the development and ensuring an environmental and social sustainable development. Moreover, it is also needed to examine current environmental legal, regulatory and institutional framework and sectoral policies to assess that the environmental and social issues are adequately covered in energy sector besides assessing the capacity to manage the environmental and social aspects/issues of water resources development projects.

The SSESA presents a more proactive approach than Environmental Assessment as it integrates environmental and social considerations into the strategic levels of decision-making process. The SSESA provides significant in depth analysis of the environmental and social issues (direct and indirect upstream site and downstream impacts) associated with the various storage and hydropower developments and also helps to examine sectoral polices and legislation for consistency with water resources and support for environmental considerations. Further, this assessment reduces upfront planning and preparation costs and minimizes the risk of serious problems which multi-purpose water infrastructure projects encounter due to environmental and social aspects.

Therefore, in above context SSESAs of the whole Indus Basin could serve as a basis for project specific environmental assessments and environmental management plans and help in addressing and internalizing environmental issues in water resources development and management planning. This assessment will assist in the water sector, in general, and hydropower, in particular, for objective decision-making on the most desirable and sustainable levels through a strategic planning approach that balances economic development, social equity and environmental sustainability. The SSESA of Indus Basin will also promote the inclusion of environmental and social considerations in the country's energy policy and produce outcome with a power strategy that will put forth different development options including an assessment of environmental and social impacts. Furthermore, it would also serve as a pilot for development of a broader sectoral assessment framework in the context of *"Water Resources and Hydro Power Development - Vision 2025 Program"*.

3. Objective of the Assessment

The overall objective is to undertake a comprehensive SSEAs of storage and hydropower development investments/options in Indus Basin. The specific objectives are; **i**) to examine sectoral polices and institutional framework for consistency with water sector development, in general, and hydropower development, in particular, and support for environmental considerations, and enhance the capacity to organize and manage water related environmental and social issues. **ii**) to enhance sustainable

hydropower through improvements in power strategy including/considering all environmental and social aspects, **iii**) identify potential impacts, including cumulative impact, to allow informed and transparent decision-making in the selection of storage and hydropower investments, **iv**) to define the best storage and hydropower options to meet the expected energy demand, while taking into account technical, financial, environmental and social considerations. The assessment will be performed in close consultation with key stakeholders.

4. Scope of Work

The scope of work of the SSEA of Indus Basin will include, but not limited to:

I. Review and analyze the social and environmental legal, regulatory and institutional framework and its effectiveness and applicability in water resources development, in general, and in hydropower development, in particular; assess whether environmental and social issues are adequately covered by current practices in storage and hydropower development; and give recommendations to improve environmental, social, legal, and institutional framework for efficiency and effectiveness of environmental and social policies and design an institutional capacity development plan for improvement of the management efficiency to tackle environmental and social priority impacts sustainably from storage and hydropower investments within the Indus Basin.

II. Review current policies and legislations (federal and provincial) regarding sustainable development of energy , but not limited to *"Policy for Power Generation, 2002"*, *"The Energy Security Action Plan (205-2030), 2005"*, *"National Energy Conservation Policy, 2005"*, *"National Environmental Policy, 2005"*; assess that environmental and social issues are adequately covered in energy sector and identify elements that may hinder implementation; and provide recommendations to improve overall sustainable energy development outcomes by integrating environmental and social considerations in the country's energy policy.

III. Based on all available environmental and natural resources information/data gathered from project/consultants reports, provide detailed assessment and gaps of available and needed primary and secondary information/data which are required for assessment of environmental and natural resources conditions in the development of water resources and hydropower investment areas and propose a comprehensive plan for collection of adequate information.

IV. Review the energy demand/forecasts of the Government of Pakistan and prepare an assessment of energy needs for the next 5,10,15 & 20 years, based on national policies and targets set in the *"Energy Security Action Plan 2005-2030",* to meet the requirements of Pakistan's Vision 2030 for reliable and quality energy supplies.

V. Prepare an updated inventory of storage and hydropower development investments/options, based on identified and available information in the studies carried out by WAPDA in the context of *"Water Resources and Hydropower Development–Vision 2025 Program",* including scale, geographical location, design and operation, priority and implementation period as well as optimizing existing investments/projects by increasing operational efficiency and improving productivity and demand side management.

VI. Undertake preliminary economic valuation, environmental and social impacts assessment of the major individual investments under considerations in the Indus Basin.

VII. Carry out analysis of Cumulative Impact Assessment to estimate the potential cumulative impacts (positive and negative, direct and indirect, long-term and

short-term) of the hydropower options (individual projects or set of projects) on the environment, natural resource base and socio-economic conditions, taking into account the baseline situation, and multiple ongoing and planned water resources development and hydropower investments in the Indus Basin.

VIII. Carry out best practices analysis of cumulative impact assessment taking into account cumulative and sequential effects of expansion, and in that context, identify number of conditions for the hydropower development in the Indus Basin, including environmental flows required to ensure an environmental and social sustainable Indus Delta. This will also include climate change impacts on hydropower projects as well as the project's potential impacts on environmental and socio-economic conditions.

IX. Carry out analysis of risks (technical, financial, economic, environmental and social risks) of identified hydropower options (individual or sets of projects) taking into account the high levels of uncertainty and the potential large impact of a low probability events. The outputs of the risk analysis should also be considered for comparative analysis.

X. Carry out a comparative analysis of hydropower options including priority options identified under *"Water Resources and Hydropower Development–Vision 2025 Program"* taking into account, inter-alia, scale, geographical location design & operation, alternative sites, financial, economic, broad environmental and social, political, legal and institutional considerations/criteria in order to identify and prioritize the best options available (including multi-purpose nature of some of the available options) to meet the power requirements of the country. Comparative analysis should assess the situation and overall risk in best case scenarios as well as with and without development scenario in the Indus Basin.

XI. Formulate appropriate measures to mitigate, reduce/eliminate or offset negative impacts and enhance positive impacts of the storage and hydropower options (individual or sets of projects) and recommend broad strategic plans/initiatives and provide instruments for their implementation for reducing/eliminating negative impacts to acceptable levels or mitigating environmental and social impacts

XII. Design/develop a programmatic mechanism for monitoring and evaluating environmental and social performance in the management of hydropower projects in the Indus Basin.

XIII. Formulate recommendations for establishment of a mechanism for setting environmental priorities and policies, as well as program goals for environmental and social management of storage and hydropower projects in the Indus Basin and also provide instruments to improve coordination between different agencies which are engaged in water resources and environmental and social regulations.

XIV. Enumerate comprehensive guidelines to develop a communication strategy and design a central data sharing arrangement to help developers for strengthening the project preparation, taking into account lessons learnt.

XV. Develop a framework and implementation mechanism for consulting stakeholders within Federal and Provincial Governments, representatives of the relevant interest groups/representative bodies and civil society.

XVI. Identify the relevant stakeholders among governmental and non-governmental agencies and outline a realistic consultation work plan and schedule to consult different groups and ensure consultation process and continuous dialogues regarding ongoing and proposed multipurpose alternatives.

XVII. Hold at least five (5) Consultative Workshops to assess the full implications of identified/selected best hydropower options/alternatives. Also ensure that those

stakeholders which could not be consulted in this process should have the opportunity to provide their opinion/feedback.

XVIII. Provide an executive assessment of the positive tangible impacts of the measures proposed based on outcomes of study. The proposed measures/recommendations should be implementable in the present circumstances.

XIX. Finalize the SSESA Report.

5. Completion Period

The assignment is scheduled to be completed over a period of **Thirteen (13) months** starting with the signing of contract, whereas Fourteenth (14th) month has been earmarked for completion of Codal formalities.

6. Outputs/Deliverables

The main deliverable of the study is a comprehensive SSESA Report that includes the findings from all the activities to be undertaken accordingly to the scope of work as given in Section 4. In addition to this report, an Inception Report, Interim Report and Mid Term Report will also be prepared and submitted. The detail of the reports and their tentative submission schedule are given below:

Sr. No.	Title of Report/Presentation/Workshop	Schedule for Submission
1.	**Inception Repot** (10 copies alongwith electronic copies on CD)	**One (1)** month after commencement of the services.
2.	Organize a presentation on the Inception Report to share the road map for conducting the study.	Within two weeks after the submission of Inception Report
3.	**Interim Report** Covering at least TOR items **IV & V** as given in Section 4 above and stakeholders' consultation plan that will be adopted to carry out the SSEA. (15 copies alongwith electronic copies on CD)	By end of **4th** month after commencement of the services
4.	Organize a presentation on the Interim Report.	Within two weeks after the submission of Interim Report
5.	**Mid Term Report** Covering at least TOR items **I to VIII** as given in Section 4 above and Detailed/updated methodology to undertake the comparative analysis of power options/alternatives. (15 copies alongwith electronic copies on CD)	By end of **8th** month after commencement of the services.
6.	Organize a presentation on the Mid Term Report.	Within two weeks after the submission of Mid Term Report
7.	Organize **"One Day Workshop"** on Mid Term Report in consultation with the client for stakeholders' consultation.	As per plan of the Consultants
8.	**Draft Final Report** Covering all activities/TOR items (**I to XIX)** as given in **Section 4** and document the stakeholders' consultation process including information provided, feedback received and consultation tools.	By end of **11th** month after commencement of the services.

Sr. No.	Title of Report/Presentation/Workshop	Schedule for Submission
	(20 copies alongwith electronic copies on CD)	
9.	Organize a presentation on the Draft Final Report.	Within two weeks after the submission of Draft Final Report
10.	Organize **"One Day Workshop"** on Draft Final Report in consultation with the client for stakeholders' consultation.	As per plan of the Consultants
11.	**Final SSESA Report** (50 copies alongwith electronic copies on CD)	By end of **13th** month after commencement of the services.
12.	**Completion of Codal formalities**	**14th** Month after commencement of the services.

7. Staffing

The study will be conducted by a suitable consultant's team ("the consultants"). The consultant should be able to demonstrate its experience in preparation of basin/region-wide SSESA in the water sector particularly with reference to storage and hydropower development programs in the river basins. The consultant's team will comprise experts in at least the following specialties: dam/hydropower engineering, hydrology, climate change, power system planning, power economics, environmental and water resources economics, environment (strategic/sectoral environmental assessment, ecology, ecosystems etc), social/socio-economic, finance (including project management), public consultation, and other experts as needed.

8. Institutional Arrangement

PMPIU under WCAP will oversee the execution of the study through the consultant in close collaboration with WAPDA and concerned provincial institutes.

Appendix – 2.1

SUMMARY OF DHP POTENTIALLY SIGNIFICANT IMPACTS

Potential significant impacts during pre-construction stage:

- Acquisition of 4,643 ha of land, including 143 ha of agricultural land
- Relocation of 767 households from 34 villages, 17 from right bank villages and 17 from left bank
- Effect on various civic amenities: 31 mosques, 7 schools, 1 motel, and 2 Basic Health Unit
- Cutting of about 21,000 trees from the construction areas and reservoir inundated area.
- Submergence of 46 Km of KKH, 2 suspension bridges on Indus (at Largani and Kandia).
- Submergence of an historical wooden mosque at Seer Gayal and 17 graveyards.

Potential significant impacts during construction stage:

- Increased traffic on KKH and along on access roads due to the Project related vehicles. About 200 to 300 construction vehicles use KKH and access roads to the construction sites. The anticipated impacts are traffic congestion, safety hazards due to the increased traffic and increased air and noise pollution
- Potential air, noise, soil and water pollution from the construction areas, including yards, quarry areas, and worker camps
- Effect on fish movement upstream and downstream due to construction of coffer dams, and on fish habitat due to increased load of sediments from in river construction activities
- Influx of about 2700 immigrant construction workers and induced migration from the service providers will create a boomtown scenario in Dasu, which is a small town without any major infrastructure.

Potential significant impacts during Operation and Maintenance (O&M) stage:

- Changes in natural flows especially during low flow seasons, due to lack of water flows between dam and tail race. Future peaking operation in post – Basha scenario may alter the low flow season hydrograph of the downstream. The water regulation will improve resulting in better water availability for irrigation and ecological services.
- Effect on fish movement upstream and downstream due to dam, and fish mortality when fish passes through intake tunnels, tail race tunnels and spill ways. Alteration of fish habitat in the reservoir area due to alteration of riverine ecosystem to lacustrine ecosystem.
- Changes in the downstream water quality due to lesser sediment flow from the reservoir or high sediment content during reservoir flushing.
- The life of Tarbela reservoir would increase by 15 years due to entrap of sediments by Dasu.
- The Dasu HPP will produce 18440 GWh of power per annum.

Appendix – 2.2

PUBLIC CONSULTATION WORKSHOPS

2.2.1. Discussion Topics

Review the potential issues that could result from **cumulative and induced impacts** from the existing and future hydropower and storage projects in Indus River as described in the presentation (also summarized below). Please discuss and provide recommendations on the following

Topic	Comments/Output
1. Additional potential impacts/concerns of cumulative development	
2. Key topics/areas where planning/development interventions are required to deal with identified cumulative impacts	
3. Guidance on integrated planning/development for addressing cumulative impacts	
4. Guidance to consultant team and WAPDA to incorporate in Hydropower project planning and design	
5. Key sector documents: planning/development/strategic; environmental assessments (strategic, sector, project)	

Key issues for cumulative and induced impact assessment

1. River Hydrology
2. Power Transmission & Industry
3. Fisheries
4. Forestry And Bio-Diversity
5. Social Issues
6. Agriculture And Livelihood
7. Transport
8. Floods
9. Urban Development
10. Water Supply And Irrigation
11. Institutional Issues and Capacity of WAPDA

2.2.2. Feedback of Stakeholders Workshops

Extensive consultations were carried out during the detailed design phase of the project, primarily through community consultations, jirgas and stakeholder consultation workshops. 2,392 persons were involved in various consultation meetings at the project sites and consultation workshops (Table 2.2.1) between April 2012 and October 2012.

Table 2.2.1: Number of Persons Covered In By Various Consultation Meetings

Sr. No.	Activities	No. of participants
1.	Social environmental surveys and inventory survey	1,435
2.	Jirga meetings, consultation meetings	718
3.	National consultative workshops	239
Total		**2,392**

Considering the significance of DHP in the national context and its potential impacts on Indus basin, provincial level stakeholder consultation workshops were conducted in Peshawar, Karachi and Lahore in September 2012 (Figure 2.2.1). These workshops were attended by the respective provincial EPAs, wildlife, fisheries, forest, archeology, and public health departments, universities, NGOs and civil societies. A national level workshop was held in Islamabad on October 2, 2012, which was participated by the provincial EPAs from Baluchistan and KP; development agencies such as ADB, JICA and World Bank; national government departments such as Planning Commission, Ministry of Climate Change, Federal Flood Commission, National Highway Authority, NGOs and universities (Table 2.2.2). Attendance at stakeholder consultation workshops is shown in Table 2.2.3.

Table 2.2.2: Organizations participated in Workshops

Peshawar	Islamabad	Lahore	Karachi
• Saalik Foundation, Peshawar • C.R.G. Caravan (NGO), Peshawar • Energy & Power Dept., KP, Peshawar • Environmental Protection Agency (EPA), KP, Peshawar • Wildlife Deptt., Govt , KP, Peshawar • Conservator Forest, Govt., KP, Peshawar • Health Department, Govt. ,KP, Peshawar • Sarhad Hydel Development Organization (SHYDO), KP, Peshawar • University of Peshawar • Highway Authority, KP, Peshawar • Deptt. of Archeology, Govt., KP, Peshawar • Deptt. of Fisheries, Govt. of KP, Peshawar • WAPDA	• World Bank, Islamabad • Environmental Protection Agency (EPA), Balochistan • Indus River System Authority (IRSA) • Irrigation Deptt., Balochistan • Project Management unit (PMU), Deptt. of Social Welfare, Rawalpindi • Pakistan Engineering Council (PEC), Islamabad • Sungi (NGO), Islamabad • PMPIU / WCAP, Ministry of Water & Power, Islamabad • Arid Agriculture, University, Rawalpindi (AAUR) • P&D Division, Govt. of Pakistan, Islamabad • Asian Development Bank (ADB), Islamabad • Japan International Cooperation Agency (JICA), Islamabad • Private Power Infrastructure Board (PPIB). Govt. of Pakistan, Islamabad • Environmental Protection Agency (EPA), KP, Peshawar • United Nations Development Program (UNDP), Islamabad • 100 Small Dams	• Pakistan Engineering Council (PEC), Lahore • Punjab Agriculture Research Board (PARB),Lahore • Space & Upper Atmosphere Research Commission, (SUPARCO), Lahore • Sustainable Development Study Centre, Govt. College University, Lahore • Punjab Deptt. of Fisheries, Lahore • Aurat Foundation (NGO),Lahore • Dept. of Agriculture Punjab, Lahore • World Wildlife Fund (WWF), Lahore • Veterinary University and Animal Science, Lahore • Environmental Protection Agency, Punjab, Lahore • University of Engineering and Technology, Lahore • Deptt. of Archaeology, Punjab University, Lahore. • Energy & Power, Govt. of Punjab • WAPDA	• University of Sindh • Nadirshaw Edulji Dinshaw (NED) University • Mehran University, Jamshoro • Livestock & Fisheries, Govt. of Sindh • Project Coordination and Monitoring Unit (PCMU), P&D, Sindh • Engg. Review Magazine • Pakistan Telecommunication Corporation Limited (PTCL) • Environmental Protection Agency, Sindh • Social Welfare Deptt, Sindh. • Wild Life Deptt, Govt. of Sindh • Culture Deptt.,Sindh • State Life Insurance • Shirkat Gah (NGO) • WAPDA

Peshawar	Islamabad	Lahore	Karachi
	Organization, Balochistan • Chief Engg. Advisor / Chief Federal Flood Commission (CEA/CFFC), Islamabad • Pakistan Agriculture Research Council (PARC), Islamabad • Duaa Foundation (NGO), Islamabad • Ministry of Climate Change ,Islamabad • Deptt. of Archaeology Govt. Pakistan. • Comsats Institute of Information Technology (CIIT), Islamabad. • National Disaster Management Authority (NDMA), Govt. of Pakistan, Islamabad • Pakistan Environmental Protection Agency, Islamabad • WAPDA		

Table 2.2.3: Attendance at Stakeholder Consultation Workshops

Sr. No.	Date	Location	Participants
1	September 9, 2012	Peshawar	41
2	September 17, 2012	Lahore	88
3	September 24, 2012	Karachi	37
4	October 2, 2012	Islamabad	73
Total			**239**

The formats of the consultations meeting were as follows: (i) brief presentation on the technical/engineering design; (ii) presentation on the project environmental assessment; and finally (iii) brainstorming session with round table discussions and/or question and answer session on project impacts and mitigations. The participants were provided with booklets on project information and maps. In the brainstorming sessions, participants were given discussion points on the potential impacts of the project.

Comments and suggestions received in the consultation workshops are summarized in Table 2.2.4.


Workshop at Peshawar


Workshop at Lahore

Workshop at Karachi


Workshop at Islamabad

Figure 2.2.1: Photographs of Stakeholder Workshops

Table 2.2.4: Summary of Discussions in Consultation Workshops

Stakeholders Comments and suggestions	Action Point/Response
Development of an agricultural terrace in the hilly areas will take several years of effort and hard work. Development of agricultural terraces to be considered for the affected households in their new resettlement areas.	Agricultural terraces will be developed in the resettlement sites.
Physical cultural resources in the area are to be properly documented.	A detailed report has been prepared on Cultural Resources. Details are Included in the PCR Plan.
The people in Kohistan have unique social culture, which may be affected by resettlement.	The social structure of the affected people will not be disturbed and will remain same. Relocation of the affected people will be still within their annual migration range.
It is apprehended that existing health facilities will not be enough to meet local and inward migrant worker's need. How the Project will address these health needs?	A public health action plan has been developed. Public health issues such as safe drinking water, safe disposal of sewage, safe collection and disposal of solid waste, protection against dust and community health are considered as part of EMP.
Protection of aquatic flora and fauna should be considered in project design. Requirement of environmental flows for the sustainability of downstream habitat is to be assessed.	Environmental flows will be designed for the Project. But the assessment on how much flows to be released require further studies. It is an established practice in Pakistan to design 10% of average minimum monthly flow as environmental flows. But actual assessment should be based on the habitat requirement.
KKH is life line of northern areas as it is only highway connecting northern areas with reset of the Pakistan. Impact of construction traffic on KKH to be assessed.	A traffic management plan is prepared to address the traffic related issues along KKH and along the access roads to the Project sites.
Impacts during demobilization of contractors are to be considered in the EIA	Contractors' demobilization is considered in the EMP and ECPs.
WAPDA shall have an Environmental Monitoring Unit at Project Site for supervision of EMP implementation.	An Environmental Unit is recommended for both DHP (WAPDA) and supervision consultants.
Initial filling of reservoir may affect the downstream release of water to Rabi crops	The first water filling of reservoir will be carried out during mid-June slowly at the rate of 1 m/day. The rest of the river water will be allowed to flow downstream of the dam through LLO. No impact on Rabi crop will be expected.
Low flow season operation of the dam and its impact on aquatic life to be considered.	The reservoir will be operated as runoff river power generation – not as peaking power generation. Hence the water level in the reservoir will be maintained at 950m and additional water will be released to downstream. Impacts on downstream aquatic life is assessed during peaking and flushing operations (expected to be start after 15 years of operation if Basha is not constructed by that time) may impact the downstream Impacts.
Project design shall consider geohazards (landslides and earth quakes) in the area.	The Project is designed complying with guidelines of International Commission on Large Dams (ICOLD) to deal with geological and geomorphological hazards. State of art engineering modeling was carried out for

Stakeholders Comments and suggestions	Action Point/Response
	design of dam.
Floods from GLOFs will be a serious risk to the Project. Early warning system for flood forecasting is necessary for the safe operation of the Project.	Design flood (Probable Maximum Flood) of the Project considered extreme flood events from GLOFs and extreme rainfall events. A flood telemetry network will be established in the upstream of Dasu for early warning system and better management of floods.
Security issues are to be considered during implementation of the Project.	Security situation in the Project area is assessed and a plan is prepared to address these issues in one of the SRMP volume on 'Hydropower Development, Conflict and Security Issues: A Perspective'
Historical and archeological sites are to be protected. DHP should support the Archeology Department of Peshawar for protection of Shatihal rock carvings, a designated archeological site.	The PCR plan considered the protection of Shatihal rock carvings.
Impact on the community and their livelihood due to relocation to higher elevation.	A livelihood restoration program is proposed in RAP with both short term and long term goals to mitigate any impacts on livelihood.
Community based conservations should be promoted. The conservancy at Kaigah where Markhor is protected by private arrangement and selling one trophy annually for $100,000 is good example.	The Project identified a suitable site in the Project area (Kandia valley) for development of similar community based conservation.
Traffic on KKH requires careful planning if construction of Basha and Bunji projects start along with Dasu.	Currently there is no confirmed schedule available on construction of Bash and Bunji. This issue is further studied as part of the CIIA.
There are no proper health facilities in Kohistan. Health and safety of construction workers and host community need to be planned.	A public health action plan is prepared to address these issues.
Indus valley is a flyway for migratory birds from Siberia to Sub Continent. Impact of transmission line on birds' migration to be assessed.	Bird collision and electrocution are potential threats on migratory birds. These issues will be addressed in the Transmission line EIA
Electromagnetic waves from transmission lines and their impact on human health to be assessed.	These issues will be addressed in the Transmission line EIA
Cumulative impacts of hydropower development on Upper Indus Basin on Lower Indus Basin should be monitored.	The present assessment limits its scope of Upper Indus Basin (Tarbela Catchment). A detailed study is in pipeline from WCAP on 'Strategic/Sectoral Environmental and Social Assessment of Indus Basin'
Impact on migratory birds and important bird areas (IBA) to be assessed.	Impacts on migratory birds are assessed during construction phase of the project. During operation stage, the project will not have any impact on migratory birds. Dasu reservoir might act as a staging ground for a variety of migratory birds that come under the Indus flyway and flying south from the northern latitudes. Large water bodies have traditionally attracted diverse migratory birds in northern Pakistan.
Indus river ecology should be protected. Feasibility of fish ladders should be studied.	Impact of both Dasu and other projects on Indus on the Indus river ecology are assessed and necessary mitigation measures are recommended in the Aquatic

Stakeholders Comments and suggestions	Action Point/Response
	Ecology, Terrestrial Ecology and CIIA reports. Detailed surveys were conducted as well as field teams have substantial prior experience on flora and fauna of northern Pakistan. Also the mitigation measures are recommending creation of protected area and studies of biodiversity to promote long-term sustainability and informed decision-making to utilize the wild resources of the project area.
The Project design should consider geological hazards (seismic activity and faults) in the Project area.	The Project is designed complying with guidelines of International Commission on Large Dams (ICOLD) to deal with seismicity and faults. State of art engineering modeling was carried out for design of dam.
Climate change impacts may trigger GLOFs, high erosion and sedimentation; and finally may affect the Project.	A climate change assessment study was under taken as part of EA.
Habitat management plan for endangered species is to be proposed.	A community conservation area is proposed for protection of important fauna in the project area such Markhor, musk deer, monal pheasant and Tragopan peasant.
Lost community facilities in the affected villages are to be restored in the new resettled villages.	All basic amenities like roads, water supply, irrigation, sanitation, schools and any other facilities that were lost will be built in the new resettlement areas.
Involvement of local community in planning and development process is very important.	Consultation meeting were carried out in all the project villages through PRA techniques.
Ensure timely & frequently stakeholders meetings for suggestion and feedback.	WAPDA has established a full time office at Dasu which is constantly providing a forum to consult on any and all issues. An Executive Engineer of WAPDA heads the office. DCO is also involved.
Proper compensation of affected community is needed, to make it more transparent & clear; affected persons be given proper guidance.	Recommended in RAP.
Capacity of WAPDA in term of human resources needs to be increased to address social and environmental issues.	Field level social and environmental units will be established in DHP.
Potential livelihood and income generation activities to start	Short term and long term livelihood restoration plans are recommended in RAP
Education sector is very important in this area. Focus on Education & Health sector.	Education and heath will be considered in the social development plan and benefit sharing of the Project
Involvement of women is very important. Design livelihood livestock related activities for women.	A Gender Action Plan is prepared.
Mobilization of women for capacity building related to income generation activities need to be more focused	A Gender Action Plan is prepared.
Invertebrate fauna / aquatic flora should be addressed	Invertebrates are already studies within the domain of aquatic ecology.
Establishment of fish hatchery	Fish hatcheries are recommended as part of livelihood development plan.
Motivate local people for terrace farming.	Recommended in RAP
Livestock farming through providing quality animals breeds	Recommended in RAP

Stakeholders Comments and suggestions	Action Point/Response
Downstream communities are generally beneficiaries of the hydropower and irrigation projects. These benefits are perpetual and will pass on to their next generation. The upstream communities are the affected communities by the project and will not the benefit by the project. There should be a planning mechanism to take the perpetual benefits to upstream community.	A benefit sharing mechanism is proposed in Section 9.5.2 of EIA
Climate change and global warming to be dealt in a comprehensive way	Climate change impacts and risks are addressed in Section 5 of EIA
Management and governing mechanism to transfer the benefits and mitigate adverse impacts is recommended	An organization chart and governing mechanism is proposed for implementation of social and environmental management plans.
Carbon foot prints are to be calculated	Greenhouse gas emission from the project is calculated.
Other government departments are to be consulted	All relevant departments of the Project are invited to the stakeholder consultation workshops.
Pre and post effect monitoring should be presented	Pre and post monitoring is proposed for implementation of EMP
Disaster risk reduction checklist that was approved by the government is a requirement for approval of planning documents and PC1. These components are to be considered in the study	The checklist is prepared as part of PC1.
Long term benefit for the affected population shall be contemplated and recommended	A benefit sharing mechanism is proposed
Cumulative impacts on river, and biodiversity should be made part of the study	Cumulative and Induced Impact Assessment is prepared covering these issues
Pakistan signed conference on climate change and hence has access to climate and adaptation fund. The project has to be conceived in a way to access to the funds. No project in Pakistan was able to get these funds.	The Project's CDM potentiality is presented in Section 6 of EIA
Invertebrates and aquatic flora are the food sources of migratory bird. They should be studied.	Dasu reservoir will not support these features because of high water velocities and rapid sedimentation
Fish hatcheries to be established to conserve the local species	Fish hatcheries are recommended for reservoir fisheries development and livelihood plan
Motive local farmers in livestock farming and provide them quality breeds for sheep and goat	Livestock farming is included in the livelihood restoration plan of the Project
Motivate local people for terrace farming. NARC help can be taken	These recommendations will be included in livelihood plan of the project.
Community should be educated about Infectious diseases. Necessary vaccination should be provided.	The recommendation is included in Public Health Action Plan of the Project.
Sedimentation in catchment area should be covered and properly addressed	Landslide prone area in Dasu reservoir areas are identified and will be protected.
National heritage should be properly conserved	Conservation measures are proposed for Shatial rock carvings.

Appendix – 2.3

MANDATES OF MINISTRIES AND AGENCIES RESPONSIBLE FOR DEVELOPMENT AND MANAGEMENT

2.3.1 Ministries / Agencies responsible for Sector Development and Management

Ministries and agencies responsible for planning or managing sector development are listed in Table 2.3.1; abbreviations used in Table 2.3.1 are defined in Table 2.3.1a.

Table 2.3.1 Ministries and agencies responsible for planning or managing sector development (Definitions of abbreviations are provided in Table 2.3.1a)

Sr. No.	Sector	Central	Provincial	Distt.
1.	Water-hydrology, Water Use and Quality	MoWP, WAPDA (SWH, SMO)	I&P	-
2.	Vulnerability to Flooding, Flood Management Aspects	MoWP, CEA/CFFC, WAPDA, NDMA	I&P, PDMA	DDMA
3.	Forestry and Bio-diversity	MINFAL	PFD	DFO
4.	Agriculture and Livelihood	MINFAL	PAD	DAO
5.	Social Issues (i.e., involuntary resettlement, loss of income, ethnic minorities, cultural impacts considering religious and cultural values associated with Indus and health risks including risk of HIV/AIDS)	MoCC (Environment), MoRA MoH	PEPA, MoRA, MoH	DEPO
6.	Fisheries	MINFAL	I&P	DFO
7.	Transport	MoC	PTD	DTM
8.	Water Supply	MoWP	WASA	WASO
9.	Irrigation	MoWP	I&P	
	Canals	Customary, Riparian and other Rights Recognized by Public Deptts. & Courts		
	Tubewells	No Rights to the State - Community Tubewells by FOs & Community Groups		
	Springs	No Rights to the State - Community Rights in KPK and Communal Rights in Balochistan		
10.	Urban Development	PC	P&D	DCO
11.	Power Transmission	MoWP / PEPCO, NTDC	I&P	-
12.	Industry	MoIP	MoI	DIM
13.	Institutional Issues and Capacity	MoWP, WEC	PEPA	DEPO
14.	River Ecology	MoWP, MoCC (Environment)	PEPA	DEPO

Table 2.3.1a Definitions of Agency Abbreviations used in Table 2.3.1

CEA/CFFC	Chief Engineering Advisor / Chairman Federal Flood Commission
DAO	District Agriculture Officer
DCO	District Coordination Officer
DDMA	District Disaster Management Authority
DEPO	District Environment Protection Officer
DFO	Divisional Forest Officer
DIM	District Industries Magistrate
DTM	District Transport Magistrate
I&P	Irrigation and Power Department
MINFAL	Ministry of Food Agriculture and Livestock
MoC	Ministry of Communication
MoCC	Ministry of Climate Change (Environment)
MoH	Ministry of Health
MoI	Ministry of Industries
MoIP	Ministry of Industries & Production
MoRA	Ministry of Religious Affairs
MoWP	Ministry of Water and Power
NDMA	National Disaster Management Authority
NTDC	National Transmission Dispatch Company
P&D	Planning and Development
PAD	Provincial Agriculture Department
PC	Planning Commission
PDMA	Provincial Disaster Management Authority
PEPA	Provincial Environmental Protection Agency
PEPCO	Pakistan Electric Power Company
PFD	Provincial Forest Department
PTD	Provincial Transport Department
SMO	Scarp Monitoring Organization
SWH	Surface Water Hydrology
WAPDA	Water and Power Development Authority
WAPDA	Pakistan Water and Power Development Authority
WASA	Water and Sanitation Authority
WASO	Water and Sanitation Officer
WEC	WAPDA Environmental Cell

2.3.2 Mandates of Ministries/Agencies responsible for Sector Development and Management

Ministry of Water and Power

In country like Pakistan, where agriculture continues to form the major portion of national economy and increasing importance is laid upon industrial development, the need for optimum development of Water and Power resources cannot be over-emphasized.

The Role of Ministry

In the changing scenario of private sector advent to Pakistan Power sector, the Ministry of Water and Power, besides all policy matters relating to development of these two resources, performs certain specific functions also, such as carrying out strategic and financial planning for the long term master plans in public and private sector. The long term power sector projects submitted by WAPDA and its allied corporations are being scrutinized in the Ministry through its attached departments keeping in view the technical and financial viability of such projects. This indirectly results in great savings to the National Exchequer as un-viable projects are either phased out or are processed with optimum financial planning and technical viability. Similarly private sector projects in power sector are being processed by PPIB in close supervision of the Ministry which sets the policy guidelines for approval of private projects. Five year plans and Annual Development Programme (ADP) in Water and Power sector are all overseen by the Ministry. The Ministry Water and Power also monitors activities in the fields of power generation, transmission and distribution and performs supervisory and advisory role for smooth operation of power sector. It also coordinates inter-provincial water sharing issues and activities related to irrigation, drainage, water logging and monitors the operation of Indus Water Treaty of 1960 between Pakistan and India. Water and Power Wing are the main functionaries of the Ministry including office of Chief Engineering Adviser/Chairman, Federal Flood Commission and PPIB.

Water and Power Development Authority (WAPDA)

WAPDA, the Pakistan Water and Power Development Authority, was created in 1958 as a Semi-Autonomous Body for the purpose of coordinating and giving a unified direction to the development of schemes in Water and Power Sectors, which were previously being dealt with, by the respective Electricity and Irrigation Department of the Provinces.

- Since October 2007, WAPDA has been bifurcated into two distinct entities i.e. WAPDA and Pakistan Electric Power Company (PEPCO). WAPDA is responsible for water and hydropower development whereas PEPCO is vested with the responsibility of thermal power generation, transmission, distribution and billing. There is an independent Chairman and MD (PEPCO) www.pepco.gov.pk replacing Chairman WAPDA and Member (Power) who were previously holding the additional charges of these posts.
- WAPDA is now fully responsible for the development of Hydel Power and Water Sector Projects.
- PEPCO has been fully empowered and is responsible for the management of all the affairs of corporatized nine Distribution Companies (DISCOs), four Generation Companies (GENCOs) and a National Transmission Dispatch Company (NTDC). These companies are working under independent Board of Directors (Chairman and some Directors are from Private Sectors).
- The Companies are administratively autonomous and leading to financial autonomy by restructuring their balance sheets by bringing their equity position to at least 20 percent, required to meet the prudential regulations and to facilitate financing from commercial sector (approved by ECC).
- The Loan Liability Transfer Agreements (LLTA) have been signed with Corporate Entities and execution of loan transfer is complete.
- All Entities have the physical possessions of all their operational assets.
- On 24th Feb. 2007 Ministry of Water & Power notified NEPRA approved Tariff for all Distribution Companies replacing unified WAPDA Tariff.
- Legal Agreements such as Business Transfer Agreements, Operation Development Agreement, Energy Supply Agreement, Business Supplementary

Agreement and Fuel Supply Agreement etc. were executed between WAPDA and Corporate Entities to facilitate commercial operations.

- Regulatory instruments like Grid Code, Distribution Codes, Performance Standard for Distribution Companies and Transmission Companies were drafted and got approved from (www.nepra.org.pk) in 2007.
- All major lenders gave their consent for transfer of their loan from WAPDA to Corporate Entities, thus 326 loan assumption agreement were signed amongst respective Companies, WAPDA and EAD (Economic Affairs Division) GOP.
- CPPA is established under the coverage of NTDC for payments from DISCOs to IPPs, GENCOs and NTDC. Ultimately, it will function independently under Federal Govt. and all forthcoming IPPs will be under CPPA.

The Charter of Duties of WAPDA is to investigate, plan and execute schemes for the following fields:

a. Generation, Transmission and Distribution of Power.
b. Irrigation, Water Supply and Drainage.
c. Prevention of Water logging and Reclamation of Waterlogged and Saline Lands.
d. Flood Management.
e. Inland Navigation.

The Authority comprises of a Chairman and three (3) Members working through a Secretary.

WAPDA is one of the largest employers of human resources in Pakistan. Over the years WAPDA has built-up a reservoir of Technical know-how and expertise which has made it a modern and progressive organization.

Pakistan Electric Power Company (PEPCO)

In 1998, the government founded PEPCO to initiate and manage the unbundling of WAPDA. WAPDA was restructured into 15 separate entities incorporated under the Companies Ordinance 1984. WAPDA Hydroelectric was allocated ownership and management of 14 hydel power stations with a total installed capacity of 6,444 MW. Four separate thermal power generation companies (GENCOs) were allocated the thermal generation assets of WAPDA. The transmission network was transferred to the National Transmission and Dispatch Company (NTDC). Nine separate distribution companies (DISCOs) were formed that also act as the monopoly retailers of electricity in their designated areas.

National Transmission and Dispatch Company Limited (NTDC)

National Transmission & Despatch Company (NTDC) Limited was incorporated on 6th November, 1998 and commenced commercial operation on 24th December, 1998. It was organized to take over all the propertise, rights and assets obligations and liabilities of 220 KV and 500KV Grid Stations and Transmission Lines/Network owned by Pakistan Water and Power Development Authority (WAPDA). NTDC operates and maintains twelve 500 KV and twenty nine 220 KV Grid Stations, 5077 km of 500 KV transmission line and 7359 km of 220 KV transmission line in Pakistan.

NTDC was granted Transmission Licence No.TL/01//2002 on 31st December 2002 by National Electric Power Regularity Authority (NEPRA) to engage in the

exclusive transmission business for a term of thirty (30) years, pursuant to Section 17 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Main Functions

- Central Power Purchasing Agency
- System Operator
- Transmission Network Operator
- Contract Registrar and Power Exchange Administrator

i) Central Power Purchasing Agency (CPPA): As the Central Power Purchasing Agency (CPPA), for procurement of power from GENCOs, Hydel & IPPs on behalf of Distribution Companies (DISCOS), for delivery through 500 kV, 220 kV & 132kV Network.
ii) System Operator: For secure, safe and reliable operation, control and despatch of generation facilities.
iii) Transmission Network Operator: For Operation & Maintenance, Planning, Design and expansion of the 500 kV and 220 kV transmission network.
iv) Contract Registrar and Power Exchange Administrator (CRPEA): As CRPEA, to record and monitor contracts relating to bilateral trading system.

Ministry of Climate Change

In pursuance of Cabinet Division's notification number SRO.826 (1)/2002, the Ministry of Environment, Local Government and Rural Development was bifurcated and an independent Ministry of Environment was established on 22-04-2002. Ministry of Environment is the focal point on the subjects of Environment, Ecology, Human Settlement and Forests in Pakistan.

In terms of Rule 3(3) of Rules of Business of 1973, the Government has allocated the following business to the Ministry of Environment.

1. National policy, plans and program regarding:-
   i) Environmental Planning, Pollution and Ecology;
   ii) Housing, Physical Planning and Human Settlements including urban water supply, sewerage and drainage.

2. Dealings and agreements with other countries and international organizations in the fields of Environment, Housing, Physical and Human Settlements.
3. Quaid-I-Azam Memorial Fund.
4. Economic Planning and Policy making in respect of Forestry and Wildlife.
5. Administrative control of:-
   i) Pakistan Environmental Protection Agency (Pak-EPA)
   ii) Pakistan Forest Institute (PFI).
   iii) Zoological Survey Department (ZSD).
   iv) Quaid-I-Azam Mazar Management Board (QMMB).
   v) National Energy Conservation Center (ENERCON)
   vi) Pakistan Environmental Planning and Architectural Consultants Limited (PEPAC)
   vii) National Council for Conservation of Wildlife in Pakistan (NCCW).

6. Ministry of Environment is headed by a Federal Minister while the Federal Secretary holds the administrative charge. It comprises five wings namely Administration, Development, Environment, International Cooperation and Forestry. Each of the Wings is responsible for its respective functions. Moreover, the Ministry controls the specialized departments such as the

Energy Conservation Center (ENERCON), Pakistan Forest Institute (PFI), National Council for Conservation of Wildlife (NCCW) and Zoological Survey Department (ZSD). The Ministry is responsible for implementation of National Environment Policy, planning and international environment coordination. A National Conservation Strategy Unit set up in the Ministry is responsible for coordination of the implementation of the country's National Conservation Strategy. A UNDP funded NEAP Support Programme has been established in the Ministry with a view to strengthen its capacity in various operational areas.

7. In addition, the Pakistan Environmental Planning and Architectural Consultants Limited (PEPAC) was incorporated in 1974 to provide town planning and architectural consultancy services for projects initiated by the government, semi-government and autonomous entities. It is a limited Company and is managed by a Board of Directors.
8. In the Environment Sector, the key initiatives of the Ministry during the period under report include formulation of the National Environment Policy, National Clean Development Mechanism (CDM) Strategy, implementation of ongoing projects / programs and development of new projects including participation in major international forums.

Planning Commission of Pakistan

To prepare a more comprehensive national plan of development, the Government of Pakistan decided to set up a Planning Board on 18th July, 1953.

Subsequently, vide the Government of Pakistan Notification No. Cord(I)-8/84/58-I, dated the 22nd October 1958, the President was pleased to re-designate the National Planning Board as the Planning Commission. Cabinet Division's Resolution No. Cord(I)-8/29/59-III dated 3rd June, 1959 defined its objectives in the following terms.

The economic and social objectives of the Government are to promote the welfare of the people and raise the standard of living of common man by developing to the utmost the resources of the country as rapidly as possible by making provision for the basic necessities of life, educational and health facilities, and work under just and human conditions; by ensuring equitable adjustment of rights relating to the ownership and use of land and between employers and employees; and by preventing the concentration of wealth and means of production and distribution in a few hands to the detriment of the people as a whole; and by securing social justice and equal opportunity to all.
Consistent with these objectives, the functions of the Planning Commission were to be :

i. In consultation with the Central and Provincial Governments and other appropriate agencies:-

   a. to prepare a national plan at periodic intervals for the economic and social development of the country;
   b. to make assessments from time to time of the human and material resources of the country; and
   c. to prepare the Annual Development Programme (ADP) within the framework of the national plan and on determination of priorities, to propose the allocation of resources.

ii. To stimulate and where necessary initiate the preparation of development programmes and projects; to examine and advise on all such programmes and projects with a view to deciding whether these

conform to national objectives and, in general, whether these contemplate the most efficient use of national resources.

iii. To recommend such adjustments in the national plans as may be necessary in view of the changing economic situation.

iv. To co-ordinate the examination of development programmes and projects in consultation with the appropriate authorities and to secure the approval of the Central Government to acceptable programmes and projects.

v. To advise on the nature of the machinery for securing the efficient execution of the national plan.

vi. To watch and evaluate the progress of implementation of the development program

vii. To advise on important economic policies and problems of various fields.

viii. To advise the Central and Provincial Governments, whenever so required, on economic policies and problems.

ix. Development of appropriate cost and physical standards for effective technical and economic appraisal of projects.

x. Coordination of all work pertaining to:

a. Indonesia - Pakistan Economic and Cultural Cooperation (IPECC);
b. Iran - Pakistan Joint Ministerial Commission;
c. Turkish - Pakistan Joint Ministerial Commission.

National Disaster Management Authority (NDMA)

National Disaster Management Authority (NDMA), is the lead agency at the Federal level to deal with whole spectrum of Disaster Management Activities. It is the executive arm of the National Disaster Management Commission (NDMC), which has been established under the Chairmanship of the Prime Minister, as the apex policy making body in the field of Disaster. In the event of a disaster all stakeholders, including Government Ministries/Departments/Organizations, Armed Forces, INGOs, NGOs, UN Agencies work through and from part of the NDMA to conduct one window operation. NDMA aims to develop sustainable operational capacity and professional competence to undertake the following task:-

1. Coordinate complete spectrum of disaster risk management at national level.
2. Act as Secretariat of the NDMC to facilitate implementation of DRM strategies.
3. Map all hazards in the Country and conduct risk analysis on a regular basis.
4. Develop guidelines and standards for national and provincial stakeholders regarding their role in disaster risk management.
5. Ensure establishment of DM Authorities and Emergency Operations Centres at provincial, district and municipal levels in hazard-prone areas.
6. Provide technical assistance to federal ministries, departments and provincial DM authorities for disaster risk management initiatives.
7. Organize training and awareness raising activities for capacity development of stakeholders, particularly in hazard-prone areas.
8. Collect, analyze process, and disseminate inter-sectoral information required in an all hazards management approach.
9. Ensure appropriate regulations are framed to develop disaster response volunteer teams.
10. Create requisite environment for participation of media in DRM activities.
11. Serve as the lead agency for NGOs to ensure their performance matches accepted international standards, e.g. the SPHERE standards.
12. Serve as the lead agency for international cooperation in disaster risk management. This will particular include, information sharing, early warning,

surveillance, joint training, and common standards and protocols required for regional and international cooperation.

13. Coordinate emergency response of federal government in the event of a national level disaster through the National Emergency Operations Centre (NEOC).
14. Require any government department or agency to make available such men or resources as are available for the purpose of emergency response, rescue and relief.

Ministry of Religious Affairs

The Ministry of Religious Affairs is responsible for the pilgrimage beyond Pakistan, Muslims pilgrims visits to India for Ziarat and Saudi Arabia for Umra & Hajj. It is also responsible for the welfare and safety of pilgrims and zairines. Ministry of Religious Affairs consists of one division, Religious Affairs Division. Please visit the web site of the Religious Affairs Division for a more comprehensive and detailed information about its Policies, Publications, Information and Services, Forms, Tenders, Jobs, News & Press Releases, and Related Links.

This Ministry is responsible for the pilgrimage beyond Pakistan, Muslims pilgrims visits to India for Ziarat and Saudi Arabia for Umra & Hajj.The welfare and safety of pilgrims and Zairines. The main activities also include research based Islamic studies, holding of conferences, seminars ,training education of Ulemas and Khateebs , exchange of visits of scholars of Islamic learning with the liaison amongst foreign and international institutions. This Division also performs the activities like management of Ruit-e-Hilal, Dawah , council of Islamic Ideology, infants and minor adoption laws. There are six subordinate offices working as Directorates of Hajj of this Ministry and two Autonomous bodies i.e. Council of Islamic Ideology and Pakistan Madrassah Education Board.

Ministry of Communications

Ministry of Communications functions as a central policy making and administrative authority on Communications and Transport Sector in the Country. Ministry of Communications consists of one division Communications Division Please visit the web site of the communications Division for a more comprehensive and detailed information about its Policies, Publications, Information and Services, Forms, Tenders, Jobs, News & Press Releases, and Related Links.

The main objectives / functions of the Ministry of Communications are:

- Prioritization of development projects and operational activities according to economic, social and strategic needs of the country.
- Provide effective support to the economy.
- Promote international competitiveness of our exports and increase operational effectiveness to meet challenges of globalization.
- Integrate remote areas of the country into the economic mainstream.
- Improve project monitoring and implementation.
- Train and improve quality of human resources.
- Enhance good governance through incentives and disciplinary action.
- Improve values and ethics to build responsive organizations.
- Provide safe and smooth travel on National Highways & Motorways.
- Provide an efficient, reliable and speedy postal service matching the private sector courier services.
- Carry out research on road engineering, building and management.

- Modernize post and provide exemplary service to the public.
- Open up unexplored areas through expanding national roads networks.

Organization of the Division
The Ministry of Communications consists of the main Ministry headed by a Federal Secretary. It has been organized into 2 wings (namely) Administration Wing headed by Joint Secretary-I and Roads & Road Transport Wing headed by Joint Secretary-II. There are a number of autonomous as well as attached / subordinate departments under the Ministry. The existing staff strength of Ministry of Communications (Main) is 198.

The Ministry of Communications exercise administrative control over the following Departments / Organizations:

i) National Transport Research Centre.
ii) National Highway & Motorway Police
iii) National Highway Authority
iv) Construction Machinery Training Institute

Allocation of Business
The Federal Government has allocated following business to the Ministry as per schedule-II of Rules of Business 1973.

1) National Planning, research and international aspects of road and road transport
2) National highways and strategic roads; National Highway Council and Authority; Administration of Central Road Fund and Fund for Roads of National Importance.
3) Mechanically propelled vehicles; Transport Advisory Council; Urban Road Transport Corporation.
4) Enemy Property.
5) National Highways and Motorway Police.

Flood Management Institutions

Although flood management is the responsibility of the provinces, a number of federal departments are also involved with Federal Flood Commission acting as the coordinating body with all the provincial departments and technical agencies. A brief description of the role of various departments is provided below:

Flood Forecasting Division
The Flood Forecasting Division (FFD) of the Pakistan Meteorological Department plays a central role in the flood forecasting and warning in the country. The department sources hydrometeorological data from various national and international sources including satellite data to prepare flood forecasts, which are disseminated to various flood management and relief organizations.

Provincial Irrigation and Drainage Authority
The Authority plays a prominent role in flood management through planning, design, construction and maintenance of flood protection works. It also undertakes flow measurements at specific rivers and irrigation canal sites.

Water and Power Development Authority
The Authority is the custodian of Tarbela and Mangla dams and undertakes the day to day reservoir management for irrigation flow releases. The authority helps FFD in

providing rainfall data from telemetric rain gauge stations and flood data at various locations in the Indus River System.

Provincial Relief Department
The relief departments are headed by the Relief Commissioner who coordinates relief efforts during and after the floods. The Commissioner also undertakes flood preparatory actions such as inspections of flood protection measures and establishment of flood warning and flood relief centers at the local government level.

Pakistan Army
The army carries out search and rescue missions during the flood emergency. It also mobilizes necessary resources to fill the breaches that often occur in the protective embankments during the flood events. Provincial governments provide the material support for its operation.

Emergency Relief Cell
The Emergency Relief Cell has been established in the Cabinet Division of Federal Government. The relief cell plans for major disasters including floods by stockpiling basic life necessities required by the population affected by the flooding.

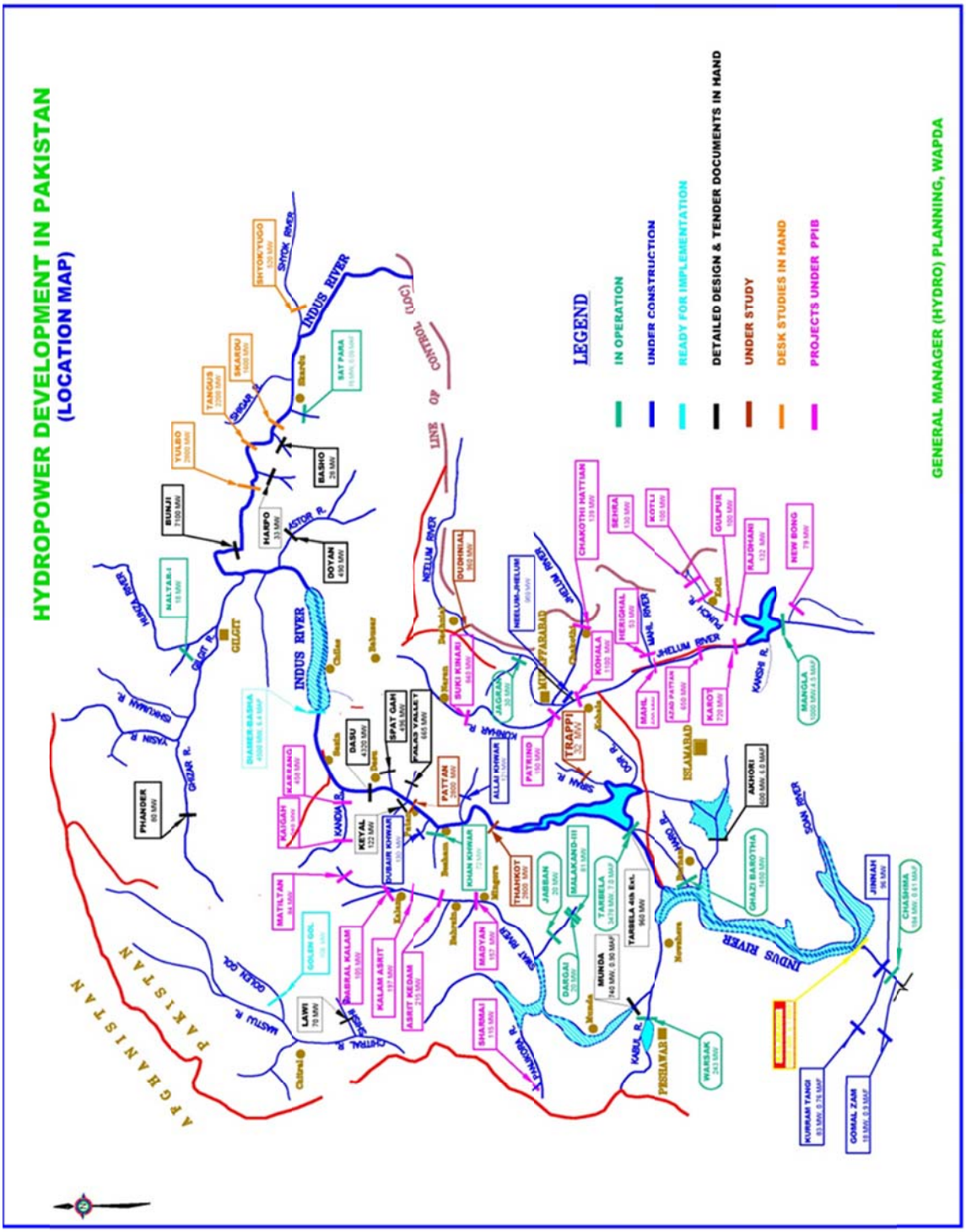
Civil Defence Organization
This organization assists local administration / Army in rescue, evacuation and relief measures and provides personnel for flood management training in rescue and relief work.

Federal Flood Commission
Federal Flood Commission is the lead federal agency in providing the necessary institutional framework to support the provincial flood management measures. The Commission has been successful in modernizing the flood management policy of the country through two major projects, Flood Protection Sector Project I and II. FPSP-II has vastly increased the flood forecasting capabilities of the Flood Forecasting Division. In addition, further construction of embankments and spurs along major The Commission has also been instrumental in preparing the National Water Policy.

In addition, the provincial departments of Health, Agriculture and Livestock, Food, Communication and Works and Planning and Development play an important role in flood management in the country.

Appendix – 4.1

LOCATIONS OF HYDROPOWER PROJECTS IDENTIFIED IN WAPDA's VISION 2025



Appendix – 4.2

DESCRIPTION OF HYDROPOWER PROJECTS IN UPPER INDUS BASIN

4.2.1. Zone 1

4.2.1.1 Satpara Hydropower Project

The Satpara dam multipurpose project with an installed capacity of 13.2 MW was built in Northern Areas, 6 km south of Skardu city. Salient features of the project are shown in **Table 4.2.1.1**. It is located 16 km north of Deosal planes and about 3 km downstream of Sadpara village. It is a natural lake formed by the glaciers having a surface area of 689 acres. The dam has a dead storage of 38500 acres-ft and live storage of 54122 acres-ft. The project will generate 12MW electricity from with one powerhouse and 13.2MW with two powerhouses. The project will irrigate about 10000 acres of land on right side of Sadpara nullah up to Hussainabad village and 11000 acres of land on left side of Skardu city. The land on left side of the nullah is spread up to Hoto village just upstream of Ayub Bridge. To deliver power from the proposed powerhouse new transmission lines and improvement of existing transmission system will be required. Northern Areas of Pakistan is a land locked areas with a population of 1.20 million (census report 1998). At present more than 50% of the population (This figure is less for rural areas.) has access to electricity in their homes and many of those experiences frequent load shedding, blackouts on daily basis throughout the year.

The proposed Satpara dam is designed to meet the Baltistan's growing electricity demand in the context of poverty alleviation program and economic development objectives. Besides power generation the Satpara project will help the region in agricultural development by irrigating about 21000 acres of barren land. Another utility of project is to fulfill water supply requirements of the Skardu city as the city is expanding very rapidly due to new economic activities.

Satpara dam is located on Satpara nollah about 6 km south of Skardu city, which is a left tributary of the Indus River and flow from south to north direction. It starts from Deosai planes, flow through Satpara village and Skardu city and finally discharges in to the Indus River. The Satpara basin has two distinct parts; the upper consisting high altitude hilly terrain, which contribute almost 90% flow and the lower (downstream of Sadpara) shares 10% respectively. The nullah has a 275km^2 watershed area. The dam is located at WAPDA's gauging station site just downstream of existing in intake of lake. The elevation at dam site is 2630 m.a.s.l. The Satpara project is one of the major power project in Northern areas of Pakistan in Baltistan region comprises dam with reservoir surface elevation at 2666 m.a.s.l. costing approximately Pak Rs. 2090 million (2002) including irrigation facilities. The water of the reservoir, which would inundate an area of 2.8 km^2, has a total volume of 114.247 million m^3 storage. The total area of the reservoir would be 2776143 m^2. To optimize the capacity of the dam Shatung nullah in Deosai planes will be diverted through a tunnel, which will carry a discharge of 6 m^3/s. the length of the tunnel is proposed 5 km.

Table 4.2.1.1 Salient Features of Satpara Hydropower Project

Reservoir	Full supply level	2666 m.a.s.l.
	Gross storage capacity	92622 Acre-ft.
	Active storage capacity	54122 Acre-ft.
	Surface area	686 Acre.
Hydropower Characteristics	Installed capacity	13.2 MW
	Annual energy	81GWh
Irrigation development	Left side of Skardu city up to Hoto village	11000 Acre
	Right side of Skardu city up to Hussainabad village	10000 Acre
Other social and economic benefits and environmental imports	Incremental dry flow	6 m^3/s
	Flood control	yes
	Resettlement	8 families

4.2.1.2 Bunji Hydropower Project

The Bunji Hydropower Project (BHPP) is located in the Gilgit-Baltistan areas (Northern Areas) of Pakistan. Salient features of the project are shown Table 4.2.1.2.The dam is a roller compacted concrete dam with a height of 190 m and available gross head of 418 m. The crest elevation of the proposed dam will be El 1,690 m and the total length will be 400 m. Two diversion tunnels will be excavated in the right bank of the dam site for diversion of the water during construction. Two cofferdams, one upstream and other downstream of the dam, will be constructed to divert the river water through the diversion tunnels during the construction of the main dam. The proposed configuration of spillway includes four spillways bays and chute installed in the central part of the dam and two bays and chutes installed in the right bank. The crest level of spillway bays will be at El 1,685 m, which is also normal top water level of the reservoir. The spillway is designed for a design flood of 22,400 m³/s and a safety check flood of 36,000 m³/s.

The proposed reservoir has a total length of 22 km and is surrounded by steep and narrow Rocky Mountains. The reservoir will have a live storage of 252 Mm³. The maximum and minimum reservoir levels of the dam are El 1,685 and 1,675 m respectively. Freeboard of 5 m has been provided to cater for the flood rise during passage of the 1,000 year return flood. The depth of reservoir varies from 200 m near dam to 10 m at the upper limit of reservoir.

The design discharge of 1,900 m³/s is proposed to be diverted into the five headrace tunnels of 11.6 m diameter. The length of each tunnel is 7.8 km. These tunnels have to pass through the Sarkund ridge from the dam site to the powerhouse site and will cross the Main Mantle Thrust/Raikot-Sassi Fault-Zone.

The powerhouse includes 3 underground caverns at the toe of mountain on the left bank of the Indus River near Hosi Das village to generate over 7,000 MW of power. The tailrace tunnel approximately 600 m in length will be excavated from the outlet of the powerhouse. This will then open into the 36 m wide tailrace channel with 1:2 m slopes for a length of approximately 1 km. A downstream weir will be constructed at the confluence with the Indus River.

Table 4.2.1.2 Salient Features of Bunji Hydropower Project

Dam and Reservoir

Dam height	190 m (including 5 m freeboard)
Dam type	RCC gravity
Gross head for power generation	Approx. 440 m
Dam foundation elevation	1,490 m
Dam crest elevation	1,690 m

Reservoir length when full	22 km
Reservoir surface area	4.18 km²
Reservoir volume when full	252 Mm³
Reservoir top water level (full)	1,685 m
Reservoir minimum operating elevation	1,675 m
Spillway crest elevation	1,669 m
Spillway gates invert elevation	1,669 m
Spillway gates size	18 m wide x 16 m high
Upper mid-level gate invert elevation	1,620 m
Lower mid-level gate invert elevation	1,595 m
Mid-level sluice gate size/number	6 m wide x 12 m high; 5 Nos.
Sluicing gates invert elevation	1,565 m
Sluicing gate size/number	10 m wide x 12 m high; 4 no
Minimum downstream compensation flow	20 m³/s
Number and size of diversion tunnels	2 No; 9 m wide x 12 m high inverted “U”
Capacity of diversion tunnels	7,000 m³/s (10 yr flood)

Intake Structures, Headrace Tunnels, Surge Shafts and Pressure Shafts

Design discharge	1,900 m³/s
Intake invert elevation	1,654 m
Intake gates: 5 number	5 No; 6 m wide x 9.8 m high
Headrace tunnels	5 No
Headrace tunnel diameter	11.6 m horseshoe in gneiss
	9.0 m circular in MMT zone
	11.6 m circular in high stress amphibolite
	11.6 m circular in low stress amphibolite
Headrace tunnel length	7.8 km (1.49 km through MMT zone)
Upstream surge shaft internal diameter	16 m
Surge shaft gates invert elevation	1,614 m
Surge Shaft gates size/number	2 no per surge shaft; 5 m wide x 8 m high
Penstock configuration	Double bifurcation
Vertical shaft (concrete lined)	7 m internal diameter
Upper pressure shaft (concrete lined)	7 m internal diameter
Lower pressure shaft (steel lined)	5.8 m internal diameter (4 m d/s of bifurcation)

Underground Powerhouse and Tailrace Channel

Number of units	20
Unit generator rating	362 MW(402 MVA at 0.9 power factor)
Type of Turbine	Vertical Francis
Generation voltage	21 kV
Transformers	128 MVA single phase (3 per unit plus 4 spare)
Transmission voltage	765 kV AC
HV switchgear	GIS underground with bus ducts to 2 surface transmission take-off areas
Turbine centreline elevation	1,222 m
Operating floor elevation	1,235 m
Powerhouse cavern	28 m wide x 62 m high x 558 m long
Transformer cavern floor elevation	1,235 m
Transformer cavern	16 m wide x 29 m high x 533 m long

Gate gallery floor elevation	1,260 m
Gate gallery	8 m wide x 9.8 m high x 452 m long
Tailrace channel	976 m long x 36 m wide, side slopes 1:2
Tailrace channel bed elevation	1,231 m
Tailrace water elevation	1,243 m

4.2.1.3 Naltar Hydropower Project

Naltar Phase-III Hydro Power Project is located in the Gilgit district of Northern Areas. Salient features of the project are shown in **Table 4.2.1.3.** Naltar Gah is a major tributary of Hunza River.

Table 4.2.1.3 Salient Features of Naltar-I Hydropower Project

A weir will be constructed to divert the flow of Naltar Gah into headrace channel, 3500 m long passing through about … m long gravel trap chamber and … m long sand trap chamber. Distance from the weir to the gravel spill is about … m. The headrace channel runs along the Naltar Gah up to the village GHUMASAT and finally turns right where a deep cut of 20 m will be required to take the headrace to forebay area. The alignment of headrace mostly passes through the forest area and potato fields. The diverted water after flowing through the channel enters into the forebay/ reservoir. The reservoir will be connected to a spillway structure for disposal of surplus water in to a natural creek and finally it will be discharged in to Naltar Gah downstream of powerhouse. Providing a structure at collecting canal will dissipate the energy of flow. The length of collecting canal is ..m. Water from reservoir / forebay then enters into 395 m long steel penstock pipes. A flushing gate will also be provided in the forebay above the bottom for flushing of fine materials, which could damage the turbine's blades.	
Weir/Intake:	The intake structure consists of a weir with lateral intake located on upstream of existing weir site of phase-I hydropower project and wooden bridge. The spilling section has a length of about 25m and the intake area is separated from the spilling section by a dividing wall. The intake area is 2.50m wide. The water level at intake site is 2954 m.a.s.l and water depth is 1.75 m. The sand trap area will be just downstream of intake and the size is approximately 50m x 60m. A gravel spill system with one chamber for flushing sediment upto a diameter of 2 mm is located on right bank of the Naltar Gah. The gravel trap is 16m long, 5m wide and 4.5m high.
Sand trap:	The sand trap placed on a relatively flat area is preliminary designed for removing sediments greater than 0.2 mm in diameter. The structure is approximately 32m long 10m wide and 4.5m high. It is containing two chambers.
Head race channel:	A rectangular head race channel is designed as an open channel to carry a discharge of 13 m^3/s and will be covered to avoid an additional overflow section and to provide easy passage. The channel is 3347m long and has a depth of 2.3m and 2.4m wide.
Forebay:	An open tank, concrete lined having 200 m length and 50 m width will be constructed on open terrace. The open tank will be used for daily pounding. The volume of the forebay is approximately 50,000 m3. The full supply level is 2940 m.a.s.l. The water depth will vary from 7m to 10m.
Penstock:	Two numbers of supported type penstock having a length of 1127 m will be used for carrying a discharge 13 m^3/s. The diameter of penstock will be 1.69m. The penstocks will be laid on steep slopes on right side Naltar Gah.
Powerhouse:	The powerhouse consists of the machine hall and a service block. A surface type powerhouse on right side of Naltar Gah will be constructed having dimensions 30m long 20m wide .The powerhouse is consisting of two units of Pelton type turbine with 375 rpm. 12 MW peak power during winter will be generated. The plant factor of the unit is 58.8%. The elevation at powerhouse

	site is 2578 m.a.s.l.
Tail race:	Since the powerhouse is located approximately 25m above normal water level, tailrace is designed as a concrete spilling channel, approximately _____ m height with a gradient of _____% .
Switchyard:	The switchyard area located lateral to the service block has dimension of 70m x 60m. The level of the switchyard corresponds to the road level for easy access.

4.2.2. Zone 2

4.2.2.1 Khan Khwar Hydropower Project

The Khan Khwar Hydropower Project with capacity of 72 MW is located on Khan Khwar, a right bank tributary of river Indus at Besham. Salient features of Khan Khwar Hydropower Project are shown in **Table 4.2.2.1**.

The Hydropower project consists of a reservoir of 1,050,000 cu.m total capacity. The intake is located 9 km upstream of Besham on Mingora-Besham road. This capacity is created behind a 30 m high concrete gravity dam. From the intake structure a concrete lined tunnel with net diameter of 3.70 – 3.90 m and 4,540 m length will transfer 35 cu.m/sec. of water to the surge shaft. From there a pressure shaft will lead to the power house. The power house is located below KKH on the right bank of River Indus near PTDC motel. The tailwater is discharged to the Indus River.

Table 4.2.2.1 Salient Features of Khan Khwar Hydropower Project

RIVER	Khan Khwar	
	Catchmentment area at dam site	637 km^3
	Mean annual discharge	23 m^3/s
	Annual runoff	717 hm^3
COMPILATION OF MAIN STRUCTURES		
RESERVOIR	Total storage capacity	1.05 hm^3 ($hm^3=10^6$ m)
	Active storage capacity	0.40 hm^3
	Buffer volume	0.20 hm^3
	Dead volume	0.45 hm^3
	Surface area	0.10 km^3
	Length of reservoir	1.60 km
DAM STRUCTURE	Concrete gravity dam	
	Height above river bed	30 m
	Crest length	110 m
	Width at river bed (extended)	75 m
	Stilling basin-length	60 m
FLOOD CONTROL	Design flood (return period)	
	1000 years	3750 m^3/s
	3 radical gates each	10 x 12 m each
	2 bottom outlets	6 x 7 m each
RIVER DIVERSION	Diversion flood (return period	
	10 years) during construction	1375 m^3/s
	2 diversion tunnels	
	(horse-shoe) cross section area	60 m^2 each
	Cofferdams	
INTAKE	Stoplogs	
	Trashracks	
	Rack cleaning machine	
	Intake gates	
HEADRACE TUNNEL	Pressure tunnel	
	Length from intake to surge tank	4540 m
	Internal diameter	3.70 – 3.90 m
	Access tunnel – length	100 m

SURGE TANK	Surge shaft	
	Internal diameter	9.00 m
	Height	58 m
	Lower chamber	
	Length	90 m
	Cross section	25 m^2
	Upper chamber	
	Length	55 m
	Cross section	36 m^2
PRESSURE SHAFT	Vertical shaft	
	Internal diameter	3.25 m
	Difference in height	183 m
PRESSURE TUNNEL	Pressure tunnel	
	Length surge tank to powerhouse	425 m
	Internal diameter	3.00-3.25 m
POWER HOUSE	External powerhouse	
	Turbine shaft	
	Depth below machine	
	half flow	27 m
	Mean diameter	23 m
	Machine hall	
	Length	40 m
	Width	30 m
	Height	15 m
TAILRACE	Tailrace tunnel- Length	75 m
	Outlet Structure	
HYDRO MECHANICAL EQUIPMENT	Number of units	2
	Type of units; Vertical Francis	2
	Speed	500 rpm
	Discharge per unit	16.50 m^3/s
	Total discharge – Francis units	33.00 m^3/s
	Auxiliary turbine	
	Type : TURGO	
	Discharge	2 m^3/s
ELECTRICAL EQUIPMENT	Generators	
	Number of units	2
	Speed	500 rpm
	Capacity	40 MVA
	Transformers	11/132 kV
	Auxiliary equipment	
	Switchgear	132 kV
POWER AND ENERGY		
DESIGN DISCHARGE	2 Francis (16.5 m^3 /s each) Auxiliary turbine Total design discharge	33 m^3 /s 2 m^3 /s 35 m^3 /s
OPERATION GUIDELINES	Stop of generating during	
	Periods	50 m^3/s
	Minimum restwater	500 l/s
ANNUAL TURBINE RUN OFF		
RESERVOIR	Storage volume for four hours	
	Daily peak operation	400.000 m^3
	Buffer storage (sedimentation)	200.000 m^3
HEAD	Maxium operation level	825 m.a.s.l. (meter above sea level)
	Mean operation level	823 m.a.s.l.
	Normal draw sown level	820 m.a.s.l.
	Mean tailwater level	568 m.a.s.l.
	Maximum tailwater level (Indus flood acc. 100 years return period)	570 m.a.s.l.
GROSS HEAD	Maximum gross head	257 m
	Mean gross head	253 m
	Minimum gross head	242 m
LOSSES	Q_{design} =35 m^3/s	12 m

NETHEAD	Maximum nethead	245 m
	Mean nethead	241 m
	Minimum nethead	230 m
ENERGY OUTPUT	Installed capacity (2 Francis)	68500 kW
	Auxiliary capacity (1 Turgo)	3650 kW
	Total installed capacity	72150 kW
	Mean annual energy	310GWh

4.2.2.2 Allai Khwar Hydropower Project

Allai Khawar Project is located on Indus river with a capacity of 120MW (2x60 MW) with facility provision for a future extension to 2010 MW by one additional unit of 70 MW. The main features of the selected and proposed scheme alternative (High Dam alternative) are shown in **Table 4.2.2.2**.

Table 4.2.2.2 Salient Features of Allai Khwar Hydropower Project

Reservoir:

Life storage volume	19,50	hm³
Dead volume	3,40hm³	
Total storage volume	22,80	hm³

Dam:

Dam type	Concrete arch dam	
Height approx.	120,00	m
Elevation of dam crest	1255,00	m.a.s.l
Elevation of valley bottom	1143,00	m.a.s.l
Max. operation level	1250,00	m.a.s.l
Min. operation level	1200,00	m.a.s.l
Max. flood level	1250,00	m.a.s.l (design)
	1252,00	m.a.s.l (PMF)
Design flood (HQ 10000)	1200,00	m³/s
Spillway	4 flap gates 7,00/10,00 m each	
Flushing arrangement	1 bottom outlet 3,75/4,75 m	
	Flushing tunnel 2,00 m diameter	
Construction flood (HQ10)	450,00	m³/s
Diversion method	Cofferdams and tunnel	
Tunnel diameter	6,00	m concrete lined
Tunnel length	224,00	m

Diversion from Natai Khwar:

Length of diversion tunnel	1024,00	m
Min. diameter of diversion tunnel	3,25	m concrete lined invert
Type of diversion tunnel	free flow mode	

Head Race:

Low pressure tunnel length	1669,00	m
Low pressure tunnel diameter	3,40	m concrete lined
Surge tank height approx.	105,00	m
Surge tank diameter	6,00	m concrete lined
Pressure shaft length approx.	1158,00	m
Pressure shaft diameter	2,40	m steel lined
Pressure shaft inclination	38,00	°
Tailrace tunnel length approx.	526,00	m free flow mode
Tailrace tunnel diameter	3,40	m concrete lined
Total length of waterway approx.	3323,00	m

Powerhouse:

Powerhouse type	Cavern	
Number and type of turbines	2 Pelton turbines	
Elevation of turbine axis	552,40	m.a.s.l
Gross head	699,60	m
Design discharge	27,20	m³/s
Design capacity	163,00	MW
Mean annual energy output	578,00	GWh/a
Plant factor	40,48	%

4.2.2.3 Duber Khwar Hydropower Project

Duber Khwar hydropower project is located in Patan Tehsil of District Kohistan. Salient features of the project are shown in **Table 4.2.2.3**.

The power statation will be located at Patan by diverting water of Duber and Keyal Khwars through tunnels into Indus valley. A dam of 19 m height is constructed across Duber Khwar near village Banil to divert water through an intake structure and lead it through a tunnel and penstock to turbines installed at Patan Powerhouse.

Table 4.2.2.3 Salient Features of Dubair Khwar Hydropower Project

Location		**Powerhouse**	
Pakistan, Khyber Pakhtunkhwa (KP), Indus Kohistan District		External powerhouse	
		Max. depth below Machine hall floor	27 m
Organization		Machine hall Length	38 m
Sarhad Hydel Development Organziation (SHYDO)		Machine hall Height	15 m
		Tailrace	
River		Open tailrace canal length	190 m
Catchment area at weir site	380 km²	Covered canal length	75 m
Mean monthly discharge	19.27 cm³/s	Total length	265 m
Total Annual Flow	608 hm³		
		Hydro-Mechanical Equipment	
Compilation of Main Structures		Number of Peltan Turbines	2 No.
Reservoir		Speed	428 rpm
Total Storage Capacity	536,000 m³	Discharge/unit	14.5 cm³/s
Live Storage Capacity	370,000 m³	Total discharge	29 m³/s
Dead Storage Capacity	96,000 m³		
Surface Area	50,000 m³	**Electrical Equipment**	
Length of Reservoir	570 m	Generators: Number	2
		Speed	428 rpm
Weir		Capacity	80 MVA
Height above riverbed	30 m	Transformer voltage	11/132 kV
Weir length	111 m	Switchgear	132 kV
Width at riverbed	66 m		
Stilling basin length	64 m	**Power & Energy**	
		Design discharge	
Flood Control		2 Pelton (14.5 m³/s each)	29 m³/s
Design Flood (return period 1000 years)	2500 m³/s		
2 overflow sections	6.00/2.5 m each	**Operation Guidelines**	
5 bottom outlets	6.00/6.7 m each	Stoppage Generators during the periods	Q>80 m³/s
		Max restwater, Winter	290 l/s
River Diversion		Summer	150 l/s
Diversion flood during construction	600 m³/s		
2 construction stages 1. Left side 2. right side		**Reservoir**	
		Live storage for 4 hrs Daily peak	370,000 m³
Intake		Net volume	440,000 m³
Stop logs, Fine rack, intake gate, gate shaft		Dead volume	96,000 m³
		Total volume	536,000 m³
Headrace Tunnel			
Pressure Tunnel length upto surge tank	5243 m	**Head**	
Excavation diameter (TBM)	4 m	Max operating level	1218 m.a.s.l
Internal diameter	3.9 m	Normal min operation level	1209 m.a.s.l
Access Tunnel length	188 m	Turbine Axis	677 m.a.s.l
		Max Gross Head	540 m
Surge Tank		Min Gross Head	531 m
Surge shaft internal diameter	5 m		
Height	66 m	**Losses**	
Lower chambers, length	2 x 60 m	Q_{design} 29 m³/s	24 m
Upper chamber, length	80 m	Net head (29 m³/s)	
Access Tunnel, length	65 m	Max net head	516 m
		Min net head	517 m
Penstock Tunnel			
		Energy Output	
		Installed Capacity (2 Pelton)	130 MW

Length	202 m	Mean annual energy	595 GWh/a
Cross section	5.1 m with x 4.65 m height	Mean annual peak energy	187 GWh/a
		Mean annual off-peak energy	408 GWh/a
Penstock		Annual plant factor	52 %
Diameter	2600 mm		
Total Length	1395 m		

4.2.2.4 Diamer Basha Dam Project

Construction of Diamer Basha Dam Project (DBDP) will form an important plank of WAPDA's Vision 2025 Programme, approved by the Government of Pakistan in 2001. Salient features of the project are shown in Table 4.2.2.4. Its basic objective will be to augment the water and power resources of Pakistan for boosting irrigated agriculture and electricity generation. These two inputs are essential for sustaining the national economy and particularly food and fibre needs of burgeoning population of Pakistan, currently (2010) estimated around 175 million and growing at the compound annual rate of over 2 %.

Agriculture sector of Pakistan is under huge stress as a result of reducing irrigation supplies due to progressive siltation of the three on-line storage reservoirs at Mangla, Tarbela and Chashma. In addition, some new irrigation projects with aggregate water allocations of about 4.2 billion cubic meters (BCM) are nearing completion as part of Vision 2025 Programme. Despite significant industrial development, Pakistan's economy continues to be agro-based with as much as 65 % foreign exchange earnings from agriculture. Concrete measures are thus necessary not only to sustain but enhance supplies for irrigated agricultural production. This could be best accomplished through construction of large water storage projects like Diamer Basha Dam.

Primary objectives of DBDP are to improve significantly the storage capacity in the stressed Indus River System and to inject a big chunk of relatively cheap and clean (due to the renewable nature) energy to the electricity starved National Power Grid. Main national benefits of the project will comprise:

- Enhanced water storage capability of the Indus River System by adding about 7.9 BCM of live storage at a time when the on-line storages will have lost over one-third of original capacity of about 19 BCM
- Increased useful life of downstream Tarbela reservoir by about 45 years through trapping large amount of sediment
- Optimization of water and power benefits through conjunctive operation with Tarbela reservoir
- Alleviation of flood damage of the Indus River, particularly in the reach Kalabagh to Gudu.
- Providing about 18,100 GWh of energy per annum from its installed capacity of 4,500 MW.
- Enabling about 1100 GWh of additional generation at Tarbela due to conjunctive operation of two reservoirs.

Sizeable addition to other two existing hydropower projects of Ghazi-Barotha and Chashma due to routing of additional water provided by storage at Diamer Basha will be possible. Besides the above national benefits, a major 'trickle-down effect' of the project will be significant improvement in socio-economic conditions in the backward Northern (Gilgit-Baltistan) Areas of Pakistan.

Table 4.2.2.4 Salient Features of Diamer Basha Dam Project

Element	Details / feature	Description
Catchment	Area	153,200 km²
	Mean Annual Inflow	62 BCM
	Probable Maximum Flood (PMF)	49,4170 m3/s
Location	On Indus river near Chillas (Northern Area & K.P) river, 300 Km upstream from Tarbela dam and about 40 Km downstream of Chillas town	
Dam and Reservoir	Type	Roller compacted concrete (RCC)
	Crest Level	1,170 masl
	Full Reservoir Level (FRL)	1,160 masl
	Minimum Operation Level (MOL)	1,060 masl
	Length of Reservoir	102 km
	Surface Area	115.2 km²
	Storage Capacity	13 % of Inflow
	Height	272 meters (885.6 ft)
	Length	939 meters (3079.92 ft)
Spillway	Type	Ogee Type with Flip Bucket and Plunge Pool 11.5 m x 16.24 m (14 Nos.) Radial gates
Outlets	Low level	2
	Sluicing	5
Reservoir	Gross Storage	8.10 MAF (10 BCM)
	Live Storage	6.40 MAF (7.9 BCM)
Power House	Installed Capacity	4500 MW
	Location and Type	Underground, one each on right and left side
	No. of units	12, each of 375 MW (4500 MW)
Annual Energy	18,500 GWh	
Project Benefits	• Generation of Hydropower • Employment generation during construction and O&M of the project. • Uplift of socio-economic conditions. • Development of fisheries	
People affected	27000 persons	
Project Cost	Rs 894.000 billion (US$ 11.178 B)	
Executing Agency	WAPDA	

Source: DBC, 2009

4.2.2.5 Dasu Hydropower Project

Dasu Hydropower Project (DHP) is a proposed run of the river power project on Indus River. Salient features of the Project are shown in **Table 4.2.2.5**. Water and Power Development Authority (WAPDA) is the implementing agency of the Project on behalf of Government of Pakistan. This project forms the part of WAPDA's vision-2025 program. The aim of vision 2025 is to improve hydropower generation capacity, the revival of the country's economy and above all meet the future needs of Indus Basin Irrigation System.

The DHP is proposed to be located on Indus River, about 8 km upstream of Dasu Bridge near Dasu town, in Kohistan District of Khyber Pakhtunkhwa province, Pakistan. Geographically it is located 74 Km downstream of Diamer-Basha Dam Project measured along the river. The Dasu dam site is a mountainous region. The Project site is accessible from Islamabad by GT Road and Kara Kurram Highway (KKH) via Abbotabad-Mansehra-Besham- Pattan-Dasu. There is no rail link or airport to Dasu. River transport also does not exist.

The implementation of the project would include construction of about 230m high Roller Compacted Concrete (RCC) gravity dam on Indus river at a site about 8 km upstream of Dasu bridge. Impoundment of the dam will create a reservoir about 74 km long with an average width of 290m and having a surface area of about 21.5 km^2 at conservation reservoir level of 950m. The maximum flood level will be 957m. The Project is planned to have an installed generating capacity of 4,320 MW without any loss of downstream flow in the Indus river. An elevation of 957m has been adopted as the limit of reservoir submergence for potential impacts.

Table 4.2.2.5 Salient Features of Dasu Hydropower Project

Item	Features
- Catchment area at dam site	158,800 km^2
- Average discharge at dam site	2,068 m^3/s
- Safety Check Flood (SCF) w/o Basha	50,360 m^3/s
- Basic Design Flood (BDF) w/o Basha	24,360 m^3/s
Reservoir	
- Gross Storage Capacity (El.950m)	1.41x 10^9 m^3
- Operational Storage Capacity	0.82x 10^9 m^3
Water Level	
- Flood Water Level under SCF	EL. 958.27 m
- Full Supply Level (FSL)	EL. 950.00 m
- Low Water Level (LOL)	EL. 900.00 m
Diversion Tunnel	
- No. and Shape	2 no, D-shape
- Size and Lining	17mWx20mH, shotcrete lined
- Length	1,261m/1,101m
Main Dam	
- Type	Gravity Dam (RCC type)
- Maximum Height above foundation	242m
- Crest Length (Curved)	570.0m
- RCC Volume	4.98 x 10^6 m^3
Spillway	
- Number of Bays	8
- Type and Size of Gates	Radial, 16.5 m wide x 20m high
- Maximum Discharge Capacity under SCF	36,800 m^3/s
- Plunge Pool	190m from dam toe
Low Level Outlet	
- Number and Size	9 no. (Circular, 6.4 m diameter, 200m length)
- Type and Size of Gates	Service gates: fixed wheel, 8.4mWx8.4mH
	Guard gates: fixed wheel, 4.9mW x 6.4mH
	Regulating gates: Radial, 4.9mW x 6.4mH
- Discharge Capacity under SCF	10,800 m^3/s at reservoir El.958m
Power Intake	
- Number and Shape	4 no, D=12m, Flatbed type
- Removal Trashrack	4 sets,
- Intake service gates	4 no, 6.0m wide x 8.5m high
- Intake maintenance gates	4 no, 6.0m wide x 8.6m high

Item	Features
Power Tunnel	
- Number and Shape	4 no, circular
- Size and Lining	D=12m, concrete lined
- Average Length	500m
Power Generation	
- Installed Capacity	4,320 MW
- Generating Units	12 no, Francis turbines
- Generating Unit Capacity	360 MW, 167 rpm
- Powerhouse Location	Underground, left bank
- Powerhouse Cavern L × W × H	425m × 31m × 66m
- Transformer Cavern L × W × H	425m × 22m × 37.5m
- Maximum Gross Head under 12-unit operation	192.60 m
- Design Head	Under study
- Rated Discharge (12 units)	2,600 m^3/s
- Rated Voltage	21 kV
- Total Energy (w/o Basha)	18,440 GWh/annum
- Plant Factor	Under study
Tailrace Tunnel	
- Number and shape	4 no, D-shaped
- Size and lining	10mW x12.5mH concrete lined
- Discharge per Tunnel	650 m^3/s
- Average Length	2,200m in average
- Surge Chamber	4 no, D=37m, H=45.5m
- Draft Tube Gates	12 no, 5.0mW x 12.5mH
- Tailrace Gates	8 no, 5.0mW x 12.6mH
Tail Water Level	
- Flood Water Level under SCF	EL. 778.00 m
- Tail water level under 12-unit operation	EL. 757.40 m
- Tail water level under 3-unit operation	EL. 752.90 m
Power Transmission	
- Transmission Voltage	500 kV (AC)
- Powerhouse Substation	GIS, Underground
- Transmission Substation	AIS, Surface

4.2.2.6 Keyal Khwar Hydropower Project

The Keyal Khwar Hydropower Project is 122 MW on Keyal Khwar, the right bank tributary of Indus. Salient features of this Project are given in Table 4.2.2.6

Table 4.2.2.6 Salient Features of Keyal Khwar Hydropower Project

River Diversion	Upstream rockfill some 4 m hogh, steel pile seal 2 concreate pipelines, 1.75 m diameter,140 m length. 24 m^3/s, discharge capacity (circa 1 in 10 years dry season).
Concrete Gravity Dam	Crast circa 37.5 m above river bed level at elevation 1427.5 masl. Foundation circa 25 m below river bed level. 290,000 m^3 rock excavation. 80,000 m^3 concrete.fill.

Free Overflow Spillway (weir, cute, apron)	3 bays, each 4m wide at elevation 1423.0 masl 175 m^3/s,discharge capacity, 33,000 m^3 concrete.
Low Level Flushing Outlets	3 x gated outlets each 5 m high x4 m wide. Discharge capacity: 703 m^3/s.
Headrace Power Waterways	Rated discharge 20 m^3/s. Single barrel bell-mouth power intake, trashrack, maintanence/emergency gates. Headrace tunnel: shotcrete lined, 3.8m finished diameter, circa 7,000m total length, 109,000 m^3 underground chambers, 35m^2 flow area, 81m length, 43,000m^3 underground excavation. Inclined surge tunnel: 3.5m x 3.5m D-shape, 245m length, 3,000m^3 underground excavation. Vertical Pressure Shaft: steel lined, 2.2m internal diameter,62m deep, 5,000m^3 underground excavation. Pressure tunnel: steel lined, 2.2m internal diameter, 631m length, 6,000m^3 underground excavation.
Power Cavern Transformer cavern	Power cavern:56.5m long, 16.2m wide, 34.3m high. Transformer cavern: 37.0m long, 12.0m wide, 8.3m high. 2 x Pelton vertical axis turbine-generators each 61MW. 2 x 73 MVA generators,2 x 3-phase 11kV/136kV transformer. 44,000 m^3 underground excavation (both caverns and all associated tunnels and adits).
Tailrace Power Waterway	Single free flow tunnel: shotcrete lined, 4.0m x 4.0m D-shape, 179m length, 4,000m^3 underground excavation.
Powerhouse Switchyard	Conventional outdoor, 132kV double busbar, 8 bays.
Transmission Lines	2.3kmlong, 132kV double circuit to Duber Khwar.
Duber Khwar Switchyard	2 bay extension
Valley Access Road	Re-alignment and widening of existing 6.4km long track to 5.4m wide carriageway of maximum grade 10%.
Reservoir	FSL 1422.5 masl, MOL 1406.5 masl, 240,000 m^3 total capacity, 50,000 m^3 live capacity, 16,000 m^2 surface area at FSL, 350 m long at FSL.
Energy Generation	Average 426 GWh per year. Firm base (24 hours) power in summer 37 MW. Firm peak (4 hours) power in winter 25 MW.

Source: KKC 2007.

4.2.2.7 Lower Spat Gah Hydropower Project

The lower Spat Gah Hydropower Project is a 496 MW run of river project and could generate 1994GWh per year. Salient features of the project are shown in **Table 4.2.2.7**. With an annual reliability of 96% the hydropower plant can deliver 398GWh of firm energy, which can be used for 4 h peaking per day.

Table 4.2.2.7 Salient Features of Lower Spat Gah Hydropower Project

Technical Data	Unit	LS Scheme
Water and Energy Management		
Catchment area	km²	1066
Mean annual flow	m³/s	38.7
Design discharge	m³/s	81.0
Annual run off	hm³	1220
Max. considered full supply level	m.a.s.l	1510
Turbine axis	m.a.s.l	765
Gross head	m	745
Net head	m	710
Installed capacity	MW	496
In Cascade:		
Total Energy	GWh	2106
Firm Energy	GWh	693
Secondary Energy	GWh	1416

Annual Reliability for peaking	%	95
Stand along:		
Total Energy	GWh	2007
Firm Energy	GWh	443
Secondary Energy	GWh	1564
Annual Reliability for peaking	%	96
Dam / Reservoir / Weir		
River bed elevation at damsite	m.a.s.l	1460
Min. operating level	m.a.s.l	1485
Dam height	m	57
Volume of dam	m^3	1018500
Design flood	m^3/s	3600
Total storage at max. FSL	10^6 m^3	2.1
Active storage at max. FSL	10^6 m^3	1.7
Dead storage at max. FSL	10^6 m^3	0
Length of reservoir	km	0.6
River bed slope upstream of damsite	%	7.2
Type of dam		CFRD
Headrace structure		
Length of headrace tunnel	km	12.6
Inner diameter of headrace tunnel	m	5.5
Length of pressure shaft	km	1.1
Inner diameter of pressure shaft	m	3.7
Length of pressure tunnel	m	53
Inner diameter of pressure tunnel	m	3.7
Powerhouse / Tailrace tunnel		
Length of tailrace tunnel	km	0.5
Tunnel profile (width / height)	m	6.5/7.5
Number of Pelton type turbines		3

4.2.2.8 Lower Palas Valley Hydropower Project

The lower Palas Hydropower Project has been designed at Feasibility Study level and evaluated. Key design parameters for the hydropower plants of Palas valley cascade as the outcome of the optimization study are listed in **Table 4.2.2.8a**; salient features of the project are shown in **Table 4.2.2.8b**.The design has been founded on a range of investigations and studies covering the fields of topography, hydrology, geology, seismicity, socio-economy and environment. Based on the results of those studies the scheme is both technically and economically feasible.

The hydropower scheme could be commissioned and supplying electricity to the national grid by end of 2017. With an installed capacity of 665MW, the power plant will generate on average 2590 GWh per year as stand scheme. Of this energy, almost 80% is generated during the hot summer months of highest system demand. With an annual reliability of 95% the hydropower plant can deliver 588 GWh of firm energy, which can be used for 4 h peaking per day.

The total installed capacity for the Palas Valley cascade results in 1196 MW and for Lower Palas in 663 MW.

Table 4.2.2.8a: Key Design Parameters for the Hydropower Plants of Palas Valley Cascade

Stage	Design level	Full supply Level (m.a.s.l)	Rated Net Head (m)	Discharge (m^3/s)	Inst. Capacity (MW)
Upper Palas	PFS	2615	431	43	160
Middle Palas	PFS	2140	608	71	373
Lower Palas	FS	1495	760	101	663

As outcome of the Final Feasibility Design, the turbine axis level and the hydraulic losses have been adjusted and it resulted to raise the capacity to 665 MW for Lower Palas project.

Table 4.2.2.8b: Salient Features of Lower Palas Valley Hydropower Project

Technical Data	Unit	LP Scheme
Water and Energy Management		
Catchment area	km^2	920
Mean annual flow	m^3/s	46.1
Design discharge	m^3/s	101.0
Annual run off	hm^3	1454
Max. considered full supply level	m.a.s.l	1495
Turbine axis	m.a.s.l	690.5
Gross head	m	805
Net head	m	760
Installed capacity	MW	665
In Cascade:		
Total Energy	GWh	2635
Firm Energy	GWh	934
Secondary Energy	GWh	1701
Annual Reliability for peaking	%	95.7
Stand along:		
Total Energy	GWh	2590
Firm Energy	GWh	588
Secondary Energy	GWh	2003
Annual Reliability for peaking	%	95.4
Dam / Reservoir / Weir		
River bed elevation at damsite	m.a.s.l	1448
Min. operating level	m.a.s.l	1470
Dam height	m	55
Volume of dam	m^3	362350
Design flood	m^3/s	4080
Total storage at max. FSL	10^6 m^3	3.0
Active storage at max. FSL	10^6 m^3	2.5
Dead storage at max. FSL	10^6 m^3	0
Length of reservoir	km	1.3
River bed slope upstream of damsite	%	4.5
Type of dam		CFRD
Headrace structure		
Length of headrace tunnel	km	18.5
Inner diameter of headrace tunnel	m	6.0
Length of pressure shaft	km	1.2

Inner diameter of pressure shaft	m	4.0
Length of pressure tunnel	m	49
Inner diameter of pressure tunnel	m	4.0
Powerhouse / Tailrace tunnel		
Length of tailrace tunnel	km	0.4
Tunnel profile (width / height)	m	6.5/7.5
Number of Pelton type turbines		3

4.2.3. Zone 3

4.2.3.1 Tarbela Dam Project

The primary objective of Tarbela Dam Project (TDP) was to store water to mitigate the effect of diverting the three eastern rivers by India and to increase agricultural production in the existing canal command areas along the Indus main river. Salient Features of Tarbela Dam Project are shown in Table 4.2.3.1. Tarbela was designed to: provide storage to replace the water of existing canals (command of about 1.8 mha) dependent on the three eastern rivers; and improvement of supplies to the canals off-taking from the Indus main (command of about 6.9 mha). A subsidiary goal was to generate low-cost hydropower to meet the country's requirements. The ultimate goal of TDP was to provide a firm base for progressive development of the irrigation system to bolster the national efforts of increased agricultural productivity to meet the requirements for the burgeoning population.

Because of its storage capacity of 11.5 bcm and re-regulatory-cum-integrating impact of large reservoir, it was expected that TDP would substantially increase the canal head diversions. It was projected that after full utilisation of Tarbela storage (1985) the existing (1960-67) average IBIS withdrawals of about 108 bcm would have increased to about 128 bcm. Consequently it was expected that cropping intensities in the provinces of Punjab and Sindh (comprising about 97% of IBIS) would also increase substantially. According to feasibility estimates contained in the Indus Special Study [hereafter referred to as the Lieftinck Report (1968)], the cropping intensities in Punjab would increase from 95% (1965) to 114% (1975), 131% (1985) and 150% (2000). Similarly, cropping intensities in Sindh would increase from 90% (1965) to 100% (1975), 115% (1985) and 137% (2000). Regarding power, on full development of 2100 MW, TDP was predicted to provide an annual average generation of 12600GWh.

TDP as evaluated in the Lieftinck Report was the largest water storage and hydroelectric project in Pakistan. In fact, it probably represented the largest single construction work ever to have been contracted in the world. The project, as envisaged, comprised essentially a major earth and rock-fill dam with an impervious upstream blanket, two auxiliary embankment dams, two chute spillways, and four outlet tunnels each of 13.7m maximum diameter.

The powerhouse would be located on the right bank of the river at the foot of the dam. The substructure was designed to be constructed in stages of four generating units each served by pen-stock from one tunnel. It was decided to initially build the powerhouse for four generating units. Eight more units would be installed at a later date to equip three right bank tunnels with power.

Table 4.2.3.1 Salient Features of Tarbela Dam Project

Reservoir		
Length		97km (60 miles)
Area		260 km2 (100 sq. miles)
Gross Storage		14.3 bcm (11.6 MAF)
Usable Storage		11.48 bcm (9.3 MAF)
Main Dam		
Maximum Height		148m (485 ft)
Length of Impervious Blanket		2025m (6640 ft)
Original		1524m (4999 ft) modified
Auxiliary Dam 1: Max Height		105m (345 ft)
Auxiliary Dam 2: Maximum Height		67m (220 ft)
Service Spillway: Design Discharge		18,386cms (650,000 cfs)
Auxiliary Spillway: Design Discharge		24,070cms (850,000 cfs)
Tunnels		
Diameter		13.72m (45 ft)
Capacity at E1 457.3m (1500 ft)		
Tunnel 4		2605cms (92,000 cfs)
Tunnel 5		2494cms (81,000 cfs)
Power House	**Planned**	**Actual**
Power Units:		
Tunnel 1	4 x 175=700 MW(1975)	4 x 175= 700 MW(1977-78)
Tunnel 2	4 x 175=700 MW(1978-79)	6 x 175= 1050 MW(1982-85)
Tunnel 3	4 x 175=700 MW(1980)	4 x 432= 1728 MW(1992-93)
Total Installed capacity	**=2100 MW**	**= 3478 MW**

4.2.3.2 Tarbela Extension-IV

Salient features of Tarbela Extension-IV Project are shown in Table 4.2.3.2. The water which is currently spilled through the spillway (loses its energy in the structures downstream) 5 would be diverted to the Tunnel 4 where it would pass through the three 470 MW turbines and generate electricity which would be transmitted to the unified common grid. The energy of this water, which is otherwise wasted in the spillway structure, would now be used for generating clean electricity (about 4,000 GWhs).

Table 4.2.3.2 Salient Features of Tarbela Extension-IV

Parameter	Detail
Tunnel 4	
Location	Tunnel 4 runs from the intake and through the right abutment of the dam for approximately 900 m. The downstream control structure is connected to the tunnel at the portal in the rock face. The control structure is located between the foot of a steep slope to the west and the Tunnel 3 control structure to the east.
Purpose	Irrigation releases when reservoir level below the spillway level
Type	Concrete/Steel Lined
Cross Section	Circular 13.7 m – 11 m
Length	914 m
Outlet Type	Flip Bucket
Intake Level	To be confirmed
Design Flow	2000 cubic metres per second (m^3/s)
Proposed Powerhouse	
Location	Location B-1 was chosen as the site for the powerhouse
Type of Turbine	Vertical Francis Turbine
Number of Units	Three
Unit Generator Rating	450 MW
Total Generating Capacity	1,350 MW

Type of Generator	Vertical Shaft Umbrella
Generating Voltage	18 kV or 20 kV
Turbine Centre Line Level	327.6 m
Annual Energy	2,809 GWh
Tailrace Channel	
Length	Not applicable as water flows directly from turbines to Ghazi Barotha head pond
Type	Not applicable
Tailrace Water Level	Between EL 344.1 m and 335.3 m
Penstock Connection to Tunnel 4	
Type of Penstock	Steel, probably concrete encased and buried

Source: T4CJV

Appendix – 5.1

FISHERIES STATISTICS AND POLICIES

This appendix contains a summary of KP District fish production, fishing licences, and revenue and information on the national strategy for inland capture fisheries

5.1.1. KP District fish production, fishing licences, and revenue

The following data are presented in this section:

Table 5.1.1.1: District wise Fish Production, in KP, 2005-06 to 2007-08
Table 5.1.1.2: District wise No. of Fishing Licenses, issued in KP, 2005-06 to 2007-08
Table 5.1.1.3: District wise revenue of Fisheries Department, 2005-06 to 2006-07

Table 5.1.1.1: District wise Fish Production, in KP, 2005-06 to 2007-08

Districts	Production in Metric Tons											
	2005-06				2006-07				2007-08			
	Total	Trout	Non-Trout	Value in Rs.	Total	Trout	Non-Trout	Value in Rs.	Total	Trout	Non-Trout	Value in Rs.
Abbottabad	-	-	-	-	-	-	-	-	-	-	-	-
Bannu	9.439	-	9.439	943900	19.697	-	19.697	1969700	2.440	-	2.440	244000
Battagram	0.000	-	-	-	0.000	-	-	-	0.990	0.990	-	346500
Buner	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Charsadda	0.000	-	-	-	0.000	-	-	-	0.340	-	0.340	34000
Chitral	2.526	0.149	2.377	289850	2.920	0.210	2.710	334000	5.780	3.100	2.680	1085000
D.I.Khan	213.323	-	213.323	21332300	212.430	-	212.430	2124300	153.670	-	153.670	15366700
Hangu	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Haripur	7.859	-	7.859	785900	4.500	3.000	1.500	1200000	12.130	-	12.130	1213100
Karak	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Kohat	19.839	-	19.839	1983900	33.225	-	33.225	332500	14.500	-	14.500	1450000
Kohistan	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Lakki	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Lower Dir	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Malakand	0.000	-	-	-	36.000	-	36.000	3600000	35.000	-	35.000	3500000
Mansehra	2.562	2.262	0.300	811700	0.770	0.770	-	269500	0.000	-	-	-
Mardan	0.000	-	-	-	36.000	36.000	-	46470000	220.000	-	220.000	22000000
Nowshera	14.000	-	14.000	1400000	0.420	-	0.420	42000	6.460	-	6.460	646000
Peshawar	42.350	-	42.350	4235000	0.208	-	0.208	20800	52.160	-	52.160	5215600
Shangla	4.793	4.793	-	1677550	0.325	0.325	-	97500	0.114	-	0.114	11400
Swabi	38.000	-	38.000	3800000	48.000	-	48.000	4800000	30.000	-	30.000	3000000
Swat	271.093	32.370	238.723	35201800	69.369	69.369	-	24265150	206.320	20.670	185.650	25798550
Tank	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
Upper Dir	0.000	-	-	-	0.000	-	-	-	0.000	-	-	-
TOTAL	**625.784**	**39.574**	**586.210**	**72461900**	**463.864**	**109.674**	**354.190**	**85525450**	**739.904**	**24.760**	**715.144**	**79910850**

Source: Directorate of Fisheries, KP, Peshawar

Table 5.1.1.2: District wise No. of Fishing Licenses, issued in KP, 2005-06 to 2007-08

District	2005-06			2006-07			2007-08		
	Total	Trout	Non Trout	Total	Trout	Non Trout	Total	Trout	Non Trout
Abbottabad	0	-	-	0	-	-	0	-	-
Bannu	7	-	7	6	-	6	10	-	10
Battagram	1	-	1	0	-	-	22	22	-
Buner	0	-	-	37	-	37	40	-	40
Charsadda	72	-	72	75	-	75	78	-	78
Chitral	620	221	399	955	373	582	977	385	592
D.I.Khan	0	-	-	0	-	-	14	-	14
Hangu	0	-	-	0	-	-	0	-	-
Haripur	195	-	195	141	141	-	237	-	237
Karak	0	-	-	0	-	-	0	-	-
Kohat	156	-	156	75	-	75	253	-	253
Kohistan	3	3	-	0	-	-	0	-	-
Lakki	0	-	-	0	-	-	0	-	-
Lower Dir	0	-	-	61	-	61	60	-	60
Malakand	91	-	91	50	-	50	89	-	89
Mansehra	1618	1575	43	746	703	43	1220	1149	71
Mardan	66	-	66	67	-	67	76	-	76
Nowshera	57	-	57	39	-	39	55	-	55
Peshawar	111	-	111	276	-	276	261	-	261
Shangla	66	-	66	48	-	48	171	-	171
Swabi	143	-	143	84	-	84	70	-	70
Swat	2064	1432	632	859	346	513	588	354	234
Tank	0	-	-	0	-	-	0	-	-
Upper Dir	0	-	-	4	4	-	0	-	-
TOTAL	**5270**	**3231**	**2039**	**3523**	**1567**	**1956**	**4221**	**1910**	**2311**

Source: Directorate of Fisheries, KP, Peshawar

Table 5.1.1.3: District wise revenue of Fisheries Department, 2005-06 to 2006-07

District	Revenue During the Year 2005-06 (Rupees)									
	Total	Lease Money	Licenses Fee		Sale of Gold Fish	Orn: Fish	Sale of Fish Seed	Compe-nsation Fee	Misce-llaneous	Recovery
			Trout	Non Trout						
Abbottabad	0	-	-	-	-	-	-	-	-	-
Bannu	152200	137500	-	700	-	-	13800	200	-	-
Battagram	500	-	-	500	-	-	-	-	-	-
Buner	11400	-	-	8000	-	-	-	3400	-	-
Charsadda	52400	-	-	33600	-	-	-	18800	-	-
Chitral	0	-	-	-	-	-	-	-	-	-
D.I.Khan	2251800	2251800	-	-	-	-	-	-	-	-
Hangu	0	-	-	-	-	-	-	-	-	-
Haripur	1344175	1330500	-	12875	-	-	-	800	-	-
Karak	0	-	-	-	-	-	-	-	-	-
Kohat	516269	351000	-	19350	-	100	101500	32700	11619	-
Kohistan	1500	-	-	1500	-	-	-	-	-	-
Lakki	0	-	-	-	-	-	-	-	-	-
Lower Dir	0	-	-	-	-	-	-	-	-	-
Malakand	21550	-	-	18600	-	-	-	2950	-	-
Mansehra	1696200	-	1575000	107500	-	-	-	13700	-	-
Mardan	286290	-	-	25600	-	-	258890	1500	300	-
Nowshera	39500	-	-	26600	-	-	-	12900	-	-
Peshawar	590870	105500	-	60200	-	-	360831	35140	29199	-
Shangla	5380	-	-	1980	-	-	-	3400	-	-
Swabi	49250	-	-	33500	-	-	-	15750	-	-
Swat	693078	-	57250	155500	-	-	306527	96700	77101	-
Tank	0	-	-	-	-	-	-	-	-	-
Upper Dir	0	-	-	-	-	-	-	-	-	-
TOTAL	**7712362**	**4176300**	**1632250**	**506005**	**0**	**100**	**1041548**	**237940**	**118219**	**0**

(contd…….)

District	Revenue During the Year 2006-07 (Rupees)									
	Total	Lease Money	Licenses Fee		Sale of Gold Fish	Orn: Fish	Sale of Fish Seed	Compe-nsation Fee	Misce-llaneous	Recovery
			Trout	Non Trout						
Abbottabad	0	-	-	-	-	-	-	-	-	-
Bannu	235816	152500	-	600	-	-	82216	500	-	-
Battagram	0	-	-	-	-	-	-	-	-	-
Buner	13900	-	-	13900	-	-	-	-	-	-
Charsadda	57600	-	-	38900	-	-	-	18700	-	-
Chitral	108400	-	37300	60000	1000	-	500	9600	-	-
D.I.Khan	2533783	-	-	2426333	1200	-	-	4150	102100	-
Hangu	0	-	-	-	-	-	-	-	-	-
Haripur	214814	203014	-	11800	-	-	-	-	-	-
Karak	0	-	-	-	-	-	-	-	-	-
Kohat	886715	733000	-	20325	-	420	120800	8800	3370	-
Kohistan	137739	-	-	-	116339	-	15000	-	6400	-
Lakki	0	-	-	-	-	-	-	-	-	-
Lower Dir	32681	-	-	21300	-	-	-	6100	5281	-
Malakand	27250	-	-	17500	-	-	-	9750	-	-
Mansehra	177200	-	69800	11500	14400	50000	-	8000	23500	-
Mardan	408620	-	-	27800	-	-	375180	4530	1110	-
Nowshera	27300	-	-	19100	-	-	-	8200	-	-
Peshawar	657190	-	-	77200	3000	-	412210	29350	135430	-
Shangla	37275	-	14800	-	21125	-	-	1350	-	-
Swabi	55650	-	-	32800	-	-	-	22850	-	-
Swat	1893193	-	55000	79000	1079540	-	616985	53850	8818	-
Tank	0	-	-	-	-	-	-	-	-	-
Upper Dir	73000	-	2000	-	-	-	71000	-	-	-
TOTAL	**7578126**	**1088514**	**178900**	**2858058**	**1236604**	**50420**	**1693891**	**185730**	**286009**	**0**

5.1.2. National Strategy for Inland Capture Fisheries

The following is the strategy for inland capture fisheries for Pakistan, extracted from the *National Policy and Strategy for Fisheries and Aquaculture Development in Pakistan* (Ministry of Food, Agriculture and Livestock 2006).

Strategy axis (SA) 2b: Inland capture fisheries.

Major problems and constraints to address:

Over-exploitation of resources:

In inland water bodies, uncontrolled harvesting has resulted in depletion of stocks. Illegal methods such as dynamiting and the use of toxic chemicals and gases have resulted in major kills and have negatively affected fish populations. However, no estimation of the impact of these methods on inland waters' fish stocks or fish fauna has been carried out in Pakistan.

Landings of some commercially important species such as mahseer, kabanas, rita and a number of other cat fishes have decreased substantially despite the stocking of some natural water bodies.

No stock assessment of freshwater fish resources has been carried out over the last 15 years. This lack of information has prevented the determination of losses and changes in freshwater species composition, optimal harvesting levels and has impeded the implementation of adapted management measures.

Increase in pollution and environmental degradation:

Pollution has also increased in inland water bodies throughout the country, especially in the vicinity of large population and industrial centres, negatively impacting upon catches and the livelihoods and health of fishing communities depending on capture fisheries.

Implementation plan objectives and activities to address these constraints:

Plan objective (PO) 2B.1: Rehabilitate inland aquatic habitats damaged by pollution and environmental degradation.

2B.1.1 Contribute to the monitoring of impacts of pollution on water regimes and habitats when these have negative impacts on inland fisheries, and suggest remedial measures where necessary.

2B.1.2 Establish laboratories, including mobile testing units of water, soil and fish tissues.

2B.1.3 Contribute to negotiations for the establishment of plants for the treatment of industrial waste and domestic sewage to minimize pollution of inland aquatic environments and externalities to other users.

2B.1.4 Lobby for the implementation of the existing law on pollution control and enforcement of pollution controls in inland water bodies in all provinces.

2B.1.5 Lobby for a ban on use of polythene bags.

2B.1.6 Give law enforcement powers to Fisheries Department officials with regard to pollution control and equip them with modern technologies.

Plan objective (PO) 2B.2: Control over-exploitation of inland fisheries resources.

2B.2.1 Make concerted efforts to enforce the prevention of all forms of Illegal, Unreported and Unregulated (IUU) fishing in inland water bodies.

2B.2.2 Conduct resource surveys, and species stock assessments in inland waters.

2B.2.3 Set catch limits in freshwater bodies based on MSY.

2B.2.4 Prepare and implement a plan for the management and sustainable exploitation of each national water body based on the FAO Code of Conduct for Responsible Fisheries (CCRF) and related guidelines.

2B.2.5 Implement control measures from outlet canals to prevent fish from escaping and increase productivity of canals.

Plan objective (PO) 2B.3: Promote sustainable management of inland aquatic resources.

2B.3.1 Monitor the spread and impact of introduced and transplanted such as Tilapia and Chadu (an indigenous species) on indigenous species, and of invasive plant species such as Salvinia molesta on inland water bodies.

2B.3.2 Promote the use of environmentally-friendly biological, chemical and mechanical methods to control the spread of invasive, non-indigenous species.

2B.3.3 Implement ecosystems-based approaches to inland fisheries management when and where practically possible.

2B.3.4 Initiate a programme of awareness-raising targeted at the general population and at fishing communities about freshwater fish bio-diversity, natural fisheries environments and sustainable resource development.

2B.3.5 Restock freshwater bodies with seeds/fingerlings of commercially-important carp species.

2B.3.6 Establish fish sanctuaries in all provinces for endangered species.

2B.3.7 Declare zones up to 1 km up and downstream of headworks and barrages as reserved areas for fish breeding and survival.

2B.3.8 Establish a registration system for all fisherfolks.

Plan objective (PO) 2B.4: Establish sustainable exploitation of untapped inland resources.

2B.4.1 Ensure that hatcheries in all provinces enhance biodiversity through the production of fish seed of local species, such as Mahaseer, Sher mahi, Soul, Singahri, Khagga, Malli.

2B.4.2 Stock fingerlings of local species in natural water bodies.

2B.4.3 Investigate the potential to enhance cold-water fisheries.

Plan objective (PO) 2B.5: Promote sport fishing activities in inland water bodies.

2B.5.1 Dedicate water bodies to sport fishing activities.

2B.5.2 Rationalise the cost of license fees and establish a fool-proof system of collection of license fees.

2B.5.3 Advertise sport fishing and organise regular tournaments under government supervision.

2B.5.4 Ban the use of fish seed as bait for sport fishing.

Appendix – 5.2

SOCIO-ECONOMIC BASELINE

Socioeconomic baseline information of the CIIA study area is divided in to 3 Social zones – Zone 1, Zone 2 and Zone 3 (Figure 5.2.1). The area under Social Zone one will be impacted area of Basha Dam, while Social Zone two will be the area of impact of Dasu Hydropower Project and Social Zone three will be area of impact of Tarbela 4thExtension. The following districts fall under all these three socials zones.

Zone 1 - Diamer and Kohistan District

Zone 2 - Kohistan, Diamer, Shangla and Batagram District

Zone 3 - Haripur and Swabi District

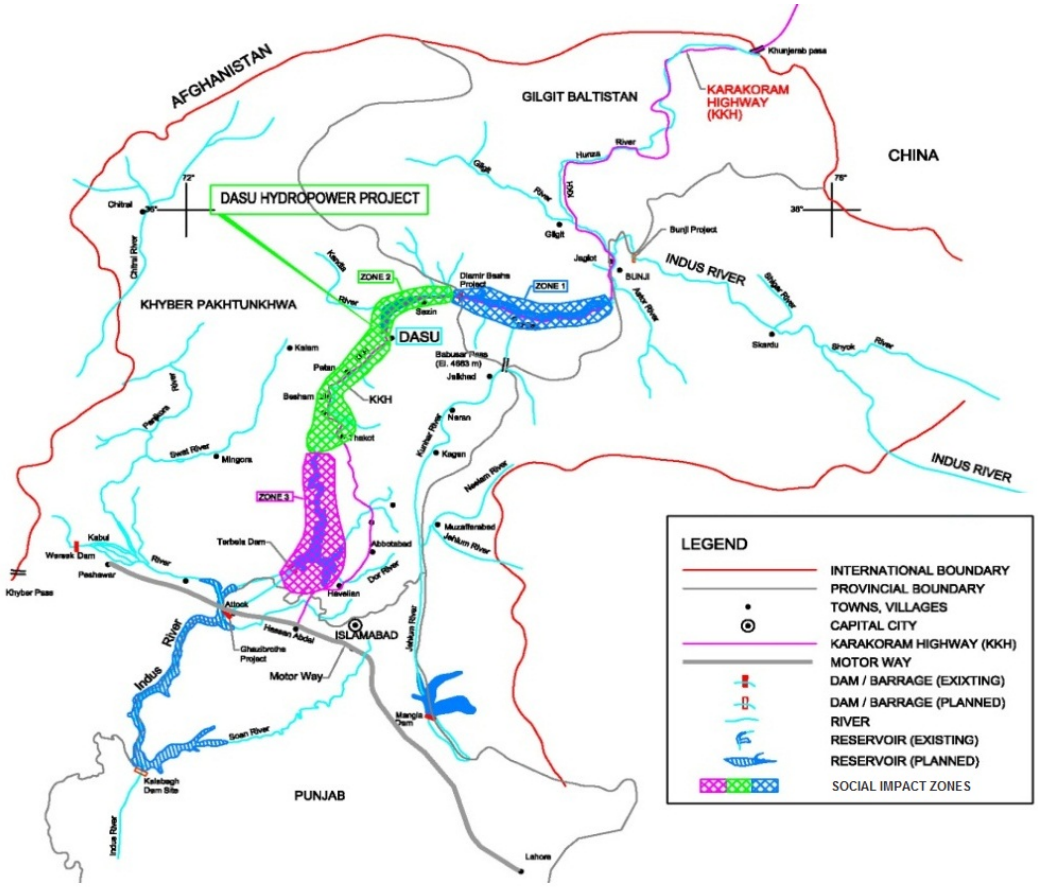


Figure 5.2.1: Social Impact Areas

The social baseline condition is being described for all three zones (Table 5.2.1). The parameters of baseline condition will be as under:

(i) Demography: population with household size; tribes; language; and religion;
(ii) Economy: economic condition: livelihood; income; livestock; industry; Credit availability
(iii) Social Infrastructure and Services: health; education and literacy; Dwelling source of drinking water; electricity; road network; Tele communication; cultural heritage; NGOs; Mechanism for resolving disputes; poverty status, reduction of natural resources contributes to poverty, disabled persons, indigenous people and gender issues.

Table 5.2.1: Population, with average household size and annual growth rate

District	Area (km^2)	Population	Average household size	Density (people/km^2)	Annual growth rate
Zone-1					
Diamer	10936	207107	8.4	12	3.13
Kohistan	7492	472570	6.4	63.1	0.09
Zone 2					
Kohistan	7492	472570	6.4	63.1	0.09
Diamer	10936	207107	8.4	12	3.13
Shangla	1586	434563	8.1	274	3.27
Batagram	1301	307278	6.6	236.2	0.58
Zone 3					
Haripur	1725	692228	6.6	401.3	2.19
Swabi	1543	1026804	7.7	665.5	2.96

Source: District Census Reports, 1998.

According to the latest available District Census Reports (1998), the district falling with the zones have the following populations: Diamer (207,107), Kohistan (472,570), Shangla (434,563), Battagram (307,278), Haripur (692,228), and Swabi (1,026,804) with varying density from 12 in Diamer to 666 in Swabi per sq km.

5.2.1. Main Tribes of Districts

Being on the route of the conquerors of Central India, the tribes and castes of the districts are a multitude of various races from the north. The key tribes in Zone 1 District Diamer are two types who consider them as substantially different from the majority of population in Pakistan. They retain a strong sense of attachment to their mother land. These are local and non-local tribes. Local tribes are Sheen and Yashkun while non-local tribes are Soniwals, Kohistani, Kashmiri, Gujar, Pattan, and Swati. Both local and non-local tribes are further subdivided in clans.

As for as Kohistan District is concerned, on the swat side the tribes are divided into two groups:Manzar and Money.They are two brothers; sons of Nafria. Tribes of Dubair, Kandia and Ronolia belong to Manzar group, those of Bankad, Jijal, Pattan, Kayal and Seo belong to Money group. Both main tribes are further subdivided in clans.

In Zone 2, it is said that the preaching of Islam in Shangla was affected by Mahmood Ghaznavi brave General Khushal Khan in or about 1.000 A.D, When Dalazak Afghans became the rulers of Swat and its allied areas. So most of inhabitants are Afghani, The major tribes in the area are given as below; Afghan; Gujar/Ajar; Syed; Main and Qureshi.

While in Batagram, most of inhabitants are Swatis. The major tribes in the area are: Swati, Gujar, Akhunkhel, Syed and Qureshi.

In Zone 3, the key tribe in the Swabi district is Yousafzai, an off-shoot of Pathans. Resident in the District Razarsare: Rajars; Utman; Jadoon; Gadoon; and Khatak. In the Haripur district the Punjabis and Kashmiris are in the majority as compared to Pathans.

The key tribes and castes include: Tareen; Dilazak;Tarkheli; Gujar; Awan; Mishwani; Pathan; Gakhar; Jdoon; Sayyed; Tanoli; and Turks.

The majority of the people in the Project area are Pakhtun with the other key tribes, castes in the Project area being: Awan; Yousaf Zai; Syed; Mughal; Mashwani; Bafanda; and some working classes (artisans).

5.2.2. Language

In Zone 1 District Diamer, Shina is the most common language spoken by all the affected peoples. Historically, origin of this language comes from Sansikrit and Iranian Persian. Shina language is without alphabet and is considered only a spoken

language. Another language namely Broshaski is also understood and spoken by all the peoples of the District area.

While in district Kohistan, Kohistani, shina and Pashtoare spoken by the majority of population.

In Zone 2, Pashto is the predominant language being spoken in Shangla and Batagram districts.

In Zone 3, Pashto is the dominant language spoken in the Swabi district by 96% of the population.Punjabi, Sraiki and Urdu are the other, minor languages spoken. The mother tongue spoken in the Haripur district is predominately “Hindko” with the other languages spoken being similar to the Swabi district.

5.2.3. Religion

In Zone 1, population of the Diamer and Kohistan districts is almost entirely Muslim and most of the people belong to Hanfi Sunni Sect.

Religious leaders, as compared to other areas in Pakistan, have gripping influence on the local population. Local religious leaders have strong hold on the social set-up of the area. There prevails a sense of suspicion that outsiders, particularly development agencies / NGOs, have some hidden agenda of social change. In particular, NGOs are considered as a threat to the existing social structure and traditions. Thus, the information disseminated through Imams of the mosques is considered more reliable.

Due to influence of the Religious Leaders and the distance from other parts of the country, dissemination of daily general information is very limited. Electronic media such as television is still very much abhorred by the local religious leaders. Newspapers are not easily available in the villages. Anyway, due to the high illiteracy rate only few people would be able to read them.

Thus, most of the information is disseminated by the Imams through sermons of Friday prayers.

In Zone 2, populations of Kohistan, Shangla and Batagram are almost all Muslim.

5.2.4. Economic Condition

5.2.4.1 Livelihood

In Zone 1, the traditional subsistence farming system and animal husbandry is widely practiced since generations in Diamer and Kohistan districts. It is the predominant economic system, which in general supplies the people with most of the daily needs. Majority of the affected households are having land for growing crops and fruits as well as feeding the livestock. Most of the daily consumer goods such as wheat, maize, potatoes, vegetables, fruits, milk, butter, eggs and meat are being produced for self-consumption. In other words, agricultural farming is the prevailing livelihood system of self-reliance and sustainability in the Districts area.

In Zone 2, majority of people earn living by farming, while many locals are farming as tenants on the land owned by the land lords of the districts.

In Zone 3, the main occupation of the inhabitants of the Swabi district is agriculture and people are mostly landless tenants. However, a few educated people are engaged in Government or private service. The livelihood of the local population of the district mainly depends on agriculture and livestock rearing. The livestock serves as an income source which they sell to meet their needs. The people of the district live a simple life including the standard of their clothing and their diet. Unemployment, lack of potable water, basic health and education facilities, electricity and roads are the major issues for the people of the district. Similarly, in Haripur district agriculture remains the main occupation of its inhabitants. The proportion of people serving in the Government sector is higher due to the existence of the Pakistan Telecommunication Industry in

Haripur as well as the Hazara Fertilizer Factory. There are also a large number of people serving in the Armed Forces.

Most of the people in the Project area are dependent upon labor. They work in nearby cities, Gadoon industrial estate, Karachi and abroad.

5.2.4.2 Income

In Zone 1, mean family income per household was between PKR 7,000 and 10,000 per month. However, there were cases with family income less than PKR 2000 per month. There were also some groups, in particular land-owners, businessmen and governmental employees living mostly in Chilas, Ges Pain and GesBala, in Lower Bunar Das and Lower Gonar Farm, who had a higher monthly income. In this category fell the local tribes of Sheen, Yashkun and Kameen due to renting of their landed properties in the valleys and income from their additional agriculture in uplands.

It has been estimated by Diamer Basha Consultant (DBC) that ratio between cash and non-cash income in the households is 30:70. Cash income in the households of local tribes may be somewhat higher who, besides land, have supplemented sources of monthly salary or net profits from their business.

Regarding Kohistan, the average income of family is between PKR 3200-14000/month/ household,

In Zone 2, the average income of family is between PKR 3500-15000/month/household. While in zone three, under the prevailing socio-economic conditions in the districts, the income of an average household is very low. However, a small number of the people had larger incomes.

According to the social impact assessment survey, the majority of the people in the Project area belong to the low income group. The average monthly income ranged between PKR 5,000 to PKR 7,000. This implies that the majority of people in the Project area live below poverty line.

5.2.4.3 Livestock

Livestock is a prestigious symbol and an additional source of income for the farming community, besides providing milk, ghee and meat. Information relating to livestock in all Districts is presented in Table 5.2.2.

Table 5.2.2: Livestock status in all zones area

Item	Districts					
	Diamer	**Kohistan**	**Shangla**	**Batagram**	**Haripur**	**Swabi**
Cattle	22620	169357	204946	59885	96388	170507
Buffalo	5579	36403	129041	106882	93799	71118
Sheep	59920	277539	59480	24482	10327	15660
Goat	549311	786242	289828	128420	149982	93302
Camel	0	131	306	0	423	821
Horse	3624	6378	2847	739	1270	2658
Mule	311	17923	4458	1230	221	265
Donkey	12221	38293	8210	7984	19083	34754
Poultry	585612	482785	896029	457353	596471	813820

Source: Livestock Census, 1998.

5.2.4.4 Industry

In Zone 1, there is no industry available in both districts. Some fine embroidery is being done by women folk .It is mostly done on items of personal use i.e. chudders, shirts and pillow.

In Zone 2, Shangla and Batagram are not an industrially developed area like other district of the province. There is only one flour mill namely Dubair Flour Mill situated at Besham.

In Zone 3, an industrial estate established in 1988 is situated at Gadoon in the Swabi district. However, with the withdrawal of incentives available to the industrial estate, a large number of industries have been abandoned. The main industries remaining are cement, cigarette, tanneries and flour mills. There are no industries of major importance within the Project area.

In the Haripur district, Hattian Industrial Estate was established in 1985. Industrialization has mostly brought structural, positive changes in the socio-economic conditions of the district, including the establishment of a large number of chemical industries, cotton, fiber, textiles, telephone Industries of Pakistan and brick plants which are functioning now in the district.

5.2.4.5 Credit Availability

Credit plays important role in the lives of the poor and lower middle class families in districts area. There are two major source of credit, institutional and non-institutional. The availability of institutional credit is very limited in the Project area mainly due to a lack of knowledge and also the high rate of interest charged on loans. The main users of non-institutional credit are shop keepers and relatives of well-off families in the settlements. These loans are mainly used for domestic and social needs such as marriages, birth ceremonies, funerals, health and education.

5.2.5. Social Infrastructure and Services

5.2.5.1 Health facilities

The health facilities are limited in the districts. Therefore are compelled to go to down districts to avail medical facilities. The overall situation of health facilities are given in Table 5.2.3.

Table 5.2.3: Overall situation of health facilities in all Districts

Health Facilities	Districts					
	Diamer	Kohistan	Shangla	Batagram	Haripur	Swabi
Hospital	5	1	5	1	3	3
Basic Health Unit	4	37	15	39	39	41
Dispensary	15	4	11	0	12	8
Rural health Centre	0	2	0	3	5	2
Mother &child health centre	0	0	0	0	2	3
First Aid Post	23	0	0	0	0	0
Leprosy Clinic	1	2	2	2	0	0

Source: District Census Reports, 1998

The health services are extremely poor due to the lack of medical facilities and doctors, in particular female doctors in all districts of three zones, and often partly functional or totally closed due to various reasons. Even the functioning health facilities lack adequate staff and medicines. In particular, women for any medical treatment have to travel sometime more than 40 km to avail appropriate health facilities. Due to poor and unhygienic living conditions and a lack of potable water, ill health is prevalent. The most common diseases in the area are malaria, diarrhea, hepatitis and skin diseases.

A 2007 World Health Organization study of Swabi District health facilities found that the local population suffers poor access to district health facilities due to long travel distances, poor road conditions and high costs of travel. When services are accessed,

people are often faced with absent staff, poor supplies and non-provision of essential services. Women and children are negatively affected by poor quality maternal, child health and immunization services.

5.2.5.2 Education Facilities

Like health facilities, education facilities in districts of all zones are not considered satisfactory. The overall picture of educational facilities in Districts area is provided in the Table below.

The study areas especially in rural area in most cases have only primary schools, which due to the tradition in this area, are only for boys. The girls are almost excluded from any education. Most of the parents, particularly men in the study area are not convinced about sending their daughters to the school. Therefore, the illiteracy rate is high. The Census Data of 1998 reported that the overall illiteracy rate was higher with women. The status of education facilities varies between districts. The overall picture of education facilities can be judged from Table 5.2.4.

Table 5.2.4: Education Facilities in all Districts

Education Facilities	Districts					
	Diamer	**Kohistan**	**Shangla**	**Batagram**	**Haripur**	**Swabi**
Degree college	2	0	2	1	2+1	2+1
Inter college	0	0	1	0	1	1
Higher Secondary school	0	1	1	1	4+3	4+2
High school	14	10	28	20	63	65
High for Girls	0	0		1	15	21
Middle school	28	56	28	25	56	51
Middle school for Girls	6	4		9	27	25
Primary school	128	732	599	338	656	496
Primary school for Girls	22	147		166	251	388
Mosque school	5	0	0	157	0	76
Social action programs	94	0	0	0	0	14

Source: District Census Reports, 1998.

5.2.5.3 Literacy

A person who can read and write statements with an understanding, in any language prevalent in Pakistan, is considered as literate. The literacy ratio is measured as the number of literate people compared to the population of the age of 10 years and above. According to the population Census of 1998, districts literacy ratio of districts; Diamer (23.33); Kohistan (11.08); Shangla (14.7); Batagram (18.31); Haripur (53.7) and Swabi (36.0). But significant difference also observed that literacy ration of female in these districts are much lower than male literacy ratio.

5.2.5.4 Dwellings

The people generally live in katcha houses made of stone and mud. The roofs are generally flat. The houses have poor ventilation. The hearth is made in the centre of living room to keep it warm during winter. People are living in cold regions and keeping their stock in their own living rooms in some cases. In most of the villages throughout the district the houses are made in clusters. The practice of construction of entirely wooden houses also exists in the districts. Generally houses consist of one or two rooms with a verandah and a boundary wall but now construction spacious houses with separate kitchens and bathrooms have been started. The male members of the villages meet together daily in Hujras(guest rooms).

Latrines are also being found in the houses. But in most cases people use to go out in open air to satisfy the call of motion. In Zone 3, in Haripur and swabi districts, most houses are *pucca* in the city; houses in rural areas are mostly *katcha.*

5.2.5.5 Sources of Drinking Water

Residents of the districts of all three zones, Diamer, Kohistan, Shangla, Batagram Haripur and Swabi have access to two types of drinking water, within the house and from outside the house. The percentage of access to water within their houses are; Diamer (13.89); Kohistan (12.45); Shangla (12.7); Batagram (24.36); haripur (55.2), and Swabi (79.4). The rest collect water from outside sources (Table 5.2.5).

Table 5.2.5: Drinking Water by Locality (%)

Source	Districts					
	Diamer	**Kohistan**	**Shangla**	**Batagram**	**Haripur**	**Swabi**
Inside	**13.89**	**12.45**	**12.7**	**24.36**	**55.2**	**79.4**
Pipe	11.53	9.09	11.8	23.38	49.6	10.9
Hand pump	0.58	0.51	0.3	0.18	0.3	17.2
Well	1.79	2.86	0.6	0.81	5.3	51.3
Out with	**86.11**	**87.55**	**87.3**	**75.64**	**44.8**	**20.6**
Pipe	10.57	4.32	14.9	24.08	15.6	4.4
Hand pump	0.04	0.04	0	0.07	0.6	1.3
Well	0.65	0.22	1.8	17.80	12.8	10.0
Pond	1.40	1.93	2.0	2.46	1.8	0.6
others	73.45	81.02	68.6	31.23	14.0	4.3

Source: District Census Reports of 1998.

5.2.5.6 Electricity

According to the District Census Reports, the majority of houses are equipped with the electricity as the source of lighting, both in urban and rural areas. All districts of three zones area is connected with a nearby national grid system however, shortage of electricity and load shedding is normal practice in all districts of zones (Table 5.2.6).

Table 5.2.6: Source of Light in All Districts (%)

Source	Districts					
	Diamer	**Kohistan**	**Shangla**	**Batagram**	**Haripur**	**Swabi**
Electricity	57.46	2.90	15.2	42.35	76.3	83.4
Kerosene oil	29.12	50.30	78.9	51.16	22.7	15.3
others	13.42	46.80	5.9	6.49	1.0	1.3
Total	100	100	100	100	100	100

Source: District Census Reports of 1998.

5.2.5.7 Road Network

The districts area of Zones 1 & 2 are linked directly through construction of KKH, while upper valleys of said zones area linked with districts headquarters through paved and un paved roads and bridges. In the Districts of Zone 3, there is a chain of national, district and rural roads available in the Swabi district. Farms are linked to markets by a roads network. Completion of the M1 project (Motorway between Peshawar and Islamabad) has also improved links from and to the district with other cities. According to the Census of 1998 the total length of roads in the district was 335 km whereas the Haripur district is linked with the famous Shahr-e-Resham (Karakoram Highway) through Hazro road. Haripur is also linked with Taxila (Punjab) via Khanpur. A road from Haripur city leads to Ghazi and there is also a network of farms to market roads. The total length of the roads in the Haripur district is 260 km.

5.2.5.8 Tele Communication

The telecommunication services are available in and around the districts area. The services of all the mobile providers are available in districts area. Pakistan Telecommunication Company Ltd. is providing land lines and wireless telephone services in districts area.

In all districts of three zones, the following telecommunication facilities have been provided by the District Government (Table 5.2.7).

Table 5.2.7: Availability of Communication Facilities in All Districts

Facility	Districts					
	Diamer	Kohistan	Shangla	Batagram	Haripur	Swabi
Telephone Exchange	9	2	1	1	18	22
Public Call offices	11	0	0	0	0	0
Post office	22	10	23	56	101	92

Source: District Census Reports, 1998

5.2.5.9 Cultural Heritage

In Zone 1, based on the research carried out since 1984 by German Scientists from Heidelberg Academy of Science and Humanities (HASH), 1about 30,000 rock carvings have been identified. Most of these carvings will be submerged under Diamer Basha Dam Project. In Dasu influence area, there are 46 rock carvings near Shatial.

In zone 2, there is a rich cultural and historical background. Not far from Tarbela, opposite the village of Darband there is the site (Aornos or PirSar) where Alexander the Great and his army fought his last battle with an army of “barbarians” before returning downstream along the Indus to return to Greece. Somewhat later in time numerous Buddhist stupas were built along the Indus valley, some of them probably near Tarbela.

5.2.5.10 Non- Government Organizations (NGOs)

In Zones 1 & 2, though a number of non-governmental organizations (NGOs) are registered in the area, most of them are not functional or effective. The most active NGO is Northern Area Development Project (NADP). It is working since nine years in Diamer district with the main office in Chilas (now reportedly in the process of being phased out). The core areas of activity are Chilas, Darel and Tangir subdivisions of Diamer district, with coverage in terms of community and infrastructure development.

NADP, co-financed by International Fund for Agriculture Development and the Government of Pakistan, have focused on:

i) Improving food security through increased crop and livestock production and irrigation.
ii) Enhancing agriculture and livestock related activities.
iii) Improvement of rural roads to open up the areas to nearby markets.

To pursue the above objectives, NADP activities include the components of: Community and Women’s Development; Village Infrastructure Development; Agriculture Development; Livestock Development; Social Forestry and Range Management; Valley Roads Construction; and Strengthening of Regional Agriculture Support Services Another most important and outstanding NGO of Northern (Gilgit-Baltistan) Areas is Agha Khan Rural Support Programme (AKRSP) with headquarter at Gilgit. However, due to some religion political reasons, AKRSP is not active in Diamer district. Other relevant NGOs are International Union for Conservation of Nature (IUCN) and World Wildlife Fund (WWF) with their regional Headquarters in Gilgit.

Local NGOs are recognized only after registration with the Department of Social Welfare of Northern (Gilgit-Baltistan) Areas. Reportedly, 71 NGOs are registered with this Department in Chilas. As for as Kohistan District is concerned, there are some local Non-Government Organizations (NGOs) workings in the project area as well as in entire District like

- Rural Area Development Organization (RADO)
- Palas Development Association(PDA)
- Abaseen Rural Support Organization(ARSO)
- Karakuram Development Organization(KDO)

All these NGOs are working at union council as well as valley level. Also, there are some INGOs working in District Kohistan which are as under:

- Welthungerhilfe (WHH) working on multi sector fields like water supply, sanitation and hygiene promotion (WASH)and energy
- Catholic Relief Services (CRS) working on Energy, Education and WASH
- Church World Services (CWS)working on livelihood in selected union councils of District Kohistan
- German Red Cross in collaboration with Red Crescent Society of Pakistan working on Health in Kohistan district
- Communication for Effective Social Services Delivery (CESSD) working on Health

There are few national organizations working in different parts of District Kohistan including in project area are:

- Sarhad Rural Support Program (SRSP)
- Salik Development Foundation (SDF)
- National Integrated Development Pakistan (NIDA Pakistan)
- Indus Social Welfare and Development Organization (ISWDO)
- Social Awareness and Development Organization (SADO)

In Zone 3 areas, the NGO sector has made enormous contributions to the economic development in Pakistan. The Ghazi Barotha Taraqiati Idara (GBTI) and Sungi Development Foundation are of note and are mentioned as they work actively in Tarbela Project area. GBTI was the project NGO for Ghazi Barotha Hydro Power project; in addition they are working with communities in the health and education sectors. Pakistan and provincial KP Rural Support Programs are also working in the Haripur and Swabi districts.

5.2.5.11 Mechanism for resolving disputes

In all districts of study area, people have various disputes and conflicts on different issues, like other parts of the country. However, they resolve their minor disputes through the heads of families while major disputes are resolved through the *jirga* (a tribal assembly of elders that make decisions by consensus). In case of serious matters, local influential politicians intervene to settle the dispute. Police and the court of law is the last option.

5.2.5.12 Poverty Status

Taking into consideration the nature and scope of the sources of income from *barani* (rain fed) agriculture, livestock, employment status, investment profit, remittances from main metropolitan cities of Pakistan as well as abroad, most importantly from the analysis data gathered from the focused groups and separate discussions with men and women of the all districts of study area; it would be safe to conclude that every

second person in the study area was living below the poverty line and earning less than $1.50 per day, per person.[1]

5.2.5.13 Disabled Persons

Disability refers to malfunctioning of any organ of the body, visible or invisible. The disability is classified as blind, deaf and mute. Crippled, insane, mentally retarded, multiple disability and any other visible disability. Between one and three percent of the population are classified as disables in the study area (Table 5.2.8).

Table 5.2.8: Disabled Persons status in Districts of all zones

Disability	Districts					
	Diamer	Kohistan	Shangla	Batagram	Haripur	Swabi
Blind	11.66	7.99	7.7	5.18	6.6	6.9
Deaf/Mute	10.89	5.91	8.2	0.38	10.5	6.4
Crippled	33.72	41.31	36.1	57.07	30.8	24.4
Insane	3.73	2.63	6.5	3.3	10.1	6.6
Mentally Retarded	11.0	15.34	7.8	6.7	9.1	9.0
Multiple Disability	12.70	10.60	10.9	11.60	7.6	8.1
Others	16.30	16.22	22.8	15.77	25.3	38.6

Source: District Census Reports, 1998

5.2.5.14 Indigenous People

There is no universally accepted definition of indigenous peoples. Indigenous peoples may be referred to in different countries by such terms as: indigenous ethnic minorities; indigenous cultural communities; hill tribes; minority nationalities; scheduled caste tribes; and particular tribal groups. Such groups can be considered indigenous peoples for operation purposes when they possess the following characteristics:

a) Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
b) Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
c) Customary cultural, economic, social or political institutions that are separate from those of the dominant society and culture; and
d) A distinct language, often different from the official language of the country or region.

In considering these characteristics, national legislation, customary law and any international conventions to which the country is a party are also taken into account. However, according to World Bank operation practices in Pakistan, only Kalash people are considered indigenous in Pakistan.

5.2.6. Gender related Issues

Gender issues are gaining importance in development projects because female members of the community are generally neglected while designing, assessing and implementing such projects. Females are generally more vulnerable than male members of the society and the Project is no exception to this. In Zones 1 & 2, health status of women is the poorest of all groups of local population. They are exposed especially to: poor nutrition; air pollution from internal cooking procedures; early marriage; and frequent childbirths. Gender discrimination is very prominent in study area. Girls are deprived of school education. The gender situation is further complicated by:

i) Early marriage of girls.

[1] As per the Tarbela 4th Extension Consultant Survey, 2010.

ii) Restriction on women's mobility.
iii) Poor domestic sanitation conditions.
iv) Long working hours (both for girls and women) including working on the farms.
v) Preference to sons over daughters.

They do not allow even any interaction between women of their area and women from outside their village. Traditional laws regulate the relationship between men and women, giving men a dominant position. Due to these social taboos the allocation of resources, education, health and skills favor men.

In Zone 3, gender situation is better as compared to the other two zones. According to one sources[2], 51.2% of those participated in the study were involved in the decision making process relating to important issues such as the sale and purchase of property and the schooling and marriages of their children. 46% were literate having received formal and/or informal education. Around 65.6% of the women consulted are housewives and remain engaged on a full time basis in household chores including food preparation, cleaning, and housekeeping, caring and rearing of children and taking care of old and sick members of the family. About 18% of the women were contributing to the household income through both indoor and outdoor activities such as teaching, dress making and shop keeping. Women are also engaged in undocumented and informal rural economy such as the raring of animals.

[2] EIA Tarbela 4th Extension Project, 2010.