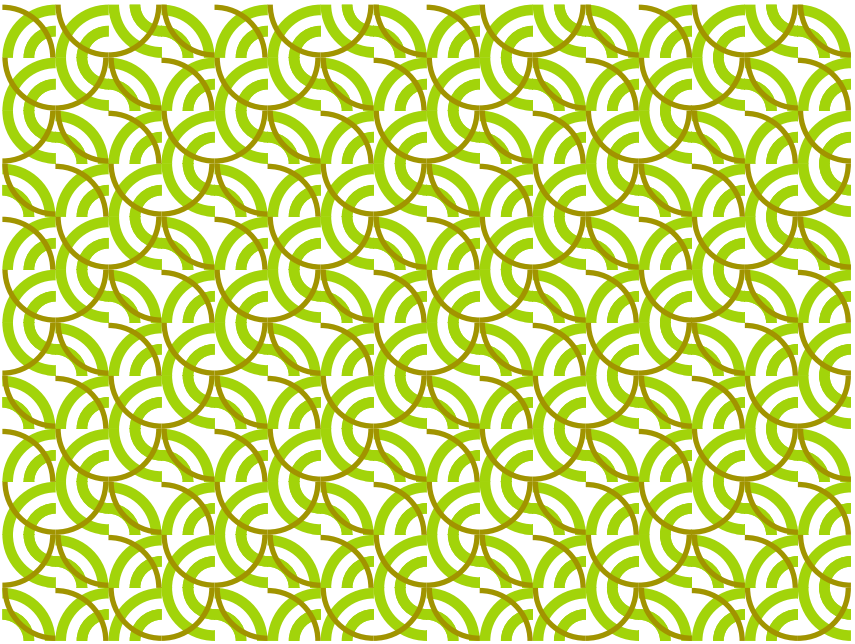
HEINRICH BÖLL STIFTUNG
PAKISTAN

INFRASTRUCTURE IN FRAGILE ECOSYSTEMS:

A Case of Deosai National Park, Gilgit-Baltistan, Pakistan

Muhammad Wasim
Fazal Karim



Discussion Paper
Publication Series "Resource Equity"
2017

INFRASTRUCTURE IN FRAGILE ECOSYSTEMS:

A Case of Deosai National Park, Gilgit-Baltistan, Pakistan

Discussion Paper
Publication Series "**Resource Equity**"
2017

Muhammad Wasim
Fazal Karim

HEINRICH BÖLL STIFTUNG

The Heinrich Böll Stiftung is a German foundation and part of the Green political movement that has developed worldwide as a response to the traditional politics of socialism, liberalism, and conservatism. Our main tenets are ecology and sustainability, democracy and human rights, self-determination and justice. We place particular emphasis on gender democracy, meaning social emancipation and equal rights for women and men. We are also committed to equal rights for cultural and ethnic minorities. Finally, we promote non-violence and proactive peace policies. To achieve our goals, we seek strategic partnerships with others who share our values. Our namesake, Heinrich Böll, personifies the values we stand for: protection of freedom, civic courage, tolerance, open debate, and the valuation of art and culture as independent spheres of thought and action.

For further information on our programs in Pakistan please visit our website:

www.pk.boell.org

Disclaimer:

This discussion paper was prepared with the support of the Heinrich Böll Stiftung, Pakistan. The views and analysis contained in the publication are those of the authors and do not necessarily represent the views of Heinrich Böll Stiftung.

This publication is not for sale.

Infrastructure in Fragile Ecosystems: A Case of Deosai National Park, Gilgit-Baltistan, Pakistan

Discussion Paper, Publication Series "Resource Equity", 2017

Authors:	Muhammad Wasim & Fazal Karim
Contributors:	Babar Khan (PhD) & Saeed Abbas
Editor:	Saleem Khilji
Cover & Design:	Suffi Bilal
Printer:	Art Impact Printers

About the Authors

Muhammad Wasim

Muhammad Wasim did his graduation in Environmental Studies from Quaid-e-Azam University Islamabad. At present, he is working with World Wide Fund for Nature-Pakistan as a research officer. Earlier, he has worked with the Ministry of Climate Change, Islamabad, and Water and Sanitation Extension Programme Gilgit-Baltistan. He has been conducting compliance evaluation inspections, i.e. Initial Environmental Examination and Environmental Impact Assessments.

Fazal Karim

Fazal Karim did his MPhil in Natural Resource Management from University of Arid Agriculture, Rawalpindi. Currently, he works for World Wide Fund for Nature-Pakistan as a Conservation Officer. His work on nature conservation to mitigate emerging climate change issues in mountainous areas is of significance. His publication titled "Impact of climatic factors on land-use changes using geo-spatial techniques" has recently been published in "*Journal of Applied Agriculture and Biotechnology*". He has delivered lectures on mountain ecosystem, wildlife and natural resource management at Karakoram International University.

About the Contributors

Dr Babar Khan

Dr Babar Khan has a doctoral degree in Ecology from Chinese Academy of Sciences, China and a post-graduate degree in Agriculture (Soil & Environmental Sciences) from Agricultural University, Peshawar. He has been working with Food Agriculture Organization, International Union for Conservation of Nature, and World Wide Fund for Nature-Pakistan since 2002 on Natural Resource Management, Participatory Biodiversity Conservation and Protected Area Management with a focus on pasture/rangelands, climate change, high altitude wetlands, human-wildlife conflict, agro-pastoral livelihoods, mountain value chains, environmental education/awareness, and climate risk reduction. Currently, he is working for World Wide Fund for Nature-Pakistan as Director Wildlife / Head for Sindh and Balochistan region. He has published more than 50 articles, three books (authored and co-authored) and several media reports.

To his credit are: a gold medal from University of Azad Kashmir (1998); Presidential Award "Ezaz-e-Sabqat" by the Government of Pakistan (2000); Youth Green Skills Award by Aga Khan Development Network (2003) and Special Dissertation Award by Chinese Academy of Sciences (2013).

Saeed Abbas

Saeed Abbas is a PhD Research Scholar in Zoology at University of Karachi, Pakistan and the only ornithologist of Gilgit-Baltistan region with extensive research work on diversity, distribution and conservation needs of Mountain Avifauna. Saeed Abbas has been working for World Wide Fund for Nature-Pakistan since 2012 on Natural Resource Conservation and Management with a focus on snow leopard and habitat conservation, climate change, high altitude wetlands, human-wildlife conflict, improved livelihoods, environmental education/awareness, and climate risk reduction, in Gilgit-Baltistan region of Pakistan. Currently, he is serving as conservation coordinator / head for Gilgit-Baltistan region. He has to his credit 17 publications and several media reports.

Acknowledgement

The authors are pleased to thank Heinrich Böll Stiftung, Pakistan for its technical and financial support to develop the paper. The authors are also thankful to Dr Mehjabeen Abidi Habib (Government College University, Lahore) and Ms Mome Saleem (Heinrich Böll Stiftung, Pakistan) for their guidance and continued support in this regard.

We are indebted to all the respondents, including key government officials, subject experts, and community activists, for sparing their precious time in the field, and sharing their views, opinions, and suggestions with the authors.

Last but not least, we would like to thank all the staff at World Wide Fund for Nature-Pakistan, Regional Office, Gilgit-Baltistan for their support at all levels.

Table of Contents

Acronyms

ASL	Above Sea Level
DNP	Deosai National Park
EIA	Environmental Impact Assessment
GBEPA	Gilgit-Baltistan Environment Protection Agency
GBWMB	Gilgit-Baltistan Wildlife Management Board
GoGB	Government of Gilgit-Baltistan
HWF	Himalayan Wildlife Foundation
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
KNP	Kirthar National Park
NESPAK	National Engineering Services Pakistan
PC-1	Planning Commission Form number 1
PEPA	Pakistan Environment Protection Agency
PEPL	Premier Exploration Pakistan Limited
WAPDA	Water and Power Development Authority
WWF	World Wide Fund for Nature-Pakistan

Abstract

This discussion paper assesses the socio-economic and environmental hazards that may occur due to the proposed diversion of Shatung river, situated at Deosai plains of Gilgit-Baltistan, Pakistan. A plan to divert Shatung river into Satpara Dam already exists; the plan is to increase the latter's power generation capacity and to satisfy the increasing domestic, industrial and public water needs of Skardu Town and the adjacent villages during the low flow/winter season. However, no Environmental Impact Assessment (EIA) has been conducted so far. Only the locally-active environmental protection bodies have put up some resistance against this plan arguing that the diversion would primarily violate the Gilgit-Baltistan Wildlife Protection, Preservation and Management Act, 1975. During the investigation for this discussion paper, it was learnt that the diversion may result in serious damages to the ecology of the Deosai National Park (DNP) and its existing flora and fauna fed by Shatung river. Moreover, the requirements of Satpara Dam and expected outcomes of the diversion might not be achieved when the river water level decreases in winter season. If the diversion takes place, it would have serious implications for the fragile alpine ecosystem of Deosai plateau, and its biodiversity.

1. Introduction and Context

Deosai plateau, one of the most fragile alpine ecosystems in the world, is located between Skardu and Astore districts of Gilgit-Baltistan at an altitude of about 4000 meters above sea level (ASL) (Hussain et al. 2015). This remote plateau being at the confluence of three distinct mountain ranges, i.e. western Himalaya, Karakorum mountain Range (Ladakh), and Zanskar, possesses unique flora and fauna in Northern Pakistan (Woods and Kilpatrick 1997). Deosai is an area known for its significant contribution of freshwater towards the Indus river system and in this way is an important catchment area.

The plateau like a high land cold desert with sparse vegetation and harsh environmental conditions, is rich in biodiversity and serves as an alpine refuge for many species, particularly small mammals.

Biodiversity of Deosai National Park	
Large mammals	11 species
Small mammals	13 species
Reptiles	03 species
Birds	130 species
Fish	03 species
Plants	582 species

Source: Ecological baseline study of Deosai National Park (Himalayan Wildlife Foundation, 2014)

It has an abundance of marmots, the highest concentration of Chinese birch mice (Sicista concolor), and one of the two known sites of Abbott's high mountain shrew, namely Crocidura pergrisea (Woods & Kilpatrick 1997). Generally, the plateau is the abode of alpine herbs with a record number of 582 plant species (Stewart 1961), mostly of high medicinal and aromatic value. Its high altitude wetlands, i.e. Sheosar lake, Bara Pani, Kala Pani, Shatung river and other streams provide important habitats to water birds, rare fish species, small mammals, amphibians, insects, reptiles and other invertebrates (Himalayan Wildlife Foundation 2014). Apart from nomads, more than 13,000 villagers, who are settled in the park peripheries, depend directly or indirectly upon park resources for their subsistence.

Therefore, in appreciation of the social, economic and environmental significance of Deosai plateau, the Government of Gilgit-Baltistan (GoGB) in May 1993 (the then Northern Areas Administration), had notified some 3626 km^2 of the plateau as an International Union for Conservation of Nature (IUCN) Protected Area Category-I

Deosai National Park	
Established	May 1993
Location	Western Himalayas, Pakistan
Area	approx. 3000+ Km^2
Altitude	3300- 4000 m ASL
Temperature	12 °C to -20 °C
Climate	Remains snow-bound for more than half of the year
Biodiversity	Himalayan brown bear, snow leopard, Siberian ibex, golden marmot, resident and migratory birds, fish, plants and herpeto fauna

Source: Ecological baseline study of Deosai National Park (Himalayan Wildlife Foundation, 2014)

National Park[1] under Section 5 of the Northern Areas Wildlife Protection, Preservation, Conservation and Management Act, 1975 known as Gilgit-Baltistan Wildlife Act, 1975. This notification was made in response to the need to protect rare and unique biodiversity of the plateau, especially the remaining western most populations of the endangered Himalayan Brown bear (Ursus arctos) and its associated wildlife species in their natural habitats while maintaining the ecological balance of its fragile ecosystem (Hussain et al. 2015).

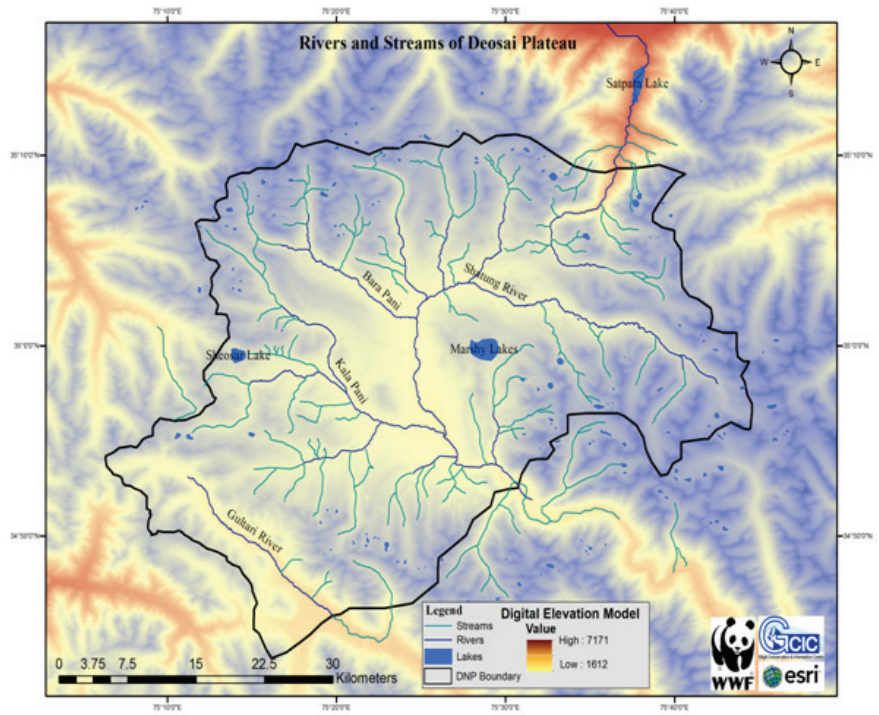
Subsequently, the Gilgit-Baltistan Forest, Wildlife and Environment Department, in collaboration with Himalayan Wildlife Foundation (HWF) and World Wide Fund for Nature-Pakistan (WWF), prepared a management plan in 2016 to maintain and regulate the ecological and biological resources of the park and to minimize the negative impact of existing as well as emerging conflicts.

Gilgit-Baltistan Wildlife Protection, Preservation and Management Act, 1975 and the rules framed there under strictly prohibit interferences that may cause disturbance to prominent wildlife species and their habitats inside a national park. Hence DNP is not an exception. Picking, plucking or damaging a flower and removing a plant, animal, bird, fish, stone, or any other natural object from the park unless granted permission for specific research objectives is strictly prohibited. Even carving or writing on any natural object is not allowed inside the park.

Moreover, the park management plan, approved by Gilgit-Baltistan Wildlife Management Board (GBWMB), had ways and means to ensure optimum care,

1 Areas that are strictly set aside to protect biodiversity and also possibly geological/ geomorphological features where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.

Map: Rivers and streams of Deosai plateau



Source: Geographical Information System Laboratory, Gilgit Conservation & Information Center, WWF-Pakistan

protection and in-situ conservation of key wild resources. It also had fixed penalties for violations, if rendered on the park premises to ensure that park resources are managed for the benefit of the park ecosystem and its beneficiary human communities. Obviously, these limitations and prohibitions are imposed to commensurate the state obligations against the international conventions and treaties[2].

In 2012, Water and Power Development Authority (WAPDA), Pakistan, with the assistance of United States Agency for International Development (USAID), completed Satpara Dam project near Skardu, Gilgit-Baltistan. The purpose was to generate electricity while alleviating downstream flooding, and increasing the supply of irrigation water for downstream Satpara Dam. WAPDA officials reported that Satpara Dam was expected to obtain half its water from the Satpara lake catchment and the other half from the water diverted from the Shatung river, a nearby watershed (USAID 2010). However, as a proper Environment Impact Assessment (EIA) was not conducted, therefore, locally active environmental organizations[3] had succeeded

2 See Convention on biodiversity, Conservational monitor system, Ramsar and United Nations Framework Convention on Climate Change

3 The World Wide Fund for Nature (WWF), International Union for Conservation of Nature (IUCN), and the Himalayan Wildlife Fund (HWF)

in arguing that diversion of water from the Shatung river would violate the Gilgit-Baltistan Wildlife Act (1927). WAPDA agreed to defer the diversion and study the potential environmental impact arising from the diversion, however, plan to divert the waters of the Shatung river still exists. Diverting water from the Shatung river to Satpara Dam without a proper EIA, may have disastrous implications for the fragile alpine ecosystem of Deosai plateau, and its associated biodiversity, particularly when climate change has intensified human induced pressures on high altitude ecosystems.

This paper is therefore, an attempt to conduct a rapid assessment of social and ecological implications of diverting water from the Shatung river to Satpara Dam, particularly in the context of fast changing climatic scenarios.

2. Learning from the Past

One of the primary purposes of the designated wilderness areas is the protection of natural endowments, including but not necessarily limited to ecosystem functions and services at large (*Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act* 2014). However, direct and indirect effects of human activities, both internal and external to the wilderness, usually threaten the ecological integrity of protected public lands (Allin 1985). Accelerated research programs on 'threats to wilderness' are needed to realize the purpose for which wilderness areas were established and to improve our understanding of the natural ecological systems. Generally, ecosystems within wilderness areas are affected by a variety of water projects, including dams, river and stream diversions, infrastructure and even cloud seeding (a method to create rainfall by seeding the formation of raindrops). Dams, reservoirs, or water conveyances (ditches, canals, dykes, tunnels, and pipelines) which are built prior to the protected area are present in about 15 per cent of the designated wildernesses worldwide (Reed et al. 1989). Many such developmental works have not only brought about social and economic welfare to humans but also caused tremendous degradation to protected ecosystems and biodiversity (Kingsford 2000).

Life on land and in the lakes, rivers, and other aquatic habitats on the earth is vitally dependent on freshwater - a resource that comprises only a tiny fraction (0.3 per cent) of the global water pool (Robert et al. 2001). Humans rely on freshwater resources for drinking, irrigation, hydropower generation and industrial use as well as production of fish and waterfowl, transportation, recreation, and waste disposal (Rosenberg, Mc Cully and Pringle 2000). The land and water development projects worldwide have brought about tremendous social and economic benefits to the mankind on the one hand, and on the other led to decline in ecological integrity and biodiversity (Wilson & Carpenter 1999).

The practice of diverting rivers particularly for hydroelectricity generation is relatively new. Many of its hazards are neither well understood, nor are they well considered during the planning of diversion works (Anderson, Freeman, Pringle 2016). However, in some cases, development impact simply cannot be mitigated. The wisest approach is to leave a wilderness un-altered through strategic planning to protect sensitive species and ecosystems.

Generally, major water diversions are detrimental to water systems within rivers and streams. Accelerated soil erosion and slope failure often affect water quality and physical conditions of the stream or river as well as native fish populations. In most of these areas, dams are built at existing lakes to raise water level and control the run-off timings. However, mainstream dams generally alter the temperature, sediment load, and the flow regime of rivers and streams they impound. Small diversion structures, such as dams, dikes, weirs, and locks are known to upset the ecological balance of an area far out of proportion to the size of the diversion structure (Blaham 1976).

Canter (1985) summarized the impact of infrastructure development on the surrounding environment of a project such as building of a dam/reservoir. According to him land use by the construction teams results in environmental degradation and air, water and soil pollution. Such projects also impact water flow causing extreme floods or accidents like dam break, or anaerobic water conditions in reservoirs or Hydrogen Sulphide fish kill during and after reservoir filling. Land use, population density, and the socio-economic structure around a new reservoir or development project in the long run also damage the environment.

3. Why an EIA?

The intent of an EIA study is to identify the environmental issues expected to arise during construction and operation of the project. It also aims at preparing mitigation program to manage and minimize environmental effects and maximize secondary benefits (Ortolano & Shepherd 1995). An EIA seeks to compare various alternatives available for the project to incorporate the mitigation of environmental impacts into the design of the project at planning stage (Shepherd & Bowler 1997).

Pakistan Environmental Protection Act, 1997 has made EIA mandatory for all developmental projects, which in terms of its cost qualify for an EIA under the Schedule of "Review of IEE and EIA"[4] Regulations, 2000 (Pakistan Environmental Protection Agency 1997). For instance, in the case of Kirthar National Park (Box 1) where in July 1997, a government move to allow oil and gas exploration activities inside the park sparked a major controversy and debate, and ultimately a court of law ordered to stop the oil exploration activities in the park (Khan & Khan 2004).

Another somehow similar case (Box 2) is of the New Murree City Project launched by the Punjab Government in Murree, Pakistan in 2005 (International Union for Conservation of Nature 2005).

A similar plan (Box 3) to divert water of the Shatung river from DNP to Satpara dam exists. Shatung is a natural watercourse inside DNP, which originates from its southern catchments and flows across DNP to Shingo Shigar river after joining Bara Pani, Kala Pani and several other small and medium streams inside the park. A dedicated EIA is mandatory for any such initiative under the Pakistan Environmental Protection Agency Act (1997) extended to Gilgit-Baltistan in 2001 and the Gilgit-Baltistan Environmental Protection Act (2014) endorsed by the GoGB in 2017.

4 contains lists of projects that require an initial environmental examination (IEE) and environmental impact assessment (EIA)

Box 1: Oil Exploration in Kirthar National Park (KNP)

Situated 80 km north of Karachi, Kirthar National Park (KNP) was declared a wildlife sanctuary on October 28, 1972 and was eventually declared a national park on January 31, 1974. In a surprising move in July 1997, the Government of Pakistan, through the Ministry of Petroleum and Natural Resources, awarded a license to Premier Exploration Pakistan Limited (PEPL) for exploration activities at Dunbar Block, a region which falls within the precincts of the park despite the fact that mining activities were strictly prohibited in any national park under the Sindh Wildlife Protection Ordinance framed in 1972. Ultimately, the Sindh Wildlife Department opposed the move pleading that oil and gas exploration activities in the protected area would endanger the habitat of a variety of animals, birds and reptiles for which the park is a safe haven. Besides, wildlife, historical monuments like the Rannikot Fort and the tombs at Taung - each being several hundred years old - are situated inside the park. Taking into consideration the WWF proposal to conduct a biodiversity study before the EIA is conducted, the government ordered to conduct an EIA by an independent consultant group. It stipulated that until then no activity would be carried out. It further said that based on the EIA recommendations, the possibility of change in the park's protected area status will be considered (Khan & Khan 2004).

Box 2: New Murree City Project

Located at the highest point in the Punjab Province (2,223 m), New Murree city project was envisaged to be a tourist city of international standard. It was expected to spread over an area of 4,111 acres (about 16 square kilometers) at Patriata ranging in elevation between 2,000m to 2,200m ASL. Its area included 3,849 acres of the Murree Forest Division and 262 acres of Rawalpindi (North) Forest Division. According to a National Engineering Services Pakistan (NESPAK) report, there were about 146,000 trees in the forest of the project area and the proposed plan had to account for removing five to eight per cent of these trees (a total number of 11,680). Tree removal would be site specific with the provision to modify building layouts for minimizing tree felling. But, given the record of enforcing such bans and quotas in the past, a wider damage to these prime forests could not be ruled out (International Union for Conservation of Nature 2005). On July 31, 2007, the Supreme Court of Pakistan ordered an end to the project, which was termed a manmade disaster for the entire Murree forest range.

Box 3: Shatung River Diversion Project Plan

Location:	Deosai National Park (~4000m ASL)
Weir and Intake:	OGEE type 151 ft. long and 270 ft. wide
Closure Dyke:	750 ft. long
Approach Tunnel:	2000 ft. and cross section of 7ft. X 7 ft.
Tunnel Inlet portal:	includes excavation, backfill, concrete works, various types of rock support and shotcrete
Tunnel:	a horseshoe concrete lined tunnel with 6 ft. and 7 inches radius having capacity of 3 cumec flow with a total length of 6483 meter will be constructed
Tunnel Outlet Portal:	includes excavation, backfill, stone pitching for surface protection and drains, rock support and shotcrete
Miscellaneous Works:	drilling, grouting, drainage wells & cutoff walls, roadway sand bridges and instruments and other mitigation cost

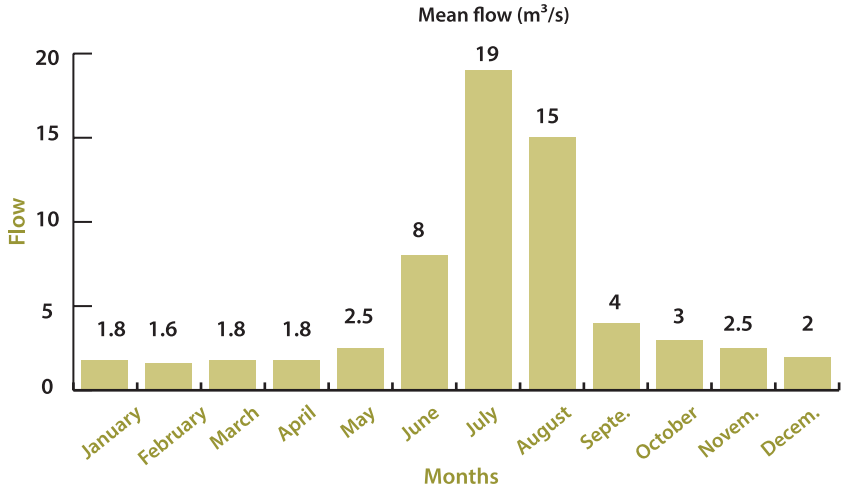
Source: Planning Commission Form number 1 (PC-1) Shatung nullah diversion project, 2014

4. The Ecological Cost of Proposed Diversion

Deosai is an externally drained low relief plateau with widespread summit regions that form a significant part of the Indus river catchment. On the park premises, there are a number of important wetlands in the form of rivers, lakes, marshlands, peatlands and streams that are particularly significant from the perspective of aquatic habitats and ecotourism. These include Shatung river, Kala Pani and Bara Pani alongside several lakes and streams.

Like other snow-fed highland streams, the Shatung river water level starts rising by the mid of April when temperature in the catchment area rises enough to accelerate glacier melting. Generally, July is the month of peak flows. In August, water levels in the Shatung start falling rapidly. From September to November, the flow gradually goes on declining while December to March is the period of very low flows (Exhibit 1).

Exhibit 1: Mean monthly extended flow of Shatung river

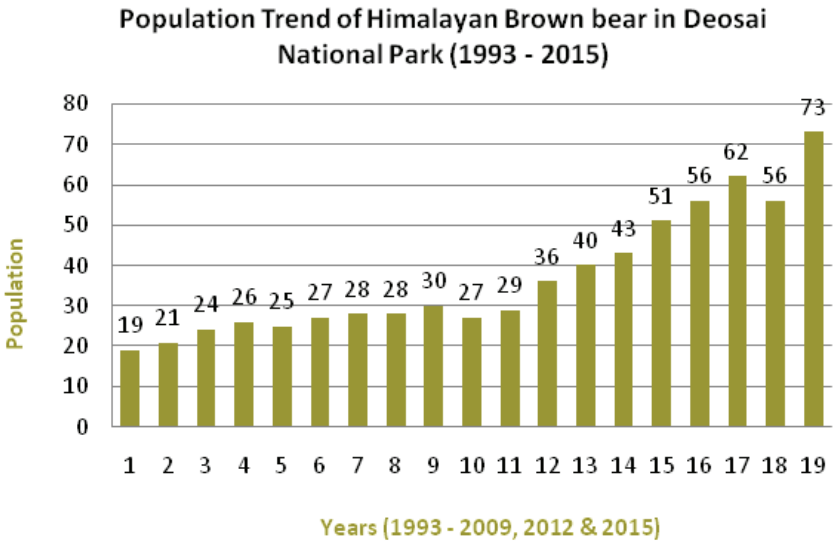


Source: PC-1 of Shatung nullah diversion project, 2014

These cold waters are home to a huge number of rare fish fauna belonging to three species, viz. Tibetan Stone Loach (Triplophysa stoliczkae), Tibetan Snow Trout (Diptychus maculatus), and Indus Snow Trout (Ptychobarbus conirostris). They offer more than six per cent of the vertebrate diet for the endangered Himalayan Brown bears. These fish species are highly adaptable to the cold waters of the plateau where they breed (Kok et al. 2005).

Deosai also hosts a variety of invertebrate and vertebrate fauna; documented fauna includes 11 species of large mammals, 13 small mammals, 130 birds, three freshwater fish, one amphibian and two reptiles (Nawaz et al. 2006). Deosai has been recognized as the main stronghold of Himalayan Brown bears (Exhibit 2), as almost one bear is found in every 31.25 km^2 area of the park (Schaller & Roberts 1997).

Exhibit 2: Brown bear population in Deosai National Park (past 2+ decades)



Source: Ecological baseline study of Deosai National Park (Himalayan Wildlife Foundation, 2014)

During interviews with stakeholders, for the preparation of this discussion paper, a majority perceived that the intended diversion of the Shatung river may alter the fragile alpine ecosystem of DNP. Such a diversion of the Shatung river would contravene the existing park rules enforced under the Gilgit-Baltistan Wildlife Act 1975.

Preliminary discussions raised concerns that a project to divert river water will entail excavation and drilling, which may bring about unusual changes in the topography of the area, and result in the destruction of vegetation cover. Project works would lead to trigger soil erosion thus resulting in deterioration of water quality downstream from the increased sediment load and flow restrictions during winter.

Water quality degradation may adversely impact the health of aquatic ecosystem and its associated biota, including fish and invertebrates. Fish fauna and invertebrates may also be affected both up and downstream the Shatung river due to changes in food resources availability.

Discussants were of the view that the quantity of non-biodegradable waste generated may be the one outcome of a labor workforce to impact this ecosystem. Additionally, spillage of oils and lubricants into the freshwater courses during the construction phase may contaminate freshwater streams.

Some argue that as the proposed Shatung river diversion site is elevated (i.e. at an altitude of 4000m ASL), water may freeze even before the onset of winter ceasing almost any water flow which is already very low in volumes when it reaches downstream (<2 m^3/sec). These arguments suggest that the technical reasons for creating enhanced water flow from the Shatung river into downstream water courses may be seriously flawed, and merit careful scrutiny and debate.

5. Conclusion and Recommendations

An intended diversion of the Shatung river is a critical issue, which requires thinking out of the box to reach an acceptable solution. The DNP is an important national asset with services rendered for the whole of the water systems of Pakistan. There is a growing concern that the intended diversion may cause irreversible environmental changes in the fragile alpine ecosystem of this protected area.

The diversion may impact the abundance and diversity of biophysical conditions, and can cause disruption to the resident and migratory fish species during and post construction activities. Freezing and thawing effects will lead to increase in erosion and sedimentation in the proposed water channels and tunnels due to the formation of ice and snow melting in the winter season. Furthermore, as the volume of water declines in the autumn and dwindles to very little in the winter, any expected augmentation of downstream water and power development is highly questionable and merit further scrutiny and debate.

Keeping in view the ecological sensitivity, legal considerations and international environmental obligations concerning DNP, it is imperative to take adequate measures to explore more appropriate sites.

Alternate sites for water diversion should be sought that are legally and technically feasible, socially acceptable, economically viable, and environmentally suitable. Technical studies and stakeholders' scrutiny are important components to explore alternate options to meet the desired objectives while addressing downstream needs of Skardu town in connection with protecting the park. The diversion of the Shatung river is not the only option to meet energy and water needs; it is our collective responsibility to explore other feasible sites for this purpose.

References

Allin, CW 1985, 'Hidden agendas in wilderness management', *Parks & Recreation*, USA, vol. 20, no.5, pp. 62-65.

Anderson, EP, Freeman, MC & Pringle, CM 2006, 'Ecological consequences of hydropower development in Central America: impacts of small dams and water diversion on Neotropical stream fish assemblages', *River Research and Applications*, vol. 22, no. 4, pp. 397-411, viewed 02 August 2017, http://onlinelibrary.wiley.com/doi/10.1002/rra.899/full

Blaham, TH 1976, 'Effects of Water Diversions on Fishery Resources of the West Coast, Particularly the Pacific Northwest', *Marine Fisheries Review*, pp. 46-50, viewed 02 August 2017, http://spo.nmfs.noaa.gov/mfr3811/mfr38117.pdf

Canter, LW 1985, Environmental Impact of Water Resources Projects, Lewis Publications, Chelsea, Michigan.

Gilgit-Baltistan Environmental Protection Act, 2014, Environmental Protection Agency, Government of Gilgit-Baltistan, Gilgit.

Gilgit-Baltistan Forest, Wildlife and Environment Department 2016, Report on autumn seasonal wildlife survey in Deosai National Park, Directorate of DNP, Skardu.

Himalayan Wildlife Foundation 2014, Ecological baseline of Deosai National Park (draft report), HWF, Islamabad, Pakistan.

Hussain, Z, Mirza, SN, Ashraf, MI, & Nizami, SM 2015, 'Grassland Productivity and Carrying Capacity of Deosai National Park, Gilgit-Baltistan, Pakistan', *Journal of Agricultural Research*, vol. 53, no.3, viewed 02 August 2017, http://apply.jar.punjab.gov.pk/upload/1456204265_119_13._Paper_No._286.pdf

International Union of Conservation of Nature 2005, Rapid Environmental Appraisal of Developments in and around Murree hills, IUCN, Pakistan, viewed 02 Aug 2017, www.iucn.pk/pdf/new_murree_report.pdf

Jackson, RB, Carpenter, SR, Dahm, CN, McKnight, DM, Naiman, RJ, Postel, SL and Steven WR 2001, 'Water in Changing World', *Issues in Ecology*, Spring 2001, viewed 20 August 2017, https://www.esa.org/esa/wp-content/uploads/2013/03/issue9.pdf

Khan, A & Khan, R 2004, Drivers of Change Pakistan: Civil society and social change in Pakistan, Institute of Development Studies, University of Sussex, UK, Viewed 02 August 2017, http://www.researchcollective.org/Documents/Civil_Society_And_Social_Change_In_Pakistan.pdf

Khan, AA and Rajput RA 1998, The biodiversity of the Deosai plateau, Baltistan, Northern Areas, Pakistan, pp.180-197, in Irmtraud Stellrecht (ed.), Karakoram-Hindu Kush-Himalaya: Dynamics of Change (Part-I), Culture Area Karakoram Scientific Studies, 4.

Kingsford, RT 2000, 'Ecological impacts of dams, water diversions and river management on floodplain wetlands in Australia', *Austral Ecology*, vol. 25, no. 2, pp.109-127, viewed 02 August 2017, http://onlinelibrary.wiley.com/doi/10.1046/j.1442-9993.2000.01036.x/full

Kok, OB, Haddad, CR, Van Niekerk, DJ, Butler, HJB & Nawaz, MA 2005, 'Invertebrates as a Potential Food Source of Brown Bears on the Deosai Plateau, Northern Pakistan', *Pakistan Journal of Biological Sciences*, vol. 8, no. 1, pp. 13-19, viewed 02 August 2017 https://www.researchgate.net/publication/45726929_Invertebrates_as_a_Potential_Food_Source_of_Brown_Bears_on_the_Deosai_Plateau_Northern_Pakistan

Nawaz, MA, Shah, M, and Zakaria, V 2006, 'Environmental Baseline of Deosai National Park' (draft report), Himalayan Wildlife Foundation, Islamabad.

Northern Areas Wildlife Protection, Preservation, Conservation and Management Act, 1975, Forest, Wildlife and Environment Department, Government of Gilgit-Baltistan, Gilgit

Ortolano, L & Shepherd, A 1995, 'Environmental impact assessment: challenges and opportunities', *Impact Assessment,* vol. 13, no. 1, pp. 3-30.

Pakistan Environmental Protection Act 1997, *The Gazette of Pakistan*, Islamabad

Pakistan Environmental Protection Agency 2002, Initial Environmental Examination Report, Satpara Dam project, PEPA, Islamabad.

Reed, P, Haas, G, Beum, F and Shcrrick, L 1989, Non-Recreational Uses of the National Wilderness Preservation System: a 1988 telephone survey. pp. 220-228, Wilderness benchmark 1988: proceedings of the national wilderness colloquium. U.S. Forest Service General Technical Report, viewed 02 August 2017, https://www.srs.fs.usda.gov/pubs/gtr/gtr_se051.pdf

Roberts, JT 1997, 'The Mammals of Pakistan', Oxford University Press, New York

Rosenberg, DM, Mc Cully, P & Pringle, CM 2000, 'Global-scale environmental effects of hydrological alterations: introduction', *Bioscience*, vol. 50, no. 9, pp. 746-751

Schaller, GB, 1997, 'Mountain Monarchs, Wild sheep and goats of the Himalaya', The University of Chicago Press, Chicago, Illinois, USA

Shepherd, A & Bowler, C 1997, 'Beyond the requirements: improving public participation in EIA', *Journal of Environmental Planning and Management*, vol. 40, no. 6, pp. 725-738

Stewart, RR 1961, 'The Flora of The Deosai Plains', *The Pakistan Journal of Forestry*, vol. 9, no. 3, pp 225-295, viewed 20 August 2017, http://pahar.in/wpfb-file/1961-flora-of-the-deosai-plains-by-stewart-s-pdf/

United States Agency for International Development 2010, Satpara Development Project Evaluation, USAID, viewed 20 August 2017, pdf.usaid.gov/pdf_docs/PA00M2Z4.pdf

Virk, AT, Sheikh, KM, & Marwat, AH 2003, Northern Areas strategy for sustainable development, IUCN, Pakistan, viewed 02 August 2017, https://cmsdata.iucn.org/downloads/nassd_strategy.pdf

Wilson, MA & Carpenter, SR 1999, 'Economic valuation of freshwater ecosystem services in the United States: 1971–1997', *Ecological Applications,* vol. 9, no. 3, pp. 772-783, viewed 02 August 2017, http://onlinelibrary.wiley.com/doi/10.1890/1051-0761(1999)009%5B0772:EVOFES%5D2.0.CO;2/full

Wilderness Areas, Ecological Reserves, Natural Areas and Heritage Rangelands Act 2014, Alberta Queen's Printer, Canada.

Woods, CA and Kilpatrick, WC 1997, 'Biodiversity of Small Mammals in Mountains of Pakistan', pp. 437–467, in SA Mufti, CA Woods and SA Hasan (eds), *Biodiversity of Pakistan,* Pakistan Museum of Natural History, Islamabad, Pakistan, and Florida Museum of Natural History, Gainesville, Florida, USA.

World Wide Fund for Nature-Pakistan 2016, Management Plan for Deosai National Park, Gilgit-Baltistan, WWF, Gilgit, Pakistan.