

# ECONOMIC VALUATION OF ECOSYSTEM SERVICES OF QURUMBER NATIONAL PARK IN GILGIT-BALTISTAN, PAKISTAN

Amjad Ali<sup>1\*</sup>, Arshad Ali Shedayi<sup>2</sup>, Haider Raza<sup>3</sup>, Ejaz Hussain<sup>4</sup> and Syed Asar ul Hasnain<sup>4</sup>

\*Corresponding author [amjad.eco@kiu.edu.pk](mailto:amjad.eco@kiu.edu.pk)

<sup>1</sup>Department of Development Studies, Karakoram International University, Gilgit-Baltistan, Pakistan

<sup>2</sup>Department of Plant Sciences, Karakoram International University, Gilgit-Baltistan, Pakistan

<sup>3</sup>WWF Pakistan, Gilgit-Baltistan, Pakistan

<sup>4</sup>WWF Gilgit Office, Pakistan

## ABSTRACT

Communities in high-altitude regions are particularly dependent on ecosystem services for their survival. Understanding the economic value of ecosystem services is crucial for sustainable management of mountain ecosystems and associated policy development. This study estimated the economic value of selected ecosystem services provided by the Qurumber National Park (QNP) using data collected from 393 local households. This value was estimated as PKR 738.37 million (US\$ 4.28 million<sup>1</sup>) per year, corresponding to PKR 615,308 (US\$ 3569<sup>1</sup>) per household per year. Provisioning services contributed PKR 706.828 million (US\$ 4.01 million<sup>1</sup>) per year which constituted 96 per cent of the ecosystem service value. This study argues that given the lack of economic opportunities and high poverty rate in the valley communities, pressure on the park's resources is increasing, resulting in depletion of important ecosystem services in the park, thereby posing a key challenge for conservation efforts. This study recommends a need to better recognise the ecosystem services provided by the park in policy decisions. An efficient institutional mechanism should be developed to provide alternative livelihood options for the local community to minimise pressure on the park's natural resources. The findings of this study serve as baseline information for both researchers and policymakers to maintain this vitally important mountain national park.

**Key words:** high altitude park, value assessment, local development, conservation, livelihoods

## INTRODUCTION

Ecosystem services are benefits which humans can derive from the natural ecosystems for their physical, social and economic well-being (Millennium Ecosystem Assessment, 2005). This concept was originally developed to raise awareness for ecosystem and biodiversity conservation (Birkhofer et al., 2015). Ecosystem services are classified into four categories: provisioning services, regulating services, cultural services and supporting services. Provisioning services include material outputs from ecosystems such as water, food and other resources. Regulating services include benefits arising from the abiotic and ambient biotic environment such as disease control, flood control and climate regulation. Cultural services include non-material uses such as recreational activities and cultural benefits, while supporting services include the nutrient cycling that maintains the conditions for life on Earth (Millennium Ecosystem Assessment, 2005).

In high-altitude regions, ecosystem services and biodiversity are under-researched in terms of their ecological relationships and the benefits they offer to both mountain and downstream communities (Murali et al., 2017), and to eco-tourists. In recent times, development activities in these landscapes have caused significant environmental degradation and are threatening biodiversity. Sharma et al. (2015) argued that a lack of understanding and an inability to acknowledge the importance of the monetary value of these ecosystem services and their contribution to local economies are major factors that hamper more sustainable management of such areas. Valuation of such mountain ecosystem services could provide data to support better management (Huang & Upadhyaya, 2007; TEEB, 2009), and enhance decision making directed towards conservation of related ecosystems (Bateman et al., 2010; Kumar, 2005; Pearce, 2001). Such evaluations



Last village in the Qurumber valley © EJAZ WWF-Pakistan

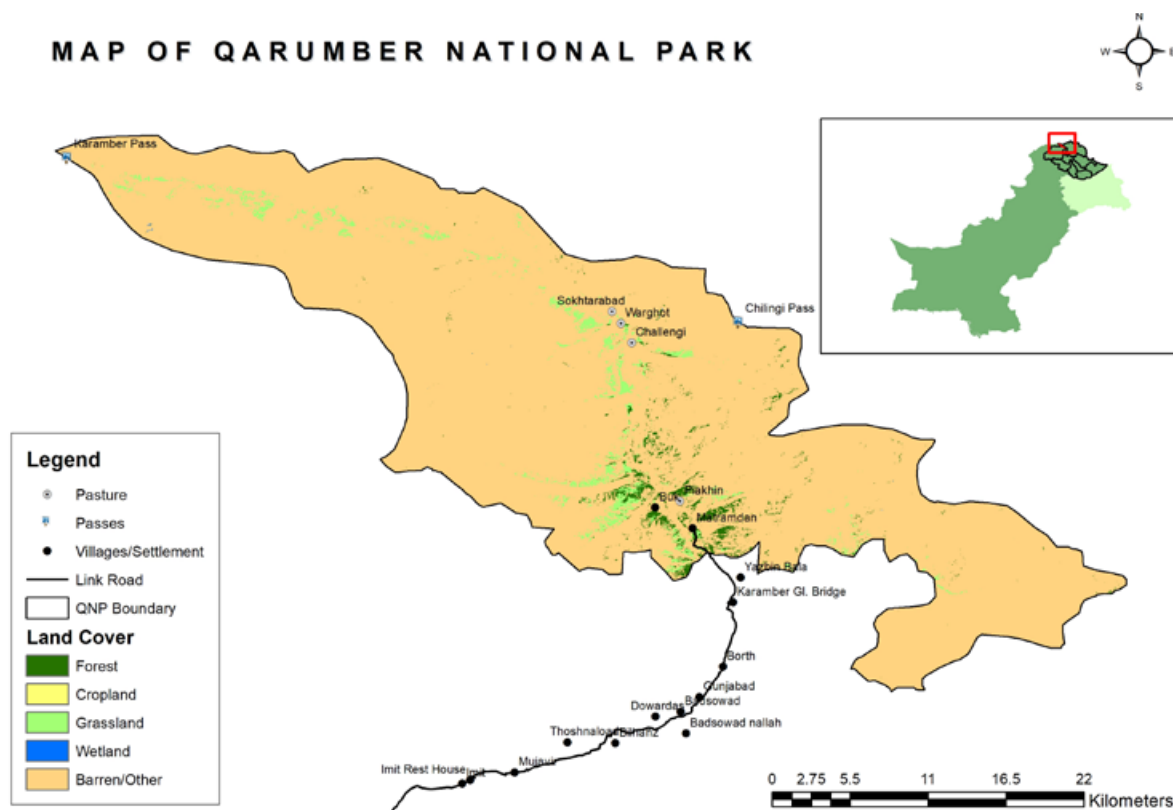
can enable managers to assess potential trade-offs among ecosystem services (Shedayi et al., 2022; Schroder et al., 2016) and identify efficient allocation of the resources associated with protected areas (Pisani et al., 2021).

Mountain regions in Pakistan contain unique ecosystems and species, landscape features such as glaciers, and important natural resources such as water, pastures and forests. As such, they are a major source of ecosystem services upon which millions of people depend. The mountainous region of Gilgit-Baltistan in northern Pakistan presents a good example of such endowments and dependencies. However, with rapid socioeconomic development, and climate change, pressure on ecological resources is increasing. Developments in the region are generating significant economic benefits, but at the same time contributing to adverse impacts on mountain ecosystems and biodiversity. Ensuring adequate consideration of such environmental impacts is therefore of increasing importance. In this context, adopting an environmentally sensitive development perspective has the potential to provide sustainable livelihoods to the local community and in the long run conserve natural resources and landscapes.

National parks play a significant role in conservation, and if they are properly managed can also generate significant earnings to governments and local communities. The economic valuation of protected areas is currently receiving considerable attention from policymakers and park managers, as such information can assist with the

identification and design of funding mechanisms and the provision of sustainable recreation opportunities to tourists (Pisani et al., 2021). However, there is a dearth of valuation studies in the context of mountain regions in Pakistan, even though these regions provide important ecosystem services to both mountain and downstream communities. In such circumstances, economic valuation of protected areas can be instrumental in persuading governments to initiate efficient management mechanisms for the sustainable flow of ecosystem services. Mountain ecosystems of Gilgit-Baltistan are hot spots for international and domestic tourists, contributing significantly to the economic value of the cultural ecosystem services of Pakistan (Shedayi et al., 2022). However, current development activities in the region, increasing population and climate change pose serious threats to the provision of important mountain ecosystem services, demanding immediate attention from policymakers (Shedayi et al., 2016).

This paper estimates the economic value of ecosystem services provided by the Qurumber National Park (QNP) in Gilgit-Baltistan and provides an insight into the current dependency of local communities on the services of the national park. Results of this study will help the park authority to devise a better management plan for the conservation of the protected area's values. They could also assist the Government of Pakistan to assess the economic feasibility of an ecosystem payment mechanism designed to increase funding for the park and contribute



**Figure 1.** Map of the study area

towards improved environmental conservation efforts. The findings also serve as a starting point for considering the views of local people who directly contribute to the management of the park as well as assist with provision of enhanced recreational opportunities for domestic and international tourists. Furthermore, the findings of this study can serve as a baseline for further research into the value of ecosystem services derived from protected areas in remote mountain regions.

## METHODS

### Study area

Qarumber National Park in Ishkoman, Ghizer District of Gilgit-Baltistan, Pakistan was officially established in 2011 by the Department of Wildlife and Parks, an agency of the Government of Gilgit-Baltistan, Pakistan (Figure 1). The ecosystems of QNP are mainly high altitude deserts where annual rainfall rarely exceeds 150 mm. QNP, which covers an area of 73,800 hectares, is unusual in the sense that the local communities of Qarumber valley approached the Government of Gilgit-Baltistan urging its establishment. QNP serves to conserve the vitally important natural resources of the valley and also provides significant economic and ecological benefits to local communities. The Qarumber valley is sub-divided into many small villages and the buffer zone of QNP has approximately 1,200 households. Most of the communities

living in the buffer speak the Wakhi language, with the Khowar language also commonly spoken by local people. The main source of households' livelihoods is agro-pastoralism. Goat and sheep rearing are the dominant practices while a considerable number of households also rear cattle and yak. Table 1 indicates the areas of various land class categories in the Qarumber valley and QNP. These areas were determined from Landsat 8 OLI data of 2016. It is evident from Table 1 that 51 per cent of the valley and 66 per cent of the park are covered by snow and glaciers which are the sole sources of fresh water supply for the buffer zone communities. Soil/rocks stood second in terms of land coverage, accounting for 28 per cent of the valley and 27 per cent of the park. Grass/shrubs covered 19 per cent of the valley and 7 per cent of the park, whereas agricultural land covered only 0.8 per cent of the valley and 0.06 per cent of the park.

Across the Gilgit-Baltistan region, less than 2 per cent of the land is under cultivation and in the Qarumber valley the figure is even lower, at only 0.77 per cent. As indicated in Table 1, much of the area is covered by snow and glaciers which are the main sources of water for drinking and irrigation. Water is one of the main ecosystem services in QNP, supporting both the domestic needs of downstream communities and sustaining the productivity of crops. Qarumber valley residents grow maize, wheat, potatoes, a variety of vegetables and



Land cover class	Qurumber valley		QNP	
	Hectares	Percent	Hectares	Percent
Snow/glacier	68,413	51.216	48,704	65.826
Soil/rocks	37,978	28.431	20,290	27.423
Grasses/shrubs	25,694	19.235	4,837	6.538
Agriculture land	1,034	0.774	45	0.061
Sparse conifer	282	0.211	21	0.029
Water	100	0.075	79	0.106
Broadleaved, conifer	73	0.054	7.	0.010
Peatlands	5	0.004	5	0.007
<b>Total</b>	<b>133,578</b>	<b>100.000</b>	<b>73,989</b>	<b>100.000</b>

**Table 1:** Land cover classes in Qurumber valley and QNP

fruits such as apple, peach and cherry. These goods are primarily produced for local consumption.

### Data collection

Data for this study were collected using a survey of households conducted during October and November 2021 in all villages of the Qurumber valley. Survey design was assisted by a literature review (Din et al., 2020), two focus group discussions and six in-depth interviews with local residents and members of the village welfare organisation, as well as input from WWF-Pakistan. Thirty respondents provided feedback on a pilot version of the survey which prompted several useful amendments. The final survey is given in the supplementary online material. The survey covered 32 per cent of the total population in the study area (393 households out of 1,200). A survey team was hired from the local population (who therefore knew the local language and were aware of the cultural sensitivities of the region) for final data collection. The survey team was given one day of training before the start of the survey.

The household questionnaire, which included closed and open-ended questions, was divided into five sections. Questions in the first section related to households' socioeconomic and demographic profiles and the second section contained questions related to perceptions of the relative importance of ecosystem services provided by the park. Section three included questions related to the types of crops grown by households and the market value of each crop. Section four contained questions related to the types and quantities of fruits produced and their market prices. The final section contained questions related to the livestock owned by households and the market value of this livestock.

### Valuation method

Following guidelines in MEA (2015), this study considered provisioning and regulating services. The provisioning services of the park were evaluated using the current market price method whereas a benefit transfer method was used in the valuation of regulating services of the park. Following Sharma et al. (2015) and Din et al. (2020), the estimation of total provisioning services of the park (TVP) was made using the following equation:

$$TVP_i = \sum_{i=1}^n (HH) * (NV_i)$$

where  $i$  represents the various provisioning ecosystem services,  $HH$  is the cumulative number of households living in the buffer zone, and  $NV_i$  is the annual average benefit obtained per household.

### Valuation of provisioning services: crops

During our discussions with the local communities of the Qurumber valley, we found that the staple crops are wheat, maize, potatoes, vegetables and barley. Based on the studies of Sharma et al. (2015), Murali et al. (2017) and Din et al. (2020), the market price method was used in estimating the value of these crops:

$$\begin{aligned} & \text{Net annual crop income per household} \\ & = (\text{crop yield per household} \times \text{local price of the} \\ & \text{crop in kg}) \\ & - \text{input cost of the gross income} \end{aligned}$$

Based on the focus group discussions with the local community, we considered the input cost as 60 per cent of the gross income from crops. The above equation gives a net annual value of crops per household and this value is



Local community campaigning for protection of QNP natural resources © EJAZ WWF-Pakistan

multiplied by the total number of households (1,200) in the study area to give the total economic value of the crop.

#### **Valuation of provisioning services: fruits**

Through the focus group discussions, we identified the main fruits grown by households in the valley as apples, apricots, pears, grapes and cherries. Using the market price method, the valuation of these fruits was made using the following equation:

$$\begin{aligned} & \text{Net annual fruits income per household} \\ &= (\text{annual fruit production per household} \\ & \times \text{local price of the fruits in kg}) - \text{input cost} \end{aligned}$$

The input cost of producing these fruits was assumed to be 30 per cent of the gross value of the fruits.

#### **Valuation of fuel wood**

Qurumber National Park provides fuel wood for the community living in the buffer zone. In the household survey we asked households to report their annual consumption of fuel wood collected from the QNP. This turned out to be 40 kg per household. The valuation of this fuel was then estimated using the following equation:

$$\begin{aligned} & \text{Net annual value of fuel wood per household} \\ &= (\text{annual fuel wood consumed per household} \\ & \times \text{local price of the fuel in kg}) \end{aligned}$$

Owing to the prevailing high unemployment rate (observed during the focus group discussions with the local community), the opportunity cost of time for labour in the collection of fuel was taken to be zero.

#### **Valuation of domestic water consumption**

Much of the QNP is covered by snow and glaciers which are the sole sources of freshwater for the inhabitants living in the buffer zone of the park. In this study, we used minimum per capita water consumption (WHO, 2013) and multiplied it by the local price of water (Murali et al., 2017) to estimate the total value of water per household.

#### **Valuation of cultural ecosystem services: trophy hunting**

Communities living in the buffer zone of QNP have successfully established conservation practices where open hunting is not allowed. The valley has a good population of Himalayan Ibex (*Capra sibirica hemalayanus*) and a trophy hunting programme has been successfully practised in the region. We collected data from the conservation organisation of the Qurumber valley regarding revenue generated from the trophy hunting programme. Annually, an average of four to five permits are granted to hunters, and annually around PKR 0.7-0.8 million are earned from the trophy hunting programmes. This study calculated the net earnings from trophy hunting by subtracting the management fee (20 per cent of the gross income). The net revenues go directly to civic development of the valley.

#### **Valuation of regulating services: carbon sequestration**

The carbon sequestration index (CSI) measures the potential of vegetation at a particular site to sequester carbon in comparison to the total emissions at that site. If the value of CSI is less than one, then the area is considered a carbon emitter, whereas if the value of CSI is greater than one, the site is considered a carbon sequester

(Wahyudi & Afdal, 2019). Din et al. (2020) estimated the value of carbon sequestration for QNP using the benefit transfer method. They calculated the annual value of carbon sequestration using the following equation:

$$\begin{aligned} & \text{Annual Value of Carbon Sequestration} \\ &= \text{area under cultivation and grassland} \\ & \times \text{corresponding carbon sequestration index} \times \\ & \text{per unit price of CSI} \end{aligned}$$

This study used the carbon sequestration result estimated by Din et al. (2020).

## DATA ANALYSIS AND RESULTS

### Villages sampled

This study surveyed ten villages in the Qurumber valley using the systematic random sampling technique. During our focus group discussion and personal interviews with the local community, it was established that Qurumber valley has a population of around 1,200 households. In order to obtain a representative sample, we sought responses from 400 households. However, seven questionnaires were not properly completed and we thus obtained 393 valid responses, representing 32 per cent of the total population of the Qurumber valley. The distribution of the sample is shown in Table 2.

**Table 2:** Sampled villages in Qurumber valley

Village	No. of responses	Percent
Badswat	40	10.2
Bilhanz	62	15.8
Borth	11	2.8
Lower Gishgish	42	10.7
Immit	147	37.4
Matramdan	12	3.0
Nowbahar	6	1.5
Shamshabad	18	4.6
Tashnalot	36	9.2
Upper Gishgish	19	4.8
<b>Total</b>	<b>393</b>	<b>100.0</b>

### Perceived importance of ecosystem services

QNP provides significant ecosystem services for the local community living in the buffer zone. In the household survey, we asked respondents about the importance of various provisioning, regulating and cultural services

provided by the park. Responses were rated for importance on a scale as indicated in Table 3.

Table 3 shows that 80 per cent of the respondents considered the pastures of QNP to be important in terms of providing fodder for livestock. The most important provisioning service was water (100%) followed by wildlife (93%) and energy resources (92%). Respondents rated flood prevention (93%) as the most valued regulating service, followed by climate regulation (92%), water regulation (92%) and carbon sequestration (90%). Tourism and recreational services were considered important by all respondents with knowledge generation (94%) also regarded as important by most people.

### Economic valuation of provisioning services

Local communities living in the Qurumber valley get direct as well as indirect benefits from QNP. Table 4 shows the estimated economic value of provisioning ecosystem services of the QNP at both household and aggregated levels. The total economic value of the provisioning services of the Qurumber valley was estimated to be PKR 706.828 million per year which translates into PKR 0.589 million per household per year. Provisioning services contribute approximately 96 per cent of the total economic value with the most important of these being livestock, domestic water use, fuel wood and livestock production.

### Agriculture products (crops and fruits)

The net annual value of crops was estimated to be PKR 0.0272 million per household per year after deducting input costs which were assumed to be 60 per cent of their gross value. Similarly, the annual net value of fruits was estimated to be PKR 0.0037 million (PKR 3,700) per household per year after subtracting input costs which were assumed to be 30 per cent of their gross annual value. The shares of crops and fruits in the total value of provisioning services were 4.6 per cent and 0.6 per cent respectively (Table 4).

### Livestock

Livestock rearing is the major source of livelihood in this remote mountain region in Pakistan. While focus group discussions revealed that livestock rearing is declining, a significant number of households still follow this traditional practice. Yak, cows, goats and sheep are the most commonly kept livestock in the valley. In the household survey, respondents were asked about the number of livestock they kept. The average herd size was ten animals per household. This livestock is heavily dependent on fodder from grasslands in the buffer zone. The total economic value of livestock was estimated to be

**Table 3.** Community perceptions regarding importance of ecosystem services

Types of ecosystem services		Percentage of responses				Sum (3+4)
		Not important	Moderately important	Important (3)	Very important (4)	
Provisioning Services	Fodder	14.2	5.1	13.0	67.2	80.2
	Energy resources	0.0	8.4	20.5	71.2	91.7
	Medicinal plants	7.6	1.5	28.0	62.3	90.3
	Raw materials	7.4	3.3	28.5	60.8	89.3
	Genetic resources	4.6	9.2	31.0	55.9	86.9
	Water	0.0	0.0	24.7	75.3	100.0
	Wildlife	5.9	1.5	25.0	67.7	92.7
Regulating Services	Flood prevention	5.3	1.5	24.7	68.0	92.7
	Carbon Sequestration	6.1	3.6	35.6	54.7	90.3
	Climate regulation	5.9	1.8	37.0	55.2	92.2
	Water regulation	5.9	1.8	39.0	53.2	92.2
Cultural Services	Knowledge generation	5.1	1.8	40.0	53.7	93.7
	Educational value	6.9	8.0	23.7	61.1	84.8
	Culture	7.6	3.6	38.0	50.6	88.6
	Aesthetic value	8.1	13.0	29.3	50.1	79.4
	Tourism and recreation	0.0	0.0	37.0	63.0	100.0
	Mental health benefits	7.4	3.8	36.0	53.2	89.2

**Table 4.** Valuation of ecosystem services of QNP

Services of QNP	Total value (million PKR)	US\$ <sup>1</sup> (million)	Average value (million PKR/household/year)	Percent
<b>Provisioning services</b>				
Crops	32.68	0.19	0.0272	4.6
Fruits	4.43	0.03	0.0037	0.6
Fuel wood	178.56	1.04	0.1488	25.3
Domestic water use	341.64	1.98	0.2847	48.3
Livestock	149.52	0.87	0.1246	21.2
<i>Provisioning subtotal</i>	<i>706.83</i>	<i>4.10</i>	<i>0.589</i>	<i>100</i>
<b>Cultural service (trophy hunting)</b>	<b>0.6</b>	<b>0.00</b>	<b>0.005</b>	
<b>Regulating service (carbon sequestration)</b>	<b>30.94</b>	<b>0.18</b>	<b>0.0258</b>	
<b>Aggregated ecosystem service value</b>	<b>738.37</b>	<b>4.28</b>		





Migratory birds at Qurumber river © EJAZ WWF-Pakistan

PKR 149.52 million per year which translates into PKR 0.125 million per household per year, with the share of livestock in total provisioning services at 21 per cent.

### **Fuel wood**

Households in the buffer zone use wood as an energy source and QNP directly provides much of this fuel wood. We estimated the total annual value of fuel wood in the valley to be PKR 178.56 million per year which translated into 0.1488 million per household per year. The share of fuel wood in the total value of provisioning services was 25 per cent.

### **Domestic water consumption**

Communities living in the buffer zone of QNP depend heavily on the water resources originating from the park. Three major glaciers are located within the park and glacier melt is the primary water source for domestic consumption. The estimated total economic value of domestic water consumption in the valley is PKR 341.64

million per year, equivalent to PKR 0.2847 million per household per year. Domestic water consumption was the most significant component of provisioning ecosystem service value at 48 per cent.

### **Cultural service**

A trophy hunting programme is being successfully implemented in the Qurumber valley. In 2021 five permits were granted for the hunting of Himalayan Ibex, with an average price per animal of approximately PKR 150,000. The regional government charges 20 per cent of the income as a management fee, with the remaining 80 per cent going directly to the local community conservation organisation. This income is used for various civic purposes in the valley. This study estimated that the annual total income earned from trophy hunting is PKR 0.6 million which translates to PKR 500 per household per year.



## Regulatory service

The total value of carbon sequestration for the QNP was obtained from the study of Din et al. (2020). The total value was estimated to be PKR 30.94 million per year which translates to PKR 25,785 per household per year in the valley.

## Economic value of QNP ecosystem services

The economic value of ecosystem services associated with QNP was estimated to be PKR 738.37 million per year which translates to PKR 615,308 per household per year in the valley. The contribution of provisioning services was estimated to be PKR 706.828 million per year which is approximately 96 per cent of the economic value of the QNP ecosystem services and each household in the buffer zone receives PKR 589,023 per year. Cultural services contribute PKR 500 per household per year which is 0.08 per cent of the ecosystem service value. The contribution of regulating ecosystem services was estimated to be PKR 25,785 per household per year which accounted for approximately 4 per cent of the QNP ecosystem service value.

## Limitation of the economic estimates

Due to the lack of current and historical data, the economic values of two important services of the park could not be estimated: tourism and timber. The values obtained in this study therefore should be counted as the minimum value of QNP ecosystem services. It is hoped that future research might remedy this shortcoming.

## Local community perceptions of QNP

Local communities in the buffer zone are increasingly being accepted as partners in the effort towards sustainable management of natural resources. Such community-based conservation is based on the notion that conservation strategies should include local communities in decision-making, and conservation should be of interest to, and conducted by and for local communities, who are then active partners in protected area management (Zhang et al., 2020). It follows that conservation based on the local community achieves its goals by: (i) allowing local communities to live in and around the protected area to ensure their participation in land use management decisions; (ii) ensuring local community access and use rights over a protected area's natural resources; and (iii) ensuring economic benefits from conservation actions flow to the local communities (Nilsson et al., 2016). It has been widely accepted and reported that community-based conservation programmes have multiple benefits for local communities (Bajracharya et al., 2006). Decreased poaching and provision of direct economic

benefits through activities such as trophy hunting and game shooting have been shown to accrue from such programmes (Di Minin et al., 2021).

Given the potential for additional income generation for local communities, further promotion of trophy hunting in the QNP needs to be considered. Currently, the price per trophy hunt is around PKR 150,000 to PKR 200,000 per license, and important local income is earned from this sport. While discussing the income from trophy hunting, one of the focus group participants noted:

*“Conservation of wildlife is really a great concept and we have conserved our previous wildlife through a community-based conservation model. Annually, we earned around PKR 400,000-500,000 from the trophy hunting programme and these earnings go directly to the development programmes of the valley.”*

During one of our focus group discussions, a 60-year-old male participant noted that:

*“We, the people of Qurumber valley, had ourselves demanded the establishment of QNP and our case is unique because local people have themselves realised the importance of protected area and conservation efforts and thus, we had requested government for the establishment of QNP because it will have multiple benefits to our generation in terms of conservation of our precious assets and provision of economic opportunities to local communities.”*

Since QNP was mainly established on the demand of the local community, the local community foresee many potential benefits to offset the costs of QNP. However, costs and benefits may vary over time and from person to person. The establishment of the park has imposed economic opportunity costs on the local population in terms of limiting potential future access to park resources and an inability to increase the area of cultivated land. This issue warrants closer scrutiny, and assessment of the magnitude of such costs is recommended.

Several focus group respondents also highlighted various challenges facing the valley. One participant urged action regarding the imprecise delineation of the QNP boundary:

*“We request the forest and wildlife department of the Gilgit-Baltistan government to help us in defining the boundaries of the QNP. People from the other side (Khyber Pakhtunkhwa side) falsely claim the ownership of Qurumber Lake despite the fact that historically Qurumber Lake belongs to Ishkoman valley. Therefore, there is a need for provincial government level action to be taken.”*

During focus groups, it was also observed that local communities have limited livelihood options and their dependency on park resources is very high. Given the lack of economic opportunities and high poverty in the buffer zone communities, pressure on park services is increasing, so there is a significant risk of degradation to important ecosystem services provided by the park. There is a critical need for managers to work with local communities to identify alternative livelihood options in the region. During interactions with the local communities, it was observed that the valley has a significant comparative advantage in the production of mountain-specific products such as apples, apricots and walnuts, but lack of market access and limited capacity to add value is hampering the growth of such industries. There is the potential to address such issues through local training programmes focused on achieving market potential through value chain development and value-adding initiatives. Appropriate tourism development within the park also offers significant potential for generating additional income for local people across the valley.

Communities of the Qurumber valley are highly vulnerable to climate change. Various natural hazards have already been exacerbated in various parts of the valley. For example, in 2018 a glacial lake outburst flood in the Badswat area of Qurumber valley disconnected the area from other parts of the valley. The debris transported by the flood blocked the river and it created an artificial lake. Agricultural land, livestock and many houses were swept away by the flood. Such events are now occurring annually in this part of the valley. Such hazards have a significant impact on the socioeconomic life of the local communities. Despite this, adaptation strategies and options are very limited and valley residents continue to be highly vulnerable to the impacts of climate change. An important emerging policy agenda relevant to Qurumber valley is to understand the adaptation capacities of local communities. In this connection, capacity building within local communities to manage climate change impacts is a critical need.

## CONCLUSION

QNP is important for the conservation of important natural resources in the valley and also provides significant economic and ecological benefits to the local community. The study shows that local communities in the QNP buffer zone are highly dependent on park ecosystem services for their well-being and subsistence. A feature of QNP establishment is that it was a local community demand-driven initiative. The results show that the economic value of QNP ecosystem services are estimated to be PKR 738.37 million per year which translates to PKR 615,308 per household per year. The contribution of provisioning services is estimated to be PKR 706.828 million per year which is 96 per cent of the total economic value of QNP ecosystem services.

The success of any policy intervention in the QNP will largely depend on the extent to which policymakers are equipped with the full contextual data, knowledge and the capacity to make informed decisions. Other factors important for the success of policy implementation are the provision of enabling conditions for capacity building in local communities, strengthening governance and stakeholder engagement, equitable benefit-sharing, and promoting value synergies in ways that minimise trade-offs between conservation and development. This study shows that QNP has significant environmental, economic, cultural and social values that policymakers should consider and incorporate into their planning and management decisions. The potentially conflicting economic drivers associated with inappropriate development present a major threat to the flow of services from the park, so it is important to ensure that the park management plan generates tangible economic benefits for local communities. To this end, providing employment opportunities and diversifying economic opportunities are urgent priorities. Failure to address such needs will jeopardise the livelihoods of the local communities and place at risk the conservation and sustainable management of the QNP. Although not assessed in this research, the QNP has significant potential to attract increased numbers of domestic and foreign tourists. To capitalise on this opportunity while ensuring the sustainable growth of this sector, an economic assessment of current and projected tourism within the park, together with an enhanced dialogue between ecotourism experts and policymakers, is recommended as a basis for developing an enhanced ecotourism management plan.

## ENDNOTES

<sup>1</sup> 1 PKR = US\$0.0058 rate for 1 November 2021

## SUPPLEMENTARY ONLINE MATERIAL

Community questionnaire

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## ABOUT THE AUTHORS

**Amjad Ali** is Assistant Professor in the Department of Development Studies at Karakoram International University and also a PhD candidate in the Department of Economics. His main research areas encompass environmental and tourism economics and he has authored several articles in international peer reviewed journals.

**Arshad Ali Shedayi** has a PhD in Ecology from the University of Chinese Academy of Sciences with a focus on climate change and ecosystem services. He has published research papers in international journals and is currently working as an assistant professor in the Department of Biological Sciences at Karakoram International University.

**Haider Raza** is currently serving as the Director of the NBS and Regional Head for North Pakistan at WWF (World Wide Fund for Nature) Pakistan. With over twenty years of experience in research and work related to the environment, water management, nature-based solutions, and biodiversity, Haider Raza brings extensive expertise to his role.

**Ejaz Hussain** is working as a senior conservation officer at the WWF office in Gilgit-Baltistan and he has a Master's degree in Biological Sciences from Karakoram International University, Gilgit-Baltistan, Pakistan.

**Syed Asar ul Hasnian** is associated with the WWF Gilgit-office and his main research areas include environmental engineering and management. He has worked in many national and international projects related to environment issues in mountain regions of Pakistan.

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## RESUMEN

Las comunidades de las regiones de gran altitud dependen especialmente de los servicios ecosistémicos para su supervivencia. Comprender el valor económico de los servicios ecosistémicos es crucial para la gestión sostenible de los ecosistemas de montaña y para el desarrollo de las políticas correspondientes. de los ecosistemas de montaña y el desarrollo de políticas asociadas. En este estudio se ha calculado el valor económico de determinados de los ecosistemas del Parque Nacional de Qurumber (PNQ) a partir de datos recogidos en 393 hogares locales. Este valor se estimado en 738,37 millones de PKR (4,28 millones de USD1) al año, lo que corresponde a 615.308 PKR (35691 USD) por hogar y año. hogar al año. Los servicios de aprovisionamiento aportaron 706,828 millones de PKR (4,01 millones de US\$1) al año, lo que constituían el 96% del valor de los servicios ecosistémicos. Este estudio sostiene que, dada la falta de oportunidades económicas y el alto índice de pobreza de las comunidades del valle, la presión sobre los recursos del parque está aumentando, lo que se traduce en el agotamiento de importantes servicios ecosistémicos en el parque, y en la pérdida de biodiversidad. de importantes servicios ecosistémicos en el parque, planteando así un reto clave para los esfuerzos de conservación. Este estudio recomienda la necesidad de reconocer mejor los servicios ecosistémicos que presta el parque en las decisiones políticas. Debería desarrollarse un mecanismo institucional eficaz que ofrezca opciones de subsistencia alternativas a la comunidad local para minimizar la presión sobre los recursos del parque. minimizar la presión sobre los recursos naturales del parque. Los resultados de este estudio sirven como información de referencia tanto para tanto para los investigadores como para los responsables políticos, con el fin de mantener este parque nacional de montaña de vital importancia.

## RESUME

Les communautés des régions de haute altitude sont particulièrement dépendantes des services rendus par les écosystèmes pour leur survie. La compréhension de la valeur économique des services écosystémiques est cruciale pour la gestion durable des écosystèmes de montagne et pour l'élaboration des politiques correspondantes. des écosystèmes de montagne et l'élaboration des politiques correspondantes. Cette étude a estimé la valeur économique de certains services sélectionnés fournis par le parc national de Qurumber (QNP) en utilisant des données collectées auprès de 393 ménages locaux. Cette valeur a été estimée à 738,37 millions PKR (4,28 millions USD1) par an, ce qui correspond à 615 308 PKR (35691 USD) par ménage et par an. par ménage et par an. Les services d'approvisionnement ont contribué à hauteur de 706,828 millions PKR (4,01 millions USD1) par an, ce qui représente 96 % de la valeur de l'écosystème. 96 % de la valeur des services écosystémiques. Cette étude soutient qu'étant donné le manque d'opportunités économiques et le taux de pauvreté élevé dans les communautés de la vallée, la pression sur les ressources du parc augmente, ce qui entraîne l'épuisement d'importants services écosystémiques dans le parc. d'importants services écosystémiques dans le parc, ce qui représente un défi majeur pour les efforts de conservation. Cette étude recommande de mieux reconnaître les services écosystémiques fournis par le parc dans les décisions politiques. Un mécanisme institutionnel Un mécanisme institutionnel efficace devrait être développé pour fournir des moyens de subsistance alternatifs à la communauté locale afin de minimiser la pression sur les ressources du parc. minimiser la pression sur les ressources naturelles du parc. Les résultats de cette étude servent d'informations de base pour les chercheurs et les décideurs politiques. les chercheurs et les décideurs politiques afin de préserver ce parc national de montagne d'une importance vitale.