ECOSYSTEM VALUATION FOR ENHANCED TRANSBOUNDARY WATER COOPERATION IN THE KABUL RIVER BASIN

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ABSTRACT

The ongoing transboundary water conflicts in the Kabul River Basin (KRB) are narrowly conceptualised in terms of quantitative water distributions leading to win-lose situations, which are exacerbated due to ongoing insurgencies, climate change, growing industrialization, and urbanization. The existing trans-boundary water mechanisms are state-centric, bilateral, exclude other actors, and disregard the broader biodiversity & ecosystem services (BESS) of the river basin for enhancing human well-being. In our existing research endeavour, we have tried to explore a novel idea of using the BESS concept to bring together multiple stakeholders across the KRB and transform the water sharing conflicts by enabling a re-definition of the water management problem in the context of green water economy and evidence of shared environmental benefits. For the said purpose we have market-based valuation services to estimate the provisioning services of upstream area (Chital) of KRB on the Pakistani side. This is a working paper, and we are not presenting the full-blown study results. This study is based on 200 randomly selected households. The result of the study reveals that the total economic value of the provisions of ESS of river Kabul is significantly high with an average economic benefit per household of 963490 PKR/YR ($4817), Which is higher than the economic benefits obtained from Pakistan's high-elevation Kurumba National Park (893250 PKR/HH/YR, Din et al., 2020). The study shows that ESS provided by river Kabul are vital for livelihood of the residents as the ESS provided are the main source of income for the localities. This enduring study has policy implications, though the study isn't complete, but the results on the Pakistani side of KRB suggests that the natural flow of water is a win-win situation for both Afghanistan and Pakistan and certain ways and means should be explored for cooperation between the people of both the country for the mutual welfare of this region.

Key words: Kabul River Basin, Biodiversity and Ecosystem Services, Valuation, Market-Based Pricing Method

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BESS	Biodiversity and Ecosystems Services
CICES	Common International Classification of Ecosystem Services
ESS	Ecosystem Services
KRB	Kabul River Basin
SDGs	Sustainable Development Goals
TEV	Total Economic Valuation

INTRODUCTION

Biodiversity and ESS is a complex but significant area, which influences the wellbeing of the humans in different ways. ESS can provide provisioning services as well as regulating services, literature has shown different approaches for valuation of provisioning ESS (Hayha, 2014). Placing an economic value on nature can be a powerful tool as it makes the invisible benefits identifiable. The ESS represents outcomes of a natural systems which benefits the people. The significance of water as a natural resource and ecosystem provides a wide range of service and various functions as the use of water for drinking, industrial, and irrigation purposes including livestock (Bujnovsky,2018).

River water services provide various benefits in terms of social and ecological, which benefits the people and contributes to the wellbeing of the area. Globally in 150 countries, there are a total of approximately 310 transboundary rivers, and water related conflicts are frequent and increasing due to the current worsening situation of global water situation. Several water treaties are in place between various countries, yet the conflicts emerge frequently (Wang et.al. 2021). The water politics of transboundary rivers are emerging as a compelling research field in social hydrology. Many international basins are governed by multi-level institutions. Besides, the valuation of the benefits of river system can positively contribute towards efficient river water management and reducing water related conflicts and problems. (Zhao & Khan, 2019). However, this is not the case in the Kabul River Basin (KRB).

The Kabul Basin between Afghanistan and Pakistan is not governed by an international agreement and boundary problems (i.e., the contested Durand Line) affect the relationships. Water conflicts in the KRB between Afghanistan and Pakistan have intensified since 2000, coupled with security issues due to the ongoing insurgencies in the region. Growing industrialization, urbanization, and climate change which affects the continuity of snow-fed rivers, environmental hazards, and the geostrategic importance of the area further exacerbate these disputes. The existing transboundary water mechanisms are state-centric and bilateral, exclude other relevant actors and emphasize water quantity as the basis for water sharing. These agreements disregard the broader Biodiversity and Ecosystem Services (BESS) of the river basin or what these services could imply in terms of enhancing human well-being. BESS of water include biodiversity and (a) provisioning (e.g. food production), (b) regulating (e.g. climate & water regulation), (c) supporting (e.g. nutrient cycling), and (d) cultural (recreational, spiritual) services (Millennium Ecosystem Assessment 2005; Sukhdev et al. 2010). The value of global BESS is estimated at $145 trillion in 2011 at a time when global GDP was $73.3 trillion (Costanza et al. 2014). Extrapolating to the river basin between the two countries, one can argue that understanding the value of the BESS in the region could lead to a different problem framing and enable integrative multi-level bargaining leading to win-win solutions. While BESS values the interdependence of humans and nature, it also offers conceptual and empirical tools to communicate with a wide-ranging audience (Costanza et al. 2017), and reveals the cost of damage, it may lead to the commoditisation or privatization of such resources (Sullivan 2013). The proposed research aims to avoid such commoditisation but analyse if a better understanding of the water BESS can change the behaviour of relevant and powerful actors while addressing socio-relational (dispute resolution, capacity building, inter-generational equity) and ecological (pollution prevention, protection of BESS) goals and thereby contribute towards the Sustainable Development Goals (SDGs). By embracing economic, ecological, and social-relational mechanisms, the BESS concept connects the environmental system with politics and decision-making as well as fosters interdisciplinary science (Schröter et al. 2014). By building bridges between science and practice, it enables integrated trans-disciplinary approaches to solve such complex issues (Hoppe 2011). The conflicts of water associated with transboundary river basins can be solved with ecological valuation through shared environmental benefits.

This working paper aim to analyse and evaluate the provisioning services both for self-consumption and for the market selling purpose, which can be used to bring together multiple stakeholders across the KRB and convert the water related conflicts intro shared environmental benefits with the evidence of provisioning services of ESS. This study sought to develop the understanding for transforming win-lose position into integrated win-win situation with shared benefits.

MATERIALS AND METHODS

2.1 Study Area

The current study has considered the valuation of ESS of KRB in upstream and lower stream areas. The current paper is a working document, in which the data from the upstream has been collected and analysed from district Chitral while lower stream is yet to be accomplished. Chitral is in extreme northern side of Khyber Pakhtunkhwa and is considered as one of the highest altitude areas globally. The geography of the district has Gilgit Baltistan province in the east, and Afghanistan on its northern and western side, and on the south side it is shared with the districts of Swat and Dir of Khyber Pakhtunkhwa (Qaisar & Ali, 2009). It has an area of 14850 sq. km area. It lies within 350 15′ 06" to 360 55′32" North and 710 11′ 32" to 730 51′ 34" East with a population of 414,000, as per district government of Chitral.

The population of Chital is heterogenous in characteristics, with ethnic diversity and contain 24 union councils. There are different ethnic group residing in Chitral with 11 different languages used by the locals. Each group has its own cultural values. Administratively, the area is immediately divided into two districts: Upper Chitral and Lower Chitral.

Kabul river Basin flowing through Chitral in Pakistan and Afghanistan and in both the countries, the people in the surrounding of this basin are Pashtuns and Non- Pashtuns both. It is the fourth largest basin of Afghanistan. Kabul river water is used for irrigational purpose in both the countries. The river is fed by river Chitral which has its origin in Chitral, the extreme northern part of Pakistan. Out of total 700 KM length of the Kabul River, 560 km flows in Afghanistan and remaining in Pakistan, it joins with River Indus at Attock district. Kabul River Basin along other two river basins including Upper Indus Basin and Panjnad River Basin are a part of larger Indus River Basin, but the Kabul River Basin is located inside Pakistan and Afghanistan (Yousaf, 2017).

With the increase in population residing along Kabul River basin, the needs for the drinking and non-drinking water are also increasing. Both countries including Pakistan and Afghanistan are heavily dependent on the rivers of Kabul River Basin (Yousaf, 2017). Most people in the study area undertake agriculture cropping as income source, other sources of revenue are fuelwoods, medicinal plants, livestock, fishery, mines, and minerals etc.

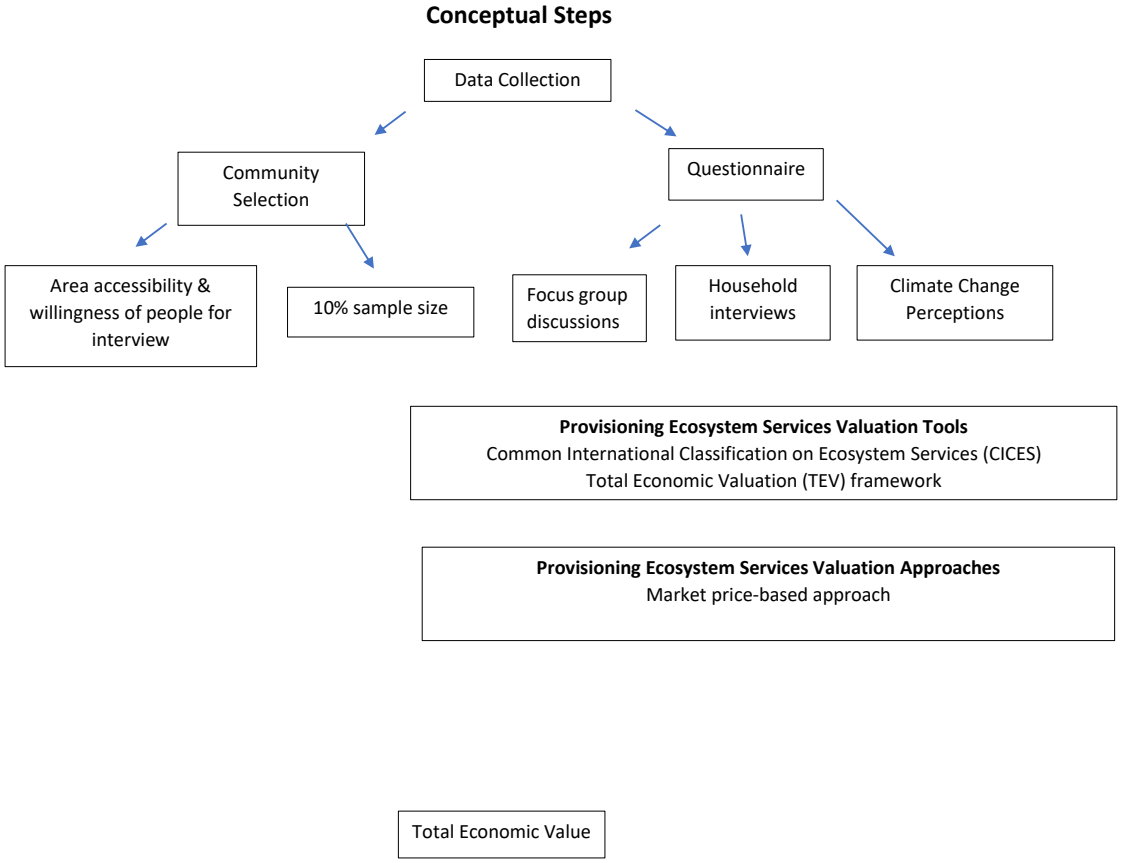
Consequently, for the purpose of our present study, that is, the valuation of Ecosystem Services (ESS) in KRB, 100 household in-person interviews were conducted using pretested questionnaire in Districts Upper Chitral, mainly in Boni, Mustuj, Yarkun and Bragoal Pass areas. Whereas almost the same number of interviews were also carried in Lower Chitral areas involving Garam Chasma, Darosh, and Ayun-kalash areas. These specific locations were identified during key informant sessions. Considering the climatic condition, this field work was executed during the month of October 2021.

2.2 Conceptual Steps

To explore the objectives, the study followed an established arrangement. Primarily, based on the differences in provision of ESS, the distribution of areas was carried out the for the purpose of data collection. Subsequently, a pilot study was completed in the lower Chitral area. Accordingly, a total of 200 structured questionnaires were filled: 100 from upper and 100 from lower Chitral. The questionnaire was prepared based on the *Guide for Rapid Economic Valuation of Wetland Ecosystem Services of Ministry of Japan.* Conceptually, the study has relied on the 'Common International Classification on Ecosystem Services' (CICES) and the 'Total Economic Valuation' (TEV) framework, suggested by 'The Economics of Ecosystems & Biodiversity' (TEEB) to value the ESS. Since, this is an ongoing study, therefore, only the provisioning services of KRB are being considered. Following the

work of (Grizzetti et al. 2016), our present study, has relied on Market price-based approach for the valuation of ESS of KRB.

Figure 1: Conceptual Framework



2.3 Data Collection

Community Description and Selection

The entire area of KRB comprises upstream (Chitral) and downstream areas, that is, Warsak to Nowshera areas. Present data was collected only in the upper stream (Chitral) areas of Garam Chashma, Darosh, and Ayun-Kalash, Boni, Mastuj, Yarkun, and Bragoal Pass. Focus Group discussions were held with the local representatives by the core team members to have a complete idea of the ecosystem services, corresponding to cultivated crops, animal feed, vegetables and the kind and quantity of natural resource harvesting like wild animal feed, medicinal plants, fuel wood and wild vegetables. Data was collected from households and the communities. The number of questionnaires filled in each community includes: Garam Chashma = 33, Darosh = 33, and Ayun-Kalash = 34 from upper Chital and Boni = 25, Mastuj = 25, Yarkun = 25, and Bragoal Pass = 25 from lower Chitral. The respondents were adults, above the age of 18 years, including male and female. These number of questionnaires in each sub strata are based on population proportion.

Questionnaire

The secondary data revealed that most common agricultural products of these areas are wheat, tomatoes, potatoes, beans, maize, barely pulses, onion, rice, and different other vegetables. The inhabitants of the area collect medicinal plants, wild grass and fuel wood from the non-agricultural land and nearby forests. Some amount of the agricultural product is used for household use while the rest is sold in the market for income generation. Those households who deal in livestock mostly use

wild grass from the forest and the non-agricultural land is used as pastures. Hence, this information was used to design the questionnaire. To acquire further information at the household level, a questionnaire was prepared based on toolkit for ecosystem service assessment (TESSA) (Merriman, J .C, Murata, N., 2016). Each household was asked specific questions about the Ecosystem Services (ESS) obtained through agricultural cultivation. We also gathered data on the perceived implications of climate change on supplying ESS by asking respondents if climate change has affected the ESS, like crop cultivation, animal rearing, and availability of water.

2.4 ESS Identification and Economic Valuation

For the economic valuation, the interview responses were collected and compared to each provisioning ESS typology. These were assigned codes and assigned to supplying ESS groups based on the 'Common International Classification of Ecosystem Services' (CICES) table (Spangenberg and others 2014). For estimating the economic value of supplying ESS, the 'Total Economic Valuation Framework' (TEV) proposed by 'The Economics of Ecosystems & Biodiversity' (TEEB) was employed (Brander and others 2017).

The TEV framework is a well-organized way for outlining all of the benefits provided by an ecosystem. Because it reflects value in economic or other market-based units that can be compared across ESS kinds, the TEV framework is a well-known instrument for economic appraisals of ESS (R Pomfret, 2019). The provisioning ESS is evaluated using this paradigm by applying direct and indirect usage values that humans use. We used market pricing method to calculate ESS values. This approach has also been used in previous investigations, such as those done by (Murali et al., 2020) and (Thapa et al, 2020 & Grizzetti et al. 2016).

2.5 ESS Valuation based on Market Price

To determine the value of supplying ESS, the market price-based technique is employed. Because provisioning ESS is frequently sold, market pricing is thought to provide meaningful information on value (R Pomfret, 2019). This technique was used for the ESS with a Gurez Valley market pricing.

The economic values of the ESS were calculated for the following CICES classes: (i) agriculture crops (e.g., beans and potatoes tomatoes, pulses, onion, barely, wheat, maze, and perennial crops), (ii) livestock, (iii) fuel wood (iv) medicinal plants (v) water (drinking and non-drinking uses). The additional material contains information on the local market pricing used to value these ESS, as well as the methods used to calculate the economic value of each ESS. But, the values of horticulture, mineral, values generated through the tourism, and the hydroelectricity generation is not reported in this commentary, however, we are working on this aspect, and we intend to update the present estimates in the final report.

Crop economic values were calculated by taking the entire number of crops harvested each year and multiplying it by the market value. To calculate the ESS value of the agricultural yield, the value of all external inputs, such as chemical fertilizers and labor utilized, tractor and physical labor charges, were subtracted from the value of the products produced. The economic value of milk was calculated by multiplying the market value of milk per litre by the number of litres consumed per family per day multiplied by the number of days in a year. The economic worth of meat was calculated by multiplying the market price of an animal per family by the annual number of animals sold. The annual collection of medicinal plants per family was multiplied by local market prices to evaluate the economic value of medicinal plants. The economic worth of the fuel wood was calculated by multiplying the annual per household consumption by the local price of the fuel wood.

2.6 Total Economic Value

The overall economic benefit was calculated by allocating the economic value for each provisioning ESS to each home and adding the means and standard errors for each household service (Andersson et al, 2018). The respondents computed the household earning values for all of their numerous sources of income, including as employment, agricultural production, animal items sold, and medicinal herbs, and then summed them to determine the Gurez valley's average income (Asfaw et al, 2013).

RESULTS

3.1 Provisioning ESS

The provisions of ESS are widely used in district Chitral. The most common use of ESS is in agriculture and livestock i-e cultivation of agricultural products, surface water for drinking, medicinal plants, minerals, fuel wood, animal fodder, vegetables, fishing, surface water for non-drinking uses, and wild vegetables.

Table 1: Percent of Population Benefiting from ESS of KRB

	%Population benefiting				
Region	Agriculture	Fuel wood for business	Medicinal plants	Fodder for animals	Water
Upper Chitraal	100%	94%	64%	100%	100%
Lower Chitral	100%	95%	62%	100%	100%
Overall	100%	94.50%	63%	100%	100%

The table shows the percentage of population benefiting from ESS provision in upper stream (Chitral). In the upper Chitral areas, one hundred percent of the sampled population are the beneficiaries of agriculture, whereas 94% are benefiting from fuel wood business, another 64% are profiting from medicinal plants, precisely 100% gets some portion or all the fodder needed for their livestock, and 100% of the respondents are using water provided by river Kabul for drinking and non-drinking purpose. There is a similar trend in the case of lower Chitral.

3.2 Economic Values

The best ESS that is received in terms of monetary value is the water that is used for drinking and non-drinking purposes which valued 636919 PKR/HH/YR ($3185)[1] on average from the data collected from respondents. The second-best ESS that is received in terms of monetary value is agricultural crops which yields 141979 PKR/HH/YR ($710) from the data collected from respondents in district Chitral. The third best income generating ESS in district Chitral is medicinal plant and fuel wood. The data shows that among the respondents, the average income generated from medicinal plants and fuel wood is 103433 PKR/HH/YR ($517). After that, animal fodder is the 4th leading ESS in terms of monetary value, through which the respondents get 98976 PKR/HH/YR ($1012).

Table 2: ESS Valuation of KRB

ESS Benefit/YR	Agriculture	Fuel wood for business	Medicinal plants	Fodder for animals	Water
Total ESS/YR	27827885	18245642	2027293	19793485	128657654
ESS/HH/YR	141979	91228	10136	98967	643288

[1] $= 200

3.3 Discussion

Ecosystem Services Identification

The study identified a range of ecosystem services that are provided in district Chitral, Pakistan. During the survey, the communities provided information about a list of ESS that they use for household use and monetary benefits. The forests of Chitral are a source of fuel wood for local communities, safe habitat for many medicinal plants, wild animals and also a source of fodder for livestock of nearby villages (Rashid., et al 2021). All the respondents of the survey were using one or more of the ESS for household purposes and also as a source of finance. Cultivation of agricultural crops, medicinal crops, fodder for livestock, fuel wood for household use and selling in markets, surface water for drinking and non-drinking purposes and fishing were identified as the major ESS used by local communities. The ESS provided by river Kabul are the main source of livelihood for the local communities in district Chitral. The importance of ESS provided by river Kabul to the localities of district Chitral can be identified by the monetary benefits obtained by the local communities (Hayat., et al 2020).

River Kabul is an important source of various kinds of ecosystem services for the communities living nearby it. Some of the ESS is of more importance in terms of monetary benefits and some are of less importance to the localities (najmuddin., et al 2017). This study reveals a high monetary contribution in provisioning ESS to the communities living nearby river Kabul.

Total Economics Value

The total economic value of the provisions of ESS of river Kabul is significantly high with an average economic benefit per household of 963490 PKR/YR ($4817). Which is higher than the economic benefits obtained from Pakistan's high-elevation Kurumba National Park (893250 PKR/HH/YR, Din et al., 2020).

Medicinal Plants: Medicinal plants obtained from Chitral are more important because of their contribution to curing major diseases. Some of the major medicinal plants cultivated or gathered from the forests of Chitral are Artemisia Maritima, Artemisia, Brevifolia and Rosa webbiana are the dominant species, while Ephedragerardiana and Ferula narthex are also important medicinal plants found in Chitral. The total monetary value of the medicinal plants obtained from the cropping and forests of Chitral is 2027293 PKR/YR, while the average monetary benefit obtained by the respondents from the cultivation/obtaining from forests of the medicinal plants is 10136 PKR/YR. Some of the medicinal plants obtained are used by the households while the rest is sold in the local markets. Some of the medicinal plants are of very high value and are sold to bigger herbal markets in outer cities.

Fuel Wood: Fuel wood is another important provision of ESS provided by river Kabul to the communities living nearby. The total monetary value of fuel wood recorded in the survey amounts 91,228 PKR/YR($456). the value of ESS of river Kabul exceeded the economic value of fuel wood estimated by Murali et al., (2020), in the arid regions of Indian Trans-Himalayan Spiti valley. The fuel wood estimated economic values were 432 USD/HH/YR, with 11.7% of the total economic value produced by Qurumber National Park. In the Kabul river basin, the fuel wood collection varies from valley to valley.

Agricultural Crops: Agricultural production is the most important ESS provided by river Kabul. The survey shows that river Kabul is supporting agriculture sector in its basin. The study shows that river Kabul is providing ESS worth 27827885 PKR/YR. the average ESS provision by river Kabul is 141979 PKR/HH/YR. River Kabul is playing a vital role in providing food security to the localities in its basin by providing irrigation water for agriculture production (Fahima sadeqanazhad, 2018). The availability of water for irrigation purpose is, therefore, pertinent for food security and sustainable

agriculture sector in overall South Asia. Climate change brings a new dimension to agriculture and food safety in South Asia, studies suggest that the impression of climate change on crop production in South Asia could be inverse and that may be as magnificent as 18.2–22.1 per cent/year (Rasool ,2011).

Animal Fodder: River Kabul is also a major source of provision of animal fodder to livestock. The survey shows a value of 19793485 PKR/YR produced by river Kabul in district Chitral. The survey also shows that provision of ESS worth 98967 PKR/HH/YR. The monetary amount of ESS in the dry area of the Trans Himalayan Spiti Valley was recorded 523 46.2 USD/HH/YR, with a total economic share of 13.2%; Tost Nature Reserve, Mongolia 3881 ± 360 USD/HH/YR, 2.6% of the total economic value; Changtang area, India, 929 ± 67 USD/HH/YR, 6.2% TEV for nomadic communities; and Sarychat region, Kyrgyzstan, 1182 ± 177 USD/HH/YR, 4.6% of total economic value.

Water Consumption: Water is the most important and highest valued ESS provided by river Kabul in district Chitral with a monetary value of 128657654 PKR/YR. the average value of ESS provided by river Kabul in district Chitral is 643288 PKR/HH/YR. Water consumption includes both drinking consumption and non-drinking consumption (livestock, agriculture, and household use). The results of the study are aligned with past studies, begnas watershed in Nepal contributes a major portion of the water used for irrigation and household (drinking and non-drinking) use by the localities (S. thapa 2020). Another study conducted by Maheshwari (2020) shows that the Indian trans-Himalaya is a vital source of livestock existing and development in central and south Asia contributing 100% of water used for livestock purposes.

CONCLUSION

This study has been undertaken to assess the idea of the BESS concept be used to bring together multiple stakeholders across the KRB and transform the water sharing conflicts by enabling a re-definition of the water management problem in the context of green water economy and evidence of shared environmental benefits? The results of this ongoing study suggest that the ecosystem service provided by river Kabul to the localities living nearby are vital and is serving as a source of economic protection for the residents of district Chitral. Majority of the residents of basin of river Kabul are engaged in agriculture and livestock which are the direct ESS provided by river Kabul. The river Kabul is also playing a key role in maintaining the greenery of the forests in district Chitral which are safe habitats for wild animal, some medicinal plants, fuel wood, and fodder for livestock. The study shows that ESS provided by river Kabul are vital for livelihood of the residents as the ESS provided are the main source of income for the localities.

In terms of policy implications, though the study isn't complete, but the results on the Pakistani side of KRB suggests that the natural flow of water is a win-win situation for both Afghanistan and Pakistan and certain ways and means should be explored for cooperation between the people of both the country for the mutual welfare of this region.

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