

## AN ECONOMIC ILLUSTRATION OF RAVI BEAS AND SUTLEJ RIVER BASINS

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**ABSTRACT:** Economics of water is certainly multifaceted. To each of its dimensions in turn, there exists a whole range of economic activities. The paper under reference would attempt to introduce one of such an area where various dimensions of the economics of water could be seen as alarmingly visible, i.e. the eastern component of the world-famous Indus Basin, which was virtually detached from the western part because of a water treaty signed amongst the two neighboring states. The eastern part of the basin includes the rivers Sutlej, Beas and Ravi, as well as their tributaries, and western part includes rivers Indus, Jhelum and Chenab along with their tributaries. For discussion on the detrimental effects of hydraulic constructions in upper catchments of both the eastern and western sides of the basin, the pre-treaty and post-treaty scenarios were required to be taken into consideration. The findings reveal that the construction of dams on the upper catchments eventually turned out to be the cause of a severe decline in the river flows. The dam construction on the eastern rivers in particular seriously deteriorated the total environment of the eastern side of the basin as the water compensation through the link canals did not match even a part of an earlier flow pattern. The western side, however, asking for entirely a different approach, has not been made a part of this study.

**Key words:** Agricultural Economics, Water Economics, Indus Basin, Eastern Rivers, Transboundary Rivers.

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### INTRODUCTION

Because of several reasons, the Indus River System is among the most prominent river systems of the world (Ali *et al.*, 2021; Akhtar *et al.*, 2022). The impact of seasonal and annual variation in the system flows (Yang *et al.*, 2004), the characteristics of alluvial deposits (Johnson and Whipple, 2010), which may shift the sediment loading from the higher to lower altitude, yield losses and reclamation (Shafroth *et al.*, 2005), and a number of other dimensions considerably contribute towards quite a unique set of system behavior. Every single aspect, both inclusive and exclusive, may thus be seen as a subject of vast research and investigation which has so far led to the hundreds of research projects worldwide on the characteristics of this basin (Zahar *et al.*, 2008; Tipa, 2009; Huai *et al.*, 2021). It has however, been noted that all these works still remain far from being exhaustive and still permit a vast room for the further studies to go on.

Pursuant to signing of the Indus Waters Treaty the attention towards the aspects of study of variation in snowmelt component at major control structures on the primary tributaries of the system on Pakistan side, i.e. Indus, Jhelum and Chenab could be taken as one pertinent example to this stride (Singer, 2007; Immerzeel *et al.*, 2009; Kult *et al.*, 2012; Jones *et al.*, 2008). Even this single study is expected to nurture to a number of additional studies so as endeavor further to comprehend

the behavior of flows upstream of the projects (Ali *et al.*, 2020; Nilson and Bergren, 2000; Gordon and Mentemeyer, 2006), for making the operation of the works more efficient vis-a-vis sediment loading from the upper catchments and their subsequent management (Shi *et al.*, 2021; Gilbert and Wilcox, 2020; Wohl *et al.*, 2015).

It would also be required to be mentioned again that freshwater is becoming visibly scarce (Gleick *et al.*, 2021; Mancosu *et al.*, 2015). As now there is a water scarcity around the world, it would be crucial to make the most out of the available water resources (Damkjaer and Taylor, 2017; Eliasson, 2015; Di Baldassarre *et al.*, 2018). Where the rapid emergence and growth of the water deficit has mostly stayed unreported and neglected (Bogardi *et al.*, 2012), the majority of states on the other hand still think only to manage the shortages, i.e. instead of thinking to resolve the problem (Jiang, 2009; Zhang *et al.*, 2020; Khoso *et al.*, 2015). Many nations are dependent on gradually increasing imports of grain and products connected to water because now they have no other option (Ngo *et al.*, 2018; Abdelaal and Thilmany, 2019; Warner *et al.*, 2015).

The freshwater scarcity has also led to the water competition across the international borders (Munia *et al.*, 2016). Pakistan and India shares the Indus Basin comprising of 6 major rivers, out of which 3 westward rivers were granted to Pakistan, and 3 eastward rivers were granted to India in Indus Water Treaty 1960. The catchments of all of the 6 rivers are under Indian control

and construction of reservoirs on all the rivers causing a severe decline in the river flows, which is resulting in a dry water economy of Pakistan (Briscoe *et al.*, 2005). Reliable evaluation of Pakistan water needs for the ensuing decades is thus necessary as the transboundary water distribution has not only affected agricultural economy, but has also affected badly the economics of groundwater and those of environment. Hence, it is the need of the time to comprehensively study the effects of water distribution across the both sides of the international border as a step towards a regional progress viz-a-viz the above noted dimensions.

## **MATERIALS AND METHODS**

**Study Area:** The Jhelum, Chenab, Ravi, Beas, and Sutlej are the five principal rivers (tributaries) that make up the Indus System of Rivers. Near Mithan Kot in Pakistan, they all merge into a single river that empties into the Arabian Sea in the south of Karachi. Mountain ridges (watersheds) clearly define the western, northern, and northeastern borders of Indus Basin. However, due to the lack of hills and flowing rivers, the southern boundary is less distinct.

For the purpose of the Indus Waters Treaty, the basin covers a total area of about 900,000 square kilometers. The major part of it lies in Pakistan, with the other portions lying in Afghanistan, India and China. Arid to semi-arid conditions can be found in the southern part of the plains with the annual rainfall varying roughly from 05 centimeters to 75 centimeters. The annual average discharge of these rivers at rim stations is about 170 MAF (Million Acre Feet).

**Indus Waters Treaty:** When the Indian Sub-Continent was split into two sovereign nations in August 1947, the flows of water the Indus System used to irrigate an area of about 37 million acres. On the basis of equitable division, with preferred right to existing usage, whole of the water resource used to be distributed to the provinces and the princely states. When Pakistan gained its independence, a large portion of the Indus Basin fell under its jurisdiction. Out of the 37 million acres irrigated at that time, 31 million acres were located in Pakistan. While deciding upon the division, the irrigation projects were not taken into consideration when the borders were drawn between the two upcoming nations. The water dispute was thus obvious to be triggered, which was finally settled in the

form of Indus Waters Treaty in 1960 with the help of the World Bank.

As noted above, the treaty allocated three eastern rivers to India for unrestricted use and three western rivers to Pakistan with certain uses allowed to India (Article-II and Article-III of the Indus Waters Treaty 1960). The treaty thus tasked Pakistan to build a scheme of works which could replace the water supplies relying on the waters flowing through the eastern rivers till 15 August 1947. As these rivers were allocated to India for unrestricted use by the virtue of the treaty, the basins and the area lying downstream of international border was just left to fully suffer.

**The current water picture:** It is to be noted that in Pakistan, managing and developing of a water resource has posed significant obstacles for addressing a wide range of issues (Mustafa, 2002; Tariq *et al.*, 2020; Muzammil *et al.*, 2020). A huge variance in the availability of water is the most fundamental of such considerations (Pahl-Wostl, 2007; Oki and Kanae, 2006). The quality of groundwater in areas, where 81 percent of rivers flow and 65 percent of rain falls during monsoon months, changes significantly with location and depth. The sophistication of managing the water is increasing with the growing demands of water by the population and the economy, as well as by the emergence of changed pattern of periodic floods and droughts (Ghumman *et al.*, 2010).

Because of increasing population and increasing sedimentation of the reservoirs, the country is thus facing a water shortage in a several forms. Earlier, the Water & Development Authority (WAPDA) has indicated a loss in the tune of 7 BCM of storage due to sedimentation in Tarbela, Mangla and Chashma reservoirs by the year 2012/13. This loss was further estimated to exceed 8.2 BCM by the year 2017, which almost equals the original capacity of Mangla and Chashma reservoirs (Diamer Basha Dam Project PC-I).

Hence, due to serious depletion of online storages (Mangla, Tarbela and Chashma) the Indus Basin Irrigation System now lies in a dire state threatening an additional dent to the national food security. It is for this reason that the present study asks for a focus on the pre-treaty and post-treaty agricultural, environmental and groundwater scenarios so as to assess the present and future water picture of the area under question.

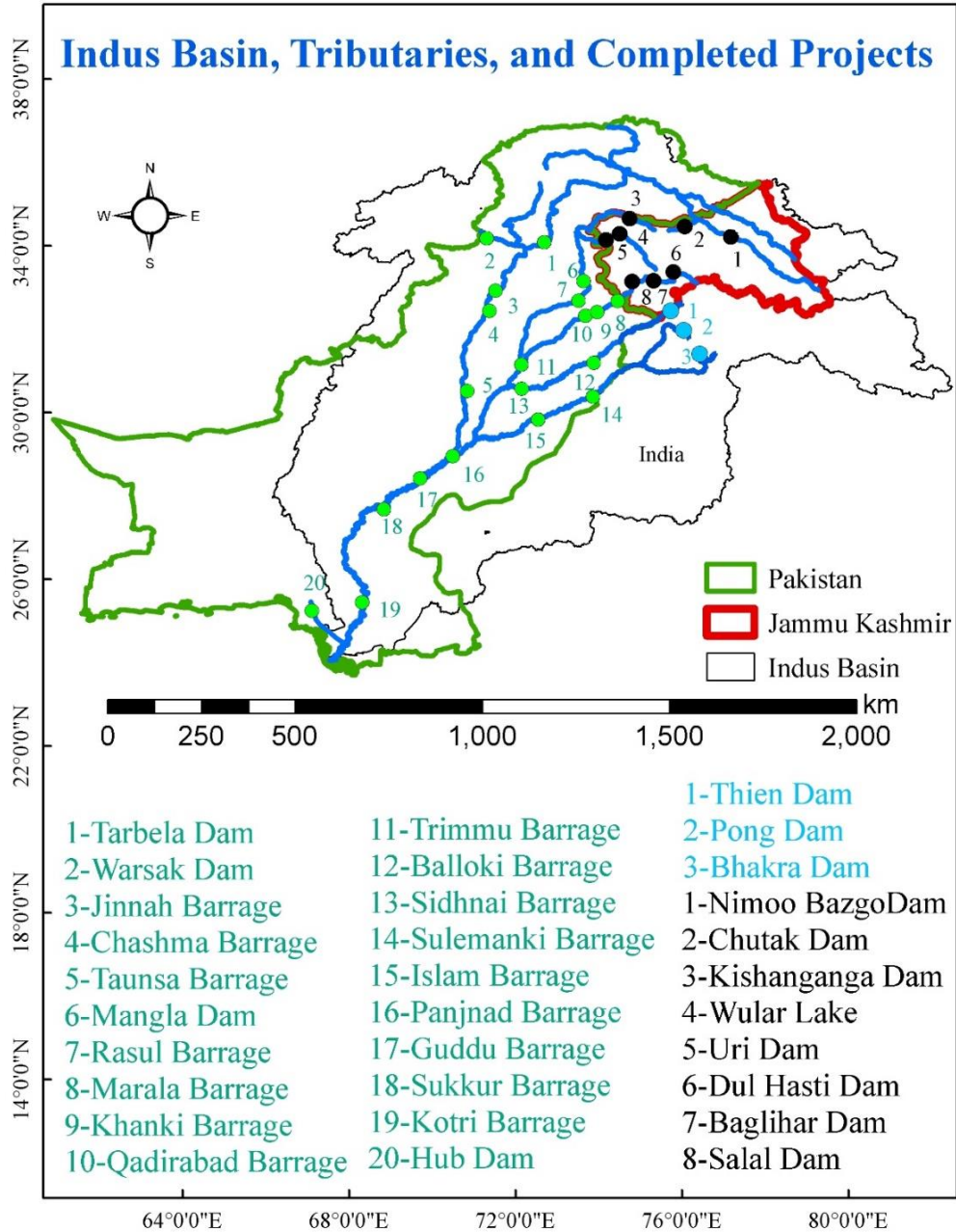


Figure 1: Indus Basin, its tributaries, and the completed projects (Pakistan projects in green, Indian projects in Jammu Kashmir in black and Indian projects in India in blue color)

Table 1. Water Distribution in Pakistan's Major Rivers:

River Basin	Proportion of Total Inflows	Seasonal Variation (%)	
		Summer (Apr-Sep)	Winter (Oct-Mar)
Indus	44	86	14
Chenab	19	83	17
Jhelum	16	78	22
Kabul	16	82	18
Others	5		

## RESULTS

**Agricultural Economics:** Such a partition of the rivers, as has been done through the Indus Waters Treaty, is a clear divergence from the idea of upper and lower riparian rights under the water international law. Pakistan had to give up the continuous flow of water from the Eastern Rivers (24 MAF), previously being received perpetually for irrigation. Though the plan as envisioned by the treaty had both the benefits and drawbacks, but now the benefits appears to be getting outnumbered. The benefits were that each nation became independent of the other in terms of the water supplies and operation of the respective projects/headworks. Each nation became in-charge of organizing, building, and managing its own facilities for its own purposes and to freely distribute its resources inside its own borders, whenever and wherever it sees right. This is also holds for operational efficiencies of the respective systems.

**Structural Economics:** The program's independence also brought forth some benefits of unique kind. The locations of the works that supply each nation or the regions under its control, along with the guarantees that neither nation will interfere with the supplies upon which the other nation depends considerably reduced the likelihood of conflicts and hostilities. During droughts, the winter supplies become extremely important as almost 80% of the flows are generated from July to September, i.e. during the monsoon season. To address this issue, the water supplies in the winter months have been guaranteed by the storage of water in reservoirs, and the drought have no impact on this availability. For instance, in case of Pakistan the total outflows from canal heads had grown from around 67 MAF to 104 MAF.

**Flood Economics:** The flaws of the plan on the other side are too crucial to be over-looked. These in particular include the diminishing pattern of the historic floods on the Sutlej, Beas, and Ravi with the sailab (i.e. flood) areas not receiving the water required for cultivation while changing the whole of the economic stride. The results were the disappearance of the whole of sailab irrigation system, which is the oldest method of using river waters. The size of this area is fairly large and so are the related economics.

**Running Costs:** The cost of sustaining irrigation also increased significantly due to the upkeep of the newly constructed connecting canals and storages. Furthermore, since storages have a finite lifespan, they cannot replace the water that flows continuously.

**Flood Economics:** In addition to above and in addition to the linked environmental problems, it was also believed that when the Eastern Rivers would lose their normal flows, the beds of the rivers would get also sedimented

and ensuing floods, even with lesser flows, would be considerably devastating.

**Economics of Groundwater:** There are adjacent pockets of both brackish and sweet water because of the origin of the groundwater sources in the Indus Basin. Sometimes the water is salty in the lower level and sweet in the upper layer. There is always a concern about brackish water and sweet water zone combining if not used appropriately. As such, when developing the replacement plan under the treaty, its utilization in combination with the river flow resources was not considered.

**Environmental Economics:** On a global and regional level, environmental ethics and development ethics are intricately linked. The Rio Conference noted that the "Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature". Similarly, the World Commission of the UN proclaimed that the "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Hence, as above dimensions are all entangled in one way or the other in the current environmental catastrophe, the freedom or preferences, the satisfaction or the benefits above costs, and the commercialism, should all be governed through the required and the relevant managerial ethics. The development of today should, therefore, be based on enlightened myths, whether one takes into account the agricultural development, river damming, diverting of water, ground extractions, or land fencing, the next 100 years would not be comparable to the past 100 years. Although the developed economies account for roughly one-fifth of the 7 billion people living on Earth, they generate and consume roughly four-fifths of all commodities and services. With four fifths of the world's population, the poor nations produce and consume one fifth of the world's goods. As a result, both sets of nations experience an increase in environmental degradation. Being a good "citizen" would only be a half of the story as the term "brotherhood" frequently used in the nineteenth century actually refers to the need of the community. But throughout most of the 20th century, the call was couched in terms of justice and human rights. But now as the ecological call have been made on a global scale, the ethics are expanding. They include not only what a society does to its slaves, women, black people, minorities, disabled people, children, or future generations, but also to its flora, wildlife, species, ecosystems, and landscapes. Similar arguments regarding the importance of empirical research may be made regarding thinking on a variety of different issues, such as drought, the preservation of biodiversity and climate change, which could be seen, along with the examples of other places, as too pertinent now in case of the eastern rivers. Several kinds of life are facing an increased

difficulty as a result of the ongoing degradation of natural habitats, the widespread extinction of plant and animal species, as well as other ecological components. Hence, there would probably be many chances for the global, as well as the regional cooperation and synergy in tackling with these issues. Therefore, the research and a conclusion would be necessary in many areas of knowledge, including political/practical philosophy and environmental ethics.

**Impacts on Water Infrastructure:** The analyses of the pre-partition utilization of the waters of Ravi, Beas and Sutlej could clearly define the extents of infrastructure which was in existence at the time of partition. The studies and analysis to this effect could have been able to elaborate these aspects in detail as the discussion in this respect would fall beyond the scope of this paper. It may, however, suffice to note that the infrastructure developed in the post-treaty era has virtually stopped all the waters on the eastern side of the Indus Basin across the international boundary of the states which emerged as a result of partition of the sub-continent in August 1947.

**Quantification and Cost Returns:** It would be important to note that the quantification of the noted impacts would essentially be required so as to initiate the steps to mitigate the ill effects. The analyses in this regard should also include the social costs which are being experienced in the form of migrations, changes in the pattern of sowing and cultivation, etc. The studies to this effect would be helpful in working towards the direction of recollecting the vast array of the lost economic benefits.

## **DISCUSSION**

**Yesterday and Today:** The world of today is that of persistent economic development, i.e. which is easy to understand and easy to implement. However, there exists a strong reliance on the concept of coexistence in the today's society to address the sustainability issues. It is also important to recognize that the pace and nature of social and economic advancements, which would be required to keep-up with or to combat with the escalating disorder, brought on by population and demand growth, might not be quite dramatic but rather needs to be comprehended and resolved. Who else would be qualified to determine that which of the prior forms or procedures would not be practical than those who understand the water economy and the policies to that effect?

It would, however, be important to be understood that peace and cooperation cannot exist in a vacuum. It is accurate to say that in order to remain fully relevant to human requirements, our instruments must interact with every aspect of our existence, including the physical, environmental, socioeconomic, managerial, as well as the political aspects. Consequently, the challenge of achieving sustainable economic development is to

satisfy the human needs for food, goods, energy, etc., while conserving and protecting minimal level of desired economic coexistence or the necessary social transformation. The experts indeed are working to create and advance the necessary policy amendments and standards which will encourage the experts in water economics and those in the engineering profession to take the initiative in these reforms.

But it would be required to be borne in mind that in order to promote sustainability a fundamental change in perspective would be needed that can consider the interconnectivity of political, social and economic aspects of today. But side by side, this would also require the water-economists and water-experts to be increasingly interdisciplinary. To guide society along a sustainable economic route, they should indeed be willing to collaborate with biologists and chemists, not to mention meteorologists, economists, ethicists, and politicians, in the ways that have never been done before. Additionally, all such experts must be prepared to take on a more significant role in the development of public policies in order to offer the appropriate incentives which would effectively benefit the community. Don Roberts also emphasized the need for us to be knowledgeable about the connections between environmental, economic, health, and social issues in order to educate others and take the lead. Alternatively, individuals who are unaware of the advantages and limitations of a modern day development would determine the agenda.

**Futuristic Optimism:** The instruments which could be used regarding the issues as highlighted above may take the guidelines from several postulates of international cooperation. These may include:

1. 1911 Madrid Declaration
2. 1966 Helsinki Rules
3. 1991 ILC
4. 1997 UN Convention

If put to just and rational use, the instruments as above and similar, have ample scope to cater for all such situations which thwart the impact area of the eastern rivers of Indus Basin, in line with the discussion as carried-out hereinabove, and that too, with the remarkable mutual harmony and the due respect for sustainable coexistence.

**Conclusion:** The Indus Waters Treaty of 1960 is a unique treaty as it divides the rivers between the two countries into two distinct parts. On the other hand, several similar treaties often called instead for sharing of the waters. Nevertheless, the Indus Waters Treaty now acts as an instrument of peace. The issues pertinent to eastern part of the basin, with which the treaty deals, should therefore be dealt under several other umbrellas available in the form of various fora, resolutions, declarations, etc. But the discussion in this regard, as conceded above, could only be taken as indicative, and

not as exhaustive, for some possible tools and models in this respect. The necessity of exploring a lot more in the same line, particularly from the point of view of data collection, certainly exists.

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