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Scale Issues in Design and Implementation of the Water Apportionment Accord in the Indus Basin

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Abstract

The 1991 Water Apportionment Accord (WAA) is an extraordinary example of subnational water allocation albeit not a perfect one. It established access and allocation of waters from the Indus River among the four provinces of Pakistan through finding political solutions to inter-provincial conflicts. However, the scale of its implementation remains subnational, creating several issues for the efficacy of the WAA. Using the analytical frame of scale–descale–rescale (SDR), this paper examines WAA by descaling its design and implementation at four scales: national, subnational, river basin and sub-river basin. Certain scale-driven interactions emerge between the provinces and the federal government that contribute to technical and institutional issues which, when seen from a scale lens, point to key challenges why WAA objectives are not fully achieved. A rescaling to the Indus River Basin shows an interconnected pattern of politics of scales leading to persisting conflicts that hinder planning and participation.

Keywords: Scale, Transboundary Water Governance, Water Apportionment Accord, Scale-Descale-Rescale, Indus River Basin

1.Introduction

Problems of scale are intrinsic to environmental governance. Governance of natural resources across political jurisdictions and biophysical scales is an established discourse in the literature on human–environment relations (Cash et al. 2006). Literature on the state of global water governance presents a complex and multifaceted scenario of competing interests among multiple actors with little understanding of what characterizes best management arrangements (Groenfeldt and Schmidt, 2013; Gupta and Pahl-Wostl 2013; Lebel et al., 2005). Most policies for water governance are scale-specific in terms of jurisdictional boundaries of policy outreach and

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expected timeframe for achieving policy impacts. Scale-specificity, therefore, provides a logical frame for understanding the interplay of natural, societal and political processes along politically drawn jurisdictional boundaries that either overlap or completely disregard the resource boundaries. Problems of scaling-up or scaling-down environmental governance has intrigued scholars of institutional arrangements at local and global scales (Gupta, 2008; Ostrom, 1999; Young, 2002). Similarly, researchers note how scale issues are interpreted differently by different actors and the trade-offs between higher level effectiveness and lower-level accountability is key to choosing the 'right' scale of governance (Cash et al., 2006; Young, 2002; Syed et al., 2020).

In the interdisciplinary policy debates, scholars highlight the need to recognize scale disconnects (Cash et al., 2006; Ostrom, 1999). The coupled natural and human systems (CNHS) scholarship even argue for considering reciprocal relationships, nonlinearities and shifts in behaviours of different components over time and space as central to understanding the scale variations. There is no real consensus on conceptual and analytical tools for incorporating scale issues. Practical applications of scale issues within policy design and implementation remain an open discourse. Using a new analysis tool – the Scale-Descale-Rescale (SDR) – this paper unpacks the scale effects of policy design and implementation at its current scale followed by descaling to multiple levels and rescaling for cumulative outcomes at basin scale.

For Indus River Basin, scale issues have not received much attention. Historically, decision making for governing Indus River as a transboundary resource has prioritized convergence to politically drawn borders over any considerations for the overall Basin management (Syed and Choudhury, 2018). Even in prioritizing political boundaries over resource boundaries, the Indus Basin management remains largely contested between Pakistan and India with little to no involvement of Afghanistan as a Northwestern riparian or China as the riparian with geographical advantage of being at all Indus head waters (Hayat, 2020; Cilliers et al., 2013). This paper analyses the policy design and institutional arrangements of the 1991 Water Apportionment Accord (WAA) through a scale-lens. The complexity emerging from scale-driven observations show a certain disequilibrium between human-environment interactions which is compromising the long-term and sustainable management of the Basin.

2.Indus River – History, Politics and Water Sharing Arrangements

The Indus Basin stretches from the Himalayan mountains in the north and flows through the alluvial plains of Pakistan's Punjab province before entering the mostly dry plains of Sindh province and draining out into the Arabian Sea in the Indian Ocean. The Indus River Basin contains the greatest area of perennial (multi-year) glacial ice in the world at about 20,000 km^2 (Archer et al., 2010). The Indus River flow is significantly dependent on snow melt from glaciers, which accounts for approximately 41% of total runoff (Lutz et al., 2013). Glacial melt is crucial

e-ISSN:2717-8277

for upstream reservoirs to store and release water to downstream areas when most needed. Approximately 80% of the total discharge in the Indus River basin occurs between April and September and the historic availability shows a rapidly declining trend against pressures of a consistently rising population resulting in considerable annual variation attributed to climate fluctuations (Yong et al., 2019).

The importance of Indus River is amplified for Pakistan with an overall 65% of the country's territory situated within the Indus Basin. This disproportionate distribution of the Basin among its riparians has serious geo-political implications, given that Pakistan maintains a near existential dependence on the Indus River for its economy and food security (Adeel and Wirsing, 2017). Within Pakistan, the inter-provincial competition over Indus waters pre-dates the 1947 division of Indian Sub-continent. During the years of negotiations preceding the 1960 Indus Water Treaty with India. The inter-provincial conflicts have remained consistent and early attempts to address the dispute led to the 1945 Sindh-Punjab Agreement that allocated 75% of the main-stem Indus to Sindh and 25% to Punjab while allocating 94% of the eastern tributaries to Punjab (Mustafa, 2010). This arrangement remained in force until 1947 when the new provincial boundary of 2 Punjabs – within the borders of India and Pakistan – were formulated. The new borders meant a revision will be to revisit the earlier formula, but such revision didn't happen immediately and instead the newly formed federal government in Pakistan began allocating water on an ad hoc basis. This created a renewed sentiment among the Sindh province administrators who viewed this ad hoc practice to be favouring to Punjab. Multiple efforts were made to address the Sindh-Punjab dispute over Indus waters through a series of technical committees eventually leading to the new formula of water sharing based on 10-day seasonal system-wide adjusted allocations. This formed the basis of the Water Apportionment Accord (WAA) which was finally agreed and signed on March 21, 1991.

2.1. WAA – a contested by time-tested instrument

An overview of the past 75 years (1945 to 2020) shows a marked increase in policy and institutional development in the Indus River Basin (Figure 1) that either explicitly or implicitly addressed water allocation. While it took thirty years to arrive at WAA, it is seen as a step towards addressing the inter-provincial distrust by providing overarching guidelines for water allocation. The federal government and the four provinces envisioned an agreeable mechanism in the form of a new institution – the Indus River System Authority (IRSA) – to legitimize the Accord through representative participation of each province and to safeguard interests of all four provinces for equitable distribution of Indus flows. The WAA is praised for containing a politically agreed formula for distributing the available Indus water to the four provinces (Briscoe & Qamar 2006), while promoting sustainable management of the Indus River Basin through balancing agricultural and environmental needs. For the first time in the history of national scale governance planning of the Indus River Basin, the WAA not only protected

e-ISSN:2717-8277

existing uses of canal water in each province, but also the environmental health of the Basin by formalizing the need for escape flows below the Kotri Barrage (last diversion structure on the main-stem Indus). This provision specifically addressed the environmental flows and apportioned the 'balance of river supplies', 'flood surpluses' and 'additional supplies' from future storages (Garrick et al., 2014).

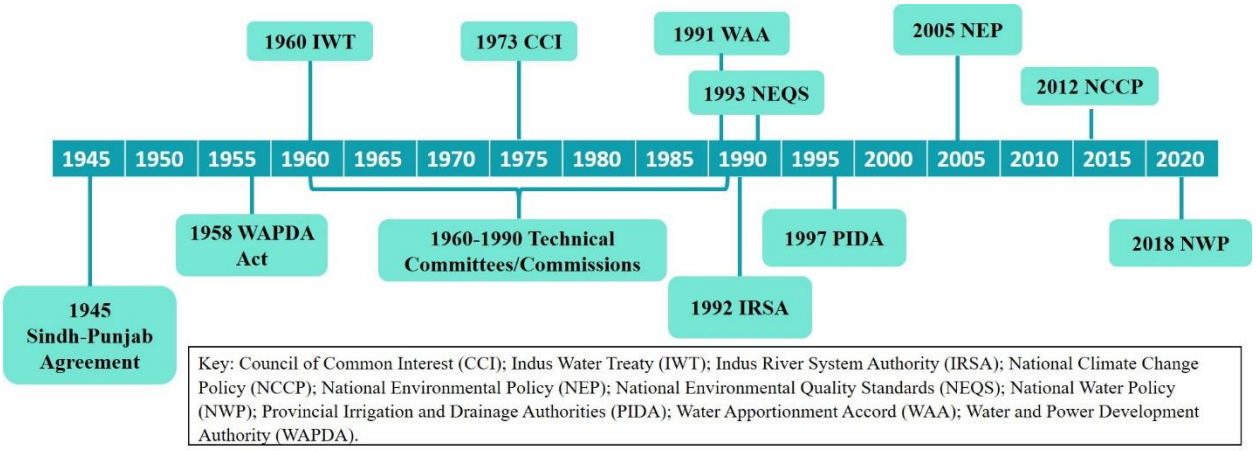

Figure 1. Key policy and institutional milestones for water distribution in Indus Basin

Between the 1960 IWT and the 1991 WAA, multiple efforts were made to resolve inter-provincial disputes. A series of technical committees were commissioned necessitated by the redefined international borders between India and Pakistan; and the provincial borders of Punjab into two Punjabs – one within Pakistan's territory and other in India's. These geopolitical changes rendered past arrangements such as the 1945 Sindh-Punjab Agreement as irrelevant, thus requiring a major shift in earlier distributive arrangements (Sattar et al. 2018; Janjua et al. 2020). During the 30 years (1960 to 1990), while the efforts to resolve inter-provincial water disputes were continuing, WAPDA was tasked to maintain water allocation on an *ad hoc* basis.

The WAA is an 8-page document, describing the water allocation and distribution formula among the four provinces of Punjab, Sindh, Northwest Frontier Province (present-day Khyber Pakhtunkhwa (KP)), and Baluchistan. The main implementation arrangement for WAA was instituted through the Indus River System Authority (IRSA), established through an Act of Parliament in 1992. While the WAA remains a key policy instrument to date, providing platform for riparian engagement and promoting improved governance of the Indus Basin, it faces increasing critique. For instance, a key limitation of the WAA is in the persisting ambiguities of using historic patterns of use instead of robust, data-driven allocations. There are several scale issues that arise due to way WAA is interpreted and operationalized. Below is the SDR analysis of WAA to highlight the key scale issues and their implications for transboundary water governance of the Indus Basin.

e-ISSN:2717-8277

3.Methodology – The Scale-Descale-Rescale Analysis Tool

Global water governance discourse acknowledges issues of competing interests with little agreement on how to incorporate these into policy action (Lebel et al. 2005; Gupta and Pahl-Wostl, 2013). Water governance policies in the Indus Basin are no exception to the complexity of competing political and socio-economic interests. What is common to water governance policies of the Indus Basin and other transboundary basins are the aspirations of implementing the principles and attributes of equitable delivery of water, participation of stakeholders in the policy process, while operating within political, social, economic and cultural constraints (Groenfeldt and Schmidt, 2013). Often sector-specific policies such as irrigated-agriculture, domestic and urban water supply, sanitation, industrial supply and environmental services, etc. are seen as the operational mechanism for incorporating principles of equity and sustainability into policy design and implementation (Pahl-Wostl et al., 2008; Syed et al., 2020). However, often sectoral policies are critiqued for their limited cross-sectoral integration (Norman et al. 2012; Norman & Bakker 2015) and lack of holistic approach to address issues that cross governance and resources boundaries (Lebel et al., 2005).

In the absence of an agreed analytical approach to operationalize scale-sensitivity assessment of water governance policies, the SDR provides an opportunity for reframing scale issues. The SDR consists of progressively unpacking the scalar effects of policies by establishing the current scale of policy in terms of its design and implementation structures (S) followed by descaling to multiple levels (up and/or down the present scale) (D), and rescaling (by integrating the aligned scales) for possible cumulative outcomes (R) (see Figure 2). The SDR essentially breaks up the given scale of policy into multiple smaller and larger units to better understand the vertical and horizontal interplay between different scales (Syed et al., 2020). In doing so, the SDR considers how the wider range of actors operating at different jurisdictional levels are interacting and influencing the decision processes. The SDR provides an analytical frame that shows the mismatch between policy impacts at multiple scales to assess the attainment of the expected impacts in a differentiated and cumulative manner. It builds on the premise that solutions to policy harmonization are seldom available at one scale and require matching multiple levels of one scale with multiple levels of another to address the spatial mismatch (Young et al., 2006).

e-ISSN:2717-8277

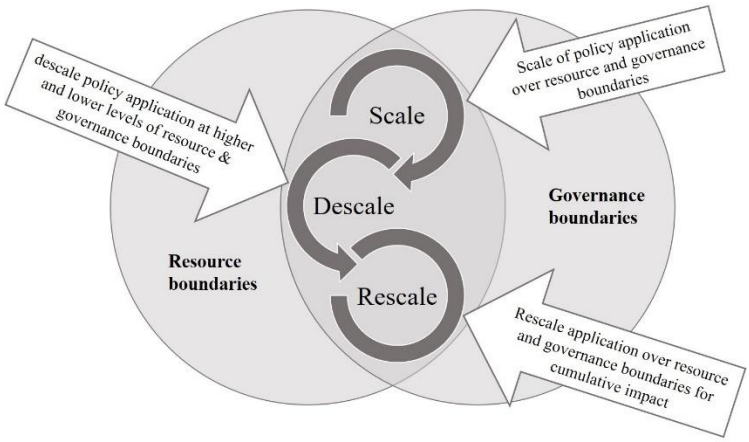

Figure 2. The Scale–Descale–Rescale analysis schematic

For transboundary water governance policies, the SDR covers both biophysical (sub-basin and basin) and governance (local, national, and multi-country) scales and recognizes the intended scope of a policy impact as its current scale. Through descaling, the SDR examines policy from a multiscale point of view, that is, the scale at which policy is designed and the scale at which it is implemented. This descaling process shows how policy design and implementation is occurring at multiple scales and the potential impact of the interplay and interactions between different scales is playing out among different actors (Moss and Newig, 2010; Termeer and Dewulf, 2014). Applying the SDR analysis to the WAA in the Indus Basin, our intention is to shed light on an aspect of WAA that has not been viewed before and that could account for some of the inadequacies of the policy design. While we remain cautious in proposing that SDR can resolve the persisting inadequacies of WAA, we are confident that looking through the scale-lens can contribute to potential realignment of politics with the CNHS perspective in governing the Indus River Basin.

4.Results from SDR Analysis of WAA

As a policy document, the WAA cannot be considered a national water sharing policy as it does not address water rights or allocative sharing for any of the special regions – namely, the northern Gilgit-Baltistan region, the north-western Federally Administered Tribal Areas bordering with Afghanistan, the north-eastern Azad Jammu and Kashmir territory under Pakistan's control, or the capital territory of Islamabad city (Arfan et al., 2020; Adeel & Wirsing, 2017). This arrangement highlights a key scale issue of political appeasement of 2 key contesting parties – the provinces of Punjab and Sindh – with a seeming attempt at generating legitimacy by involving the other 2 provinces – KP and Baluchistan.

e-ISSN:2717-8277

A mismatch exists between resource availability and entitlements claimed by Punjab and Sindh. The Indus Basin Irrigation System (IBIS) is a supply-driven system and in most years, the demand exceeds supply, distributes available quantities according to the fixed rules laid out in WAA. As IBIS is almost fully operated manually, sentiments of distrust between upper and lower Indus riparians focus on quantities reported and distributed. Despite the expanse of IBIS and an estimated US$300 billion investment, the system is devoid of effective flow measurement and water accounting with no internal reregulating storage, only rudimentary control for farm-level water delivery, and unlined and leaky distribution network (Yong et al., 2019).

Geographical locations of provinces generate hydro-politics between provinces, with Sindh, being a downstream riparian, is always concerned over Punjab's claims to water allocations (Akhtar, 2017). Such concerns are aligned with provincial governance boundaries instead of any objective analysis of resource boundaries. Repeated attempts to install a transparent and accessible measurements of canal, storage, and outflow data for use of all parties through the telemetry system have not been successful due to this inherent distrust (Bhatti et al. 2019). IRSA's organizational structures include technical and advisory committees to provide data and technical support on the operation of reservoirs and the irrigation system; and provide transparency through representation from each of the four provinces, nominated official from the federal government and WAPDA. IRSA essentially depends upon WAPDA for all data, which impeded its decision-making on a real-tile and transparent basis (Janjua et al., 2020; Aijaz & Akhtar, 2020). Table 1 provides summary of WAA characteristics and their application at multiple scales followed by detailed SDR analysis of WAA in the Indus River Basin within Pakistan.

Table 1: Scale analysis of WAA design and implementation

Current Scale	**Descale**		**Rescale**
	National & Provincial	**River & sub-river basin**	
Clauses 2, 4 and 14(b) stipulate distributional principles for canal flows and balance river supplies (including floods and future storage) among four provinces	Ambiguities around interpretation of key terms such as initial conditions, shortages and surpluses remain among provinces	Each province sends seasonal estimates to IRSA that are often skewed to provincial interests instead of transparent flow data	A basin-scale automated and transparent flow measurement and reporting system is still lacking
Clauses 3, 8, 9, 10 and 11 give authority to provinces for developing irrigation and water resources projects within their share	Strategic planning for water resource management largely focused on infrastructure development and most planning is led by federal ministry of water and power through WAPDA	WAA makes provision for voluntary re-assignment of water among provinces without impeding their entitlements, there is no specific institutional mechanism established for its implementation	NWP recommends integrated approach to water resources management, but the required institutional reforms and legal framework is still not defined

e-ISSN:2717-8277

Current Scale	Descale		Rescale
	National & Provincial	River & sub-river basin	
Clauses 5, 7 and 12 stipulate non-irrigation uses including industrial, urban and environmental flows	Industrial and urban flows, including supplies to the city of Karachi are defined as part of provincial allocations. Maintaining environmental flows is recognized but responsibility for delivering and monitoring these flows is left vague. No agreement exits among the provinces on either quantities or institutional delivery mechanism for such flows	Agreement on quantities and mechanisms to deliver industrial, urban and environmental flows are specified. Instead, provinces are expected to use their allocations for industrial and urban supplies within their allocated shares whereas environmental flows are often neither maintained nor monitored	Basin-scale monitoring of non-irrigation uses is absent, rendering flows diverted to industrial, urban and environmental uses as unaccounted. Even in flood years, the lack of system-wide monitoring makes it difficult to ascertain true flow quantities
Clause 13 stipulates establishment of IRSA with responsibility to implement the Accord	Asset management for IBIS investments – barrage structures and headwater dams – are operated and maintained by WAPDA with little role for IRSA and provincial governments	Sub-river basins e.g. Kabul and tributaries in Baluchistan are not part of WAA provisions and respective provincial governments are expected to manage these systems	No legally assigned RBO exists for Indus River Basin. IRSA is responsible for basin-wide strategic planning but its current role remains limited to operationalizing water distribution with no capacity to function as a *de facto* RBO

4.1. Current scale of WAA implementation

The current scale of WAA implementation is assigned at the provincial governance boundary while the intended goal of WAA policy is to achieve basin-wide optimal distribution. The WAA enforces distribution of canal water flows as stipulated in the clauses 2, 4 and 14(b) of the Accord. The key formula for water distribution builds on two key principles: (i) no appreciable harm; and (ii) equitable utilization. The WAA promotes the use of prior or historic uses by each province in times of sufficient water availability, whereas in times of shortages or surpluses it promotes equitable utilization. Water entitlements are based on historic uses based on the average water withdrawal between 1977 to 1982, adjusted for ten-daily-use on pro-rata basis of seasonal allocations in the different canals.

Some ambiguities exist around interpretation of key terms used in describing the distributional principles. For example, Punjab maintains that the volumes apportioned in clause 2 are contingent upon additional storage becoming available, whereas Sindh considers clause 2 as the

e-ISSN:2717-8277

baseline volume and shortages and surpluses are dealt with appropriately in the Accord. Instead of considering hydraulic or economic metrices, the WAA specifies and protects existing uses of canal water for each province. It also recognizes the importance of an environmental flow allocation and provides guidance on how the balance of river supplies should be shared after administering volumetric allocation (Anwar & Bhatti, 2018). The WAA recognized importance of environmental flows to the Indus delta, but only as an issue for Sindh and not equally shared by upstream riparians, resulting in disagreement on the exact quantities or rules for maintaining environmental flows and consistent deferment to further studies.

The lack of specific allowances for environmental flow in WAA also leads to the default of unmanaged flows resulting in marginal benefits to the basin and creating other consequences such as seawater intrusion, coastal erosion, and loss of fertile land hence a major shortcoming of the WAA in adequate basin-scale management. This problem is partly due to insufficient monitoring of inflows, outflows, and canal withdrawals. The insufficient monitoring and reliable data availability continue to impede accurate water balance calculations that could potentially resolve internal fluctuations and instil greater confidence among the provinces for decision support. The lack of optimal basin-wide monitoring is compounded by issues of unaccounted losses due to system-wide leakages, theft, and lack of data from farm-use. Nearly half of the total resource in the Indus River Basin remains unaccounted due to the monitoring and information gaps. In addition, the environmental flow to the Arabian Sea is still seen as a wasteful use of water. According to some estimates, the unaccounted losses, including beneficial consumptive landscape water use and large non-consumptive losses in irrigation, are around three times the magnitude of flow to the sea, and should be a primary focus for improved water resources management in Pakistan (Yong et al., 2019; FODP, 2012). At the current scale of WAA implementation, the mechanisms adopted by provincial governments vary significantly in terms of their interpretation of WAA provisions and intra-provincial implementation arrangements for data collection and information sharing.

4.2. Descaling WAA implementation in the Indus Basin

4.2.1.Descaling to national and provincial levels

The overlapping and often unclear responsibilities and lines of administrative jurisdictions between the federal and provincial governments remain a persistent cause of confusion in water management in Pakistan. While many aspects of water resources planning are decentralized to provincial levels, issues of environmental sustainability, sediment management, major asset management (dams and barrages), interprovincial sharing, and transboundary water issues require a suitably resourced (funding and capacity) and sufficiently empowered federal institution with mechanisms for effective provincial consultation (Young et al., 2019). There is no

e-ISSN:2717-8277

formal River Basin Organization (RBO) for the Indus Basin. Within the WAA, IRSA could be seen as the closest form to an RBO however, it lacks the requisite capacity and legislative authority to act as one. This inability of IRSA to perform as a *de facto* RBO is also evident in the continuing distrust among the provinces. As a result, no additional storage capacity has been added to the system since 1970s, and the potential of hydropower generation as well as optimal flood management remain underachieved (Briscoe & Qamar, 2006). The WAA provision for riparians to decide and modify their allocations between system-wide and period-wise uses is the quintessential expression of provincial empowerment (Syed & Choudhury, 2018; Yong et al., 2019).

Persisting ambiguities of terminology for unanticipated scenarios, like climate change induced water variability and other externalities, limit effectiveness of WAA. Studies on historical patterns and projected trends show an overall increase in temperature and precipitation in the Basin (Rajbhandari et al., 2015; Yu et al., 2013), but this data is not used in any meaningful way to adjust allocative principles. For maintaining sufficient environmental flows there is neither an agreed mechanism for determining quantities, nor an assignment of responsibilities to enforce once quantities are determined. The lack of specificity on how these flows would be accommodated within the allocations and whether these would come "off the top" (thus reducing allocations to all provinces) or out of the allocations to Sindh (where delta is located), was left unaddressed leading to a lack of action. To date, neither the recommended quantities have been verified nor any substantive steps have been taken towards addressing the mechanism for delivering and verifying environmental flows (Yong et al. 2019; Bhatti et al., 2019; Anwar & Bhatti, 2018).

4.2.2.Descaling to rive and sub-river basins

There are increased calls for strategic basin scale planning but the mechanism to coordinate such planning is yet to be agreed. Critical areas such as joint flood planning have seen some success in improving the management of headwater dams with technical support of WAPDA, but these efforts have not delivered any comprehensive mechanism to manage assets, surface water and groundwater interactions, interprovincial water sharing, intersectoral water management, environmental sustainability, or basin-scale management of sediment and salinity and other water quality issues (Yong et al. 2019). More recently, some progress is seen where the federal government convened joint planning and stocktaking with help of external partners. For instance, the Friends of Democratic Pakistan (FODP) was established in 2008 as a donor coordination group to partner with the government and assigned a joint Water Sector Task Force to provide technical expertise and policy advice.

While the World Meteorological Organization (WMO) recommends one gauge per 250 km^2, in the Upper Indus, just one gauge covers nearly 5,000 km^2 (UNDP 2017). Other recommendations include installing at least 75 Automated Weather Stations (AWS) and 35 hydrological

e-ISSN:2717-8277

monitoring stations across the Upper Indus Basin to accurately account for seasonal variations and correct the data discrepancies from valley floor monitoring stations. A key argument against calls for reviewing the WAA is that a unanimous agreement is required from all concerned parties, making it extremely difficult to negotiate any changes to the existing procedures. It took several decades to arrive at the decision for ensuring supplies to the twin cities of Rawalpindi and Islamabad (Anwar & Bhatti 2018). As the systemwide water demands continue to grow, the demand to revisit and renew existing water allocation principles requires a concerted shift in the institutional adjustments in the current federal and provincial mechanisms. Recently, some provinces have voiced their support for introducing new mechanisms in the existing provisions of the WAA to operationalize clauses 14(d) and 14(e) related to voluntary re-assignment of water among provinces without impeding their entitlements. The provincial government of Khyber Pakhtunkhwa (KP) made a public statement welcoming the discussion to establish an agreed mechanism for development of the flexible, voluntary arrangements which are needed in all arid environments. While Baluchistan refrained from any deliberate statements, both Sindh and Punjab were quick to oppose the idea.

4.3.Rescaling to Indus Basin

The WAA is lauded for being a significant achievement in addressing inter-provincial water disputes in Pakistan. This praise is well-placed especially since similar policy instruments do not exist in other parts of the Indus Basin located in India or other riparian countries. Despites its deficiencies, WAA remains a key step towards basin-wide management of the Indus River. Having survived nearly 30 years since its formulation, the WAA, as a policy instruments, has established its resilience. While there are multiple views on reviewing, revising and even doing away with the WAA, its usefulness remains uncontested. At a basin-scale, WAA contains the potential for becoming more adaptive to the changed realities of the Indus Basin and it this aspect that has merit for discussion rather than a drastic revision. Similarly, the institutional arrangements for WAA need to remain flexible to address the contingent needs of the IBIS as they arise, for instance, issues like adapting to climate change, relying more on virtual waters, and using conservation technologies more effectively to gain water efficiency and improve water quality (Janjua et al., 2020).

The mutual benefit creation could be the single most significant virtue of the WAA as opposed to current practice of contestation that creates winners and losers among the provinces resulting in *status quo* of provincial disputes. Three key areas are important to a scale-sensitive WAA as follows.

e-ISSN:2717-8277

4.3.1. Balancing institutional arrangements between province and federation

The growing challenges of climate change, and the increasing evidence of environmentally unsuitable water management with significant negative consequences, Pakistan remains vulnerable to increased water scarcity in the absence of strategic planning for the entire Indus Basin. The long-term environmentally sustainable economic development of the Indus River Basin, the IBIS, and the sub-river basins such as the Kabul and sub-river basins in Baluchistan, a basin-wide joint mechanism is needed with clear institutional and technical responsibilities for evidence-based planning. The 2018 National Water Policy (NWP) recommends a comprehensive and integrated approach to water resources management, but the required institutional reforms and legal framework is yet to be put in place.
As part of setting up the institutional arrangements referred in 2018 NWP, priority must be assigned to updating the current institutional setup of interactions limited between IRSA, WAPDA, and the provincial irrigation departments, to include missing stakeholders. Specifically, this will mean creating an institutional mechanism to address water needs of regions not originally included in WAA, including Gilgit-Baltistan, Federally Administered Tribal Areas, Pakistan-controlled Kashmir territory, and Islamabad, the capital city of Pakistan.

At national and provincial scale, the IRSA presents a unique opportunity for strengthening the existing institutional mechanism. Even though IRSA's institutional structure doesn't accord it the legal status of an RBO, it still operates as an RBO. For instance, IRSA holds the mandate for coordinating information sharing and data verification as well as the task to carry out strategic basin-scale planning. At present, IRSA performances primarily the tasks associated with operationalizing water distribution with no capacity to function as a de facto RBO. Since IRSA is a representative institution, it already enjoys the political acceptance by the four provinces and formally assigning IRSA as an RBO for the Indus River Basin could be linked with the calls for its institutional strengthening.

At the basin-scale, while the 1960 IWT brought a formal river-sharing agreement between two riparian states, India's provinces, especially the Punjab, Haryana, and Rajasthan, continue to fight over their rightful share of the waters of the Ravi, Beas, and Sutlej rivers. Inter-provincial disputes are not unique to Pakistan part of the Indus. Very little is accomplished in terms of having a set policy instrument at the basin-scale with WAA being shining light that is currently focused on one part of the basin – albeit being the larger portion – while the remainder part of Indus, especially located between several Indian States could learn from the experience of WAA to formulate a similar instrument and then aggregating it to combine the WAA with Indian equivalent of it (if there ever would be one), to a truly basin-scale instrument, creating an instrument of mutual gains for both India and Pakistan.

e-ISSN:2717-8277

4.3.2. Harmonized flow measurement

A key loophole in WAA design is presented by the method used for estimating seasonal water availability in the canal network. In the absence of an automated, transparent, and unified system throughout the IBIS network, manual calculations are carried out at select diversion points. This leads unreliable data prone to mistakes as each provincial irrigation department provides reports of flow measurements for the barrages and the heads of the canals that are located within the provincial boundaries. Most seasonal estimates are derived from correlations with prior irrigation season deliveries. Each province is responsible for providing its own estimates while IRSA adapts these estimates as the season progresses. The provincial estimated are often considered skewed if not overtly exaggerated to align with provincial interests. This practice severely undermines IRSA's authority especially since IRSA maintains no in-house technical capability to establish its own estimates or verify data provided by provincial irrigation departments (Young et al., 2019). A fully functional system-wide telemetry system has not been made operational since the WAA came into force.

In recent years, some positive development has been made although not across the entire IBIS. For instance, since 2007, Punjab is publishing on its provincial irrigation department's website, the data on flow measurements at the head of each canal (and down the canal). Updates are posted online every two weeks. More recently, Punjab has also started publishing the discharge measurements at the head of each canal with daily updates. This has been recognized as a significant step towards resolving trust deficit among provinces however other provinces are yet to follow the example of Punjab. If each province adopts similar practice, the measurements made by each province could not be verified but will also effectively build trust. If IRSA is to be transformed into an RBO for the Indus basin, its role could also be strengthened by assigning it the responsibility to verify provincial information however technical capacity for IRSA remains a key issue for it to play this role effectively.

Some recent efforts have been made towards addressing the data gap in governance of Indus and the federal government has renewed its plan as part of the 2018 NWP implementation. However, it is important to incorporate lessons from previous experiences of installing the telemetry system which included several concerns on data quality, measuring structures in the form of flumes or broad created weirs, and introducing modern technologies for direct measurements. At the same time, attention to the data delivery and information sharing mechanisms must be included in the automation planning with careful measures to limit possibilities of human error in processes as well as quick and transparent means for making data available to public and policy makers.

e-ISSN:2717-8277

4.3.3.Politics of scale and achieving mutual benefits

While the WAA makes provision for voluntary re-assignment of water among provinces without impeding their entitlements, there is no specific institutional mechanism established for implementing this. From the perspectives of equity, efficiency and conflict reduction, there is a strong case for introducing mechanisms to facilitate a voluntary re-assignment of water among users. Provinces could be better off if there were mechanisms whereby some entitlements could be temporarily transferred from one province to another. In some cases, this is because provinces do not have the infrastructure needed to use their allocations and have concerns that non-use may eventually lead to questions about its rights to that water. Their water is currently being used by others, and they would like to be compensated for this. In other cases, such a voluntary transfer (in exchange for payment) would benefit both buyers and sellers and result in water moving from lower-value to higher-value uses. In other countries this mechanism has been vital in maximizing output, minimizing conflict and providing resilience in times of drought.

Accurate and reliable information, equally accessible to all parties, independently verifiable, improve water accounting in the Indus Basin (which includes but is not limited to flow measurement at key installations). A clear set of annual or biannual water accounts like those released by other river basin authorities would go some way to reducing mistrust between stakeholders. A slightly more challenging issue, but again within the framework of the Accord, would be to improve the Operating Rules and ensure that these are well documented. For all the shortcomings of the Accord, it would be prudent to work within the Accord before embarking upon any revisions to the Accord itself. At the same time, improving the stakeholder engagement mechanism in the WAA would lead to greater legitimacy of the Accord by including additional parties and civil society groups in the consultative and information sharing processes of the Accord. However, such steps will require IRSA to step up its institutional role beyond the current water distributional tasks and take on the role of an RBO that promotes inclusive development, ecosystem services, and adaptive management. Such a shift will also require a change in the current mindset prevalent among the provincial policymakers to consider their provincial interests as part of the basin-scale issues.

An important outcome of building a mutually beneficial proposition for the provinces would be in the form of joint planning for augmenting current storage capacity at a basin scale. According to some studies, Pakistan storage capacity is well below the internationally recommended levels – 30-day supply compared to 1000-day supplies (FODP, 2012; ADB, 2013). The stalemate over any significant progress on increasing storage capacity primarily results from lack of trust among the provincial governments. Confidence building measures among the provinces in the form of independent, third-party technical studies should be considered as recommended in the

e-ISSN:2717-8277

NWP implementation framework that includes setting objectives at institutional, legal, and operational levels.

5. Discussion and Policy Implications

In considering the future course of action for governing the Indus River Basin, three specific areas are of key importance as follows.

6. Changes in the Indus River Basin

The water balance within the Indus River Basin is evidently changing due to climate change, river morphology and increased pressures of population growth and economic development. It is already becoming clearer that some of the original assumption under which WAA was designed and its implementation conducted over the past 30 years, will require to adapt to the new realities. Opening a positive dialogue for revising the WAA will not be easy despite a common understanding that systemwide demand for water is growing along with increase in climate variability in system flows and a flexible approach is needed to address the growing vulnerability of the IBIS and plan for Pakistan's water security. Politics of inter-provincial interactions will make these realities difficult to ignore and a pronounced engagement will be needed from other federal agencies as well as a broader segment of stakeholders previously not engaged in WAA formulation. Any deliberations will also need to articulate improved institutional and legal framework including implementation arrangements at federal and provincial scales as well as involvement of water users and broader communities. Upgrading IRSA into an RBO would need to figure among the key institutional reforms and generating strong political support would be the first step towards this process.

7. Balancing irrigation and non-irrigation use

The WAA was an instrument to resolve inter-provincial disputes over water sharing and while it acknowledged industrial, urban and environmental needs to be addressed from Indus waters, it didn't establish a robust mechanism for the non-irrigation uses. At the time of WAA formulation, the non-irrigation demands were relatively small and in many instances were almost entirely met by groundwater abstractions. With the economic development away from being purely agricultural reliant to non-farm manufacturing and service industries compounded by the population growth, competition for water has increased while options for supply augmentation have remained limited. Model-based assessments indicate that increased flexibility in surface water allocation within provinces—both within agriculture and between sectors—can increase agricultural profits and improve outcomes for domestic, industrial, and environmental water users (Yang et al., 2014). Ensuring reliable supplies for both irrigated

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agriculture and non-irrigation uses, especially during periods of drought and scarcity will require system-wide adaptations such as promoting high efficiency irrigation technologies, crop diversification towards high value produce, and improved practices for water conservation.

8. Modernizing institutional and legislative structure

Incorporating responsive mechanisms for inter-sectoral water allocation could be best achieved if institutional reforms are made at multiple scales. For instance, the provincial irrigation departments, together with the canal command area water boards and farmers organizations will need to work together through clearly defined arrangements for collective planning and management of water resources. Although constitutionally, water is largely a provincial matter in Pakistan, relevant policies, institutions, and legal provisions are distributed across the national and provincial levels. National institutions coexist with, and sometimes overlap with, provincial institutions, and the legal framework for each province includes its own laws and regulations overlain by relevant national provisions (Young et al., 2019). As part of modernizing institutional and legislative structures to govern the Indus River Basin, actions will be required at multiple scales for effective governance at basin scale. For instance, at basin scale, assigning IRSA the role of an RBO would mean transforming IRSA into an adaptive and learning institution with capacity to cope with variabilities and uncertainties associated with climate change and other externalities. As and RBO, IRSA will also require stronger mechanisms for consultations with and involvement of various actors, for generating and disseminating knowledge.

9. Conclusions

There is a growing recognition that basin-wide management and transboundary water governance of the Indus River cannot be achieved by WAA alone. Findings from the SDR analysis highlight that WAA implementation will remain limited due to the mismatch of actions being taken at different scales. Conflicts over Indus waters predate the IWT and while WAA broke new grounds by arriving at an expression of consensus policy, its implementation arrangements and lack of specific mechanisms for generating, sharing, and validating information remains weak leaving much to be desired. While through WAA, all provinces are increasingly working together, absence of other stakeholders has become more apparent with shifting trends in the country and in Indus River. At each governance level – national/federal, provincial/subnational, basin and sub-river basin – SDR analysis provides insights into the details of what is working well and what remains to be addressed, to achieve effective transboundary implementation of the Indus River Basin.

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