

SINDH WATER POLICY

Approved by Sindh Cabinet on 22nd July, 2023



**Irrigation Department
Government of Sindh, Pakistan**



Foreword



Water, the essence of life, is a precious resource that sustains all living beings on our planet. We in Sindh are more sensitive due to its scarcity, unreliable flows, and Climate Change events. The National Water Policy was approved in April 2018, since then, need of having our own provincial water policy for our indigenous issues and solutions was direly felt. As our global population continues to grow and the demand for water increases, it becomes increasingly evident that effective water management and governance are of paramount importance. The challenges we face regarding water availability, distribution, and quality are multifaceted and complex. Climate change, population growth, urbanization, and industrialization are placing unprecedented strains on our freshwater sources. It is my utmost pleasure to introduce this comprehensive Sindh Water Policy, a testament to our collective commitment to safeguarding and responsibly managing this invaluable resource and address the issues / problems.

This Sindh Water Policy document is the culmination of tireless efforts from our professionals, experts, academia, public sector organizations and concerned stakeholders and citizens who have collaborated to outline a roadmap for water management that transcends borders and ideologies. It aspires to establish a harmonious balance between human needs, environmental preservation, and economic development. The vision of this policy document is not just to address water-related issues but to pave the way for a future in which water is recognized as a fundamental human right and a shared responsibility. It emphasizes the value of integrated water resource management, ensuring that water is managed holistically and sustainably, encompassing its social, economic, and environmental dimensions.

By promoting water efficiency, recycling, and reuse, this policy document aims to minimize wastage and enhance water security in the face of increasing uncertainties. It seeks to empower local communities and indigenous people of province, respecting their traditional knowledge and practices, and acknowledging their vital role in water conservation. Furthermore, this policy document underscores the significance of sound governance and policy framework that incentivize responsible water use, support research and innovation, and encourage private sector engagement in water-related initiatives. It envisions a world where water governance is transparent, inclusive, and accountable, fostering collaboration across sectors and ensuring that no one is left behind. In endorsing this Sindh Water Policy, we are committing to a future that acknowledges the intrinsic link between water, biodiversity, climate, and human well-being. It is a call for collective action, a plea to safeguard the legacy of water for generations to come. We must act now, urgently, and resolutely, to implement the recommendations outlined in this policy to secure a sustainable and water-secure future.

As we embark on this journey, we must remember that change begins with each of us. By adopting responsible water practices in our daily lives, supporting Sindh Water Policy that protect water resources, and raising awareness about the importance of water conservation, we can make a difference. I extend my heartfelt gratitude to all those who have contributed to the formulation of this document. It will serve as a guiding light for governments, organizations, communities, and individuals, uniting us in our shared responsibility to safeguard and cherish this most precious of resources - water. Together, let us forge ahead on this path of sustainable water management, leaving a legacy of prosperity, equity, and resilience for generations yet to come. Last but not least, I would acknowledge the efforts of organizations and individuals involved in this successful endeavour.

Syed Murad Ali Shah
Chief Minister, Sindh



Overview



Government of Sindh's Irrigation Department in collaboration with Project Coordination & Monitoring Unit, P&D Department and Sindh Irrigation & Drainage Authority, decided to launch formulation process of Sindh Water Policy in June 2018 with support of FAO and World Bank, which was need of time after approval of National Water Policy in earlier months. The provincial genealogy of challenges and issues of water sector do always variate due to unique of climate, topography, soil structures and agronomy. The partners has done really well in sense of in-depth consultative processes, layer by layer reviews, providing feedback and approvals at every stage, which has led to final approval of this document by Sindh Cabinet. I congratulate the team on this extraordinary achievement.

The Sindh Water Policy outlines a comprehensive strategy aimed at addressing the pressing challenges surrounding water resources and their sustainable use. With increasing concerns over water scarcity, degradation, and climate change, this policy document seeks to establish a forward-looking framework that promotes efficient water management, conservation, and equitable distribution. The overarching goal of this policy is to ensure a secure water supply for present and future generations while preserving aquatic ecosystem and fostering socio-economic development.

The policy document begins by providing a comprehensive assessment of the current state of water resources, identifying key stressors and vulnerabilities. Drawing upon extensive research and consultation with experts, stakeholders, and affected communities, the policy proposes a set of strategic policy objectives. These objectives are designed to guide decision-making and drive actions at various levels of governance, from national to local, involving both public and private sectors. Central to the policy's approach is the principle of integrated water resources management, which emphasizes the interdependence of water-related sectors such as agriculture, industry, and urban development.

Emphasizing community engagement and cross-sector collaboration, the policy document seeks to foster an integrated and collaborative approach to water management. It highlights the importance of latest technical knowledge, IT and GIS Tools, empowering local communities and promoting water literacy to ensure that all stakeholders are invested in the sustainable use and protection of water resources. Furthermore, the document outlines a roadmap for investing in water infrastructure and technology, supporting research and innovation, and encouraging sustainable practices in various industries to reduce water wastage and pollution. By fostering a culture of responsible water stewardship and promoting climate-resilient strategies, the policy aims to build a water-secure future that can withstand the challenges of an ever-changing world.

Jam Khan Shoro
Minister, Irrigation Department, Government of Sindh
Chairman, Sindh Water Policy - Steering Committee



Preface



A good policy framework results in good policies. Policies that are well-drafted, consistent, easy to manage and update, and most importantly that people actually read and follow, these are all characteristics of good policies. The Sindh Water Policy fulfills all those characteristics.

During my 30-year experience of working in the water resources department, I realized that while meeting the water needs of the present, we are compromising the ability of future generations to meet their water needs. The land and its use are a complete mess, water use and availability are imbalanced and unpredictable. The water resources available to the people of Sindh are limited.

While the province of Sindh experiences increasing demographic and socio-economic stresses, the recent episodes of extreme climate factors bring additional complexities in finding solutions to reduce these stresses. Water is one of the most impacted resources, but water also provides solutions to these challenges. The efficient use of water for meeting the needs of all sectors of use is the final lifeline of the province to support its current and exponentially raising future population.

As the Secretary of the department, I trust that the Sindh Water Policy principles will provide important reference for the Government of Sindh to implement policy component in its later and spirit for securing the existence of the present and future generations of the province of Sindh.

Zarif Iqbal Khoro
Secretary to Government of Sindh, Irrigation Department
Chairman, Sindh Water Policy - Inter-Departmental Technical Committee



Acknowledgements



The Sindh Irrigation & Drainage Authority under leadership of Irrigation Department, Government of Sindh initiated the process of stakeholders consultations for formulation of Sindh Water Policy in October 2017, with the initial support from Trocaire, an Irish based organization. In this detailed process of consultations, SIDA coordinated and arranged eighteen (18) meetings, focused group discussions and workshops, where veteran irrigation experts, community leaders, academia, agriculturist, and base root level farming tenant were engaged to discuss about water, its consumer ship, future challenges, and way out to better manage this precious resource. The findings of these sessions were consolidated and disclosed at a provincial policy seminar in Karachi, held on 27th February, 2018. Meanwhile, the Sindh Cabinet approved and launched its Agriculture Policy in April 2018. In the same month National Water Policy (NWP) was signed by Council of Common Interest (CCI). As per constitution of Pakistan, Water Sector is equally managed by Federal and Provincial Governments under CCI. The NWP also encourages provinces to chalk out their own implementation strategies. Taking the que from SIDA's consultation process and considering the dire need to have a Province specific Water Policy. The Irrigation Department, SIDA, PCMU, P&D Department with the support of World Bank presented the proposal for formulation of first ever Sindh Water Policy to competent authority.

After Due deliberations and approval of Chief Minister, Sindh on 10th June, 2019, the organizational arrangement for formulation of Sindh Water Policy was lined up and notified as a three-tier institutional setup. The PCMU P&D Department, Food & Agriculture Organization of United Nations (FAO) and Irrigation Department, with SIDA, provided overall technical and project managements support. The first step of policy formulation was initiating background studies. The team supervised compilation of nine (9) studies policy guidelines. The institutional arrangement from top started with SWP Steering Committee (SC) notified under Chairmanship of Minister Irrigation and administrative heads of public and private sector organizations. The second level was, Inter-Departmental Technical Committee (IDRC) consisting of technical leads of stakeholder departments under Chairmanship of Secretary Irrigation. The third tier was Drafting Group consisting of the international and national experts. Further, to ensure careful review and incorporation of in-depth technical knowledge, the Irrigation department also notified a Departmental Committee consisting of Chief Engineers. In total four (04) Steering Committee and seven (07) IDTC meetings were organized to review the progress. The drafting group had more than two dozen on and off line meetings. The Irrigation Department's Chief Engineer's Review Committee had a rigorous task and they met regularly to review the draft policy. The above arrangements and process ensured number of consultative events, feedback from water users, farmers, academia, and stakeholders including women. The policy was presented in Sindh Cabinet Meeting on 22nd July, 2023 and got approved.

We extend our deepest gratitude and appreciation to all the individuals and organizations whose firm commitment and dedication made the formulation of this Sindh Water Policy Document possible. First and foremost, we would like to express our heartfelt thanks to ID Departmental Committee led by Mr. Zarif Iqbal Khero and members Mr. Haji Khan Jamali and Mr. Shafquat Hussain Wadho and many others, who took the lead with in-depth review and deliberations and finalized the Sindh Water Policy Document in present shape. Further, this whole process was supervised and led by Mr. Jam Khan Shoro, Minister Irrigation - Chairman SWP-SC and Mr. Sohail Ahmed Qureshi, then Secretary to GoSindh, Irrigation Department - Chairman IDTC. We are also indebted to members of SWP-SC, IDTC and Drafting Group by FAO, consisting of Dr. Frank, Dr. Bakhshal and Dr. Heman and World Bank Team. Further the national and regional levels organizations for their valuable support and collaboration throughout the entire process. Their expertise and guidance have been instrumental in shaping the comprehensive and forward-thinking policies outlined in this document.

Pritam Das
Managing Director,
Sindh Irrigation & Drainage Authority,
Secretary, Inter-Departmental Technical Committee
- Sindh Water Policy

Nazir Ahmed Memon
Project Coordinator, Directorate of Sindh Water
Sector & Barrages Improvement,
Secretary, Steering Committee - Sindh Water Policy
P&D Department, GoSindh

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Abbreviations and Local Terms

Abiana	Service charge for surface irrigation water
AWB	Area Water Board
BMU	Barrage Management Unit
CLTS	Community Led Total Sanitation
DMC	District Municipal Corporation
FAO	Food and Agriculture Organization
GCA	Gross Command Area
GDP	Gross Domestic Product
GOP	Government of Pakistan
GOS	Government of Sindh
IBIS	Indus Basin Irrigation System
IRSA	Indus River System Authority
SWRMD	Sindh Water Resources Management Department
IWRM	Integrated water resources management
Katchi Abadi	Squatter settlements
KWSB	Karachi Water and Sewerage Board
LBOD	Left Bank Outfall Drain
MAF	Million Acre Feet
Nalla	Open stormwater carrier
NEQS	National Environmental Quality Standards
PCRWR	Pakistan Council for Research in Water Resources
PHED	Public Health Engineering Department
PKR	Pakistani Rupee
RBOD	Right Bank Outfall Drain
RDD	Rural Development Department
SCADA	Supervisory control and data acquisition
SCARP	Salinity Control and Reclamation Project
SDG	Sustainable Development Goal
SID	Sindh Irrigation Department
SIDA	Sindh Irrigation and Drainage Authority
SSWMB	Sindh Solid Waste Management Board
SWP	Sindh Water Policy
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Emergency Fund
USD	United States Dollar
WASA	Water and Sanitation Authority
WSS	Water Supply and Sanitation
WRMU	Water Resources management Unit
WUO	Water Users Organization

Executive Summary

The vision of Sindh Water Policy (SWP) is to secure inclusive development and management of water resources in Sindh that fosters well-being of its citizens, society, and economy. The mission of SWP is to secure integrated water resources management through enabling institutional arrangements and effective actions based on the principles of accountability, decentralization, participation, resilience, and transparency.

The objective of SWP is to set policy directions and action plans for the active water management systems, that secure long-term safe usage of water resources through enabling institutional arrangements. The SWP describes the challenges, policy directions and actions on the following most critical aspects: water governance, management of canal and drainage system, water management in dryland areas, management of water-dependent ecosystems, and water supply and sanitation services in urban and rural areas. The SWP also outlines the way forward for implementation, reporting, coordination, and its review mechanism.

Water Governance: Governance of water resources in Sindh faces complex challenges that are the result of the combined effect of socio-economic development, changes in water use, and the impacts of climate change. There is, moreover, a heritage of unresolved issues including rising water demand, deteriorating water quality, increase in frequency of floods and droughts, environmental degradation, inequitable distribution of water, and inter-provincial water issues. The increased pressure on the water system in Sindh makes the active and integrated management of water resource inevitable. This requires that the capacity and institutional arrangements are shored up, and that one will move away from the fragmented and subsector approach towards an integrated approach, including the multifunctional operation of the canal system and the protection and harnessing of resources in Sindh's drylands, groundwater aquifers, wetlands, and Indus Delta.

On water governance, the major policy directions and actions are as follows. Sindh Water Resources Council (SWRC) shall be established with major tasks to review and coordinate implementation of the Sindh Water Policy, to recommend legislation, strategies, planning and coordination for water resources development and management, to promote multi stakeholders participation, integrated water resources management, and controlling pollution in water bodies. Sindh Water Policy Implementation Committee shall be constituted which will be responsible for the implementation of Sindh Water Policy. Furthermore, a comprehensive plan will be prepared to transform the Irrigation Department and SIDA into Sindh Water Resources Management Department (SWRMD) with the main purpose of broadening their mandate to include both irrigation and water resources management. With change in nomenclature to SWRMD, the scope and jurisdiction will be widened to cover all water resources and diversified usage. Water governance mechanism is based on the following key components: separate roles of policy, regulations, service delivery, water management, and water development, adoption of integrated water resources management (IWRM), participation of water users in operation and maintenance, protection of quality of surface and groundwater, and a systematic approach to increase flood resilience, i.e., the ability to cope with.

Management of canal and drainage system: The canal and drainage system is the lifeline of Sindh province. The significance goes beyond agriculture, as canal water supplies are equally important for municipalities, rural settlements, construction, and industries. The management

of the canal system has, however, been lacking; the widespread persistent waterlogging and salinity is testimony to this. The major policy directions and actions are as follows. The multifunctional management of the canal system needs to be optimized by the preparation of multifunctional water management plans for each canal command area with engagement of diverse stakeholders. The water distribution within and between canal commands needs to be reassessed. Water productivity needs to be vastly improved by better outreach to agricultural water users with ICT supported programs and by retailoring subsidies and regulatory provision that support unsuitable cropping pattern. Better needs to be made of saline area by systematically introducing bio-saline agriculture. To ensure an adequate financial basis, there a need to streamline abiana system and other sources of revenue for the water sector.

Water Management in Dryland Areas: There are large and important areas in Sindh where water supply, agriculture and livestock keeping depend on the effective use of rain run off or floods. These are the dryland areas outside the Indus Basin Irrigation System – the Kohistan area in the West, the Nara and Thar deserts in the East – covering 60% of the province. To serve these dryland areas, the major policy directions and actions are as follows: establish an institutional home for the integrated development of the dry land areas; work at watershed level for the development of the drylands; better manage and develop the rangelands, promote judicious use of water; and develop plan for provision of drinking water for the dryland parts of Sindh.

Management of Water Dependent Ecosystems: The prominent ecosystems dependent on water include the different wetlands, the Indus delta, and the riverine area. Though many of these have high economic and ecological value, they are generally neglected. The major policy directions and actions for water dependent ecosystems are as follows: water resources assessment in all the water dependent ecosystems considering the local site-specificity at the basin or sub-basin levels covering all sources of water; formulate master plans for ecologically sustainable development and management of water resources; develop, test and adapt innovations for rainwater and runoff water harvesting, cascades of water storage, and micro-irrigation farming in suitable areas; and establish appropriate institutional mechanisms for ecologically sustainable development in all water dependent ecosystems.

Urban Water Supply and Sanitation Services: Urban water services are needed to accommodate the safe growth of urban areas in Sindh and ensure the basic well-being of old and new urban citizens. There are, however, major challenges with the long-term quality of the urban water sources, wastewater treatment and with service delivery. The following policy directions have been identified to secure access to safe water supply and sanitation services and ensure water quality for households in urban areas of Sindh: water resource planning for cities and towns; improving operational performance of urban water and sanitation service providers; mobilize public investments for essential defective and updated infrastructure; and regulating and stimulating private sector participation.

Rural Water Supply and Sanitation Services: Access to water, sanitation and health services in rural Sindh is among the most problematic in the world and non-functionality is high. The following policy directions have been identified to secure access to safe water supply and sanitation services and ensure water quality for households in rural areas of Sindh: provision and protection rural drinking water resources, including a revision of canal lining practice;

reform and strengthen institutions and capacity to deliver services; targeted public investments; and involvement of local private sector in service provision.

Implementation, Reporting, Coordination and Review: Clear strategies for implementing Sindh's Water Policy are necessary for both the long and short-term goals to be realized. This policy adopts a risk assessment approach to water resources management covering all sources of water. A set of management responses include licensing and regulatory tools; monitoring, modelling, and investigation; vulnerability assessment; water management action plans; supporting guidelines; market strategies; and surface and groundwater education. It is necessary that appropriate indicators are developed, reported, and monitored periodically by the Government to reflect the state of surface and groundwater. These indicators will become the basis by which the success of the water policy implementation will be judged. This will indicate where adjustments to the Water Policy can be made. Policy development, coordination and review will be implemented through a stakeholder working group comprising the relevant agency and representatives of Sindh Water Resources Management Department. Once the policy is launched, the group will meet periodically to monitor performance and ensure that the implementation is progressing. The policies will be formally reviewed on a five-yearly basis.

1. Introduction

1.1 Background

There is no denying that in Sindh water services are stretched under current arrangements. There is a backlog of urgent problems such as contaminated water supplies, extensive land under water logging and salinity, unserved drinking water needs, dry tail-end areas or disappearing wetlands. Many of these translate in economic insecurity and stress at family level, impacting stability and household relations. Some of the problem spots in Sindh are among the most dire, anywhere. For all involved it is a duty to address these and contribute to a more water secure future.

The need to change the way water is used and managed is obvious. The overall direction is clear too: more effective action, going for better services and for integrated management of water resources. The demands from a wide range of users and uses need to be combined and harmonized. The management of all water resources– surface water, groundwater, rain, reuse of wastewater and flood water - needs to be closely connected. The quality of water needs to be safeguarded throughout the province for the different uses. This very much aligns with the National Water Policy of Pakistan (GOP 2018) issued by the Federal Ministry of Water Resources. The National Water Policy provides the overall policy framework for sustainable development and management of water resources in Pakistan. As per the National Water Policy, each province needs to develop its own water resources management plan keeping in view the challenges facing the province.

Water is a defining element in the society of Sindh. Policies of the Government of Sindh have consistently highlighted the importance of management of water resources for the sustainable social and economic development of the province. The Sindh Vision 2030 (GOS 2007) aspires that Sindh must have adequate water available through effective conservation, quality management, and proper distribution that meets the needs of all water users. The Sindh Drinking Water Policy (GOS 2017a) aims to provide safely managed drinking water and to enhance public awareness about health, nutrition and hygiene related to safe drinking water. The Supreme Court has ordered the Government of Sindh to prioritize the pollution-free quality of domestic water supplies. The Sindh Sanitation Strategy (GOS 2011) and Sindh Sanitation Policy (GOS 2017b) target the increase in coverage of wastewater treatment facilities in urban and rural areas. The report on Irrigation Management Strategy for Irrigated Agriculture of Sindh (GOS 2016) underlines the need to manage water resources as part of the operation of the canal system. The Sindh Agriculture Policy 2018-30 (GOS 2018), has, as one of its four objectives, improved natural resource management, and sets out actions needed to ensure that soil and water, as key natural resources for agriculture in Sindh, are conserved and maintained. It commits the government to promote better on-farm water management, regulate groundwater resources, coastal areas, and rangelands, and enhance effective controls on pollutants.

Finally, Pakistan subscribes to the global 2030 Agenda for Sustainable Development, which includes Sustainable Development Goals (SDG) on the availability and sustainable management of water and sanitation for all, improved water quality, increased water-use efficiency, protected water-related ecosystems and strengthened participation of local communities. Water is among the top three priorities in the Sustainable Development Goals Framework for Sindh. The SDG Framework targets the year 2030 and attaches high and very high importance by 2030 to increased water-use efficiency across all sectors and to ensuring sustainable withdrawals and supply of fresh water and reduce the number of people suffering

from water scarcity; to double agricultural productivity for small holders in particular; to improve water quality by reducing pollution, minimizing the release of hazardous chemicals and materials and halving the proportion of untreated wastewater; to protect and restore water-related ecosystems to achieving universal and equitable access to safe and affordable drinking water and adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. The Framework also undertakes to implement integrated water resources management at all levels. The judgment of the Justice Hani Commission made the point of adequacy of water management even more forceful, stating that human health issues due to consumption of contaminated water constitute a form of invisible violence. The same was reinforced by the Justice Kalhor Commission that challenged the Karachi Water and Sanitation Board to identify one area that was provided with safe water.

1.2 Major Concerns and Issues in Sindh

Sindh is the second most populous province of Pakistan. Sindh is home to now close to 50 million people. Water is critical to the livelihoods of the population of Sindh and the socioeconomic development of the province. Its use has transformed large parts of the province from a historically dry alluvial plain of the Indus River into cultivable lands. The changes in the last 150 years have been spectacular – from improved inundated canals to a fully controlled canal system.

The water resources available to the people of Sindh are however limited. Mean annual rainfall in the province ranges between 100 and 200 mm. The main source of water available to Sindh is the Indus River, which is diverted through the extensive hydraulic infrastructure that has been put in place over the last century in the form of the Lower Indus Basin Irrigation System (IBIS). The river water is supplied to users by diverting it to a canal system through three barrages: Guddu barrage, Sukkur barrage, and Kotri barrage. These barrages divert water to 14 main canals via an intricate system of 117 branch canals, 1400 distributaries and minors, and 44,000 watercourses (GOS 2018). The canal system in Sindh has an aggregate length of 13,325 miles (21,445 Km), and it serves a gross command area (GCA) of 5.8 million hectares. It was designed to primarily serve the agriculture sector. However, under the recent economic development following rapid urbanization and industrialization, and the population increase, the pressures from other sectors are also rising fast. Effectively, the 14 main canals have been transformed into multi-purpose canals serving agriculture, industries, households, and environment including wetlands, Indus delta and natural habitats.

Flows into Sindh at Guddu averaged 65.19 MAF between 2004 and 2019, with flows concentrated during June and September. These average flows are subject to significant interannual variability, and the flow was 43.63 MAF and the peak flow was 103.27 MAF during the same period. For 2018-2019 the inflows were for instance 49.80 MAF. Of this 35.66 MAF was consumed – most of it in agriculture (33.80 MAF). Water losses were 6.69 MAF – most of this in the kharif season. The releases after the last barrage on the Indus were 1.76 MAF (which is less than what is recommended to sustain the Indus Delta). For 2018/2019 the balance between inflows and outflows was 5.69 MAF.

A major concern in Sindh is its position as the lower riparian within Pakistan. This has many dimensions: concern on reduced surface water inflows, concern on uncontrolled flood releases during flood periods and concern on deteriorating water quality in the main Indus.

Outside of the coverage of the IBIS, available surface water resources are more limited. They result from the runoff generated in catchments during rainfall. The 2018/2019 balance estimated these to be in the order of 1.2 MAF. Though smaller they are vital for a significant and relatively vulnerable part of the population of the province. Another important and increasingly used source of water – both in the dryland and the canal area is groundwater. Groundwater resources complement available water resources in Sindh and its safe yield has been estimated to range between 4.4 MAF and 8.1 MAF.

By far the largest use of water in Sindh is agriculture. Crop consumption is around 95% of total consumption, with actual evapotranspiration varying between 26.6 MAF and 41.7 MAF. At the same time, annual domestic water demand is estimated at 1.2 MAF, industrial water demand at 0.5 MAF, and water use for livestock is relatively low. Flows to the Indus Delta to maintain its ecosystems functions are another important water use and the Indus River Accord stipulates recommended annual flows of 10 MAF per annum, though actual flows vary between the years and have often been inadequate to meet environmental flow requirements. More in general the wetlands in Sindh are a source of pride but have also at the same time been largely unmanaged and, in some cases, directly degraded by public action.

Climate change is already manifesting its impacts. Sindh has witnessed six main floods in the last twelve years, including two mega-floods that played havoc in almost the entire Province, causing loss of life, wiped out crop seasons, damage to people's assets (houses, property, and livestock) and a plunge back into poverty.

Climate change will be a strong risk multiplier. It was estimated that without appropriate investments into adaptation climate change may reduce agricultural value-added to GDP in Pakistan by around 5%. Projected impacts are multi-fold and include (a) changes to Indus river flows and precipitation patterns – affecting the canal and dryland areas alike; (b) increased requirements of irrigation water and water demand more generally; (c) reduced productivity of crops and livestock due to heat stress and other adverse impacts; (d) increased frequency and intensity of extreme weather events (droughts, floods); and (e) sea water intrusion, affecting coastal agriculture, forestry and biodiversity (f) higher incidence of typhoons over the Indian ocean affecting the coastal area of Sindh and its drainage system

Of all these risks the increased frequency and intensity of droughts and floods has been most devastating. The 2010 and 2022 floods played havoc with the lives, well-being and economy of the people of Sindh. The impact of the unusual high rainfall and flood discharge is exacerbated with the many obstructions to flood water disposal, including the conversion of the Indus flood plains into permanent occupation and the restrictions on the main flood channels by bridges and roads. There is a need for improved spatial planning within Sindh Province – planning overflow areas and opening up stormwater drains - and negotiation on flood resilience with other Provinces

Population growth and migration from rural areas to urban areas of Sindh, and Climate Change impacts are the two main concerns for water security and food security in the province. This is leading to many challenges for water resource management. These include greater demands for potable water and water suitable for industrial use; increased volumes of sewage and industrial wastewater (effluent); and a higher frequency of floods and droughts, as well as more variable

rainfall. The demand from non-agricultural sectors is rising fast and the water supply to the cities and their economies, such as Karachi needs to be secured.

Key concerns of water resources planning and management of the province, such as the alarming situation of water logging and salinity, low water productivity, water pollution, substandard wastewater disposal, water quality and quantity, poor reliability of water services, gender inequality in water access and decision making, and many others.

So far by and large water resources in Sindh were utilized but not managed – there has been little attention to sustainable use, to the balancing of different users, to water quality, the connection between surface, groundwater, floods and rainwater, to the protection of valuable wetland systems and to flood resilience.

1.3 Vision, Mission, Objectives and Framework of Sindh Water Policy

The vision of Sindh Water Policy (SWP) is to secure an inclusive development and management of water resources in Sindh that foster well-being of its citizens, society, and economy. The mission of SWP is to secure integrated water resources management through enabling institutional arrangements and effective actions based on the principles of accountability, decentralization, participation, resilience, and transparency.

The objective of SWP is to set policy directions and action plans for the active water management systems, that secure long term safe usage of water resources through enabling institutional arrangements. This will make a major contribution to secure an inclusive development of Sindh's society and economy, in which the well-being of its citizens is not jeopardized by deficient water services.

The SWP gives clear guidance to the Government of Sindh on the ecologically sustainable management and development of the provincial water resources from all sources of water (surface water, groundwater, and wastewater) and for all sub-sectors of water use (domestic, agriculture, industry, commercial and environment) at the basin level for the prosperity of people of Sindh. The specific objectives are to:

- Slow, halt and reverse the processes of degradation of water resources (surface and groundwater).
- Ensure long-term sustainability of the ecosystems' ecological support characteristics.
- Improve resilience to floods and droughts.
- Maintain the full range of beneficial uses of water resources.
- Maximize economic benefit to the canal command or river basin, province, and country.

Throughout the world, governments and water users' institutions are trying to come to grips with the concept of sustainability, and what it means, in a practical sense, for management of specific resources – surface water, groundwater and wastewater. Ecologically sustainable management and development, in terms of surface and groundwater resources can be difficult to define, even in the best characterized water basins.

Sustainable management of surface and groundwater resources involve management for the maintenance of several different aspects of the system within a specified water basin, and includes consideration of:

- Use of surface water and groundwater to meet the current and future demands and manage inter-generational equity.
- Average recharge over a specified time to maintain longer-term sustainability of groundwater.
- Beneficial use of flood water where possible Long-term and short term seasonal climatic variation in river flows, canal diversions, groundwater recharge and abstractions
- Variation and change in quality of surface and groundwater resources
- Impact on the environment from all sources of water (surface water, groundwater, and wastewater).
- Capacity of aquifer storage in various ecosystems – including those underneath the canal areas - to buffer seasonal variations by managing droughts and floods using the concept of Flood and Drought Management (FDM);
- Induced recharge from precipitation, stream flows, rivers, canals, water lakes, reservoirs, and large dams.
- Economic impacts of management options for all sources of water and for all sub-sectors of water use.
- Social and cultural impacts in terms of all sub-sectors of water use; and
- Access to the resource in an equitable manner and to ensure inter-generational equity.

Policy and practice for surface and groundwater management must, therefore, be adaptive enough to accommodate both changes in community values and a better understanding of the resource in terms of knowledge and technical aspects.

The framework of SWP policy is illustrated in Figure 1. The details of each component are described in a separate section along with policy directions and actions in the remainder of this document.

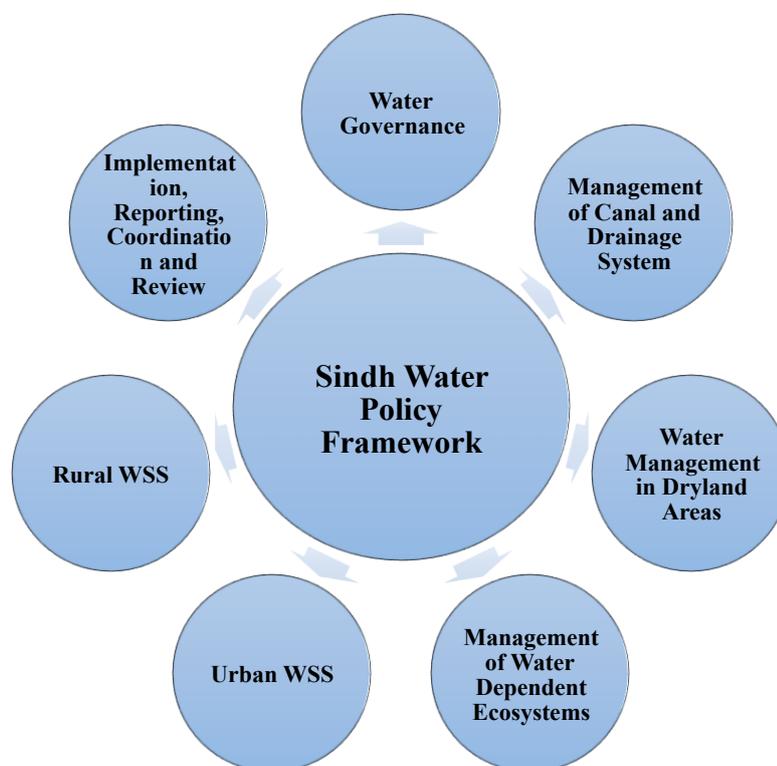


Figure 1: Sindh Water Policy Framework

1.4 Process for Developing Sindh Water Policy

The process of Sindh Water Policy Formulation was approved by the Chief Minister of Sindh with three levels of implementation supervision: Provincial Steering Committee for overall supervision, decision making, and advice to GOS, Interdepartmental Technical Committee for the contributions across all sectors and the Drafting Group for formulating the document based on consultation. The Steering Committee was notified on 5 September 2019 under notification NO:SO (C-IV) SGA&CD/4-8/16. An Interdepartmental Technical Committee was formed by the Steering Committee in its meeting held on 14 July 2020. The composition¹ of the Drafting Group was approved in the Steering Committee Meeting as well.

The SWP has been formulated to provide a strategic management framework for sustainable economic development of Sindh drawing on its natural endowment of water resources. The process for developing the SWP and this document of it was designed to:

- Create ownership and commitment to new types of actions on several burning issues in water management and service delivery for sustainable and beneficial change.
- Ensure a process that is inclusive of all types of stakeholders, recognizing their needs and viewpoints.
- Produce clear messages to all stakeholders about the path that will be taken towards better water resource management for the province.

A working group of practitioners-experts, notified by the Interdepartmental Technical Committee reviewed, the specific sections of the Water Policy and guided the detailed discussions. Within the constraints of COVID19 related restrictions five main consultations were organized as well as a large number of detailed discussions on specific issues. The policy formulation also made use of the preparatory work undertaken in 2017 and 2018 by SIDA with support of Irish Aid through Trocaire and further continued by Caritas from 2019 till 2020, in which fifteen consultations on the scope of the Sindh Water Policy were held. Moreover, in the preparation of the policy eight background papers were commissioned on various issues and all scientific articles and MSc and PhD theses related to water management in Sindh, that were published in the last ten years, were reviewed. The draft versions of the Policy were discussed with the Interdepartmental Technical Committee and the Working Group before submission and approval by the Steering Committee. A major contribution was made by the Irrigation Department with a thorough contribution on IWRM and water governance, that has been integrated into this Policy Document.

2. Water Governance

2.1 Challenges

Governance and management of water resources in Sindh faces complex challenges that are the result of the combined effect of socio-economic development, changes in water use, and the impacts of climate change. There is, moreover, a heritage of unresolved issues including rising water demand, deteriorating water quality, increase in frequency of floods and droughts, environmental degradation, inequitable distribution of water, and inter-provincial water issues.

¹ Dr Frank van Steenberg, Professor Bakhshal Lashari, Professor Heman Das Lohano with support of Dr Philippe Floch and Genevieve Hussain, as such contracted by FAO.

Sindh is located in the southern part of the country and it stands to suffer not only directly from local climatic and weather changes but also from the weather activities in the upstream Indus River and from the coastal environments. Sindh being the tail-end in the provinces is most affected by water usage and new irrigation infrastructure development. This requires high vigilance in the implementation of the Water Apportionment Accord. An emerging problem not yet covered by any regulation is the pollution of the Indus water from the upstream Provinces. This contaminated water is among others the source of drinking water by the people of Sindh, affecting their health severely. There is need of inter-provincial agreements to ensure NEQ standards required for Indus water and to monitor quality of Indus water at Guddu Barrage and report it to IRSA and CCI. A second important emerging issue is the need for well managed evacuation and where possible beneficial use of flood water, which needs to be coordinated at different scale, including at inter-provincial level. The institutional and legal capacity in Sindh has not kept with these new pressures. Besides there is a legacy of unresolved problems. Governance and management of water resources remains fragmented. There is a lack of a coherent overall framework in water resource management.

Since 1971, the Irrigation Department Sindh has been engaged in the development of Physical Water Resources of Indus River, Hill torrents, Surface water storage for multipurpose arid zone development, fresh water supplies through pipelines in Thar desert, supplying the ever increasing needs of Karachi metropolitan city and other cities in province, Research and development and water for industry like supplying water to Thar coal reserve power plants and the management of Groundwater through SCARP tube wells and Left Bank Outfall Drain tube wells and surface drains. The Sindh Irrigation department has been involved in provision of water to industries and municipalities from the existing canal allocations. A cautious start has been made curtail the discharge of effluents into the canals. Therefore, the Department has de facto already moved from 'irrigation' to 'integrated water resources development'.

In 1997, with the promulgation of Sindh Irrigation & Drainage Authority (SIDA) Act, the Department has also introduced the concept of participatory irrigation management in the canal commands on pilot basis. The SIDA Act of 1997 was later repealed and replaced by the Sindh Water Management Ordinance (SWMO) in 2002. The institutional reforms under the SIDA in the form of Area Water Boards (AWBs) at the canal level and Farmers' Organizations (FOs) at the distributary canal level were introduced in 3 AWBs. In the remaining thirteen (13) Canal Commands, the canals are still being managed by Sindh irrigation Department under the Sindh Irrigation Act of 1879.

For moving towards Integrated Water Resources Management and more effective service delivery, important adjustments in the legal arrangements are required. Some of these have to do with current inconsistencies in the Irrigation and Drainage Act 1879 and the Sindh Water Management Ordinance 2002. A new unified Law is required that will replace these two legal documents. The scope of the new unified Law is to create the basis to manage water resources and ensure effective water management in the canal and drainage systems, in the wetlands and the Delta, in the drylands and in support of all water functions, including the supply of water of adequate quality for urban and rural consumers. This new Law will create the formal basis for the new institutions in integrated water resource management. Sindh Irrigation Department (SID) is already engaged in activities related to water resources management and development in the province. Thus, there is an urgent need that SID be restructured as Sindh Water Resources Management Department (SWRMD).

There are important deficiencies in the legal underpinning of water resource management that need to be addressed too. A main area is the management of water quality. The prevailing legislation (in particular, the Sindh Environmental Protection Act) is too weak a legal framework for the control of water pollution under current circumstances in the province. It is relying on the setting of emission (concentration) standards and the booking of pollution offences. Instead, emission standards need to be specified as binding and conditions in an individual discharge permit for each authorized point of discharge by reference to the quality objectives of the receiving waters.

A second priority area is the management of groundwater. At present there is no regulation to control over-extraction of groundwater. This needs to change and the right to impose restrictions and acknowledge local regulation needs to be covered by law. Recently, a licensing committee has been constituted to review, regulate and monitor the commercial use of subsoil water in pursuance of an order of the Supreme Court issued in December 2018.

Thirdly, a more robust regulation in water supply and sanitation is required. Non functionality is particularly high in Sindh as is the extent of contamination of drinking water systems. As access to quality water is a human right, better monitoring and enforcement of water supply performance is required upon each canal as its water is also used for drinking purpose. New legislation should help protect the water resources for urban and rural water supply.

Fourth is the control of direct outlets from canals, distributaries, and minors. Over time these direct outlets have increased in number, either by official sanction or by local powerplay. These direct outlets play havoc with the capacity to manage canals hydraulically and create huge inequity, as they will always have water delivery, no matter what the water levels are in the canals. An immediate all-out ban on new water outlets is required and the power to sanction these on whatever reason needs to be withdrawn. For the existing sanctioned outlets tailormade plan needs to be prepared to see which outlets can be relocated or provided with control structures and which ones not. Non-sanctioned outlets need to be phased out.

Concomitant with the legal reform, the enforcement capacity needs to be assessed – to make sure there is enough enforcement capacity, transparency, awareness, and access to legislation by those affected to make the legislation an instrument for good water management.

Karachi Water Supply and Sewerage Board and other Metropolitan corporations in the province will be linked with the SWRMD to manage supply of water and recovery of water charges. Industries consuming water shall be provided a framework to deliberate and get allocated the water for their production needs. The water allocations to the canal system of Sindh protected under the Water Apportionment Accord 1991 will have the priority whilst at the same time water efficiency improvements will be made effective.

Experimentation of institutional reforms over a period of 18 years demands that based on the experiences a workable system using the principles of participatory irrigation management (PIM) and IWRM shall be developed and implemented in all the canals. For this purpose, an in-house understanding and ownership within SWRMD has to be developed for an agreed model of institutional reforms. This would help to address the current issue, where two levels of water governance systems at the canal level can be replaced with an agreed model of Institutional reforms and Water governance. The role of SIDA be converted into the Reforms Directorate under the SWRMD to work in all Canal Commands in the Province of Sindh. Once an agreed system of institutional reforms is introduced; the reforms process will start producing

the positive results. There is no option available for reversal to the old system, as province of Sindh will be facing severe challenges in the future, which demands that the planning, monitoring, policy and regulation of water resources management and development shall be separated from the service delivery. This aspect is rather more important after the 18th amendment, where some of the roles of WAPDA have been handed over to the provinces. But no effort has been made to look in, to the revised role of SID in the lower Indus basin for the holistic investigation and research for the Surface and Groundwater, Arid regions, coastal and deltaic regions, linking climate change impacts in future planning, Water Availability, and the assessment of the upper riparian infrastructure impacts on Lower Indus basin and on the Indus delta etc.

Finally, a comprehensive study is needed for the restructuring of SID in to SWRMD and allied directorates/institutions be also restructured to make them high performance institutions. Furthermore, there is a need to revise the Sindh Irrigation Act of 1879 in line with the revised SWMO 2002 so that all the regulations can be made in line with the concept of PIM, IWRM and FDM. Groundwater rights have not yet been introduced in the province and there is a need for conjunctive use of water through integrating surface and groundwater rights.

2.2 Policy Directions and Actions

The increased pressure on the water system in Sindh, makes the active and integrated management of water resource inevitable. This requires that the capacity and institutional arrangements are shored up, that effectiveness becomes the key word, and that one will move away from the fragmented and subsector approach towards an integrated approach including the multifunctional operation of the canal system and the protection and harnessing of resources in Sindh’s drylands, groundwater aquifers, wetlands, and Indus Delta. To make this possible, various policy directions and actions are required.

2.2.1 Establishment of Sindh Water Resources Council

The Sindh Water Resources Council shall be established with the following composition:

1. Chief Minister of Sindh	Chairperson
2. Minister for Irrigation (SWRMD)	Co-Chairperson
3. Minister for Agriculture	Member
4. Minister for Environment, Climate Change & Coastal Development	Member
5. Minister for Fisheries & Livestock	Member
6. Chief Secretary Sindh	Member
7. Chairperson P&D Board	Member
8. Secretary Agriculture	Member
9. Secretary Local Government	Member
10. Secretary Fisheries & Livestock	Member
11. Secretary Forest Department	Member
12. Secretary Industries and Commerce	Member
13. Chairperson Chamber of Commerce and Industries	Member
14. Secretary Irrigation (SWRMD)	Member/Secretary
15. Two Experts from Academia	Members
16. Any other co-opted Member	Member

The Chairperson and Members can designate another person from their organization to represent them in the SWRC meetings. The SWRC, in addition to following, will make all the necessary intervention in the water related fields.

- The Sindh Water Resources Council shall meet at least once a year and perform the following functions:
- Review and coordinate implementation of the Sindh Water Policy and periodic updating of the same.
- Recommend legislation, policies and strategies for water resources development and management.
- Planning and coordination for water resources development and management activities at provincial level to achieve objectives of policy.
- Review all major provincial water-related projects and activities in the fields of irrigation, drainage, flood control and hydropower.
- Promote multi stakeholders' participation and integrated water resources management.
- Review in consultation with concerned organizations the progress in controlling pollution of water bodies including rivers, streams, lakes and groundwater, canals, wetlands.
- Coordinating water resources database service at different level.
- Any other function for water resource development and management.

The Sindh Water Resources Management Department will serve as the Secretariat of the SWRC.

2.2.2 Sindh Water Policy Implementation Committee

The following Committee is proposed which will be responsible for the implementation of Sindh Water Policy. The composition of the Implementation Committee will be as follows:

1. Chairman P&D Board	Chairman
2. Secretary, Irrigation Department	Co-Chairman
3. Secretary, Fisheries & Livestock Department	Member
4. Secretary, Agriculture Department	Member
5. Secretary, LG Department	Member
6. Secretary, Envoir; Climate Change& Coastal Development Deptt:	Member
7. Secretary Energy Department	Member
8. Secretary, Industries Department	Member
9. Secretary, Forest Department	Member
10. Secretary Education	Member
11. Director General, PDMA	Member
12. Three renowned water experts	Member
13. Any other co-opted member	Member

The Implementation Committee shall meet twice in a year or more, frequently whenever deemed necessary to monitor the implementation of Sindh Water Policy.

2.2.3 Sindh Water Resources Management Department

Separate roles of policy, regulation, service delivery, water management, and water development through restructuring of SID & SIDA into a Sindh Water Resources Management Department (SWRMD) and introduce reforms in the associated institutions. The proposed concept for the restructuring of SID for the conduct of comprehensive study is presented in Figure 2.



Figure 2: Proposed concept for the restructuring of SID for the conduct of the comprehensive study

Sindh Water Resources Management Department (SWRMD):

Transform the Irrigation Department and Sindh Irrigation and Drainage Authority into Sindh Water Resources Management Department (SWRMD). The purpose is to broaden the mandate of the Irrigation Department and SIDA to include both irrigation and water resources management. International best practice is to consider water resource management and irrigation as two closely linked functions. Thus, the proposal is to restructure and transform the Irrigation Department/ SIDA into the Irrigation and Water Resources Department. The change of nomenclature is meant to develop and implement a plan for restructuring and capacity building for the Department to fulfil its functions. With change in nomenclature to IWRD, the scope and jurisdiction will be widened to cover all water resources and diversified usage, including hydel and navigation. This will include ensuring a professional irrigation service and rationalizing the Department's size over time and bring it in line with wider requirements, create broader professional capacity, and as well creating water resource management functions and expertise within the IWRD, in addition to basic functions of water transmission, management and utilization. The unified Sindh Irrigation and Water Resources Department would cover the

entire province, with a mandate for water resource management and sustainable delivery of water services. The Sindh Irrigation and Water Resources Department would include:

Canal Command Areas and Dryland Reforms Directorate

Canal Command Areas and Dryland Reforms Directorate become the facilitating agency to implement the massive transformation of the Area Water Boards, Farmer Organization and Water User Organizations (including outside the canal areas), to facilitate their creation of the new institutions and support and track their effective performance through capacity building, networking, and special events. To ensure adequate attention to areas outside the Indus Basin, dedicated unit for the dryland areas of Sindh would be established to manage special water resources management and the use of spate water and groundwater. The areas include Kohistan, the Nara, Thar desert and Delta area. Their management will represent a broad range of water uses – agricultural water use, public water supply, effluent disposal, flood and drought management, aquaculture, and the proper use of embankments.

Water Distribution, Conflict Resolution, and Inter-provincial and Intra-provincial Water Issues Directorate

This directorate will be responsible for addressing the concerns and issues related to water distribution, conflict resolution, inter-provincial and intra-provincial water issues. The Directorate will safeguard the Interprovincial Water related issues and strengthen the management of the SWRD and the SWRC in their discussions with other riparian's.

This Directorate will ensure the implementation of the Water Apportionment Accord 1991 and subsequent development in Accord and opposed by Sindh. Sindh's position on large dams and impacts of existing diversion and detention of water resources in upper riparian provinces will be the responsibility of this directorate to safeguard and to advise the government to safeguard rights of the Sindh and Indus delta.

Details of the problems and concerns analysed on the basis of data of water availability and use over the period of long-time and the positions taken by province of Sindh on different forums are place at Chapter No. 9.

Dams, Lakes Delta, and Wetlands Directorate

A special directorate will be created which includes the functions of the Small Dams Organization.

Wetlands in Sindh serve as water buffers and provide societal benefits. They generate food and fiber and are a habitat for fish and wildlife, including threatened and endangered species. They can improve water quality, help to slow down flooding and serve to recharge ground water, and contribute to shoreline erosion control. They also generate opportunities for recreation, education, and research and are cultural assets.

Wetlands benefits can be huge. Apart from economic benefits wetlands act as important carbon sinks and climate stabilizers and breeding grounds of birds, mammals, reptiles, amphibians, fish, invertebrate species, and other aquatic life. Out of 20,000 species of fish in the world, about 40% of all the world species live and breed in wetlands. In Sindh the Chotiari Wetland Complex for instance provides refuge to at least twelve globally threatened and eight near threatened species.

But unfortunately, the lakes and wetlands in Sindh are under inordinate pressure and risk. The threats to wetlands of Sindh are both anthropogenic and natural. They are unavailability of fresh

water, uncontrolled abstraction, disposal of untreated industrial and agricultural effluent, encroachment, siltation and shrinkage, threat to native flora and fauna species by invasive exotic species, illegal hunting, overgrazing and uncontrolled logging. In addition to low rainfall, high evaporation rate, coastal erosion, drought, and the incessant impact of a burgeoning population are aggravating wetland's situation. Manchar Lake, Asia's largest freshwater lake is exemplary of all the wetland predicaments: severely degraded by the inflow of RBOD contaminated drainage water from the completed upper part of the Right Bank Outfall Drain, its food system has collapsed and more than 50% of its people are suffering from malnutrition, whereas skin diseases are rampant. At the same time the recent flood showed how important proper flood buffering functions are of Manchar Lake (and several other wetlands). Several other wetland areas – as the Dhoras – have disappeared and their land has been converted for agricultural use for instance. In several instance bird migration to Sindh's wetlands has diminished: an example is the huge populations of Siberian cranes that no longer stay over in Sindh in large numbers. Many of Ramsar wetlands in Sindh are heavily polluted and in miserable and unhygienic condition.

Groundwater, Drainage & Water Quality Directorate

This Directorate will be dealing with the policy, planning, allocation, regulation and the operation & maintenance of important vital parts of the system – such as the Salinity Control and Reclamation Project (SCARP), Left Bank Outfall Drain (LBOD) or the Right Bank Outfall Drain (RBOD). This department will also work on strategies to reduce water logging and to ensure the safe and where possible beneficial evacuation and retention of stormwater. This hitherto is much obstructed as natural drainage lines have become closed and flood water patterns have been distorted by roads, canal and drainage embankments and ill-planned housing.

Flood Mechanism, Planning, Management & River Management Directorate

To ensure adequate operation and maintenance of the three barrages, including the flood embankments; maintain accurate flow measurements and monitoring systems via SCADA (supervisory control and data acquisition), deliver water to Canal Commands in accordance with agreed optimized allocations as stipulated in seasonal Water Allocation Plans adopted by IWDID during the seasonal planning meeting with IRSA. A major concern in the Water Allocation plans will be the reduction of waterlogging by curtailing excess water delivery and repurposing this elsewhere in the canal systems. The Barrage Management Unit will ensure the functioning (including avoiding high ponding of the barrages, the safe passage of floods and the handling of sedimentation, the structural integrity of the embankments and adequate flood and drought management strategies for the barrages. The Directorate will also look at the main Indus river system, where the construction of bridges and (unauthorized) bunds and the conversion of flood plains into farm land has severely affected the capacity of the Indus River to deal with high flood situations. The Directorate will

Irrigation Water Distribution & Infrastructure Development Directorate (IWDID)

Irrigation Water Distribution & Infrastructure Development Directorate (IWDID) that would serve as the secretariat of the Sindh Water Resources Council and that would set service standards and establish a water resource monitoring system and audit and track the performance of the water system – in terms of water resource balance, water quality, ecological values, and water services delivery; prepare annual Water Resource Management Report and cause five yearly Sindh Water Plans to be prepared.

Hydro-Agro Informatic Centre

The Hydro-Agro- Information Centre (HAI) will be established to monitor, analyse, interpret, and inform to the government & the stakeholders on all issues of water resources. The HAI will proactively share relevant information to stakeholders. The HAI will work on the auspices of the SWRMD and may be an integral part of it or be outsourced to a relevant research organization in the Province.

The TORs and the revised structure of each Directorate/Institution will be drafted and implemented with the due authorization of Provincial Water Council led by the Chief Minister Sindh. The aim would be to broaden the responsibilities base to fill the gaps in water resources management in the province of Sindh and also to achieve the intended objective mentioned under the Sindh Water Policy.

2.2.4 Water Governance Mechanism and Governance Actions

Water governance mechanism and key policy actions related to water governance, management of water resources, water quality and flood resilience are identified and presented as under (Figures 3, 4, 5 and 6).

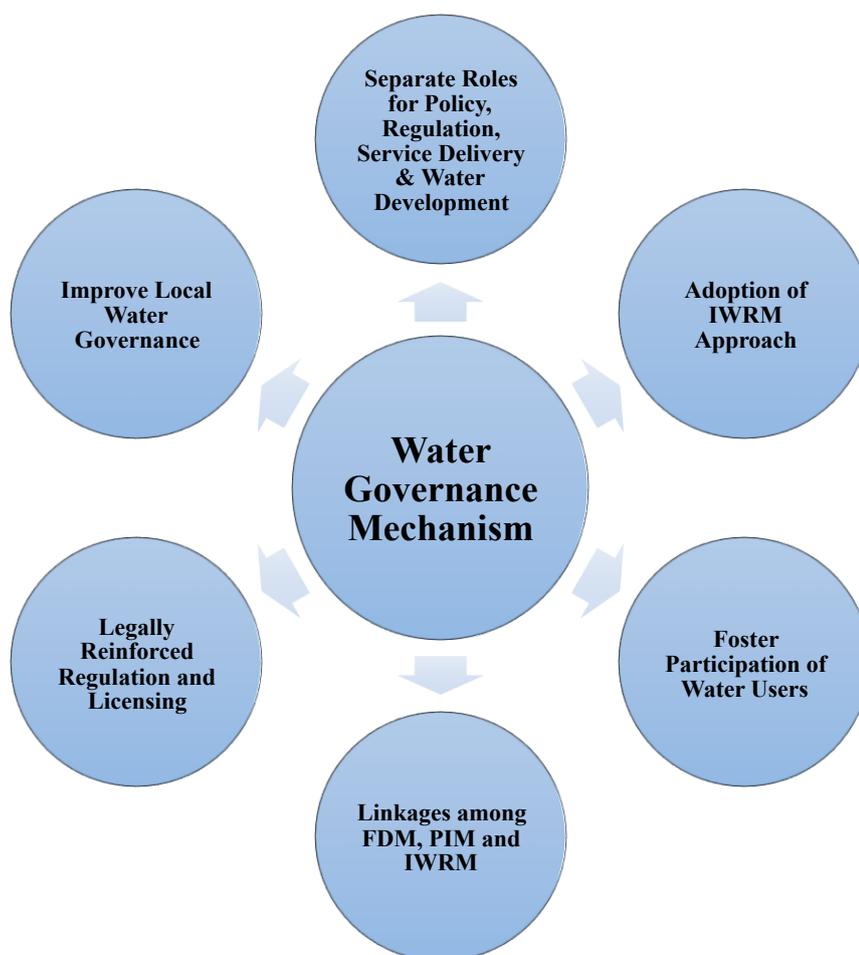


Figure 3: Water Governance Mechanism

Figure 3 presents the water governance mechanism with following key components:

1. Separate roles of policy, regulations, service delivery, water management, and water development through restructuring of Sindh Irrigation Department and SIDA into a Sindh Water Resources Management Department (SWRMD) and introduce reforms in the associated institutions. Further details of SWRMD have been discussed in the above section.
2. Adoption of IWRM approach at the basin or sub-basin level covering all sources of water (surface water, groundwater, and wastewater) and all sub-sectors of water use (domestic, agriculture, fisheries, industrial, commercial and environment).
3. Foster full participation of water users including agriculture, municipality, industries and environment in operation, management, and maintenance to ensure water availability.
4. Develop and introduce effective linkages among Flood and Drought Management (FDM), Participatory Irrigation Management (PIM), and Integrated Water Resource Management (IWRM) for effective planning, management, and development of water resources to mitigate the impacts of droughts and floods.
5. Prepare and enforce appropriate legislation for licensing of groundwater, surface water in areas outside the Indus basin canal commands and disposal of treated effluents to improve water governance.
6. Improve local water governance through enforcement merit system, control rent seeking and water theft.



Figure 4: Key Governance Actions for Managing Water Resources

Figure 4 presents the following key governance actions:

1. Develop and introduce cost-effective and efficient operation and maintenance (O&M) system for canal irrigation and water resources infrastructure to ensure equitable distribution of water in volumetric terms by reducing water conveyance losses and effective conservation of the surface water and groundwater.
2. The principle is envisaged to improve recovery of water charges (Abiana for irrigation and water charges for other users) and introduce phase-wise increase in water charges to recover the full cost of O&M. The tariffs for agriculture, domestic, industry and other uses will be devised in different areas of the province. In addition, supplementary revenue will be developed such as the exploitation of water reservoirs for recreation, the planting of tree on canal embankments and the recovery of water front property.
3. Introduce and maintain water entitlements and water availability to improve water equity a in all water related sectors.
4. Provision of knowledge and technical support to water users by the public-sector institutions and private sector for the provision of supplies and services for water use and crop production technology
5. Enforce regulation of tube-wells and wells for safe extraction of groundwater considering the site-specific aquifer conditions in different ecosystems.
6. Enforce a system of separate disposal of sewage, industrial effluents and storm water, to ensure cost-effective treatment of three types of wastewaters and use of treated water as a resource and control pollution of freshwater bodies.

Although separate disposal of sewage, industrial effluents and storm water, and treatment of wastewater will solve some of the problems of water quality, there is a need for special attention on different dimensions of water quality.

In the canal commands of Sindh, around 21.3 million tons of salts are being added from surface and groundwater. This is a sizable amount of addition of salts in a relatively smaller canal command area and thus farmers are losing crop productivity, as the drainage system is still not effective in draining out major parts of annual addition of salts to the basin.

The Indus River is polluted as quality parameters are now having higher concentration than the safe limits. Even the coliform level, which should have not been present in water bodies at all, averaged 8 per ml. The Indus River is polluted due to disposal of untreated domestic and industrial effluents. The Manchar Lake make the pollution in River Indus further distinct during periods of low flows (December-January). The sources of contamination of the Manchar lake are the Main Nara Valley Drain (RBOD-I) collecting the drainage effluents of Hairdin drain (bringing the effluent from Baluchistan), RBOD-III (draining the effluents Jacobabad, Kandhkot, Qambar-Shahdakot), Miro Khan Drainage network (providing disposal facility to two SCARP Division to control waterlogging and salinity problems in districts of Shikarpur, Larkana), and the Ghar Drainage network (providing drainage facility in district Dadu discharges). The water of Manchar lake is very toxic, which has polluted underground aquifers in the surrounding areas, and thus residents of those areas do not have any alternative sources

of drinking water. Supreme court of Pakistan has notified to release irrigation water for dilution of Manchar lake polluted water to resolve this issue.

Water pollution in the Indus River system results from three major sources: a) entry of untreated domestic effluents from the large urban towns; b) untreated industrial effluents; and c) return-flows from agricultural lands through agricultural drainage system. Most cities and towns of Sindh dispose their untreated domestic effluents into the Indus or even worse in some of the canal systems, playing havoc with the health of downstream users. Even if the treatment facility is provided, lack of monitoring results in lack of effectivity of the treatment process.

Water quality variability also depends on hydrological regime of the Indus River. Dissolved substances in river water are highly variable from one location to another, depending on their sources, pathways, and interactions with particulates.

There is a lack of coordination between EPA, SID, SIDA and law enforcing agencies. Without this coordination, nothing concrete can be achieved in managing quality of surface waters. The issue is largely of water governance and enforcement.

During 2010, 3.03 million ha in the Indus basin canal commands are severely waterlogged and 4.23 million ha are waterlogged having water table depth of <3 m. This is an indicator that 85% of the surveyed area is facing problem of waterlogging and groundwater is normally of marginal to brackish in quality.

Based on surveys conducted for surface and profile salinity, around 61% area in the province is classified as saline, saline-sodic or sodic. Rest of the 39% area is salt free in terms of profile salinity.

About 28% area in canal commands has fresh groundwater suitable for agriculture. However, thin layer of fresh groundwater is available in most of the canal commands, and this can be skimmed using skimming wells and tube-wells. A balancing of surface water delivery will help in this regard too. Quality of deep groundwater varies widely, ranging from <1,000 ppm to >3000 ppm. Some 1.4 million ha are underlain with thin fresh groundwater layer having salinity of <1000 ppm and 3.6 million ha with salinity of >1000 ppm.

Although, in certain cases saline groundwater is mixed with irrigation water, yet salts enter into the soils as a result of irrigation. Sustainability of groundwater for irrigation and municipal uses demands achieving salt balance in groundwater and irrigation system. Salt balance in groundwater and root zone is of same significance for crop production.

In the canal commands, the untreated domestic and industrial effluents are disposed to the water bodies through the drainage system which ultimately enters to the freshwater systems as the drainage system is not effectively working. There is a need to develop effective coordination with Sindh EPA so that entry of untreated effluents from domestic and industrial sources can be controlled. Most of the required legislation and regulatory framework is available with EPA and SID. The real question is that how to enforce such regulations. We must keep in mind that in Sindh still a major segment of rural population is dependent on canal supplies for meeting their domestic needs in saline groundwater zone.

The protection of quality of surface and groundwater is equally important like management of water quantity. There is a need for identification of key policy reforms related to pollution and

quality of surface and groundwater. Six key governance actions have been identified related to protection of water quality and are presented as under (Figure 5).



Figure 5: Key Governance Actions for Water Quality

1. Maintain health of the Indus River system through monitoring of surface water quality and enforce legislations to plug the entry of untreated effluents into the river system.
2. Develop water quality standard and monitor water quality of surface water, groundwater, and treated wastewater to ensure disposal of zero-risk treated effluents into the Indus River system.
3. Develop or refine existing water quality standards for drinking water, stock water, irrigation, aquaculture, and poultry.
4. Ensure effective enforcement of managing the health of surface water and aquifers in the province.
5. Provide knowledge and technical backstop support to municipalities and industries to treat/manage effluents along with enforcement of laws and regulations for not disposing the untreated effluents into the freshwater systems.
6. Create awareness and initiate programs for education of civil society to make ‘water as business for everyone’.

Figure 6 presents the key governance actions to foster flood resilience. With five floods in the last 12 years, including two mega-floods covering more than half of the province with inundation lasting several months, the need for better flood resilience and coordinated spatial planning is paramount. The effect of the floods came particularly hard down in the poorest areas on the poorest people. The devastating floods are caused by a combination of climate change triggered inordinate rainfall in the country and a compromised capacity to handle and drain away the excess water. There is a need to move to a ‘never again’ and avoid the destruction that now occurs. This requires a number of governance actions.

1. Safeguard the capacity of the Indus River to evacuate floods. This capacity is now heavily compromised due to conversion of the flood plains in more or less permanent farm land, including the construction of roads and settlements. This has replaced the official system of temporary occupation of the flood plain. It needs to be worked through area by area how this can be partly reversed creating more space for the rivers, for instance by creating inundable roads.

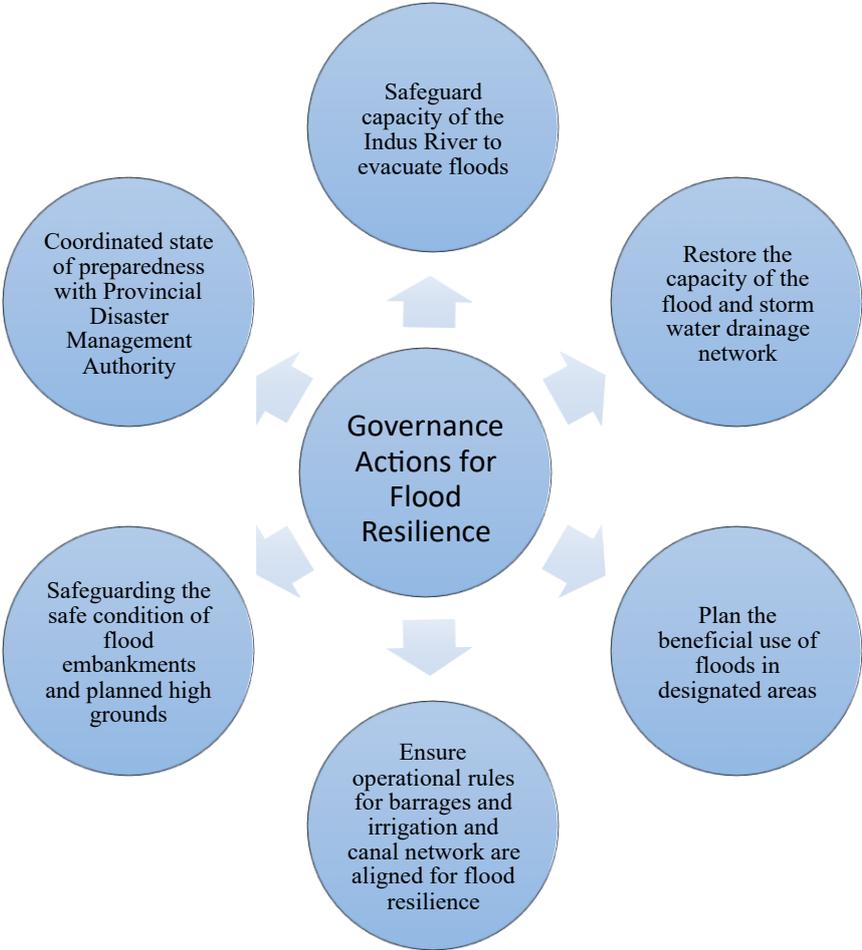


Figure 6: Key Governance Actions in Flood Resilience

3. Management of Canal and Drainage System

3.1 Challenges

The canal system is key to Sindh's present and future. Ever since it was introduced it has sustained Sindh's agricultural economy. Over the years the irrigation system has been stretched yet it has also been miraculously able to cope with the increased demands and pressures. A single telling indicator here are the cropping intensities, these now stand at 150%, way beyond the 90% foreseen at the development of the system. These increases are however inequitable and distributed against often unauthorized expanded land and crop intensity in the upper reaches. We have dried up tails of distributaries and minors, especially in Lower Sindh. Moreover, the canal system is vital, because of the multiple services it provides to Sindh's population and economy. The canal system does not only provide water to the crops, but also to households for domestic purposes, livestock, aquaculture, industries, environment, and power houses. However, the wastewater generated from industries, power houses and municipal water users is disposed of into the fresh water without treatment, and it thus pollutes the fresh water, which is ultimately used for domestic purpose downstream. The way the canal system is managed defines whether droughts and floods in Sindh are mitigated or amplified. The canal system is the defining element in the landscape in Sindh and the driving factor in public health. As the population of Sindh increases and the economy develops, the pressure on the canal system services only intensifies.

At the same time the canal and drainage system are not performing well. Water logging in Sindh remains endemic, as mentioned, and covers (depending on the season), 20 to 70% of the canal commands. This stifles agricultural production, brings salinity to the surface, and creates an unhealthy rural environment with higher incidence of water borne diseases and limited options for rural sanitation. Water logging is caused by a combination of factors: irrigation duties that are inconsistent with current situation and that were never updated, distorted natural drainage due to the construction of roads and other infrastructure; poor field water management practice compounded by a lack of discipline in canal operations and political interference; water hoarding by farmers method driven by uncertainty for next round of irrigation. All this adds up to water not being used productively but causing environmental and social hazards.

Closely related to the widespread water logging and salinity, water productivity in Sindh, or in popular terms the 'crop per drop' is very low compared to other irrigation systems in South Asia. Part of the explanation is the climate in Sindh and the crop varieties in use. But also, part of the explanation is in the poor way water is being managed with little attention in many areas to proper field water management and the lack of conjunctive management. This also translated in huge inequities in the systems, with some upstream areas oversupplied by theft or illegal devices and others in downstream deprived of water. For the canal system 65% of the water is lost through non-beneficial evaporation, meaning the water is not used for crop production.

There is a growing realization that this inequity and overuse is fuelled by the presence of many high-water consuming crops with sugar and rice topping the bill. The cropping pattern for many canal commands and sub-commands is not in line with official water availability, agroecological zoning, soils, local aquifer characteristics and drainage coefficients. Yet these highwater consuming crops are at the same time promoted through several public incentives. There is a need to reconsider the cropping patterns in Sindh and give more space for low delta crops and for salt tolerant crops and varieties.

Also, in spite of its de facto serving so many essential functions in Sindh, the canal systems are not managed in an integrated multifunctional manner. Rather the opposite: though canal management holds the key to urban and rural water supply, public health, flood protection, greening, recreation, and transport, it is primarily managed for irrigation delivery. This is the cause of a range of issues, a major one being the poor quality of the water in the canals. The reason is that the canal system receives large quantities of untreated effluents by cities, industrial estates, and sugar mills in spite of important downstream use as the source of drinking water or process water. The result is high levels of toxins being released into the human system. As the population of Sindh increases the long-term safe water resource availability need to be secured for cities and rural settlements, for the population and their economic activities and for agricultural water users in vast tail areas.

The poor performance both as an agricultural water utility and as a multi-functional system has its pendant in the institutional performance with the canal system primarily managed as an irrigation asset with little room for water resources management. In the last two decades, moreover, a dichotomy has developed with the canal system, now managed under two different regimes, the direct control under the Irrigation and Power Department and the more autonomous management of other canal systems under the Sindh Irrigation and Drainage Authority. There is a need to unify the systems and come to a consolidated integrated institutional system where the integrated management of water resources has the central place it deserves besides the adequate multi-functional management of the canal infrastructures. This was addressed in section 3.1 of this Sindh Water Policy.

Equally, the financial performance is worrying. There is no secure base for the financing of the canal system. As a result, important tasks do not get done, such as the desilting of canals / distributaries or the upkeep of drainage facilities. The collection of the abiana water charges has been a source of concern for many years and rather than improving now stands at less than 6% of the target. The fees as such are very low. Collection is now reaching the point of being negligible. Reasons are the overly complicated method of assessment and collection and the dwindling discipline to pay and to collect. A larger view on canal management financing is required, considering the multiple functions the canal system is serving.

3.2 Policy Directions and Actions

With regards the management of Sindh's canal systems there are four main policy directions:

- Optimize multifunctional management of the canal system
- Manage water resources in the canal system
- Improve water productivity and better managed production in saline areas
- Upgrading the financial management of the canal and drainage system.

The first policy direction is to respect and optimize the multiple functions that are served by the canal system: not only irrigation, but also drinking water supply, the environment, public health, and recreation. Water services to cities, villages and industries should be secure and safe. They should not be disturbed by breaches or canal closures. Most important the water quality in the canal system should be safeguarded. The untreated discharge of urban wastewater, industrial effluents and the wastewater of sugar mills should be monitored by Sindh Environmental Protection Agency strictly and should be stopped unless it is properly treated as per the effluent quality standard. Minimum safe standards should be guaranteed.

The second policy direction is to 'anag' water resources within the canal system. There is an urgent need to manage water resources within the canal system – to create more equity; to attenuate the effect of high rain fall and floods; or alternatively to create system storage for dry periods; to reduce water logging and importantly to conjunctively balance the use of surface water and groundwater in the canal system, considering the quality of the groundwater.

A third policy direction is to Improve water productivity – the crops and gainful jobs produced with the volume of water used. In close alliance with the Agricultural Policy of Sindh better water management at field level should be promoted, but also cropping patterns that align with water availability in a canal command combined with the careful use of inputs and selection of varieties.

A special concern under this policy direction is to manage crop production in saline conditions. Salinity is a feature in a large part of the canal system, but the use of salt tolerant crops and varieties combined with selective drainage or brackish water aquaculture can still provide rewarding returns.

The final policy direction under this burning issue of multifunctional water management is upgrading the financial management of the canal and drainage system. Despite its importance and despite the many functions the canal system serves, its basic operation and maintenance is underfunded with its basic expenditures depending on public subsidies or external funding. There should be adequate financial planning and budgeting for the running of this most vital infrastructure. The *abiana* system should be restructured and a wider range of functions should be charged to create a healthy financial basis for the system. Maintenance expenditures should be secured to ensure normal flow of sanctioned water.

3.2.1 Multifunctional management of canal and drainage systems

The first policy direction is to enhance the multifunctional management of the canal and drainage systems and in particular the vital role of the system in water supply, sanitation, and wastewater transport in addition to other functions.

The irrigation system is the defining element of the landscape of Sindh. It provides irrigation water but serves so many other purposes. Water is used for agriculture but also for fishery, water supply for towns, villages, construction, and industries and for bathing (animals), washing and laundry. The network of canals and embankments is furthermore used for local transport, for planting trees and for collecting sand during canal closure periods. The irrigation system is the cause of widespread water logging and salinity. This affects public health: high water tables cause a range of human and livestock diseases and may preclude the development of standard latrines. All these functions are mainly unmanaged but should be systematically incorporated in the management of the canals and drains – including the canal closures. The uncontrolled discharge of effluents in canals is another factor that negatively affects public health, especially where polluted water is used for drinking water downstream. There are moreover many 'opportunities foregone': there is much scope to make better use of the canal systems for other functions as well. An example is for instance tourism or water-front property development. One can take the example of Keenjhar Lake that is within relatively short distance from Karachi and can serve as a well-developed destination of day tourism. By doing so jobs would be created and valuable income for canal management could be generated. The polluted industrial untreated wastewater is released to Keenjhar lake during Hill torrents. The discharge of untreated effluents upstream of the lake should be stopped. Furthermore, Keenjhar which provides water to Karachi, Thatta and Jamshoro district, faces acute shortage during winter

season. To face the water crisis, a storage / Sehwan basin needs to be established at Amri bridge for augmentation of this stored water for above areas.

The multifunctional use of the irrigation systems should be systematically developed and addressed by having **multi-functional water plans** for at least every canal command. The canal level multi-functional water plans should align with the Sindh Water Planning Process. These multi-functional plans will optimize the delivery of all services: storage (including new options), irrigation, flood management, transport, fisheries. Drinking water is accepted as a human right in Sindh and should have high priority in such plans. This would require the elimination of untreated wastewater discharge from industries, sugar mills and urban areas into the canal system, the more so where there are large number of downstream drinking water users. The effluent closure program of the water utilities provides good lessons. Furthermore, creative solutions should be promoted: part of the wastewater of sugar mills can be converted into useable products. Similarly, when drains carry heavily contaminated agricultural return flows, they should not discharge into the canal system. Where communities depend on canal water for their domestic supplies and stock water, canal closures should be arranged to minimize hardship for domestic users. In areas with high saline groundwater, as common in Sindh, rural water supplies often depend on small freshwater lenses that are fed by the freshwater seepage from canals, and they need to be preserved as such.

In the improved multi-functional management of the canal and drainage system better flood management should be factored in. The response of the canal and drainage operations to high rainfall events determines very much the extent of the flood events created. As is witnessed in the last ten years, climate change comes with more monsoon disturbance over the western part of the Indian ocean and the frequency of high rainfall events increases. To prepare for such events, the water management in the canal system needs to be updated – reassessing the inflows but also modifying standing procedures on closing gates, bans on drainage evacuation, creating of additional overflows, preferably to areas where the excess water can be productively used. A good example is with the Main Left Bank Outfall Drain (LBOD) where escape structures could relieve the spinal drain and reduce the amount of storm water accumulating in Badin and instead using this excess water to recharge desert aquifers along the route of the Outfall Drain. Similarly, escapes are required to release flood water of RBOD for direct discharge into the Indus river. In general, more use should be made of flood water, including the possible activation of the old Hakra River by high flow supplies. The surplus flood water can also be diverted to Achro Thar (white desert) for irrigation. At the same time, the canal system needs to be prepared for drought situations too. Given the flat topography the scope for surface storage within the canal system is limited, but more effort can be made to store high flows in the aquifer system by routing water to areas underlain with sandy aquifers with during peak flows.

3.2.2 Manage water resources in the canal system

There is an urgent need to improve management of water resources within the canal system, under the guidance of the Sindh Water Resources Council. The current water budgets were prepared at the time of the commissioning of the barrages, but they are no longer valid. Many changes have occurred in Sindh's water system in the last decades.

This is the single most important method to address sustainability, inequity, waterlogging and even to free up water for other uses. In Sindh the area under waterlogging ranges varies from 51% to 69% - with the area under waterlogging significantly reduced after a drought. This suggests that in several areas waterlogging can be brought down by rationalizing and reducing water deliveries.

There is also need of optimizing water supplies, promoting conjunctive management of surface and groundwater and systematic reuse of drainage water where water quality allows, enforcing discipline in water deliveries and reducing the cultivation of high delta crops, water could be saved that can be used to serve tail areas, to restore environmental flows, to secure water for a variety of needs and to even expand the area under irrigation. Crop-specific conditions can be considered such as water-saving irrigation for oilseeds or bans of highly water demanding crops. The multiple natural depression and lakes, which are more than 500 in numbers, shall as far as possible be rehabilitated and upgraded to store surplus flood water, rainwater, or hill torrent excess flows. Saving of agriculture water during monsoon may shall also be diverted in these lakes.

Another reason why it is high priority is to review the water entitlements and water distribution of the different canal systems is the increased use of groundwater, in canal commands or subcommands where the shallow groundwater is fresh. The recent study of PCRWR establish that in nearly 20% of the canal area groundwater is respectively of fresh or marginal quality (Iqbal et al. 2020). In such areas it is important to move to introduce conjunctive management of groundwater and surface water. Here good balances can be struck with the rationalized canal supplies recharging the aquifers and the groundwater being used to maintain water levels at appropriate depth and not causing waterlogging. At the same time groundwater use should be controlled to avoid up-coning from deeper saline levels, risking turning fresh water brackish. Particularly for the canal command with ample freshwater supplies, such conjunctive management strategies should be developed. Canal lining practice should be aligned, acknowledging the importance of seepage of canal supplies to feed fresh groundwater areas, and scattered freshwater lenses.

3.2.3 Improve Water Productivity and Promote Bio-Saline Water Use

The water agenda in Sindh needs to be complemented by an important agricultural agenda. The aim is to manage water demand and at the same time increase water productivity. Part of this is to promote the productive use of land and water in salt-affected areas, that are widespread in Sindh.

A first policy implication is to systematically promote improved water use in agriculture. There are many methods to be more precise in farming and in the process save water, labour and farm inputs whilst obtaining higher yields. Land levelling for instance can make a huge difference and can pay for itself from the cost saving. Even so it is not widespread. There is a gamut of smart water techniques that should become common practice from the use of soil improving agents, to field water practice, to alternative wetting and drying, to better water scheduling to the use of micro-irrigation systems. The popularization of these system can give rise to a local service sector in smart technologies. Other water saving can come from better crop varieties and better farm inputs – achieving more crop per drop. Water productivity is considerably low in Sindh as well as in overall Pakistan. As per FAO (2021), irrigation agriculture water productivity in Pakistan is USD 0.30 per cubic meter, which is much lower than the figures elsewhere in the mega-systems of the region. Yield gaps – the difference between actual and realistically achievable yields – are 30-60%.

A second main policy Implication to manage demand Is to bring the cropping pattern in line with water availability for the entire designated command area and the respective agroecological zones, as being redefined. This will require the reduction of the cultivation of highwater demand crops in Sindh, particularly, sugar and rice outside the kharif season. The water requirements for these crops are three to five times higher than they are for oilseeds and

pulses for instances. The area under sugar cane and rice nevertheless has increased by 30% over the last decade.

Many of high-water demand crops – even when causing imbalance in the Sindh water system – are stimulated under a range of public support measures, be it guaranteed procurement prices or intervention prices, export subsidies, cash freight support, fertilizer subsidies, subsidies on farm machinery or outdated water taxes. The cultivation of the high-water demand crops is also stimulated by reducing market risk from procurement systems and import levies or the support from agricultural research for new varieties of these high-water demand crops. As has been decided in the Sindh Agricultural Policy such high-water demand crops should be replaced with other crops and the public incentive system should be fairly implemented and support crops that are in line with Sindh's revised agro-ecological zones. This requires an overhaul of the financial and other agriculture support arrangements and in some areas outright bans. There is also a need that where high delta crops remain in use to introduce water saving methods, as for instance dry rice cultivation or alternative wetting and drying.

Then there is also a need to promote agriculture and fisheries that is in line with the special conditions of Sindh, in particular the widespread salinity. Apart from special bio-saline plants, many common crops have varieties that are surprisingly salt tolerant in particular if combined with good agronomic practices. A good example is the cultivation of salt tolerant potatoes on well drained lands with saline water – with yields as high as in freshwater areas. Closely related to this is the promotion of aquaculture, that is far less widespread in Sindh than it could be. Yet brackish and saline fish farming, even using drainage water, can be highly rewarding and need to be supported by market chains and supply support. In cropping patterns, plants producing biofuels with low water requirements should be emphasized on the marginal lands where food and fiber crops cannot be cultivated. This will also address the national energy problem. An example for consideration is the *Jatropha* plant in the marginal land of Thatta district.

3.2.4 Get the Financing System Right

At one stage in the past the *abiana* covered all costs of the canal system and even gave a surplus. This now seems far away as even the basic upkeep of the canal system especially in the tail ends is neglected. Also, although they are essential part of the water system in Sindh, drainage facilities have no secure financial basis, as is clear from the drainage pumping stations that are not in working order and surface drains that are never desilted.

Low *abiana* rates and a constantly declining assessment make it less and less worth the effort to collect *abiana*. The *abiana* system needs to be vastly simplified based on land and irrigation duties rather than the cumbersome system of crop assessment that is now in place. For collection deposits in local banks is the way forward. The rates need to gradually rise to be at the level of real values of at least what they were thirty years ago. This needs to be discussed with farmer representatives, so as to create acceptance. The proceedings moreover need to be retained by the managers of the canal – the Area Water Boards and the Water User Organizations, as was introduced in the reforms of 2002, and there should be no administrative constraints for the AWB and WUOs to use autonomously. The improved *abiana* collection needs to be complemented by bench marking to share the performance in a transparent manner and transparency through publicly available records, but also better enforcement such as the closure of water supplies to defaulting users.

Even so it is to be accepted that the abiana for the foreseeable future will only cover a portion of the running costs of the canal and drainage system. The long-term public support needs to be secured. Other possible sources of income from the canal system – from tree planting on canal banks, fishery rights, realistic water pricing for urban water supply, tourism charges or waterfront real estate- all need to come in place to create a healthy and vibrant system. Formally canal and canal banks assets belong to the Government of Sindh, but new levies and charges should be earmarked as income sources for the Area Water Boards. This will give system operators the drive to deliver quality services to non-agricultural users and at the same time strengthen their financial basis. To set this financial realignment in motion, a financial task force representing the main stakeholders should be set up to create broad understanding and support for these overdue financial adjustments. A related activity in financial realignment is the rationalization of expenditures within the main water service provides, in particular getting rid of redundant expenditures. An important is cost item in particular in the current irrigation budgets are the costs of running public SCARP tube-wells. Many of these are either long out of order or used for private irrigation, yet electricity costs are still being charged to the Government of Sindh. The smooth decommissioning of these public tube-wells would be a major contribution to more balanced budget for the operation of the canal and drainage system. Efforts are required to switch over from electrically operated to solar energy operated tubewells.

4. Water Management in Dryland Areas

4.1 Challenges

There are large and important areas in Sindh where water supply, agriculture and livestock keeping depend on the effective use of rain run off or floods. These are the dryland areas outside the Indus Basin Irrigation System – the Kohistan area in the West, the Nara and Thar deserts in the East – covering 60% of the province.

These dry land areas have received far less attention than the Indus Basin canal areas. Large areas are deprived of social amenities such as roads, hospitals, schools, and cottage industries. However, they are home to a vulnerable population whose well-being depends to a large extent on how these more sporadic waters are managed. As water scarcity becomes manifest in Sindh, more attention is required for the dryland water resources. These areas also witness dynamic change, as can be seen from the settlement land cover expanding five-fold in the last ten years and the steadily increasing livestock population, especially sheep and goats.

The Tando Jam Declaration of 2015 which brought together more than 300 experts and practitioners from Sindh and abroad called for the mainstreaming of such dry land systems, including the development of spate irrigation systems and the recognition of the water rights of these systems. There are indications that with climate change and changed weather depression over the Indian Ocean rainfall in Sindh will change and torrential rains will become more common and that it becomes ever more important to productively harness the water in the drylands.

The Interventions in the Sindh dryland areas have been few and far between. They have by and large also not made the impact expected. There has been an emphasis on the construction of dams – which of course help to improve the groundwater storage and quality of drinking water, but not all these dams have lived up to expectations. They are often not filled with water and accumulated significant amounts of sediment. The existing hydrology of the rivers has been disturbed and affected to the detriment of downstream uses and their established rights of usage.

They have often left the population in these areas not better off – rather sometimes even the opposite. In principle if planned well and integrated with the local society and aligned with the hydrology they can render good benefits.

An emerging trend In these dryland”area’ of the province is the rapidly increasing use of groundwater. This is driven by the emergence of solar pumping – which no longer is putting a price on water abstraction. Because the aquifer systems are fragile and sometime underlain with saline water, utmost care is required, as this very scarce resource for vital drinking water and high value uses is rapidly lost.

Similarly, there has been little attention for the improvement of the rangelands in these dry areas, even though they sustain a considerable population and make a significant contribution to food security of the province. Unlike other parts of the world, there has been no effort to improve the quality of these areas by retaining their water resources, improving grazing practice or add to the quality of the rangelands. This constitutes an opportunity lost.

4.2 Policy Directions and Actions

The main challenge as part of the Water Policy is to improve the capture and use of rain runoff and flood water in the dryland parts of Sindh in sustainable manner for the benefit of the population. There are many opportunities in these areas that have not been utilized to better harness, utilize, and protect the land and water resources. Currently, a major part flows into the Indus River and only a small volume is captured for beneficial use by the local farmers. If this water is properly harnessed, stored and utilized, it will add a significant volume into to dwindling water resources. Also, a significant arable land can be cultivated, and rangelands could be made more productive. To serve these dryland areas, there are four major policy directions:

- have an institutional home for the integrated development of the dry land areas – to ensure they have an anchor point – and to formally register the water entitlements in these areas.
- to work at watershed level for the development of the drylands – come to a uniform and an intensive approach, whereby a large range of options are used
- to better manage and develop the rangelands, that make large part of the drylands – by better retaining water and improving
- to promote judicious use of water – especially for these areas where water resources are scarce and even drinking water supply is insecure.

To operationalize this policy direction, changes are required in the institutional arrangements, in the approaches and techniques used, the capacity available and in the investment priorities. Most of all, much more attention needs to be given to the sustainable development of the drylands.

4.2.1 Institutional home for integrated dryland development

The dryland potential and water resources have no institutional home. The only public organization operating in the area is the Small Dams Organization, but it has a limited remit. Several NGOs do very useful work, but it is often on a project base. There is no water strategy for the dryland areas that addresses all aspects and covers all options, including optimized spate

irrigation systems, control of groundwater use, management of watershed and rangelands and safeguarding of domestic water supply.

The first point is to Institutionally acknowledge the existence of these systems as part of the mandate of the proposed IWRD – Irrigation and Water Resources Department. A retooled and renamed Small Dams Organization could function as an Area Water Board for the dryland areas with broader agenda – the development of the water catchments, the capture of run off and hill torrent water, the development of rangelands, the support to regulation of groundwater and in general the promotion of efficient and inclusive resource use, in spate irrigation and in rangeland improvement. Unlike Area Water Boards in the canal areas, the dryland Area Water Boards will not have a direct operational responsibility, but they will work to support the functioning of local Users' Organizations in the rangelands, in the spate irrigation systems and in the areas served by small dams. Proposed is to have one Dryland Area Water Board for Kohistan and one for the Thar and Nara Desert.

A second point in strengthening the Institutional anchor for dryland development concerns land and water tenure. Often the land and water rights are not clear, and the entitlements of longtime users may be jeopardized by new developments. Unlike other Provinces in Pakistan such entitlements are not recorded in the revenue rights. The access to run off, flood water and grazing grounds should be secured in the revenue system, as a basis for better land and water use. Entitlements of all lakes, small dams (inside and outside embankments) and spate irrigation systems including incoming and out-going water flow, catchment areas shall be arranged to be transferred in the Record of Revenue Rights. Securing these land and water rights is the lifeline of general people.

At present the capacity to make sustainable, efficient, and inclusive use of the drylands is largely absent – among user groups, among the organizations working in the area and among academia. A dedicated effort to enhance the capacity in dryland development is required. There is a need to a close integration of the activities of all who work in these important areas, and formulate a common strategy and approach, based on the good experiences of the different organizations working in the drylands. The Sindh Universities and vocational training centers need to work together to develop dedicated joint programs for lowland development.

4.2.2 Catchment management

To improve water utilization and water management in the dryland areas of Sindh it is important to look at the bigger picture and manage the water resources at the catchment level. There is a need to come to a uniform approach that connect local watershed and rangeland groups to the working of government and the support of civil society and other parties. The entitlement to the land needs to be addressed so that communities can safely protect and improve the land that now is in the ownership of the Board of Revenue or the Forestry Department. The watershed area of each stream in Kohistan and Thar desert needs to be demarcated with better understanding of the hydrology. This should serve different objectives: effective recharge and water and moisture conservation, improved land management including the rangelands; productive and sustainable use of water with special emphasis on groundwater and reducing flood damage. The harnessing of water for drinking water and stock water is of paramount importance.

Thus far, there has been – unlike other parts of the world - almost no investment in watershed management in Sindh – either by community or by public and private parties. There is a need

for an integrated approach, to retain water and wisely use it in the dry lands **as priority**, subarea by sub-area. The contribution of improved recharge and better water buffering to water security and climate change adaptation can be large. This should be done based on local planning and covering many options.

Given the low rainfall (less than 300 mm) in the dryland of Sindh recharge must concentrate in areas where run-off collects. There are several safe options for point recharge – other than the current practice of dam building: subsurface dams, leaky dams, cascade dams, improved spate irrigation, sand dams, bed raisers and bed stabilizers, infiltration galleries and off-stream storage. All these options will improve storage and enhance groundwater recharge. Moreover, the condition of the dry riverbeds should be preserved so that they retain their capacity to absorb flood flows and feed groundwater resources. This can be done by careful planning, regulating and in some cases even banning sand mining from such rivers, as was done for Malir River by the Supreme Court.

Investment in the dryland has so far often focused on dam development. Instead of developing dams solely, a broad range of opportunities should be triggered, including a much larger range of techniques to capture and store water as described above, methods to improve rangelands and investment in local water regulation and water productivity. For drinking water, investment may continue to provide the dryland areas with pipelines from the canal areas, where feasible.

4.2.3 Management of rangelands

Large parts of the dryland are in use as rangelands. These can be made more productive and at the same time can also be better used to retain run off and capture rainwater. There are many measures – controlled and sequenced grazing, revegetation, and landscape-based water harvesting. Also, road infrastructure may be used to capture water – to guide run-off to areas where it can be productively used.

Drinking water in the dryland areas is very important, as it is in many cases extremely scarce. This requires a wider range of water reticulation systems and the protection of the source for long term use. There has been very positive experience with the development of the drinking water ponds, collecting run-off: in many areas this has been the only possibility to develop a local resource and it needs to be combined with proper local water treatment and the use of geomembranes. In other areas dug wells can be developed or rehabilitated by combining them with water recharge.

4.2.4 Judicious use of water in drylands

The harnessing of the fragile water resources in the lowlands should go hand in hand with proper planning and sustainable use of water by introducing water saving technologies. Groundwater where it occurs is an essential asset, but it should be monitored, and its use should not be unregulated but controlled by community and government. Unfortunately, there is abundant evidence of declining groundwater tables and the conversion into brackish water in the dry land areas, ultimately jeopardizing the availability of drinking water – making it difficult to survive in these areas. Under the burning issue the monitoring of groundwater levels is to be strengthened. What is required is the introduction of local groundwater planning and licensing of abstraction points – combined with the careful use of groundwater. Local government and civil society should work together to create awareness and have community action on the setting rules.

At the same time there is a need to use water more productively and manage flood water and groundwater conjunctively. Yields in the dryland spate irrigation are low: around 300 kgs/acre for sorghum, 200 kgs/acre for oilseeds and 370 kgs per acre for wheat. In similar systems in other countries yield are more than double. This can be achieved by better field water management (better water distribution, better bunds, and better moisture storage) and better varieties. There is also much unused scope to market of niche crops, such as arugula, guar, or medicinal plants. Where ponds are in use, geomembrane sheets and other methods of pond management can increase effective storage.

5. Management of Water Dependent Ecosystems

5.1 Challenges

The area of the Indus basin canal commands in the province of Sindh is around 5.0 million ha (12.35 million acres), representing 35% of the geographical area of the province. This means that 65% geographical area of the province lies outside the Indus basin canal command. Number of ecosystems has been identified in the area outside the canal commands and major ecosystems dependent on water are: a) wetlands; b) Indus delta; c) Kirthar range and Kohistan; d) right side of the Indus river and riverine area; e) small dams; and f) Thar desert.

Wetlands

Sindh's wetlands are generally degrading due to a whole range of human inducted threats including: a) conversion of wetlands and their immediate surroundings for agriculture and other purposes; b) changes in water flow regimes; c) over harvesting of many forms of wetlands resources; d) felling of timber and deforestation of catchments areas in Kirthar range and Kohistan; d) organic and inorganic pollution of wetlands; and e) policy deficiencies and inadequate management.

The Sindh province can benefit from wetlands by sustenance for agriculture, grazing and fisheries, provision of vital habitat for wildlife, especially waterfowl, maintenance of water quality and abatement of pollution, flood and erosion control, maintenance of both surface and groundwater supplies, tourism, outdoor education, sports and recreation, and contribution to global climate control and stability.

The key barriers to create an enabling environment remained the lack of effective and integrated policies, absence of decision-making tools and reliable information to support effective wetlands conservation planning, technical deficiencies related to skills and equipment; and the lack of general public awareness or political pressure that favour wetlands conservation.

The most serious concern is the quality of water in the wetlands. SID is by and large a canal irrigation department and having less emphasis on management of water resources and water dependent ecosystems. The mandate and role of SID in future has to be expanded under Water Resources Management Department, covering all the aspects of water including watersheds, wetlands, Indus delta and deserts.

Indus Delta

Indus delta ecosystem is a part of overall water resources of Sindh. The ecological sustainability of Indus Delta is essential to manage canal irrigated agriculture. The framework for water dependent ecosystems has to be developed so that Indus Delta is managed in an ecologically sustainable manner. The major thing which will be required in the framework is to change mandate of SID from Sindh Water Resources Management and development so that it can effectively manage Indus Delta. This would also require an integrated approach for developing component policy framework so that water resources and delta is managed in an ecologically sustainable manner. The issues affecting the sustainability of Indus delta are: a) Damming, Detention and Diversion of the water of the Indus delta affecting entire ecology of the delta and reducing silt deposition; b) less than minimum environmental flows during except occasional flood years; c) entry of pollutants from industrial, urban and agricultural sub-sectors of water use affecting aquatic life; d) rapid urbanization; e) lack of framework and methodology for valuation of deltaic and coastal ecosystems;

Kirthar range and Kohistan area

Spate flows and groundwater irrigation are the two sources of water available in the Kirthar range and Kohistan area. Locations for storage of water in small dams and ponds are available and several small dams are constructed but the none of those have the water conservation plan. However, no significant initiative except the construction of Darwat Dam has been undertaken in this ecology. The availability of floodwater from hill-torrents is extremely unreliable because persistent drought is a common phenomenon. Therefore, cascade of small reservoirs and ponds is a better option than the high dams.

No policy framework is available for floodwater, runoff, storage, conservation, and groundwater use management in these areas. Along with the policy framework for these areas, there is a need to develop a strategy how surface and groundwater can be managed in an ecologically sustainable manner so that population living in these areas can be saved from outmigration due to persistent droughts.

Right-side: Western Nara Valley of the Indus

The areas around the right side of Indus River are high potential areas, as water availability is relatively more reliable than the areas away from the river. The sources of water in this ecology are rainfall; river flows; groundwater and Spate flows. The most economical way of exploiting water for agriculture is lift irrigation from river flows; abstraction of shallow groundwater; and Spate flows.

No significant initiative has been undertaken in this ecology except the development of lift irrigation schemes by SID. These schemes performed well until there was subsidy on electric tariff. With the increase in electric tariff, it resulted in deferred maintenance of these schemes and ultimately these become non-functional. The availability of floodwater from hill-torrents is extremely unreliable because persistent drought is a common phenomenon.

No policy framework is available for lift irrigation, groundwater, floodwater, and Spate flows in these areas. Along with the policy framework for these areas, there is a need to develop a strategy how surface and groundwater can be managed in an ecologically sustainable manner.

Thar Desert

The current desert farming systems are vulnerable to droughts. Thus, there is a need to develop appropriate desert farming systems which suits local conditions and desert ecology to provide a more sustainable system of livelihood generation. Government may discourage strategy of allocating large resources to relief measures and focus more on creating opportunities for earning a living with dignity. We should learn lessons from both the earthquake of 2005 and the flood of 2010. There are serious issues of governance associated with such large dole outs which seldom change the life of the local inhabitants. They may provide minor relief but have no impact on sustainable livelihood. In fact, such approach has created more beggars. There is lack of systematic feasibilities and designs of interventions for the management and development of water in the desert. Effective institutional mechanisms are not available and thus new institutional arrangements are needed for effective planning and implementation.

Too many NGO's are involved in studies and surveys without linking it with the provincial development agenda. There are no mechanisms available within the province and in the desert to coordinate the activities of the NGOs and mainstreaming their work with the provincial development agenda.

A wealth of freshwater resources exists in pockets in the desert. Due to rapidly changing monsoonal patterns under climate change water security of Tharparkar will face greater insecurity in the near future.

Droughts and floods will come with greater intensity as evident from the analysis of historical climatic and hydrological data. Creating resilience with innovative opportunities for future development and management of water resources will address forced out migration.

5.2 Policy Directions and Actions

Four key policy actions are identified for water dependent ecosystems outside the Indus basin canal commands and are presented as under (Figure 6).

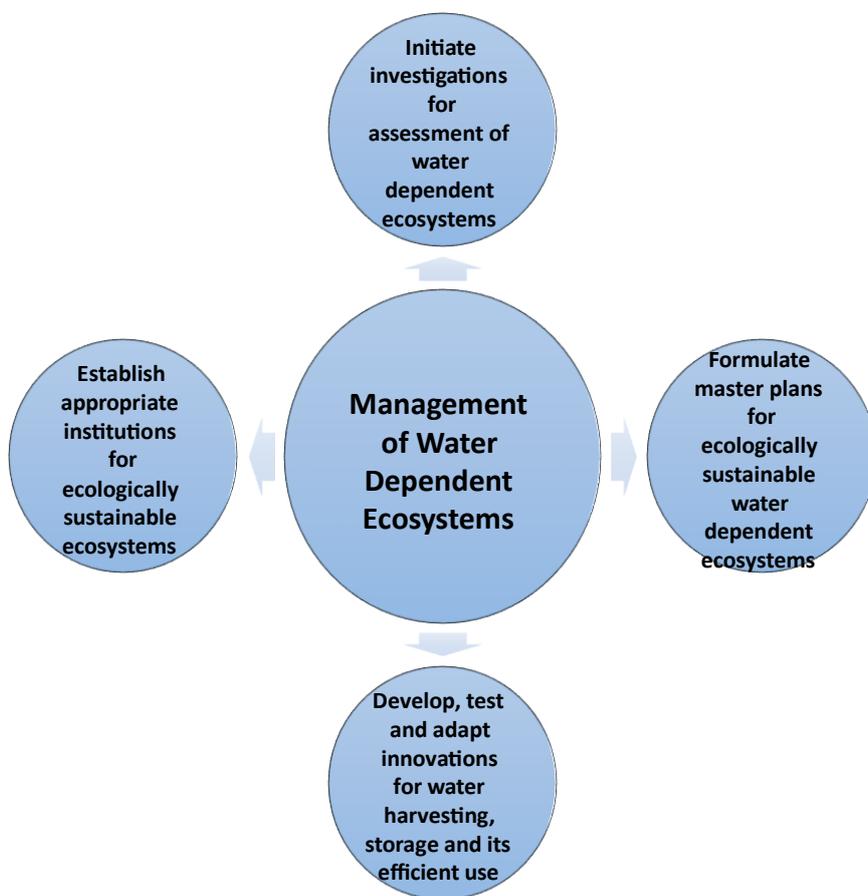


Figure 6: Key policy actions for management of water dependent ecosystems

5.2.1 Assessment of water dependent ecosystems

Initiate investigations for water resources assessment in all the water dependent ecosystems considering the local site-specificity using water balance approach at the basin or sub-basin levels covering all sources of water – rainfall, runoff, floodwater from Indus River system in wet years, groundwater, wastewater, etc.

5.2.2 Master plans for ecologically sustainable water dependent ecosystems

Formulate master plans for ecologically sustainable development and management of water resources in all the water dependent ecosystems to support new livelihoods and restore ecosystem functions through devising most optimal land use system

5.2.3 Innovations for water harvesting, storage and its efficient use

Develop, test and adapt innovations for rainwater and runoff harvesting, cascades of water storage, micro-irrigation farming appropriate to specific water dependent ecosystems in areas like right side of Indus, Kirthar range, Kohistan, and Thar desert

5.2.4 Institutions for ecologically sustainable ecosystems

Establish appropriate institutional mechanisms for ecologically sustainable development in all water dependent ecosystems

6. Urban Water Supply and Sanitation Services

6.1 Challenges

Urban water services are needed to accommodate the safe growth of urban areas in Sindh and ensure the basic well-being of old and new urban citizens. In Karachi and other big cities, most of the households (up to 80 percent) have piped water connection. Households not connected to piped water connection rely on groundwater or private sources of water. Private sources of water are very costly, making it out of reach for many. Water from tankers is as much as 29 times more expensive than piped water from municipal agencies while water from private RO treatment plants is 50 times more expensive than the piped water (WRI, 2019). Furthermore, for those connected to urban water systems, the service is at best for a few hours a day. In many cases these households also take water from tankers, as piped water supply is not sufficient.

Bulk water for Karachi is brought from water from irrigation canals, Keenjhar lake and the rain-dependent Hub Dam. There is a widespread practice in the city of, households attaching their own water suction devices to water pipes, which in turn inhibits the pressure needed for water to reach to downstream consumers located on distant and/or high elevation areas (WRI, 2019). The situation of slum areas in urban areas is much worse. Slum areas still need development works as being undertaken by Government Katchi Abadi Department as per their mandate, and after completion the same system duly laid, tested, and commissioned must be transferred to KWSB in Karachi, WASA in Hyderabad, and other local councils including municipal corporations and municipalities. Presently such areas rely on own inferior natured arrangements on their own, but which is often contaminated.

As the result of all of this, much water is not fit for drinking and cooking. Pakistan Council for Research in Water Resources collected water samples from different water sources in four cities of Sindh (Karachi, Hyderabad, Sukkur, and Badin), and found that 81 percent of samples was bacteriologically contaminated with total Coliforms, Fecal Coliforms and E. coli, and had excessive level of mineral and elements (PCRWR, 2016). Another study for Karachi found 86 percent of collected water samples had lead levels higher than maximum acceptable concentrations (Ul Haq, 2011).

Apart from the inadequate service delivery, urban water management systems are basically not in good order in Sindh. Keeping in view rapidly growing population in urban areas, there are serious concerns on the long-term access to good quality water resources from canals for the major cities in Sindh. WASH Sector Development Plan 2016-2026 identified that around PKR 100 billion will be required annually from 2017 till 2030 for getting 100% coverage of safely managed water and sanitation services. SDG Unit Sindh commissioned a study in 2019 on Localization of SDG 6 that estimated an average annual cost of PKR 114 billion to achieve 83% coverage of Water and 64% coverage of Sanitation by 2030 in Sindh. The study estimates were discussed and endorsed in the Joint Sector Review and consultative meeting held for SDG-6 with the support of Department of Local Government Sindh, UNICEF, UNDP, and Ministry of Climate Change.

A third area of concern in urban water management is wastewater disposal. Rather than treating wastewater, it is common practice to discharge effluents from industries and urban sewage into public water bodies. For example, WASA Hyderabad is disposing untreated sewage and comingled solid waste in the Indus River as well as in Phuleli canal. Industrial sites of Hyderabad are also dumping industrial wastewater directly into Phuleli Canal without treatments, creating an enormous downstream public health issue in Hyderabad, Tandon Muhammad Khan, and Badin districts. Tragically water borne diseases account for most infant deaths (Ijaz et al. 2017). The waterlogged toxic wastewater of Larkana District is pumped by Mashoori SCARP Pump House of Drainage and being dumped in Rice Canal without treatment and that irrigation water is also being consumed in downstream rural households of Naseer Abad and Johi Talukas. Wastewater of Jamshoro Thermal Powerhouse and Khanot Thermal Power Houses is dumped directly in Indus Water.

Urban infrastructure is not equipped to deal with special weather events: the widespread floods in Sindh cities of 2020 has its roots not only in unusual rainfall but also very much of urban build up areas (including the drainage system) not being able to accommodate above average quantities of water. In most of the urban areas, there is a combined system for disposal of sewage and storm water. Only in Karachi and Nawabshah cities, there is a separate system for disposal of sewage and storm water. In Karachi, domestic sewage is collected through underground pipe network, managed by KWSB. Storm water disposal is managed by KMC and DMCs. There are 41 nallas (open stormwater carrier), which take stormwater from storm water drainage network of DMCs and dispose on gravity basis into natural rivers, namely Lyari and Malir rivers. However, this storm water drainage system is not functioning due to massive encroachment which has almost blocked or drastically reduced in width and not capable to cater the rainwater and same is stagnant on road for sufficient time. Thus, storm water accumulates into the residential areas and creates pathetic conditions for the residents and business communities.

Except in Karachi and Nawabshah, there is combined sewerage system in all cities of Sindh province. Storm Water Drains are used collection of both the storm water and Domestic Sewage. Under the Sindh Sanitation Strategy all the Municipal Corporations and Municipal Committees have been directed to switch over upon two separate-System policies. As per Sindh sanitation Strategy (GOS 2011), all districts headquarter cities have been directed to switch over to separate system for stormwater and domestic sewage.

The above figures speak for deficient service provision. Serious resource constraints of the public sector and utilities inhibit the expansion of new systems to cater to the rapidly growing population. Karachi and all other cities and towns suffer from a resource crunch, which is widening the supply and demand gaps. Municipal water supply system has very old and under capacity infrastructure and operation and maintenance is insufficient. Many water filtration plants are not properly functioning. Furthermore, sewage treatment plants are insufficient and dysfunctional (WSP, 2016). Loadshedding compounds the working of the pumping stations. Financial performance is low. The Karachi Water and Sewerage Board for instance shows that receipts from water charges and arrears account for only 63 percent of total expenditure (KWSB, 2020). This is enigmatic as one could argue that providing water services to an urban population is the safest and rewarding business.

6.2 Policy Directions and Actions

Access to safe and good quality water supply and sanitation is a human right endorsed by the Supreme Court of Pakistan. It is also a Sustainable Development Goal 6: “Ensure availability and sustainable management of water and sanitation for all”. The provision of safely managed drinking water to the entire population of the province is envisioned in the Sindh Drinking Water Policy (GOS 2017a). Provision of safely managed sanitation service and sanitary environment to the entire population of the province is envisioned in Sindh Sanitation Strategy and Sindh Sanitation Policy (GOS 2011; GOS 2017b).

The following policy directions have been identified to secure access to safe water supply and sanitation services and ensure water quality for households in urban areas of Sindh:

- Water resource planning for cities and towns
- Better operators: improving operational performance of urban water and sanitation service providers
- Mobilize public investments for essential defective and outdated infrastructure, and
- Regulating and stimulating private sector participation.

6.2.1 Water resource planning for cities and towns

Keeping in view population growth and urbanization trend, short-run and long-run water resource plans need to be made for the main cities and towns in Sindh to secure and protect water services in the long run. Keeping in view the importance of megacity Karachi and other big cities including Hyderabad, Sukkur and Larkana, specific plans shall be developed for unserved and underserved areas on a priority basis, among other to secure its future water supply.

Urban water resource plans need to address for each city or town as well as slum areas for which they are developed:

- Safe long-term sourcing of water, keeping in mind the current service level gaps that are to be narrowed and closed as well as the anticipated development of the towns. For some of Sindh’s major cities – such Karachi, Thatta, Badin and Sujawal. - that are located close to the coastline, desalinization must be explored as an option too.
- Strategies for ensuring water quality, such as zero tolerance on dumping of untreated domestic sewage and wastewater from industries and thermal power houses into water bodies. The sewage and wastewater of all cities should be treated and recycled at the TDS acceptable to industries and be provided to industries and factories for their use, so that the potable water can be saved for human consumption. Furthermore, sewage and wastewater should be treated properly before disposing it in freshwater bodies such as irrigation canals, which are also source of drinking water supply. Municipal entities, industrial units, thermal power houses shall be required to treat effluents and hazardous discharge before disposal.
- Creating an urban environment free from the risk of flooding or waterlogging by integrating urban planning and urban infrastructure development with water resource management
- Overhaul the urban drainage systems, with separate system for storm water removal and sewage, the effective removal of encroachment and other activities blocking these drainage systems, and the safe disposal.

These urban water resource plans need to be integrated with the Sindh Water Strategy that is to be developed and implemented for the province as well as the canal commands and dryland

areas (see 3.1). These plans should not be paper consultancy driven exercises, but events in which different stakeholders and parties with an interest in investment and service delivery are involved. Furthermore, as per Sindh Drinking Water Policy, they should be integrated with district level plans, that will be developed to ensure equitable access to drinking water in both urban and rural areas (GOS 2017a).

6.2.2 Improving Operational Performance

In urban areas of Sindh, water supply and sewerage services are managed by: (a) agencies in two cities: Karachi Water and Sewerage Board (KWSB) and Water and Sanitation Agency (WASA), Hyderabad; (b) municipal corporations, municipal committees, or town committees in all other urban areas. Sanitation is comprised of Sewerage and Solid Waste services. Solid waste services are managed by Sindh Solid Waste Management Board (SSWMB), established following the SSWMB Act, 2014.

For better performance in delivery of services to urban areas, the existing water and sanitation agencies and utilities shall improve their operational performance. This requires improved governance through effective autonomy, accountability, and financial sustainability. As per Sindh Local Government Act 2013, large municipal entities including KWSB, WASA Hyderabad, and all the municipal corporations, municipal committees and town Committees have the legal mandate as well as the autonomy to make policies, ensure administrative and financial management, set tariffs, hire, and fire staff and maintain high quality service delivery for customers. However, at present all urban entities operate practically as government agencies with little or no autonomy for policy making, business planning or, indeed, overall management

This autonomy of urban water and sanitation utilities including KWSB, WASA Hyderabad and other local municipal authorities needs to be put in practice now to come to a significantly better performance and make them stronger players in water resource management. The utilities should undergo the transition to performance-based systems; be given full authority for tariff setting, hiring and firing as well as raising of finances to ensure effective service provision and operation and maintenance of infrastructure; enhance capacity of human resources and infrastructure for required service delivery; development of infrastructure of piped water delivery in urban; proper operation and maintenance of infrastructure including pipe system, water filtration plants, and sewage treatment plants; monitor industrial wastewater treatment; and monitor water quality provided to households. Furthermore, WSS services shall be extended to all other towns where there are no water and sanitation agencies or utilities.

At the same time the regulatory framework for the utilities should be developed. These agencies should operate competitively and should be accountable. They should have proper rules of business for efficient human resource management, tariff setting, financial sustainability, client relations, and resilience planning. Their performance should be independently verified by third party audit and made available for public.

6.2.3 Mobilize investments for essential defective infrastructure

There is a considerable backlog in essential water infrastructure. Public investment and international finance should be mobilized for water treatment and wastewater treatment for reuse of sewage water and the overhaul of urban drainage systems. Initial public investment is also required for the towns which are not yet serviced by any water and sanitation agency or

utility. These investments will have a double impact: they improve the quality of life in the urban areas, but they also reduce the harmful effect of urban wastewater on downstream users.

6.2.4 Regulate and stimulate private service suppliers

As per Sindh Drinking Water Policy, a supportive policy framework shall be developed that encourages alternative options for private sector participation, NGOs, and community organizations (GOS 2017a).

Private service suppliers play an important role in the provision of urban water services. They can provide an important service in closing the gaps and in delivering high quality water and taking care of waste water treatment. Their role should be cherished and stimulated and at the same time also regulated. This makes it possible to align them in the overall plans for water resources management and water services provision in Sindh's cities.

In Karachi, private water tankers provide water to those people not receiving through pipeline. For Karachi and other cities, packages should be developed with a range of investors and current private service providers to expand the range of services, reduce harmful effects, and agree on reasonable cost charges, to expand the services to the entire urban areas and serve many customers. At the same time agreements should be reached on the acceptable quality, cost of services and environmental effect.

7. Rural Water Supply and Sanitation Services

7.1 Challenges

Access to water, sanitation and health services in rural Sindh is among the most problematic in the world. Non functionality is high. Even where an improved system is installed, the probability of it delivering services is not certain. PCRWR (2010) conducted a study in all districts of Sindh except Karachi and Hyderabad. This study found that 58 percent of rural water supply schemes in the province are non-functional, and around half of the enumerated population remains unserved. Furthermore, the study found that 98 percent of the functional schemes are providing poor quality of water, which is unsafe for drinking purposes.

The problematic rural water supply and sanitation (WSS) situation is compounded by the difficulty of finding good quality drinking water resources in large parts of Sindh Province. A recent survey in 2019-20 (GOP, 2020) showed that now in rural areas of Sindh, 78 percent of the rural households relies on groundwater using individual hand pumps (70 percent) and private motorized pumps (8 percent). Only 9 percent of rural households uses piped water supply services while 14 percent of rural households relies on other sources – including canal water, ponds, wells, and water bearers. Water storage ponds are particularly notorious for the foul quality of water.

With 80 percent of the province underlain by saline to highly saline groundwater (Iqbal et al. 2020), small fresh groundwater lenses, created by seepage from canals, floating on the saline water make up a major part of the sources of rural water supply. These small freshwater lenses are precarious and dependent on how the water in the canals is managed and vulnerable to overuse. Lining of canals, distributaries and minors was only to be undertaken where these were passing from waterlogged areas. Unfortunately canal lining was also undertaken where there was no waterlogging. This effectively stopped seepage and, in several places, converted aquifer

systems from fresh into brackish. This undermined the provision of potable water as human right, as reinforced by the Supreme Court.

The proper management of canal and drainage systems is hence essential for rural water supply for the freshwater pockets but also for those who take water from the canals directly. The quality of surface water in the canal areas is often problematic because untreated sewerage, industrial effluents and sugar mill wastewater are directly discharged in irrigation canals. In the dryland parts of Sindh water sources are extremely scarce too. Many depend on brackish groundwater and are faced with serious health issues, such as hepatitis or kidney problems.

Sanitation coverage is equally low in rural Sindh – particularly for Asian standards. A recent survey in 2018-19 showed that 76% of the rural households did not have any form of sanitation systems: 19 percent had open drains, and only 5 percent underground drains or covered drains in rural areas of Sindh (GOP, 2020). Particularly in areas that are waterlogged – which is more than half of rural Sindh - standard latrine solutions do not work due to the high-water tables. There is a strong linkage between the rural WSS and the management of water resources in Sindh – in controlling waterlogging in the canal system, in preserving small freshwater lenses in areas with saline conditions, in providing good quality canal water throughout the year and in protecting fragile groundwater sources in dryland areas.

In contrast to urban water system, the role of private providers is very limited in rural WSS. The responsibility of water supply and sanitation (WSS) in rural areas, lies with the Public Health Engineering Department (PHED), with some provision by the Rural Development Department (RDD), and local municipal administrations. After completion, the whole infrastructure is handed over to local municipal administrations for operation and maintenance. Local municipal administrations are responsible for operation and maintenance, but they do not have structural capacity to do the same, resultantly the schemes fail to deliver, and the people are left with almost no water from the systems (Supreme Court Commission, 2018). Individual households take a large part of the burden – making their own small wells or collecting surface water, but as mentioned of often problematic quality.

7.2 Policy Directions and Actions

As discussed, access to safe and good quality water supply and sanitation is a human right endorsed by the Supreme Court of Pakistan. Universal access is a priority Sustainable Development Goal in the Provincial SDG Framework. Provision of safely managed drinking water and sanitation and healthy sanitary environment is envisioned in the Sindh Drinking Water Policy, Sindh Sanitation Strategy and Sindh Sanitation Policy (GOS 2017a; GOS 2011; GOS 2017b).

Rural WSS in Sindh is now characterized by hardcore non-access, as the result of institutional shortcomings and the difficulty of accessing water resources. To secure access to water and ensure water quality for households in rural areas of Sindh, the following Policy actions have been identified that provide framework for developing strategies and action plans in the short run as well as long run. The main policy directions include:

- Provision and protection rural drinking water resources, including a revision of canal lining practice
- Reform and strengthen institutions and capacity to deliver services,

- Targeted public investments
- Involvement of local private sector in service provision.

7.2.1 Provision and protection of water sources for rural areas

Access to safe water supply requires not only sufficient quantity but also quality of water and hygienic environment for healthy life. To provide and protect safe water for households in rural areas of Sindh, water resource planning and management is required both within canal areas and outside canal areas. For the within canal areas, the strategic water planning (see also 3.2) will focus on the following. First, the action plans will include protection of freshwater lenses that are vital to provide water to local rural people. Especially in small settlements (less than 500 people) no service is provided by PHED and self-supply from this small local groundwater resources is the only option. Protection will include (1) securing unlined canal supplies in critical areas with saline groundwater, allowing the lenses to be maintained by continued seepage from the canals. The cement concrete lining already done in such rural areas may be perforated so that canal seepage now completely stopped can restart and feed the small water pockets again to provide drinking water for rural households. (2) selective drainage interventions in waterlogged areas (as this will create the space and allow the formation of new lenses on top of saline groundwater layers) (3) properly scheduled canal closure to avoid fresh water supplies drying up for extended periods and (4) promotion of safe abstraction systems for drinking water only, such as handpumps or radial wells. Second, the action plans shall ensure water quality in water bodies including river, canals, and wetlands through zero tolerance on effluent dumping into water bodies, proper sanitation, and waste disposal. An area of special concern is Thar, where the planned coal mining may have major ramifications for the availability and quality of rural water supply. Thirdly, in dryland canal areas, the action plans will include rainwater harvesting and safeguarding scarce groundwater resources for household consumption. This aligns with the district level plans that shall be developed to ensure equitable access to drinking water in both urban and rural areas as per Sindh Drinking Water Policy (GOS 2017a).

7.2.2 Reform and strengthen institutions and capacity to deliver services

As per Sindh Drinking Water Policy, responsibilities and resources shall be delegated to local authorities to enable their assigned functions of provision of safe water supply (GOS 2017a). For better performance in delivery of WSS services in rural areas, the existing institutions shall be reformed and strengthened to enhance their capacity to deliver services and manage water resources. The following policy shall be adopted: develop standard operating procedures for water supply schemes and sanitation services, including source protection; develop standard operating procedures for functionality; annually track performance of rural water supply systems; enhance capacity of human resources and infrastructure for required service delivery; make all schemes functional; develop range of community-private-public models and create local entrepreneurship and business in rural WSS.

7.2.3 Targeted public investment

Public investment shall be targeted to tackle main issues of unserved areas. For outside canal areas, public investment shall be made for rainwater harvesting to augment the range of services. Public investment shall be made to get the water closer to houses to address the gender

issues, as a lot of women in rural areas spend so much time and do labor work to fetch water from wells.

For canal areas, public investment shall be made for the replacement of outdated infrastructure and water filtration plants (Ultra Filtration Plants and Reverse Osmosis plants), which are not properly functioning and Reverse Osmosis plants for desalination of brackish groundwater, in areas where there is no alternative to safe quality sourcing.

7.2.4 Get more involvement of local private sector for hardcore rural areas

In the current situation and foreseeable future, individual water supply will remain important in rural Sindh. For increasing coverage of service delivery of safe water to households in rural areas of Sindh, local private sector shall be encouraged for instance in promoting affordable household water treatment systems. Currently, rural households are struggling to arrange delivery of water from water bodies and freshwater lenses. Through local private sector or public-private partnership, the water delivery can be improved by establishment of smart centres, which can promote safe sourcing given the current constraints in Sindh: through appropriate pumping systems and through household level water treatment for instance. This will not only solve water delivery issues but will also generate employment in rural areas.

8. Implementation, Reporting, Coordination and Review

8.1 Implementation

Clear strategies for implementing Sindh's Water Policy is necessary for both the long and short-term goals to be realized. This policy adopts a risk assessment approach to water resources management covering all sources of water. This means the level of management applied to each of the provincial river basins will be commensurate with the degree of stress or potential threat a particular basin is experiencing. Stresses or threats may be related to the use of surface and groundwater, affecting sustainability of the river basin and aquifer system itself or dependent ecosystems, or to land use activities which have the potential to impact on quality of surface and groundwater. Central to the success of this approach will be a rapid assessment of the provincial surface and groundwater resources to identify actual stresses and potential threats. Based on this assessment, management responses will be put in place for each Barrage/canal commands, river basins or aquifer systems. Triggers will also be in place, which signal a river basin or groundwater system has moved to a higher risk category, therefore requiring more intensive management. A set of management responses is outlined in the following sub-sections.

Licensing and regulatory tools

Government decisions allowing access to, or affecting groundwater, will be made in accordance with the principles of Sindh Water Policy. For example, in issuing groundwater licenses, the Canal Commands/AWB/Basin Boards must take into account the broader environmental effects of both the abstraction and the development for which the groundwater will be used. Likewise, local government or any other authority, in determining development consent or granting licenses or permits, must consider the impacts of those developments on the associated groundwater resource. Consideration of groundwater issues should occur, where relevant, in such as local WMAPs.

Similarly, in areas outside the canal commands where public-sector investment is little in the development of water, provides an opportunity to devise licensing both for surface and groundwater so that water users or local service providers in irrigation come forward and invest in management and development of water resources. The private sector service providers providing irrigation water through lifting of river water or pumping of groundwater in Sindh are the best example. The service provider provides water during the irrigation season and charge water fee at the time of crop harvest, indirectly providing credit support to the water users.

Monitoring, modelling, and investigation

Adequate and reliable monitoring data, as well as targeted research and modelling of stressed or 'at risk' surface and groundwater basins or sub-basins are essential to the implementation of the Sindh Water Policy. This policy commits the Government of Sindh and Stakeholder institutions to provide essential baseline information.

Vulnerability assessment

All decisions are only as good as the information on which they are based. A critical aspect of the Sindh Water Policy implementation is the development of province-wide surface water and groundwater characterization, and assessments of vulnerability, quality and beneficial use. This policy commits the government to the progressive development of these management tools. Without these, assessment of the impacts of activities on surface water and groundwater resources will be inadequate and successful integration of surface water and groundwater management objectives into the broader resource management and land use planning environments will be fragmentary.

Water management action plans (WMAPs)

WMAPs will apply the goals and principles of the Sindh Water Policy at a local level. This policy framework allows managers and the water users' institutions to integrate many issues and provide an effective plan for use and protection of local surface and groundwater resources. WMAPs will be progressively developed across the province, with priority given to those river basins, sub-basins, or aquifers most at risk or severely stressed. While urgent action may be necessary in some highly stressed or at-risk systems, plan formulation will normally require undertaking several initial studies, including:

- An assessment of the resource base including rainfall, runoff, floodwater, storage, recharge and discharge, quality and variations thereof, movement and boundaries;
- Identification of water dependent ecosystems and the relationship between surface and groundwater and these ecosystems;
- Identification of places of cultural importance and the relationship between surface and groundwater and these places;
- Water demands and their location;
- More detailed local classification in terms of vulnerability and existing and potential beneficial uses;
- Development of a contaminant source inventory;
- Methods of measuring water usage; and
- Reporting of river basin or aquifer status and trends.

Plans will integrate the management of surface and groundwater by:

- Setting objectives, including environmental objectives, for surface and groundwater use and protection within the provincial Water Policy framework;

- Establishing management and allocation criteria in line with ecologically sustainable use principles;
- Determining appropriate uses and values for the resource;
- Determining levels of protection for the resource;
- Developing transfer strategies, where appropriate;
- Devising protection priorities and mechanisms for water dependent ecosystems;
- Providing protection strategies for places of cultural significance related to surface and groundwater;
- Devising wellhead protection strategies;
- Where appropriate, devising remediation strategies;
- Providing recommendations to local government regarding inclusion of specific surface and groundwater protection measures in planning instruments; and
- Devising a local monitoring and reporting strategy.

Formulation of WMAPs will require cooperation and coordination of a number of government agencies and key stakeholders. The Sindh Government will establish clear environmental objectives for surface and groundwater on a river basin, as appropriate. This will be dependent on surface and groundwater risk assessment process. This will prioritize management planning actions across Sindh and trigger action in response to specific changes in aquifer health. Performance against these environmental objectives will be audited on the review of WMAPs. The broader water users' institutions will have significant input into the management planning process, particularly advising on appropriate uses and values of the local surface and groundwater systems. Plan development, review and reporting will be through local Water Management Working Committees at the main canal level, and plans are to be 'signed off' by Government to ensure the commitment of necessary resources. Plans will be reviewed on a five yearly basis. Ultimately, the WMAPs will become part of the BMPs.

Supporting guidelines

The development of supporting operational guidelines for industry and local government will be the key to the successful implementation of the Sindh Water Policy. Guidelines on surface and groundwater issues and management options relevant to the particular industry or agency, developed through consultation, will ensure that policy objectives are integrated into the day-to-day management activities and decision-making of the relevant parties.

Market strategies

Consistent with water reforms for surface water, options for the introduction of market mechanisms for groundwater management and protection will be considered as one component of the set of Sindh Water Policy implementation strategies. Market strategies, which will be discussed in more detail in the Component Policies, may include establishment of tradable surface and groundwater entitlements, where appropriate, or surface and groundwater pricing to better reflect resource management objectives. Any pricing measures will be regulated by the Sindh Independent Pricing and Regulatory Authority, who will guide the Government to deliver arrangements for full recovery of direct costs.

Surface and groundwater education

Surface and groundwater education is an important part of the Sindh Water Policy implementation strategy. Surface and groundwater education campaign will be developed which targets a variety of audiences, ranging from school children to catchment planners, water users and environmentalists. A variety of educative tools will need to be available to reflect the level of understanding of water issues required by different sectors of the community.

Educators, local government and industry will play a key role in development and implementation of the education strategy.

8.2 Reporting

Reporting on water occurs at several different levels, and at a variety of times. There is currently an attempt to dramatically improve coordination of various environmental reporting and auditing processes. After the formulation of WMAPs, there is a process in place whereby the status of the river basin and aquifer, and the performance of the Plan against its objectives, is reported after every second year. Plans are updated every five years, if necessary. In practice only the most highly developed and stressed river basin or aquifers have had this level of review. Surface and groundwater reporting can also occur in the biannual Sindh's Water Report. This document takes an overview on the health of surface and groundwater across the province. It is necessary that appropriate resource and environmental indicators are developed and monitored by the Government to reflect the state of surface and groundwater. This work is continuing, and these indicators will then become the basis by which the success of the Water Policy will be judged. This will indicate where adjustments to the Water Policy can be made if the desired outcomes are not being met.

8.3 Coordination and Review

Policy development, coordination and review will be implemented through a stakeholder working group comprising relevant agency and representatives of WRMD. Once the policies are launched, the group will meet periodically to review policy performance and ensure implementation is progressing. The policies will be formally reviewed on a five-yearly basis. Where WMAPs exist, review and reporting will be through local Water Management Working Committees. Plans will be reviewed on a five yearly basis and signed off by the SWRMD. WMAPs will be consistent with the broader basin planning objectives and process.

9. Water Distribution Inter-provincial and Basin wide Issues

Water Distribution Issues

The Water Apportionment Accord 1991 (WAA-1991) at Para-02 apportioned the Indus River System Waters in the light of accepted water distributional principles amongst the four provinces of Pakistan. The Para-02 allocates the seasonal shares of the cropping season of Rabi and Kharif which further distributed on the 16.09.1991 in compliance of Para-14(a) of the Accord on the Ten-daily basis and made part and parcel of the WAA-1991.

The Water is not being distributed as per Para-2 of the Water Apportionment Accord 1991 (WAA-1991) since the year 2000. There was no ambiguity in distribution of water between the provinces till the year 2000. After year 2000, instead of the allocation given in Para-2 (WAA-91 allocations), IRSA distributed water in deviation to WAA-1991 and ignoring the decision of 16.09.1991.

On 04 May 2000, the IRSA vide it's letter No. Chairman IRSA/97/1042 dated 04 May 2000 referred the matter to Law, Justice and Human Right Division Islamabad for their advice and interpretation of Clause 14 of the Accord as to "whether the shortages are to be shared pro-rata on the basis of Accord shares or Historic uses". The Law Division tendered their advice, which is reproduced as below;

"As per plain interpretation of Clause-14 of the Accord, the 10 daily uses, having become part and parcel of the Accord, shall be adjusted pro-rata for sharing shortages. Any interpretation of sharing shortages on the basis of historic use shall be a violation of the concurrent Accord. Moreover, under clause 13 of the Accord, IRSA is responsible for implementation of Accord. Similarly, any dispute on the subject should have been referred to the CCI under the Constitution. Hence the formation of any other body or committee or taking any decision or interpretation on which on such report shall be a distortion of the Accord as well as violative of the constitution". The IRSA has also withdrawn his decision regarding the operation of Indus Waters other than the Accord- 1991 vide their letter No. IRSA/Adm/Gen-1/1139-57 dated 12 November 2001.

The Context

All provinces agree that the sanctity of the Water Accord, arrived at through consensus after long tedious negotiations, be maintained and that no formula outside the parameters laid down in the Water Accord (Which includes the decision dated 16.09.1991) should be adopted. Whereas the water is being apportioned as the Three-tier formula adopted by IRSA which is against the Accord and the Constitution of Pakistan.

According to Para-14(b) of the Accord, "These ten daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocation of the different canal systems and would form the basis for sharing shortages and surpluses on all Pakistan basis" conforms that there might be the Water less or more than the Para-2. The Para-2 of the Accord provides the Seasonal Allocation whereas, the total of the Ten Daily (having become part and parcel of the Accord after the CCI meeting held on 16.09.1991) is equal to the Para-2 Seasonal Allocations.

The three-tier distribution Formula does not protect the volume of water allocated to the Provinces in WAA-1991. As in said Formula KPK and Baluchistan provinces are provided water on Para-02 and exempted from sharing shortage and the Punjab gets water more than WAA-1991 Para-02 allocations. While Sindh province is the only sufferer and gets supplies much less than its WAA-1991 Para-02 Allocations. The Three Tier Formula was introduced by the Irrigation Punjab and adopted by the IRSA. A Working Paper containing the Three-tier Formula prepared by the Punjab Irrigation Department and forwarded to Chairman IRSA vide No. IWT&R/02/110/2/83 dated 22 January 2002 was circulated ON SAME DAY by the Chief Engineer IRSA to all provinces vide letter No. CE(O)/IRSA/79/243-51 dated 22 January 2002. The Three-tier formula is the recipe of three Paras of the Accord cooked by IRSA mixing Para-14 (b), Para-4 and Para-2 of the WAA-1991.

The sub-para (a) of the Para 14 provides that the System-wise allocation would be worked out separately on ten daily basis and would be a part of the Accord. This has since been worked out and approved by the CCI on 16.09.1991 and becomes part and parcel of the Accord. The sub-para (b) has two portions. The first being, that the actual system uses between 1977-82 would form a guideline for future regulation pattern. The second part says that the Ten daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocation, clearly stating that it would form the basis for sharing “shortages and surpluses” on all Pakistan basis.

Para 14(b)'s first part refers the basis of usage for the period of 1977-82 for the purposes of working out the system-wise allocation as provided in Para 14(a) that ten daily uses have to be determined. The second part of Para 14(b) when read together with Para 14(a) makes complete sense, when it says, “These ten daily uses would be adjusted pro-rata— “. Reading the Minutes dated 16.09.1991, it is apparent that the decision was “The Council of Common Interest authorized the 10-Day Seasonal System-wise Adjusted Allocations (excluding flood flows and future storages) provided by the provinces. There is no reference to the “basis of usages for the period of 1977-82”. It is apparent that the intention of the CCI was to cause the 1977-82 to be used only as a guideline for the purposes of determining the ten daily uses only, which it did and accepted by all the provinces.

Therefore, once the ‘Ten Daily Uses’ are determined on the basis of the uses for the period 1977-82, the future shortages and surpluses would be shared by all the provinces. Thus, the historical uses would not have any place in the Accord as the same has done its job for the determination of the ‘Ten Daily Uses’ and agreed upon by all the provinces on 16.09.1991 and decision taken by the CCI on that date.

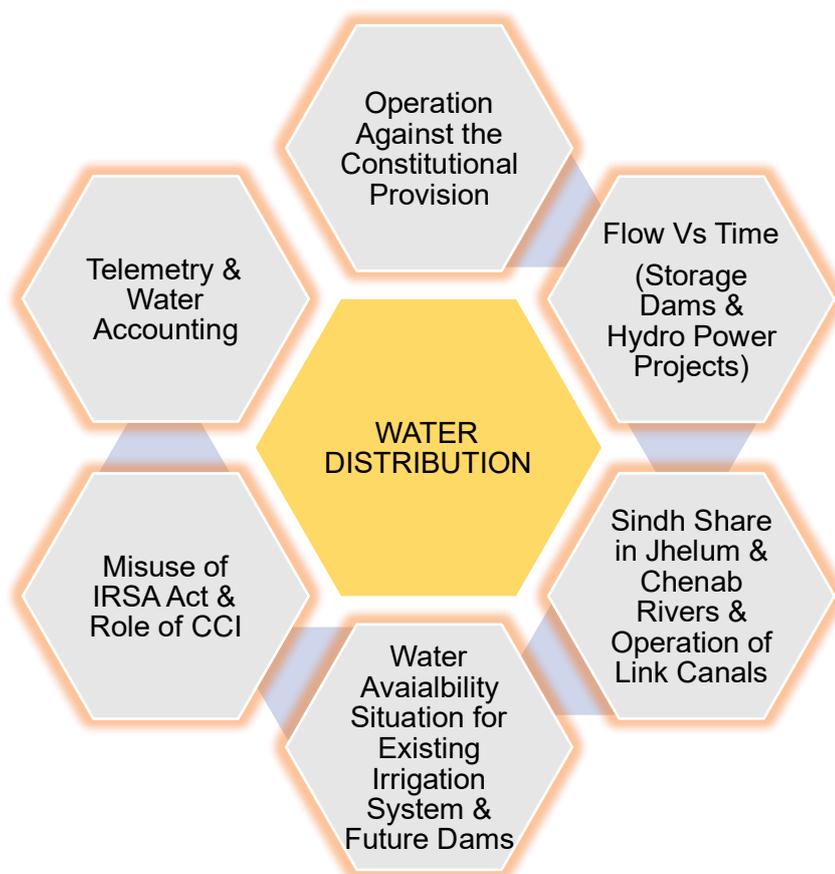
Key Policy Issues:

The Indus River System Authority (IRSA) was created in compliance to Para- 13 of the WAA-1991 with a Duty to “Regulate and Distribute Surface Waters amongst the Provinces according to the allocations and policies spelt out in the Accord” (Clause 8-1(a) of the IRSA Act 1992). The allocations to provinces are only made in Para-2 of the WAA-1991 and the Ten-daily Allocations approved by CCI on 16.09.1991. There happened a distribution of Water of Indus before the Water Apportionment Accord 1991 under the “1945 Sindh-Punjab Agreement”. After the partition of subcontinent, the Indus Water Treaty 1960 divided the Water between Pakistan and India. In the WAA-1991, except the province of Sindh, all three provinces i.e., Punjab Baluchistan and the Khyber Pakhtunkhwa were allocated the water +15.75%, +217.21% and +75.25% respectively above their allocation in 1945 Agreement whereas the Sindh received the same allocation equal to 1945 Sindh-Punjab Agreement. Annual Average System Uses of 1977-

82 presented by WAPDA in Justice Haleem Committee as mentioned in Para 14 (b) certifies the theft of Indus River System Waters by Punjab. Under the Sindh-Punjab Agreement the Punjab share was 48.33 maf and WAPDA informed to the Justice Haleem that the Punjab was using the 54.55 maf. Whereas the WAPDA identified in Justice Haleem Committee that Sindh was provided 43.53 maf against its share of 48.33 maf (i.e., 4.8 maf less than the allocation)

The province of Punjab by utilizing the water over and above the allocation made to it have develop its irrigation system by reducing the supplies of Lower Riparian provinces. Therefore, the Sindh Water Policy advocates the firm policy firm actions for the protection of water for the province of Sindh and are presented in Figure below:

Figure 1: Key policy issues for Protection of the Water Allocations, Distribution for Sindh and mastered diversion and damming of Indus waters



- ***Operation Against the Constitutional Provision***: To be further elaborated under the Policy Action Plans.
- ***Flow Vs Time (Storage & Hydropower Projects) Impacting Cropping regime***: In Pakistan, the distribution of water is governed under the Water Apportionment Accord 1991 (WAA-1991). According to the Para-14(c) of the WAA-1991 “The existing reservoirs would be operated with priority for the irrigation uses of the provinces”.

In WAPDA's Vision 2025 Programme estimated cost over US \$ 50 billion, there is no computations of water availability. In fact, even there is no mention about water availability. In this document, storage reservoirs with capacity of 59.43 maf have been included without water availability calculations. The Federal Government policy documents indicate that 4 out of 5 years availability criteria has to be adopted. The normal procedure for water availability computations is on upstream approach basis i.e., how much water is received at the rim stations, what are the abstractions, usages, system losses etc. and the outflow to the sea. Thus, the upstream approach enables the proper and complete accounting of the water in a river system. The concept of downstream approach was initiated by WAPDA for the first time in the year 1994. This approach determines the net outflow to sea without indicating the total availability and how it was utilized (Government of Pakistan Technical Committee on Water Resources – 2005).

There has been largely mastered diversion and damming of Indus waters since last 60-years that have changed the everyday behaviour of the rivers especially the main Indus stem leading to Arabian sea. That has been inflicting the lower Indus basin economy, culture and immense stress is experienced; that has forced to restructure and alter planning for existence. People are striving to meet their share of water for agriculture, safe drinking water needs, land reclamation and drainage and to meet the exceeding needs of populous cities of the province of Sindh.

At present Pakistan has a power generation capacity of 17,309 MW, out of which 6,460 MW is from hydel power. WAPDA has projected a power requirement of 75,149 MW, by the year 2025. WAPDA has identified hydel schemes with total generation capacity of 47,306 MW. According to WAPDA, 14 small hydel schemes with generation capacity of 1095 MW (ranging from 13 MW to 132 MW) are under implementation. WAPDA has completed feasibility of 25 hydel projects with total capacity of 2038 MW, most of which are very small projects. WAPDA has also completed feasibility of multi-purpose projects like Basha Dam on which the work is started. WAPDA has identified hydel project with capacity of about 20,000 MW. Also, there are major run of the river hydel projects like Dassu, Bunji, Pattan and Thakot, some of which have the potential even higher than the multi-purpose dam projects (Government of Pakistan Technical Committee on Water Resources – 2005).

Despite of the fact that, although, hydropower does not directly consume water, its generation frequently conflicts with other uses, notably irrigation, because its release schedule does not always correspond to the timing of water use of the cropping seasons. Pakistan depends almost entirely on the flows of the river Indus and its tributaries for its irrigation requirements. The flows of the Western Rivers allocated to Pakistan are highly erratic. Maximum flow of 186.79 maf occurred in the year 1959-60 and minimum flow of 97.17 maf occurred in the year 2001-02. Hydropower generation meets 19% of the world's energy needs and has been one of the main driving forces behind the construction of 45,000 large dams worldwide (WCD, 2000). The generation of electricity has little impact on the quantity of water (it is limited to the loss by evaporation in the dams) but it alters the timing of stream flows, both season-wise and hour-wise (within a day), as the timing of water releases is generally governed by the demand curve for electricity. This explains why conflicts between hydropower and downstream uses, including irrigation, in-stream uses and supporting ecosystems, often occur (Briscoe, 1999).

The economy of Sindh largely depends on the agriculture and the water is the main driver of it. The cropping seasons in the Sindh starts earlier than other provinces. The monsoon rains form

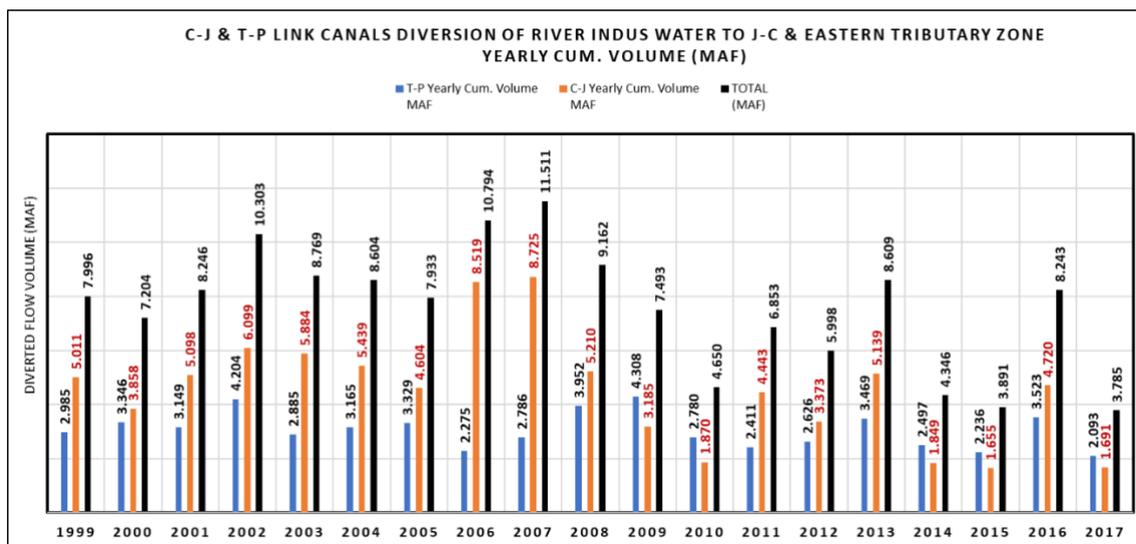
major part of the runoff in the rivers of Pakistan and are of quite an erratic and unpredictable nature which varies in each year. The monsoon season is June-September, while the pre-monsoon is from March to May and the post-monsoon covers October and November. The nature of concern/conflict of Storage Dams or delaying the supply like in the case of Hydropower Plants is of the same nature and magnitude for the Lower Riparian provinces in Pakistan as that the Pakistan faces in transboundary relations. The effects of the Kishanganga hydroelectricity project in India on downstream water availability in Pakistan resulted in diplomatic tensions between the two countries. Similarly, in Pakistan the relation of the lower riparian provinces foresees ever growing fragility risks and insecure water distribution agreed by the four provinces in the 1991 while signing the Water Apportionment Accord.

Sindh Share in Jhelum & Chenab Rivers and Operation of Link Canals:

The designs of Chashma-Jhelum (CJ) and Taunsa-Punjab (TP) link canal are however not the part of Indus Water Treaty or the Indus Basin Development Fund Agreement. These designs were prepared subsequently. The CJ and TP link canals are neither perennial canals nor flood canals, but these are enabling devices to transfer the water from Indus to the lower tributaries areas of Punjab, if and when required by the water availability scenarios in the three Western Rivers i.e., Indus, Jhelum and Chenab any stage of time. According to the figures furnished by WAPDA before the Government of Pakistan Technical Committee on Water Resources in 2005 which compared the Average inflows of the Jhelum and Chenab Rivers and Eastern Rivers contribution with Water Accord 1991 allocation of Jhelum-Chenab System. According to WAPDA, in the Kharif season, the post Tarbela inflows for these Rivers is 46 MAF against the Total 36.986 MAF Allocation of Jhelum-Chenab System (19.466 MAF of the Upper Zone including Eastern Canals) *plus* Jhelum-Chenab System (8.62 MAF of the Lower Zone including Eastern River Canals) *plus* System Losses (1.5 MAF), *plus* Mangla filling (Present 4.5 MAF and After raising 2.9 MAF). This shows that the water available in Jhelum and Chenab River System is 9.054 MAF in excess after fulfilment of all needs. The diversion of the Indus Water to the J-C and Eastern River has very severely affected the agrarian economy of Lower riparian provinces and Indus delta.

The figure 05 below, shows the volume of water diverted in the C-J and T-P links canals from the Indus River despite of excess availability canal commands of the Jhelum, Chenab and of the Eastern Rivers.

Fig - 05: 20-Years Record of Diversion of Indus Water through CJ & TP Link Canals



The above figure shows that the C-J and T-P Link Canals are diverting the volumes of water of River Indus and Kabul more than the capacity of Big Dams in Pakistan. No water should be transferred from Indus main to the J-C and lower tributary canals through C-J and/or T-P link canals during the periods when water is being stored in Mangla reservoir. C-J and T-P Link Canals are inter-provincial canals and should be operated as such as not to affect the flows towards the lower riparian provinces when there is dire need of water in sowing/nurturing the crops. The data shows that those canals are operated while there is shortage in provinces of Sindh and Baluchistan.

• *Water Availability situation for Existing Canal Commands and Future dams:*

To understand underlying stresses that has laid the situation of mistrust, intolerance, incoordination, and mismanagement in the Indus basin Pakistan, in the first instance, data of the flows of Rim stations, Barrages, Link Canals and etc. for their inflow, outflow, storages, diversions and etc. shall be metered and proper accounting procedure shall be started.

The Guddu Barrage inflows for the period of record of 1998-2018 were analysed to check the availability of water to meet the 10-daily accord allocations of Sindh and Baluchistan. A Flow duration curve was derived from the data, to check if the inflow-volumes in upstream of Guddu Barrage were available relative to WAA-1991 for Kharif and Rabi crops. The study indicated that the percentage availability for the Kharif crop is 64% to 38% (Mar 15 – May 30) and for the Rabi crop was 20% to 51% (Sep 15 – Dec 15)

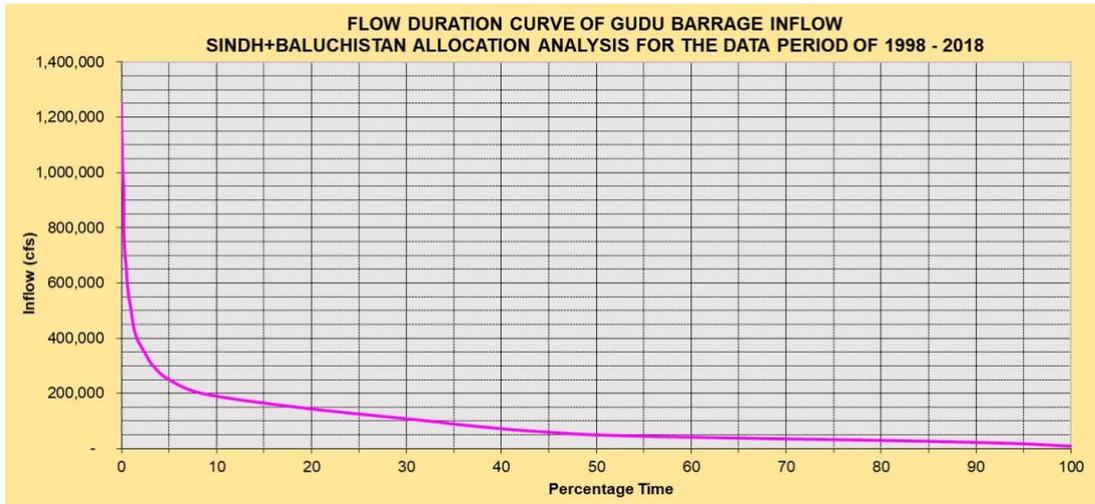


Fig - 04: Flow Duration Curve for the Guddu Barrage Inflows 1998-2018

To assess the impacts of Diversion & Detention after Indus Water Treaty 1960 on the Lower Indus specially the province of Sindh and the Indus delta, the mass curve of the cumulative flows at Sukkur barrage for the period 1961-2018 was developed. It indicates, the average annual inflows from 1961 to 2000 were 88 MAF whereas, from 2000-2018 it decreased to 52 MAF. Under the Water Apportionment Accord 1991 the cumulative share of the province of Sindh and Baluchistan is 52.63 maf. This alarming decrease in the inflow with consistent trend indicates the availability has equalled the provincial share without any provision for the Indus delta. This situation also advocates that the Indus basin shall now be declared the Closed Basin. The basin closure means scarcity and more frequent water crises, many of which are artificially created by overcommitting water resources.

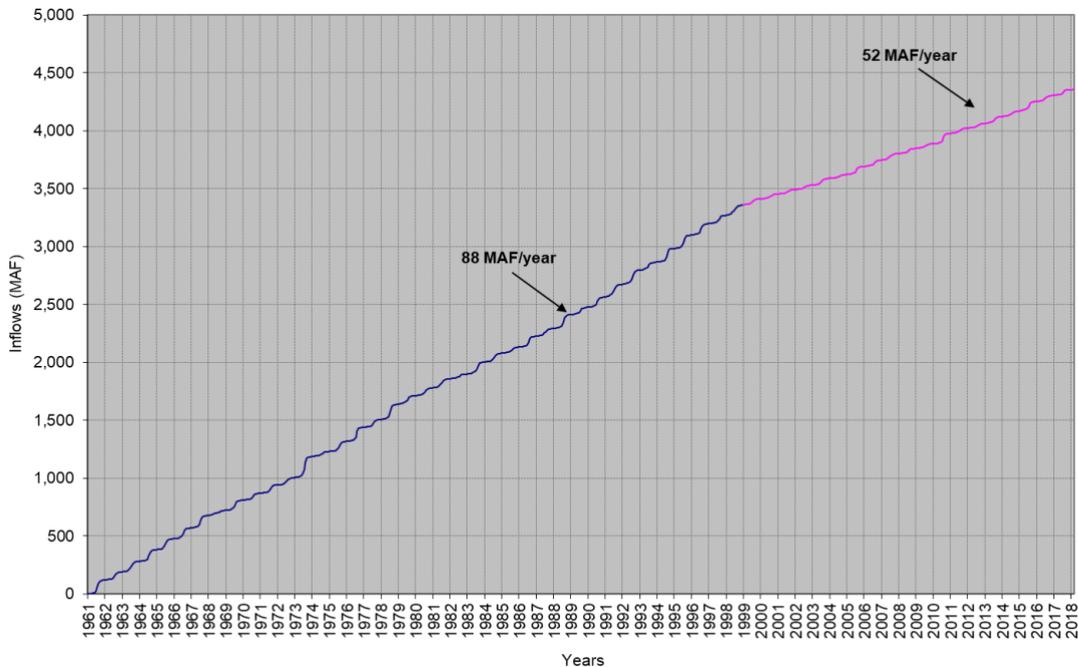


Fig - 03: Declining Trend in the Inflows reaching the Lower Indus – Diagram of inflows versus time for the period 1961-2018

Evaluation of Water Availability after Basha and Mohmand Dams

The filling of future reservoirs on Indus main will normally start only after Tarbela reservoir has attained its maximum conservation level of 1550 feet. The excess quantity in any season can be stored in the new reservoir. The stored water will first be utilized to meet the shortfall in Water Accord allocations in each 10-daily period based on the canal-wise provincial allocation approved by CCI. The water from future storages will not be distributed based on their full storage capacity, but on the basis of expected annual availability, considering that the reservoirs may not be filled up every year, and may even remain unfilled for a number of consecutive years (Government of Pakistan “Technical Committee on Water Resources 2005”).

The Study of data (1998-2018) of inflow at Tarbela dam depicts that a wide variance was recorded in the filling of Tarbela dam to its full capacity in any year.

Table - 02: Tarbela Dam analysis to identify the Excess Water Available for further Development.

Year	Tarbela Dam Fill Days	Year	Tarbela Dam Fill Days	Year	Tarbela Dam Fill Days
Aug1998-Jul1999	27	Aug2005-Jul2006	14	Aug2012-Jul2013	16
Aug1999-Jul2000	17	Aug2006-Jul2007	28	Aug2013-Jul2014	19
Aug2000-Jul2001	2	Aug2007-Jul2008	21	Aug2014-Jul2015	11
Aug2001-Jul2002	20	Aug2008-Jul2009	9	Aug2015-Jul2016	29
Aug2002-Jul2003	15	Aug2009-Jul2010	6	Aug2016-Jul2017	0
Aug2003-Jul2004	29	Aug2010-Jul2011	32	Aug2017-Jul2018	2
Aug2004-Jul2005	0	Aug2011-Jul2012	30	Aug2018-Jul2019	17

The water year is generally recognized from 1st October to 30th September of next year but in the case of Indus, during the data period of 1998-2018, the Tarbela dam has attained its maximum elevation of 1550 feet in the month of August therefore, the data was arranged from 1st August to 31st July of next year.

The 20-years data was analysed with the Bhasha and Mohmand dams. It showed the Basha dam could have filled 07-times to its full capacity with average probability of 1-in-3 years, 05-times to its 80% capacity and in 05-years it was able to capture 10%-50% inflows of Indus above Tarbela and in 02-years since the Tarbela was not filled it was not possible to store any water in Basha. The Basha may serve as replacement dam for the Tarbela. The Bhasha dam will reduce sediment influx to Tarbela thus, will enhance service delivery life of Tarbela. The storage of Basha, Mohmand dams will first provide to fulfil the water allocations of the canal commands of all provinces which are protected under Water Apportionment Accord 1991.

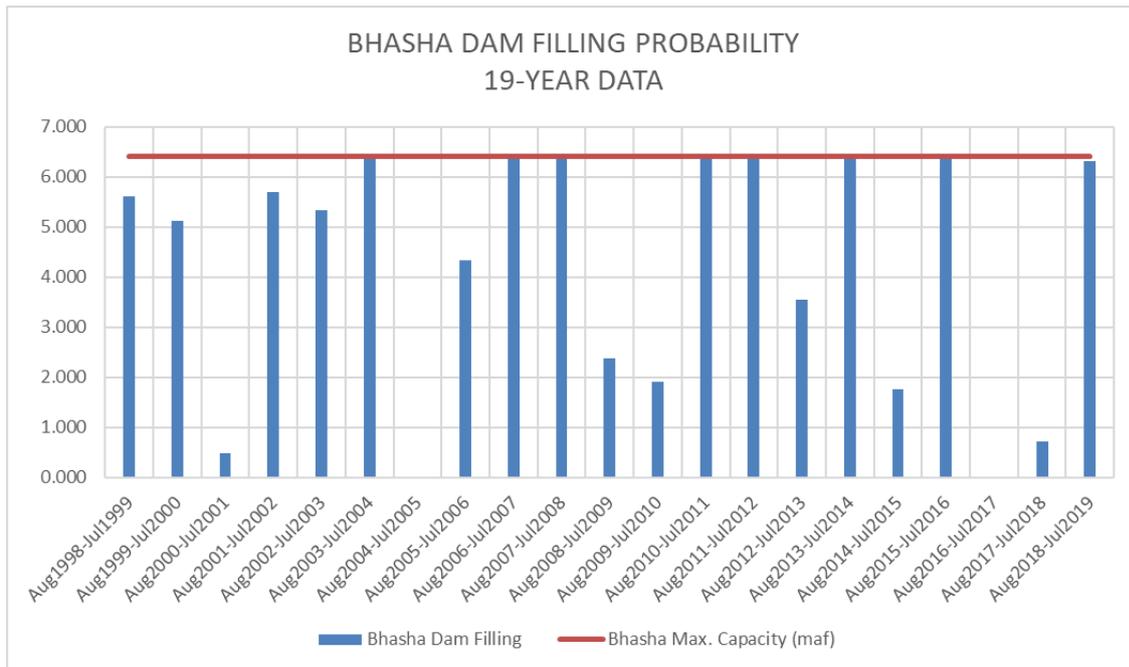


Fig - 08: Bhasha Dam Capacity Vs Water Availability Pattern

Though, the storage in Bhasha could be made during the days of surplus availability after filling Tarbela and fulfilling the indents of the provinces based on 10-daily allocations under the WAA-1991. Since the Mangla dam after its raising is being exclusively used to benefit the Jhelum-Chenab and Eastern Tributary Zone canal commands. The Bhasha should serve as a replacement dam to the lost capacity of Tarbela, shall be utilized to cater shortfall in allocated 10-daily allocations of Indus Zone. Indus zone has badly suffered due to shortages and sustained losses in Rs. billions due to non-availability of water during the sowing period of the crops in Sindh and Baluchistan provinces and requirement of outflow to sea to check sea water intrusion. About 2 million acres of land have lost in sea intrusion in the province of Sindh.

Kalabagh Dam Planning Impact on Lower riparian provinces

The last feasibility study of Kalabagh dam (KBD) was conducted in 1984-88. The WAPDA has indicated the live storage capacity of KBD to be 6.1 MAF. Kalabagh is the lower most storage site which is intended to be fixed with KBD, despite of the fact that, WAA-1991 allocations are not fulfilled for Sindh and Baluchistan. The main features of the proposed Kalabagh right bank and left bank canals as mentioned in the Project Planning Report of Kalabagh dam project by Kalabagh Consultants (July 1984) are; (a) **Right Bank Canals** will cater for Irrigation supplies for Culturable Commanded Area of 850,710 acres with maximum monthly withdrawals capacity of 8300 cusecs, (b) **Left Bank Canal** will cater for Irrigation supplies for Culturable Commanded Area of 287,310 acres with maximum monthly withdrawals capacity of 13100 cusecs. The left bank canal would include twin 33 ft diameter tunnels each 8.5 miles long and a Link-Canal to the river Jhelum (Government of Pakistan “Technical Committee on Water Resources 2005”).

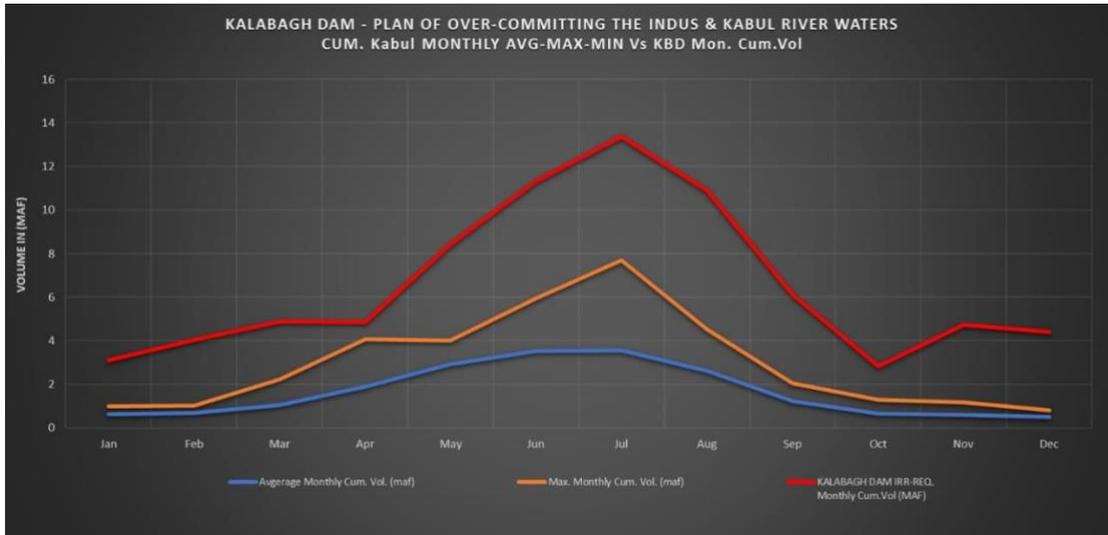


Fig - 09: Analysis of the Irrigation Requirement of Kalabagh Dam figures shown in PPR 1984-88 Vs Kabul River Inflows

Data for the year 1999-2018 was analysed to check the availability of water in the upstream of Kalabagh dam site including the inflows of Kabul River based on which the feasibility of KBD is propagated. The excess water availability of Indus above Tarela is consumed with the Bhasha dam. The figure-09 above describes that the average and maximum inflows of Kabul River are much below the proposed irrigation requirement of the proposed Canals from Kalabagh dam. Which means the new Canals proposed from Kalabagh dam will not only divert the entire storage of KBD but will also divert the water from the storage of Tarela and under construction Bhasha dam. In the figure-09 below, last 20-year data was analysed with the Basha and Mohmand Dams. Except 03-year (1 in 7-year probability) availability for any storage was identified. Moreover, the occasional flows reported downstream Kotri Barrage have contribution of tributary flows below Punjnad.

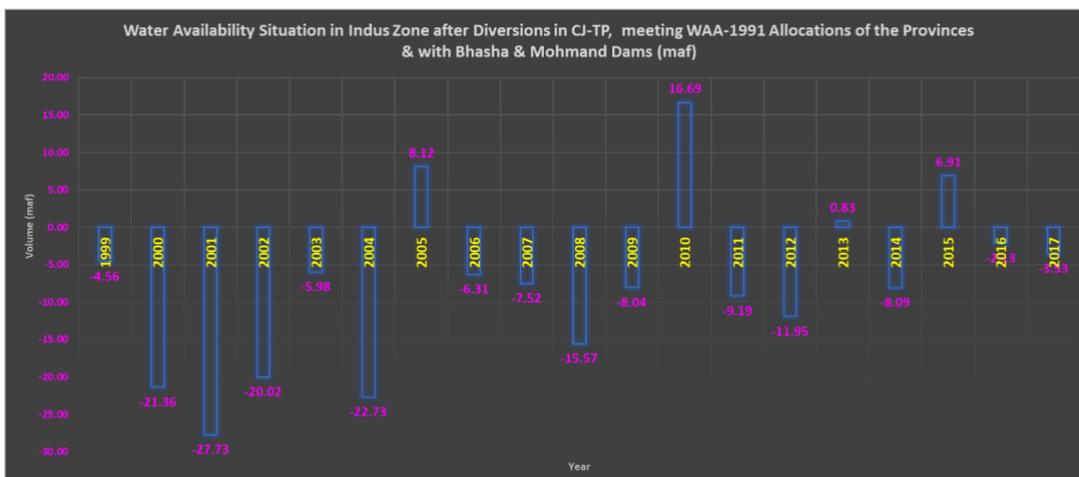


Fig - 10: Situation of Water Availability After the construction of Bhasha and Mohmand Dams.

Jhelum, Chenab, and Eastern Rivers flows for Lower riparian provinces

At the time of the Treaty, the annual water flow of three Eastern Rivers was about 33 MAF, out of which India was utilizing about 8 maf. The rest of the water (25 MAF) used to flow into Pakistan which is no more available. The Jhelum and Chenab rivers have an annual flow of about 23 MAF and 26 MAF respectively. Thus, the total flow of the tributary rivers including Eastern Rivers coming into Pakistan before Indus Waters Treaty was 74 MAF (25+23+26). The Water Accord amongst the provinces was signed in 1991 i.e., about 30 years after the Indus Waters Treaty 1960. The Water Accord allocation of Tributary area of Punjab (including areas previously getting water Eastern Rivers) under the Water Accord is 43.33 MAF (55.94 total Punjab allocation minus 12.61 MAF Punjab canals on Indus main). Thus, the balance water ($74 - 43 = 31$ MAF), after meeting the full Accord allocations of the tributary areas of Punjab used to flow downstream Punjnad and was available to lower riparian provinces before the Indus Waters Treaty. This substantial volume of water is not available to the lower riparian provinces after the Treaty anymore. It cannot therefore be said that loss of Eastern Rivers to India means that loss was confined to only one particular area/region (Government of Pakistan “Technical Committee on Water Resources 2005”).

- *Misuse of IRSA Act & Role of CCI*: To be further elaborated under the Policy Action Plans.
- *Telemetry and Water Accounting*: To be further elaborated under the Policy Action Plans.

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