

SINDH WATER POLICY

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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
IWRD	Irrigation and Water Resources 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
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
WASH	Water, sanitation, and hygiene
WRMU	Water Resources management Unit
WUO	Water Users Organization

Chapter 1 Introduction

1.1 Background and Objective

This is the Sindh Water Policy (SWP), prepared to guide the development and management of the water resources in Sindh. The availability of safe and sufficient water is a constitutional responsibility of the State Government, and the Policy is prepared in this context. Sindh's economy is maturing, its population is growing, and demographics are changing. Climate change is making itself felt – dramatic as in the succession of floods and droughts in the province, gradual as in the rising temperature and evaporative demands on water resources. Amidst all these changes the water resources available however are a given. To address current and future challenges it is imperative to come to a significantly better management of water.

There is no denying that water services are stretched already under current arrangements. There is a backlog of urgent problems, be it in 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 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, and flood water and even the reuse of wastewater - 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.

The vision of 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.

1.2 The Water Policy

Water is a defining element in the society of Sindh – the very name of the Sindh derives from its main water source. 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 Kalhoro Commission that challenged the Karachi Water and Sanitation Board to identify one area that was provided with safe water.

This Sindh Water Policy aims to reinforce all these policies by ensuring effective management of water resources for the province and the related sustainable delivery of water services.

1.3 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:

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.

- 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 practitioner-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.

The Sindh Water Policy that came out of these preparations in this document subsequently discusses the burning issues to be addressed (section 2), the policy direction and policy implications related to each of these burning issues (section 3) – including the institutional adjustments, financial arrangement, investment, capacity building and inclusiveness. The last section of the policy (section 4) discusses the immediate actions to be taken on the Sindh Water Policy and the process of securing its implementation.

Chapter 2 Water Management in Sindh: Major Concerns and Issues

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 socio-economic 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.

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 and 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 multifold 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.

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.

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 used but not managed – there has been little attention to sustainable use, to the balancing of different uses, to water quality, the connection between surface, groundwater, floods and rainwater, and the protection of valuable wetland systems.

Following consultation and the assessment of research, the concerns on water management are grouped around six burning issues that are addressed in this water policy. The first policy issue concerns the overall management of water resources, whereas the other burning issues concern the management of water in different contexts: the canal and drainage system; the dryland zones; in wetlands and in urban and rural water supply. The burning issues are briefly introduced below:

1. Managing water resources

There has so far been not enough attention to managing since water resources in an effective and integrated way: the emphasis has been on service delivery, often in silo-ed sectoral manner. The challenge of increasing water demands and climate change – added to a legacy of past problems – requires that water resource management is placed center stage and enabled by the right institutional set-up and attention to planning.

2. Multifunctional integrated management of canal and drainage systems

The canal and drainage system are the lifeline of Sindh province. Its importance cannot be overstated. The significance goes beyond agriculture, but 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 but also the deteriorating quality of the canal water and the unreliable supplies at tail end sections. The canal and drainage system are a major asset to the province and its proper management and upkeep is a prime responsibility to ensure many vital functions.

3. Serving those off grid – water management in the drylands

The drylands of Sindh cover the largest part of the province. These are areas which are sometimes forgotten, despite their relatively vulnerable but growing population. Their water resources need to be secured – for the benefit of the dryland communities but also since these are the watersheds surrounding Sindh's main water system.

4. Wetlands and the Indus Delta as buffers and resource pools

Sindh is well endowed with wetlands. Though placed in an arid climate region, it is home to more than hundred wetlands, the majority on these are on the left bank of the Indus. They are part of the environmental wealth of Sindh and help to buffer floods, recharge groundwater and secure water supplies in times of shortage. Wetlands in Sindh range from marine, estuarine, lacustrine, and riverine to palustrine wetlands. Many of them are unique in terms of biodiversity but also produce rich supplies of fish and other products. Out of nineteen declared Ramsar wetlands in Pakistan, nine are in Sindh Province. At the same time there are severe threats to Sindh's wetlands – degradation by reduced inflows, encroachment, quality deterioration and behind all this the lack of management, planning and even basic attention.

5. Urban water supply and sanitation: creating safe places for living and working

Sindh is the most urbanized province of the country: 52 percent of the population lives in cities and towns (GOP, 2020). This figure is set to increase over the next two decades, especially as fertility rates in Sindh and Pakistan are 50% higher than the Asian average. It is of paramount importance to create safe places for people to live in and for business to flourish. A main issue in urban areas is the lack of access to water supply and sanitation (WSS) services: water supply coverage is low (50%) in urban areas, delivery is mainly intermittent and the quality of water in more than 80% of the cases is insufficient. A second issues is that there is no urban water management. This showed off recently in the rampant flooding of urban areas in Sindh – combination of high rainfall and ill-equipped urban infrastructure.

6. Rural water, sanitation, and hygiene (WASH) – dealing with hard-core non-access

There is a huge backlog in rural water services. On several key performance indicators, the score in Sindh is shockingly low: actual coverage, functionality of existing rural water supply system and drinking water quality. The specific conditions of the province – the extensive area with non-potable saline groundwater and the scarce water resources in the drylands – make access to safe water highly challenging. This requires good management of rural water resources and high institutional performance, that have so far been lacking.

In the subsequent chapter the policy direction and policy implications under each of these six burning issues is discussed.

Chapter 3 Policy Directions and Actions

This section of the Sindh Water Policy discusses the challenges, Policy actions and actions on the six main major water issues in Sindh:

- Managing water resources
- Multifunctional integrated management of the canal and drainage system
- Serving those off grid – water management in dryland areas
- Wetlands and Indus Delta as buffers and reservoirs
- Urban Water Supply and Sanitation Services: creating safe places
- Rural WASH: addressing hardcore non-access.

3.1 Managing water resources

3.1.1 Challenges

Water resources management 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 past problems. An overview of some of the challenges:

- Under business-as-usual circumstances **water demand** will increase in Sindh because of the combined effect of population growth, structural change in the economy and climate change. It has been estimated that total municipal, industrial, and agricultural water demand may increase by up to 15.2 MAF if a modest climate change (+1 degrees) is assumed: from 46.8 MAF in 2018 to 62.0 MAF in 2050, a 30% increase. The largest part of the increased demand comes agriculture (12.9 MAF), but water demand from municipal and domestic users is expected to also more than double with higher demands places on quality and reliability. Given the limited nature of water resources in Sindh, better management of existing resources is imperative to deal with the future demand. Water allocations need to reassessed and rearranged, even reduced, to fairly serve all the different demands.
- **Water quality** is becoming an integrated issue that is as important as managing water quantity in Sindh. Most drinking water supplies are unsafe for human consumption due to bacteriological contamination, the uncontrolled disposal of effluents from cities and industries upstream of Sindh and inside the province, the wash-out of agrochemicals or the presence of lead or arsenic. Salinity has always been a feature of groundwater in Sindh but there is concern it is increasing due to up coning of saline water in areas where groundwater is intensely used and in coastal areas because of the ingress of sea water in the Delta. Manchhar Lake, which is biggest natural Lake in Asia, has been willfully polluted by disposal of toxic drainage influent in the absence of the completion of RBOD-II, including the unforeseen drainage inflows from Baluchistan. This has also affected the aquifer surrounding the lake of which the groundwater has become unusable. Fresh surface water supplies are not available due to unauthorized overdraws from Dado canal.
- **Floods** are a recurrent phenomenon in Sindh – the increasing frequency related with changing weather patterns. They are the cause of suffering and significant levels of economic damage. The 2010 mega flood alone affected seven million people and is estimated to have cost Sindh about 7.2 percent of its GDP, with major losses from agricultural crops (Sánchez-Triana et al. 2015). At the same time the capacity to manage floods is very limited. Several factors aggravate the flood impact, privately made embankments inside the flood plains, obstructing

the flow, and reducing the live width of the river and bridges that are made far too narrow to let river floods pass safely. Design of all bridges in Sindh including Khairpur-Larkana, Dadu-Moro, and Daulatpur-Amri, needs verification and may require their redesign if additional openings are required.

Surplus flood water also poses threats to Sukkur barrage. There is a need of suitable-size spillway on the left bank opposite to Tori breach (right bank) for diverting surplus flood water to the desert to reduce the flow to Sukkur barrage as required for its safety. This surplus flood water can be used for people of Thar for drinking and agriculture purposes only in flood seasons. This would require infrastructure including channelization, bridges and more.

- **Droughts** are equally frequent. The Thar in Sindh is amongst the most acutely vulnerable districts in all of Pakistan. Other drylands in Sindh are equally exposed, whilst the pressure on these areas increases and their fragile groundwater resources are threatened.
- **Environmental degradation** – there has been incessant degradation of water related ecosystems in Sindh, the result of the reduced inflows, the release of pollutants and the conversion of riverine forests into farmlands. This has created a loss of biodiversity and reduced aquatic productive capacity as well as several degradation hotspots such as Manchhar Lake and the Indus Delta.
- **Inequitable distribution:** This is a persistent problem, manifest in the shortage of water in tail districts, such as Badin, Tando Muhammad Khan and Sijawal on the left side and on the Dadu, Jamshoro, Thatta and Karachi on the right side. The ponding level often does not ensure the required water deliveries particularly in the dry season. Construction of Sehwan reservoir on Indus river has been proposed to retain flood water and mitigate the shortage of water especially in Phuleli canal, K.B Feeder canal and Keenjhar lake for supply of water to Karachi city and the other districts in the tail region.
- **Inter-provincial water issues** – Sindh being the tail-end in the province 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.

The institutional and legal capacity in Sindh has not kept with these new pressures. Besides there is a legacy of unresolved problems. Management of water resources remains fragmented. There is a lack of a coherent overall framework in water resource management. The focus has been on water service delivery not on water management. There is at present inadequate capacity to manage water resources, safeguard water quality or protect groundwater. All developments that affect water pathways or have adverse impacts on river flows should take all the concerned water departments onboard. For example, National Highway Authority, before constructing bridges, should consult river management authorities.

3.1.2 Policy directions

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. To make this possible four Policy actions are required:

- Institutional right setting towards Integrated Water Resources Development
- Legal reform in support of Integrated Water Resources Management and effective and fair water service delivery
- Introduce Water Sector Planning
- Establish a Water Information System and Hydro-Agro Informatic Services, including the setting up of a laboratory at Gudu Barrage to monitor the quality of incoming Indus water.

In addition to strengthening the overall capacity to manage and effectively utilize water resources in Sindh as a whole, as addressed under this burning issue, active water management and increased service delivery is required in all different components of Sindh's water sector: in the management of the canal and drainage system, in the management of the drylands, in the protection of wetlands and in urban and rural water service delivery. The latter applications of integrated water resource management are discussed in sections 3.2 to 3.5.

3.1.3 Policy actions

Institutional right setting towards Integrated Water Resources Development

The need to manage water resources actively and in integrated manner in Sindh Province and the multifunctional operation of the canal system (including the drainage infrastructure) necessitates a right setting of the organizational framework. The active and integrated management of water resources should extend to arid zones and to wetlands as well. There is now a dual system in the management of the canal system that needs to be unified. What is important is to create a single system, whereby roles and responsibilities for policy making, policy implementation, operational management and regulation in water management are distinguished covering both canal areas as well as drylands and wetlands in Sindh.

Institutional right setting is proposed as part of the preparation of this policy. The change is toward more integration: considering all uses of water and all resources (surface and groundwater) at each level, both in quantity and quality; towards more accountability, with each function to be devolved to one responsible entity, with clear rights, mandate and reporting lines; towards more decentralization: applying the subsidiary principle, devolving decision power to the lowest relevant level; towards more participation: ensure sensitization, consultation and participation in decision-making at each level and towards more effectiveness, the operational ability to address inequity, environmental degradation and low productivity.

The revised institutional setup would include:

1. Establishment of a Sindh Water Commission, as a permanent commission with an independent legal personality consisting of sitting chief justice of Sindh High Court and five to seven high level experts from different water sectoral background, directly reporting to the Chief Minister. The Sindh Water Commission will cause specific water strategies to be developed and review implementation performance, oversee the legislative framework development and assess enforcement, set water body quality objectives and effluent discharge standards, decide rules and incentives for pollution control / treatment, oversee the water auditing for Sindh Province and decide on the water allocation within Sindh Province. The Sindh Water Commission will oversee and negotiate interdepartmental issues relating to different departments in Sindh. The Sindh

Water Commission will also address interprovincial transboundary issues and will lead – with support of the Irrigation and Water Resources Department (IWRD) - the discussion with other provinces on water releases, water quality and drainage, flood management and water allocation during drought periods. In the consultations leading up to this Policy document, the need to diligently implement and even review the Interprovincial Water Accord has been repeatedly made as well as the concerns of water pollution emanating from upstream effluent disposal. The Sindh Water Commission will be instrumental in reporting and raising these issues with IRSA and the concerned leadership in other provinces.

2. Transform the Irrigation Department into Irrigation and Water Resources Department (IWRD): The purpose is to broaden the mandate of the Irrigation Department 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 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 fulfill its functions. With change in nomenclature to IWRD, the scope and jurisdiction will be widened to cover all water resources and diversified usage. This will include ensuring a professional irrigation service and rationalizing the Department's size over time, 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:

- Water Resources Management Unit (WRMU) that would serve as the secretariat of the Sindh Water Commission 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 (see next).
- Oversight and Support Unit – ensuring the required financial and human resources for the AWBs to function properly, making use of the current staff and budgets, and working towards making these more effective and tailored to the needs of the AWBs.
- Sindh Irrigation and Drainage Authority (SIDA – which may be renamed to Sindh Irrigation and Drainage Modernization Authority), to become the facilitating agency to implement the massive transformation of the Area Water Boards 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.
- Barrage Management Unit (BMU) 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 Area Water Boards in accordance with agreed optimized allocations as stipulated in annual Water Allocation Plans adopted by the Sindh Water Commission; and maintaining adequate environmental flows downstream to the Indus Delta. 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.
- Special units, dealing with the operation of important vital parts of the system – such as the Left Bank Outfall Drain (LBOD) or the Right Bank Outfall Drain (RBOD).

3. Converting all existing Irrigation Circles into Area Water Boards (AWBs), to be empowered in a stepwise approach and strengthened, to ensure effective Operational Management with focus on

sustainable water resources management (in quantity and quality). The Area Water Board in the canal and drainage areas will be responsible for the delivery of water to distributaries and minor outlets as per annually set schedule ensuring equity, based on a compilation of demands of WUOs balancing supply and demand; ensuring water resources are available in a secure and safe way to all water consumers including towns and rural settlements, fisheries and others; the maintenance of all entrusted assets (including drainage facilities); the collection of service fees from all water users; the control of effluent disposal; the management of distributary and minors where there is no effective WUO; the monitoring of water flows and water quality within their area of jurisdiction. The AWBs should be conferred full authority for the management of water within their jurisdiction, including the control of water theft. To ensure adequate attention to areas outside the Indus Basin, dedicated Area Water Boards for the dryland areas of Sindh would be established to manage special water resources development projects and oversee the use of flood and groundwater. Two dryland AWBs are foreseen: one for Kohistan and one for the Nara and Thar desert area. In addition, a special AWB may be created for the Indus Delta. The Area Water Board through their management boards will represent a broad range of water uses – agricultural water use, but also public water supply, effluent disposal, flood and drought management, aquaculture, and the proper use of embankments. The performance of the AWBs need to be carefully followed and enhanced, as based on the experience of the AWBs that have been created in the last fifteen years, the design of these boards is good but in reality, the actual performance leaves much to be desired. A careful approach of conversion to the new structures is required.

4. Creation of Water Users' Organizations (WUOs), comprising of Farmer Organizations and Water Course Associations and where feasible Drainage Beneficiary Groups in a revamped organizational structure, to ensure operational management with a focus on service delivery. These WUOs will take responsibility of minor and distributaries in the canal system, watershed/ spate irrigation systems in the drylands as well as of designated parts of wetlands. They are the main embodiment of user participation in water management. They will ensure the proper water distribution, maintenance and servicing of the infrastructure entrusted to them and will monitor the overall performance of the canal and drainage system. The management of the drainage system is a special concern and with the IWRD and concerned circles/ AWBs a plan for the management of these systems will be made.

Facilitating the implementation of IWRM principles will require adequate staffing in numbers and skill-mix and increased levels of capacity to manage evolving demands, including in water accounting, and auditing, remote sensing, other modern approaches to water resources management. At present the number of professional staff in the public water sector in Sindh is low compared to other countries and this constrains the ability to manage water resources effectively. In addition, the lower discipline and stagnated skill levels hamper the delivery of services. There is also a need not only for more technical staff, but also different capacities and a higher motivation. In the current water sector, the geographical responsibility of a single professional is very large, compared to anywhere in the world. Particularly with a broader remit in water management for different users, both better and more capacity is required. This can be managed by allocating a chief engineer for each canal, rather than many canals, to ensure proper management. Implementation of institutional reforms should be gradual and reciprocal, by ensuring the capacity and resources required for the implementation. In the reform all staff should be included, using the opportunity to emphasize their essential contribution to water management and prosperity in the province of Sindh.

Adjusting the legal arrangements for Integrated Water Resource Management and effective and fair water services delivery

As we move 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 and the Sindh Water Management Ordinance. 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, as proposed above.

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.

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 their will have 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 tailor-made 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.

Introduce Water Sector Planning

At the provincial level, water sector development and management should be guided by a Sindh Strategic Water Plan that would be updated every five years and integrate subsector performance targets and priority investments needs towards meeting the objectives of this policy. This Strategic Water Plan would be prepared would be accompanied by related plans, in particular a Sindh Flood Risk Management Plan and a Sindh Drought Risk Management Plan.

The Sindh Water Plan should inform the operation and use of water resources and the water allocation in the different canal commands of Sindh as well as in the dryland areas, i.e., Kohistan and Registan.

It should address priority concerns such as water productivity, (reduced) water logging and salinity, water quality and safe sourcing of urban and rural water supply and groundwater management. For each canal and dryland area, this dedicated water use plan will look at water resource management within the concerned area (optimized distribution, water use efficiency, safeguarding water quality, conjunctive management of surface and groundwater management, reducing drainage requirements, flood contingency management) as well as the secure service delivery to a range of functions (drinking water supply, agriculture, livestock, fisheries, environment)

Establish a water information system and hydro-agro information services.

Good water management will rely on accurate and timely information on the water available of surface and groundwater, its quality, and its consumptive use to allow transparent decision making, managed through a system that integrates the currently fragmented and incomplete data collection efforts and can do near real time water accounting: assessing the movement of water through the system. A water information and hydro-agro information center needs to be created within the operational and academic environment of Sindh with independent capacity to provide services and preferably international validation of data quality. The information service unit will be the convergence point on water information and will feed the water management plans that are made at Province and at water board level. Water testing facility at each barrage should be provided to check water contamination level.

3.2 Multifunctional integrated management of the canal and drainage system

3.2.1 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 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 and covers, depending on the season, 50 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 fueled 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, agro-ecological zoning, soils, local aquifer characteristics and drainage coefficients. Yet these high-water 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, re-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 is part of an overall move towards a new institutional arrangement that has been developed under the first burning issue 'Managing water resources' (section 3.1).

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 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.

3.2.2 Policy directions

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

- Optimize multifunctional management of the canal system
- Managing water allocation within 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 manage 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.

3.2.3 Policy actions

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 discharge of untreated effluents upstream of the lake should be stopped.

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 (see section 3.1.3). 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 (see also section 3.6).

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 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. In general, more use should be made of flood water, including the possible activation of the old Hakra River by high flow supplies. 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.

Manage water allocation within the canal system

There is an urgent need to improve water allocation within the canal system and reassess the water duties for the different canal commands, preferably under the guidance of the Sindh Water Resources Commission. 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. The water allocations were for instance not updated after the Tarbela and Mangla Dams became operational, though these had modified the entire flow regime for the province. As a result, command areas that were semi-perennial are now informally close to being perennial.

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. In a revamped water allocation 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 sub-commands where the shallow groundwater is fresh. The recent study of PCRWR establish that in 19% and 16% 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.

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 agro-ecological zones, as being redefined. This will require the reduction of the cultivation of high-water 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 area's 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.

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 use. 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.

3.3 Serving Those Off Grid – water management in dryland areas

3.3.1 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 areas 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.

3.3.2 Policy directions

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 the dwindling water resources. Also, a significant arable land can be cultivated, and rangelands could be made more productive. To serve those 'off grid' there are four major policy directions:

- (1) 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.
- (2) 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
- (3) to better manage and develop the rangelands, that make large part of the drylands – by better retaining water and improving
- (4) to promote judicious use of water – especially for these areas where water resources are scarce and even drinking water supply is insecure.

3.3.3. Policy actions

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.

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 long-time 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 outgoing 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.

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. Moreover, 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**, sub-area 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.

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 off-grid 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 geo-membranes. In other areas dug wells can be developed or rehabilitated by combining them with water recharge.

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.

3.4 Wetlands and Indus Delta as buffers and reservoirs

3.4.1 Challenges

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. Manchhar 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. Several other wetland areas – as the Dhhora's – 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.

3.4.2 Policy directions

To restore wetland functions and make wetlands contribute optimally to the economy, society, and biodiversity several policy directions are proposed:

- Set in place a co-coordinating authority for wetland management
- Develop wetland management plans for multiple use
- Combine wetland management plans with wetland investment plans with priority for the rehabilitation of the most critical wetland
- Enhance the capacity in the province to understand and effectively manage wetlands

3.4.3 Policy actions

Set in place a co-coordinating authority for wetland management

The degradation of the wetlands has its roots in the lack of institutional attention. Several departments are engaged in fragments of wetland usage, but no one looks after the management of wetlands in its entirety. Wetland management is essentially non-existent. There is a lack of vision, ownership, and coordination. Hence, as part of the institutional right setting and the creation of a Sindh Irrigation and Water Resource Department the position of Wetland Commissioner will be

created, who will coordinate the management and rehabilitation of the wetlands and cause wetland plans to be developed and implemented.

The Wetland Commissioner will coordinate for the preservation, rehabilitation, and safe use of wetlands with other sections of the Sindh Irrigation and Water Resources Management Department as well as Sindh Wildlife Department, Sindh Fisheries Department, Sindh Irrigation Department, Sindh Environmental Protection Agency (EPA), Sindh Coastal Development Authority, Karachi Water and Sewerage Board (KWSB), Sindh Culture and Tourism Department and District Administrations. The Wetland Commissioner will actively pursue the cleaning and safe use of the wetlands

A second change is that for all major wetlands local management groups will come into being representing the genuine users of the wetlands, defining their user rights and responsibilities to preserve and serve the different functions. These wetland management groups will have delegated powers as with the Water User Organizations, i.e., the right to regulate use, to improve the condition and to levy charges. They may in some cases be more diverse in composition than Water User Organizations in canal areas and will operate within the boundaries of the wetland management plans the comparable with local management groups. The establishment of Wetland Water User Groups will also be supported by a review and strengthening of regulatory provisions, in controlling illegal occupation or unauthorized use as in grazing or logging.

Wetland management plans for multiple uses

For the main wetlands in Sindh – including all Ramsar sites – wetland plans need to be made to optimize the multiple use of the wetlands, based on the current situation. A list of all wetlands in the province will be drawn up. The wetland plans will have a binding status and will be endorsed by the Sindh Wetland Commissioner. The plans will investigate and determine the boundaries/demarcation line of all wetlands (including lakes), define all functions and socio-economic groups dependent on these, the optimized multiple use of the wetland functions, the quantity/volume of water required and its preferred bandwidth of water quality and the source of this, the different activities to be undertaken and the access and closure to the wetlands. Where water quality is discussed, besides emission limits, waterbody-specific water quality standards should be introduced for different criteria (pollutants and use specific).

A special case in terms of magnitude and complexity is the Indus Delta. The Indus Delta is the fifth largest delta in the world and a designated Ramsar wetland site since 2002. Yet due to the severely reduced sedimentation (95%) and water releases (95%) since Indus barrages and dam between 1930 and 1975 the Delta has drastically shrunk and been transformed dramatically. Of the 19 creeks in the Delta only two are active still. Sea water tidal action has moved land inwards after the scouring of the Tidal Creek. Nearly 60% of the tidal floodplain is barren, while 32% was under water. Vegetation changed too: mangrove cover dropped from 16% in 1990 to 10% in 2005, though in recent years with concerted efforts it increased to 13%. Due to all these changes the area has seen severe outmigration and the once rich Indus Delta is now an extreme poverty hotspot.

The plight of this area has generated much anger and controversy but instead of all attention the situation has not improved. Part of the change is irreversible – the severely reduced sedimentation cannot be changed for instance and the flood embankment have confined the flooding range. Rather than having the area degrade further, it is a priority to reinforce the governance of the Indus Delta by establishing a dedicated Area Water Board for the Indus Delta. This AWB should manage the Delta on a day-to-day basis but should also develop a wetland management plan for the Delta with all stakeholders active in the Delta, based on the current situation. There are many options that should be combined. For surface seawater intrusion, the construction of dykes and levees in combination with the development of the Coastal Highway Development with tree plantation on both sides is for

instance very important. Yet provision would be required to maintain the tidal action necessary for mangrove forests and have adequate cross drainage to avoid extensive inundation of the coastal floodplains. Other options for the Indus Delta wetland included the promotion of biosaline agriculture and brackish water aquaculture; replanting of mangroves and protecting existing ones against cutting and overgrazing; controlling conversion; restoring dried-up river channels; ensuring water availability at the tail end of canals and equipping them with flap gates or salinity barriers to prevent saltwater flowing in; and reviving some of the former brackish lakes by adding fresh water.

A very important element is to realistically secure more water releases to the Indus Delta to control the sea intrusion which has destroyed large areas of land (2 million acres) in Thatta, Sijawal and Badin Districts and caused the abandoning of many villages, with those left behind among the poorest people in the country. In recent expert opinion 5000 cusecs of flow downstream Kotri Barrage is recommended. This environmental flow would need to come from better regulated supplies or flood releases or from water savings and contribution from all stakeholders on the pro-rata basis. It is also important to determine where such releases would go to – to the main river stem or to tail end of canals.

The wetland management plans should be developed for all wetlands under the authority of the concerned Wetland Water User Organizations, starting with the hotspot areas. Another priority wetland due to its socio-economic importance is Manchhar Lake. The rehabilitation and sustainable management of this plan needs to be placed in the context of the improvement of the canal and drainage systems of the Right Bank. As per decision of Supreme Court of Pakistan at least 500 cusec good quality irrigation water is to be added in Manchhar Lake to dilute the current toxicity. The effect would go beyond the lake itself, as by now the aquifer surrounding the lake has deteriorated as well, leaving many settlements without safe drinking water. This situation will provide temporary improvement till the under-construction Right Bank Outfall Drain (RBOD) is restarted and completed.

Seek investment in rehabilitation for multiple functions and economic benefits

Restoration, protection, and conservation of wetlands have multi-dimension advantages like socio-economic and cultural benefits, environmental conditions, biodiversity, and hydrological functions, as well as direct benefits to users, such as fishermen, collectors of aquatic products or tourism operators. These benefits can be expressed in financial and economic returns. To revive these wetlands, investments need to be actively sought based on these benefit streams: from private sector, community action, public investment, international financial support. Ramsar sites such as Haleji Lake in Thatta District and others shall be cleaned and upgraded for best use, including the sourcing of drinking water.

As part of the drive to rehabilitate Sindh's wetlands, investment plans may be developed for priority wetlands. As part of developing plan, quantify social, environmental, and financial benefits of restoration and protection and conservation of wetlands can be calculated and presented. On this basis combined public and private investment will be sought – to generate the different benefits but also to schedule the regulation, monitoring and assessment, overdue and repair of the restoration and protection and water quality. The special Wetland Water User Organizations shall look after/ monitor to keep infrastructure safe, healthy and undertake major rehabilitation/ upgrading and routine yearly maintenance, as appropriate. By restoring wetlands capacity along with removing of encroachments, these water bodies will be able to serve many functions, including contributing to the improvement of domestic water – a huge need in many parts of rural Sindh.

Develop capacity in wetland management

The level of expertise to manage wetlands is inadequate in Sindh compared to the new tasks in hand – in terms of number of specialists and in terms of skills. Several non-governmental organizations have given much attention to the management of some of Sindh's wetlands and this knowledge and

expertise is very valuable. Universities in Sindh will be encouraged to develop programs in nature-based solutions and pro-active environmental management, based on local knowledge and on international good practice. Awareness on the precious multiple functions of wetlands will be created among those living close to the wetlands.

3.5 Urban Water Supply and Sanitation Services: Creating Safe Places

3.5.1 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 (UI 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 (see also section 3.2). For example, WASA Hyderabad is disposing untreated sewage and co-mingled 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.

3.5.2. Policy directions

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.

3.5.3 Policy actions

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 Sajawal. - 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).

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.

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.

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. 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.

3.6 Rural WASH: Addressing hardcore non-access

3.6.1 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 WASH 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 WASH 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 WASH. The responsibility of water supply, sanitation, and hygiene (WASH) 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.

3.6.2. Policy directions

As discussed in section 3.5.2, 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 WASH 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.

3.6.3. Policy actions

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).

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 WASH 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 WASH.

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.

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 centers, 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.

Chapter 4 Implementing the Sindh Water Policy

4.1 Putting the policy in practice

This chapter discusses the immediate action to make the Sindh Water Policy come into practice. In the preparation of the Sindh Water Policy a recurrent observation was that there is no lack of good policies and regulation, but that implementation is the weak link. This should not be.

From the preparation of the Sindh Water Policy, it became manifest that among the main stakeholders there is uniform understanding that water resources need to be managed actively and in an integrated manner. There is a large sense of urgency that the concerns on water quality and imbalanced water allocations need to be tackled; that the canal, drainage, and water supply system are important provincial assets that need to be managed as such; that widespread water logging, low water productivity, deficient services, degraded wetlands, and neglected watersheds no longer belong to this time. Topics that in the past may have been controversial or that may have had few takers, such as the need for institutional and legal adjustments, are now endorsed across the spectrum of stakeholders and are seen as timely answers to increasing challenges. This means that implementing the Sindh Water Policy is to give shape to shared aspirations of the people of Sindh. Whereas in the past things may have been distracted by parochial interest, there is now a sense that we need to better manage water collectively. The main risk is not conflicting standpoints but lack of initiative.

Managing water resources adequately and providing better water services is one way of maturing the economy and society. It is not about protecting water resources as such; it is about creating a higher level of interaction in society where better services are provided and more value is created. As such improved water management brings quality of life, higher happiness, less family insecurity, and lower exposure to avoidable risk. In the process it creates jobs for the educated and the lesser skilled and sets the basis for a stronger economy. Addressing all the burning issues in the Sindh Water Policy is within our faculty and can be made possible by dedication and leadership.

4.2 Next steps

Whilst the support for the policy forms a good base, it is also important to manage the next steps adequately. For each policy action, first steps can be identified that can be taken in the next year, to get started on the different necessary areas. These first steps are given in the table below:

1	Managing water resources	
1.1	Institutional right setting towards Integrated Water Resources Management	Develop overall new institutional architecture for water sector, including commissioner for Wetlands and Area Water Boards for dryland areas and Indus Delta for approval to Chief Minister
1.2	Legal adjustments in support of Integrated Water Resource Management and fair and equitable water use	Agreement on main directions in redrafting of legal framework and formation of legal drafting team, ensuring unified legislation
1.3	Introduce Water Sector Planning	Develop architecture and process for rolling five-year water sector plan, anchored in new institutional arrangements

1.4	Establish a Water Information System and Hydro-Agro Informatic Services	Undertake a call for proposal for hosting services, agree on scope of activities and have secure financial model
2	Multifunctional integrated management of the canal and drainage system	
2.1	Optimize multifunctional management of the canal system	Prepare first multi-functional water management plan prepared for one Area Water Board with engagement of main stakeholders
2.2	Reassess the water allocations between canal commands	Develop plan for water reallocation between canal commands started
2.3	Improve water productivity and better managed production in saline areas	Extension and research plan for bio-saline agriculture Plan for retailoring all subsidies and regulatory provision that support unsuitable cropping systems Reactivated extension and outreach to agricultural water users with ICT supported programs on how to achieve higher water productivity
2.4	Financial readjustment of water system financing	Develop plan for streamlined abiana and for tapping other sources of revenue from water sector
3	Serving those off grid – water management in the drylands	
3.1	Have an institutional home for the integrated development of the dry land areas	Start the process of developing an Area Water Board for dryland areas, starting with Kohistan region
3.2	Come to a uniform watershed intensive approach, whereby a large range of options are used	Work with all stakeholders to come to a coordinated watershed approach, based on international good practice, focusing on priority watersheds Develop plan for provision of drinking water for the dryland parts of Sindh
3.3	Better manage and develop the rangelands by better retaining water and improving fodder practice	Develop with livestock communities plan for improved rangeland management within pilot watershed
3.4	Promote judicious use of water – especially for these areas where water resources are scarce and even drinking water supply is insecure	Develop extension package with communities, Agricultural Department, and private sector for effective water management in spate irrigation, rainfed systems and discuss participatory groundwater management
4	Wetlands and the Indus Delta as buffers and resource pools	
4.1	Co-coordinating authority for wetland management	Wetland commissioner installed, to become part of the reformed institutional arrangements
4.2	Develop wetland management plans for multiple use	Investigate and determine the boundaries/demarcation line of all main wetlands/lakes that should include quantity/volume of water required, source of fresh water, socio economic situation, integrate allocate and release freshwater for all lakes and wetlands

4.3	Combine these with wetland investment plans with priority for most critical wetlands	Develop/prepare comprehensive strategic and business plan for rehabilitation and management of wetlands with public-private partnership.
4.4	Enhance the capacity to understand and effectively manage wetlands	Develop curricula on wetland management in Sindh's universities
5	Urban water supply and sanitation: creating safe places for living and working	
5.1	Water resource planning for cities and towns	Develop action plans to ensure the required water supply and urban water management for Karachi and two other big cities keeping in view in population, population growth and urbanization trend. These urban water resource plans need to be integrated with the Sindh Water Plan
5.2	Better operators: improving operational and environmental performance of urban water service providers	Develop open access system of performance tracking for urban subareas with civil society engagement
5.3	Mobilize public investments for essential defective infrastructure	Preparation for investment in vital water treatment facilities with major downstream effects
5.4	Regulating and stimulating private service suppliers	Meetings with private parties in water services (irrigation equipment, water treatments, reverse osmosis services and water tanking) to discuss SWP and aligning and stimulating private sector role
6	Rural water, sanitation, and hygiene (WASH) – dealing with hard-core non-access	
6.1	Provision and protection rural drinking water resources	Mapping freshwater pockets in at two Area Water Boards and agree on protection of these rural water resources by improved canal operations (including canal closure), controlled extraction and local drainage improvement
6.2	Reform and strengthen institutions and capacity to deliver services	System for tracking performance of all rural water supply including scan of main challenges in place
6.3	Targeted public investments	Develop plan for provision of drinking water for the dryland parts of Sindh and the most affected areas with saline groundwater as well as for priority rehabilitations.
6.4	Involvement of local private sector in service provision	Market place organized with local private business on opportunities to provide services for rural water supply, household water treatment and sanitation

The implementation of the policy action is not the sole responsibility of a single organization, but the tasks are to be shared by many, often as a joint effort. It is important that the Sindh Water Policy is known to many and becomes a joint framework for action. For this it is important that the Sindh Water Policy and the opportunities it provides for better public health, more prosperity, and less tension are extensively communicated.

At the same time also, water has to become 'everybody's business'. The cost of wasting water must be widely understood and has to become a source of common public concern. More insight in the state of water quality in Sindh will be developed by the monitoring of water quality. Wider groups of

Sindh’s society must understand the risks of low-quality water, inadequate services, and pollution. Furthermore, the functionality of WASH services shall be tracked and reported for ensuring continuous service delivery. Campaigns shall be initiated for wise water use and the provision of safe water by mobilizing communities and schools that monitor and take the action for improvement. This campaign shall apply mechanisms like Community Led Total Sanitation (CLTS), which is an innovative methodology for mobilizing communities to eliminate open defecation. Rural households shall be made aware through media of the scope for efficient water use and household water treatment. This will create the popular basis for better water management and to pressurize for quality services.

4.3 Setting audacious targets

As a follow up to the policy, it is also proposed that audacious targets are set on some of the key indicators in each burning issue. This will set the ambition level and give the direction.

The following audacious targets should apply for each of the six burning issues:

1. Managing water resources
<i>Sindh’s new institutions managing water in integrated manner in place by 2025</i>
<i>All irrigation circles and dryland zones transferred to Area Water Boards by 2030</i>
2. Multifunctional integrated management of the canal and drainage system
<i>Water logging reduced by 30% by 2025</i>
<i>Water productivity increased by 12.5% by 2025</i>
<i>80% of agricultural subsidies aligned with better water management by 2025</i>
3. Serving those off-grid: water management in the drylands
<i>Zero depletion of groundwater resources in dryland areas by 2030</i>
<i>Uniform approach for watershed and rangeland management in use by 2030</i>
4. Wetlands and the Indus Delta as buffers and resource pools
<i>75% of all Ramsar designated wetland in Sindh having a wetland management and investment plan by 2025</i>
5. Urban water supply and sanitation: creating safe places for living and working
<i>By 2025, Karachi, Hyderabad, Sukkur and Larkana have secure water resource plans</i>
<i>50% of cities with more than 100,000 population have secure water resource plans by 2025</i>
6. Rural water, sanitation, and hygiene (WASH) – dealing with hard-core non-access
<i>Water source security improved for 50% of the rural settlements by 2025</i>
<i>By 2030, improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally, per SDG 6</i>

4.4 Keeping the broad engagement

Finally, what is important is to keep the broad engagement that was present in the formulation of the policy in the implementation as well. There is no single party responsible for the implementation of the Sindh Water Policy, but many are to be encouraged to move in same direction. The engagement

should involve leadership and field staff. The capacity building and encouragement of the latter is important to create the broad motivation and understanding to come to a higher level of water management and better services.

Fortunately, Sindh has many institutional strengths. It has a government that has been safely managing some of the world's largest water infrastructure under increasing pressure and ever higher crop intensities. Sindh has a dynamic private sector that is already taking care of part of water service delivery. It has a long record of people's engagement, and a strong civil society that facilitates development. There are many examples of remarkable success from addressing pernicious problems such as reducing direct outlets in some canal sections to providing safe sanitation to urban slum areas. Also, in the preparation it became clear that over the last decade a cadre of young talented people have been educated in various aspects of water management, yet that they are not necessarily employed on their strengths. At the same time there is a huge need for these new skills to be applied and opportunities should be created to engage this new cadre on a priority basis. Finally, Sindh province has the support of external agencies that share the concerns for better water management – FAO, World Bank, Asian Development Bank – a list that can be extended with many others

It is also proposed that there is a clear follow process to the policy that builds on the mechanisms that were created for the formulation of the Sindh Water Policy, in particular the Steering Committee reporting to the Chief Minister and the Interdepartmental Technical Committee looking at implementation. Several of the policy actions require the development of more detailed strategies and plans to start implementation. Proposed is a dedicated unit that tracks the progress on the policy and helps facilitate the implementation of first steps. This unit – preferably under the P&D Department – would annually report on the activities undertaken and the impact made on the different policy actions.

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