ACRONYMS

ADB	Asian Development Bank
ADPs	Annual Development Plans
AWBs	Area Water Boards
BCM	Billion Cubic Metres
CBO	Community Based Organization
CDA	Capital Development Authority
CDWP	Central Development Working Party
ECNEC	Executive Committee of the National Economic Council
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FOs	Farmers' Organization
GDP	Gross Domestic Product
GNP	Gross National Product
GoP	Government of Pakistan
HAD	Hyderabad Development Authority
IBIS	Indus Basin Irrigation System
IRSA	Indus River System Authority
IWMI	International Water Management Institute
KWSB	Karachi Water and Sewerage Board
MAF	Million Acre Feet
MW	Mega Watt
NCS	National Conservation Strategy
NDP	National Drainage Programme
NEQS	National Environmental Quality Standards
NWFP	North West Frontier Province
O&M	Operations and Maintenance
P&D	Planning and Development
PCRWR	Pakistan Council for Research in Water Resources
PDWP	Provincial Development Working Party
PEPO	Pakistan Environmental Protection Ordinance
PHED	Public Health Engineering Department
PIDA	Provincial Irrigation Drainage Authority
RDA	Rawalpindi Development Authority
SCARP	Salinity Control and Reclamation Project
TDS	Total Dissolved Solids
WAPDA	Water and Power Development Authority
WASA	Water and Sanitation Agency
WB	World Bank
WCD CPP	World Commission on Dams – Consultative Process in Pakistan
WHO	World Health Organization
WUAs	Water User Associations

Contents

1.0 Introduction

The Pakistan Water Situational Analysis is a component of the World Commission on Dams – Consultative Process in Pakistan (WCD CPP) Project undertaken by IUCN Pakistan with the support of Royal Netherlands Embassy, Islamabad. The Pakistan Water Situational Analysis will strengthen the umbrella project in its objective to contribute to the formulation of a shared view around the current issues related to water.

The document provides information related to water resources in terms of availability of surface water & groundwater, usage of water, relevant legislations and policies, major government programmes, institutional mechanism and strategic recommendations. It may be noted that the document is neutral and unbiased as it is based on secondary data however, the final section of strategic recommendations portray views of the expert about the water sector.

It is essential to clarify that on many occasions, multiple data information exists within the government reports Various reports and documents of the government of Pakistan have been used to compile this document and consideration has been given to select information which is realistic, acceptable and inter-verifiable. References of documents have been provided to endorse the sources of data.

2.0 Overview of the Water Sector

2.1 Available Water Resources

2.1.1 Surface Water

The main source of surface water in Pakistan is the Indus river and its tributaries, all of which are perennial and have their origins in the mountains. The sources of supply of water to these rivers are glacialmelt, snowmelt, seepage from geological formations and the run-off generated by seasonal rains in the watershed areas.

Five main rivers join the Indus from the eastern side are: Jhelum, Chenab, Ravi, Beas and Sutlej; beside these 3 minor rivers – Soan, Harrow and Soan are also draining into Indus. On the western side, a number of small rivers join Indus, the biggest of which is river Kabul with its main tributaries i.e. Swat, Panjkora and Kunar. Several other small streams such as Kurram, Gomal, Kohat, Tai, Tank, etc also join Indus on the right side. The total catchment area of Indus river system is 374,700 sq. miles of which about 56% i.e. 204,300 sq. miles lies in Pakistan.

The Indus River and its tributaries on an average bring about 154 MAF of water annually. This includes 144.91 MAF from the three Western rivers and 9.14 MAF from the Eastern rivers. Most of this, about 104.73 MAF is diverted for irrigation, 39.94 MAF flows to the sea and about 9.9 MAF is consumed by the system losses which include evaporation, seepage and spills during floods.

Outside the Indus Basin, there are smaller river basins, which drain directly to the sea on the Mekran coast of Balochistan and a closed basin (Kharan), which in total amount to an inflow of less than 4 MAF (5 BCM) annually. These streams are flashy in nature do not have perennial supply. About 25% of the inflow is used for flood irrigation.

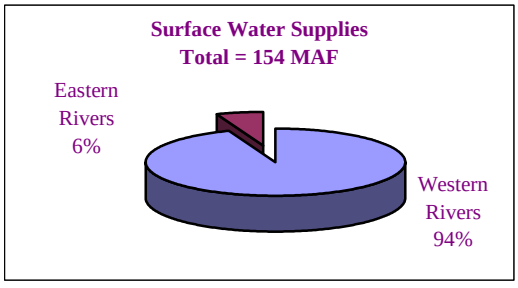
On average, during post-Tarbela period, about 39.39 MAF (48.59 BCM) flows to the sea annually. Most of this flow goes into sea during the Kharif season when 36.94 MAF (45.57 BCM) or 93.8% goes to the sea. In Rabi season, on average about 2.44 MAF (3.01 BCM) goes into the sea, and most of that is in the first few weeks of the Rabi season. For several months in the winter no flows go into the sea.

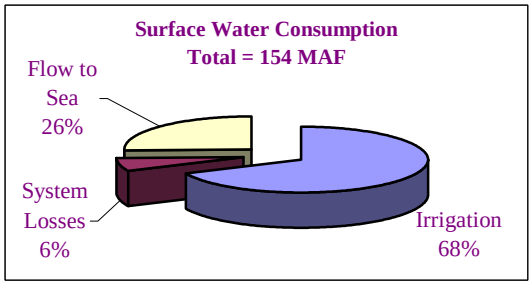
Rainfall in Pakistan is markedly variable in magnitude, time of occurrence and as well as in its aerial distribution. However, almost two-thirds of the rainfall is concentrated in the three summer months of July- September. The mean annual precipitation ranges from less than 100 mm in parts of the Lower Indus Plain to over 750 mm in the Upper Indus Plain near the foothills. There are two major sources of rainfall in Pakistan, the Monsoons and the Western Disturbances. The relative contribution of rainfall in most of the canal commands is lower when compared with the other two sources of irrigation water supply i.e., canal water and groundwater. More than sixty percent of the Kharif season rainfall is concentrated in the month of July for almost all of the canal commands.

The Monsoons originate in the Bay of Bengal and usually reach Pakistan, after passing over India, in early July and their activities continue till September. The Indus Plains receive most of their rainfall from the Monsoons. There are two periods of thunderstorms in Pakistan: (1) April-June (2) October-November. These periods are the driest parts of the year, particularly October and November. During these periods thunderstorms caused by convection bring sporadic and localized rainfall.

The entire Indus Plains (canal command areas) receive average seasonal rainfall of 212 mm (95% confidence interval ± 28) and 53 mm (95% confidence interval ± 8) in the Kharif and Rabi seasons, respectively.

Approximately 80% of the supply of the municipal and industrial water is returned to the rivers, nullahs and streams untreated, which results in deterioration of water quality and causes water borne diseases.





Pakistan shares the use of rivers in the Indus Basin with India. Under the Indus Waters Treaty of 1960 India was allowed exclusive use of three eastern rivers (Ravi, Sutlej and Beas) and Pakistan was allocated the three Western Rivers (Chenab, Jhelum and the Indus) with some uses allowed to India.

The three eastern tributaries of the Indus - Ravi, Sutlej and Beas have been allocated to India for its exclusive use. India has constructed the Bhakra Nangal Dam to harness the Sutlej, Pong Dam on Beas and Thein dam for harnessing the Ravi. The spills from these dams and unutilised flows enter Pakistan at Madhopur on the Ravi and below Ferozpur on the Sutlej.

2.1.2 Groundwater

Quantity

The Indus Basin is formed by alluvial deposits carried by the Indus and its tributaries and is underlain by an unconfined aquifer covering about 15 million acres in surface area. In the Punjab about 79% of the area and in Sindh about 28% of the area is underlain by fresh groundwater, which is mostly used as supplemental irrigation water and pumped through tube wells. Some groundwater is saline and water from the saline tube wells is generally put into drains and, where this is not possible, it is discharged into the large canals for use in irrigation after diluting with the fresh canal water.

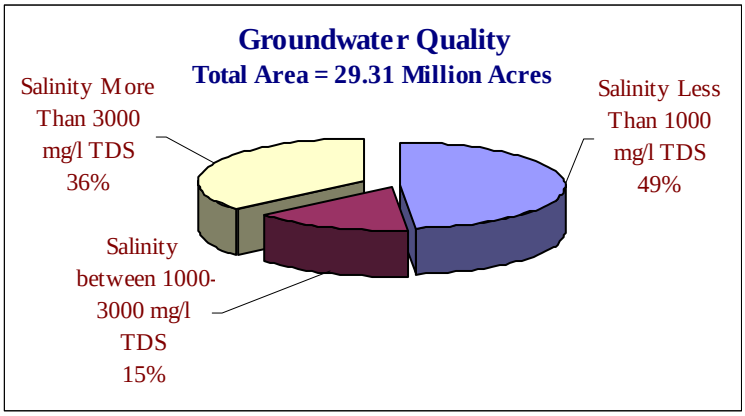
In NWFP abstraction in excess of recharge in certain areas such as Karak, Kohat, Bannu and D.I. Khan has lowered the water table and resulted in the contamination from underlying saline water. Whereas in Balochistan, the Makran coastal zone and several other basins contain highly brackish groundwater. As there is no alternative, local communities use groundwater for drinking purposes. In Mastung Valley, the groundwater has been found to have high fluoride content. The Makran coast and Kharan have also been reported to have high fluoride groundwater.

For controlling waterlogging and salinity, the Government embarked upon several programme of Salinity Control and Reclamation Projects (SCARPS) in the 60s wherein horizontal and vertical drainage by tile drains and large deep tube wells were installed respectively, to control the groundwater table. Over a period of about 30 years some 13,500 tube wells were installed by the Government to lower the groundwater table. These projects initially proved quite effective but with the explosion of shallow tubewells in the private sector, performance of SCARPs was deteriorated.

Particularly in the eighties the development of private tube wells received a boost, most of these shallow tube wells were individually owned. Now more than 500,000 tube wells supply about 41.6 MAF of supplemental irrigation water every year mostly in periods of low surface water availability.

Quality

The quality of groundwater ranges from fresh (salinity less than 1000 mg/l TDS) near the major rivers to highly saline farther away, with salinity more than 3000 mg/l TDS. The general distribution of fresh and saline groundwater in the country is well known and mapped as it influences the options for irrigation and drinking water supplies.



In the country some 14.2 million acres are underlain with groundwater having salinity less than 1000 mg/l TDS, 4.54 million acres with salinity from 1000 to 3000mg/l TDS and 10.57 million acres with salinity more than 3000 mg/l TDS.

2.2 Water Usage

2.2.1 Uses of Water

Pakistan is country where about half the workforce is related to agriculture and need water as their main raw material. Water has played a very significant role in the economic development of the nation. Water is also essential for hydropower production, which is of crucial importance for the development of energy sector in Pakistan. Water is also the basic ingredient for urban and rural water supply, industrial and mining needs, sanitation and wastewater disposal. Hence role of water is directly linked with the quality of life and the precursor for the essential functions in a developing economy.

2.2.2 Drinking

Urban Water Supply

The current water use for combined domestic and industrial supplies in the urban sector is of the order of 4.3 MAF. Most urban water is supplied from groundwater except for the cities of Karachi, Hyderabad and part of the supply to Islamabad and Rawalpindi which mainly use surface water. It may be noted that the unaccounted water in the urban water systems is very high and ranges between 30 and 40% in some cities.

Access to water for domestic purposes in the urban areas is limited to about 84%. About 58.5% of the people have piped supply to their homes and about 7.6% get their supplies

from standposts. The remaining population obtains their water supplies from hand pumps, wells, or through private water vendors.

Rural Water Supply

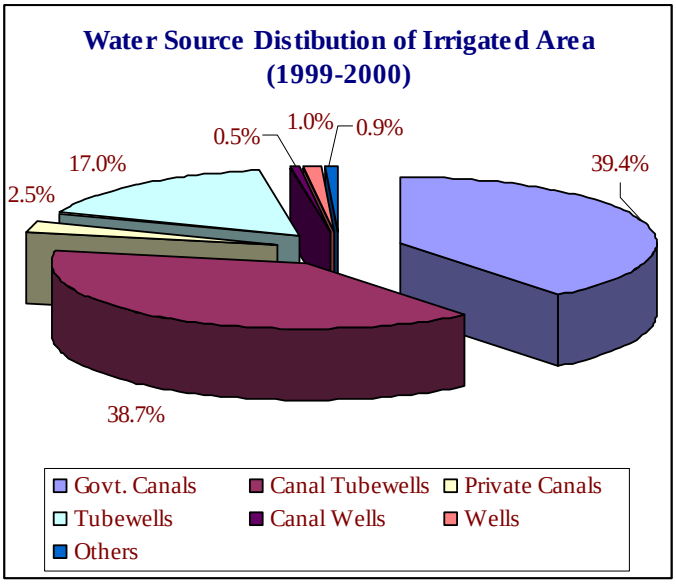
The present domestic water use in rural areas is estimated at 0.8 MAF. Most rural water is supplied from groundwater except in saline groundwater areas where irrigation canals are the main source of domestic water. Over 50 percent of village water supply is through private hand pumps.

2.2.3 Irrigation

About 68% of the rural population depends on agriculture as it employs over 46 percent of the labour force. Agriculture is the single largest sector of Pakistan's economy, and contributes about 25% of GNP. Within the agricultural sector, the contribution from crop production is about 52 percent while livestock contributes almost 44 percent. The contribution from fisheries and forestry are comparatively small, estimated at 3 percent and 1 percent respectively.

Irrigated agriculture is the major user of both, surface and groundwater resources of Pakistan. The average annual river diversions for irrigation in the Indus Basin are of the order of 104.7 MAF for irrigating over 14.6 million hectares. Of this, 67.11 MAF on average are diverted during the Kharif period, while 37.63 MAF are diverted during the Rabi period.

During the Kharif periods of the last ten years (1991-2001), Punjab used 34.3 MAF annually, while Sindh & Balochistan used 31.4 MAF and NWFP used 2.35 MAF. During the Rabi periods of the last ten years, average withdrawals by Punjab, Sindh & Balochistan and NWFP were 19.87 MAF, 16.06 MAF and 1.46 MAF, respectively.



During the year 1999-2000 the total irrigated area from all the sources, including private canals, schemes, wells and tubewells and publicly owned infrastructure was of the order of 18.06 million hectares. About 77.4% of the total irrigated area of Pakistan falls in Punjab, 2.8% area falls in NWFP and 19.8% in Sindh/ Balochistan.

In the last 25- 30 years, ground water has become a major supplement to canal supplies especially in the Upper Indus Plain where ground water quality is good. Groundwater resources of Pakistan extend from the Himalayan foothills to the Arabian Sea and are contained in the alluvial deposits of the Indus Plains. The large scale tubewell pumpage for irrigation started in the early sixties. The number of private tubewells also grew steadily with time. There are presently over 550,000 tubewells in the IBIS and the annual pumpage in all canal command areas has been estimated to be 41.6 MAF of which more than 90% is used for irrigation..

The current estimated irrigation efficiency in Pakistan is 35.5% which means that only 35.5% of the water is actually used by the crops. Irrigation efficiency is a compound of three efficiencies i.e. Canal-head efficiency, watercourse efficiency and farm efficiency.

Irrigated area of Pakistan is highly affected by waterlogging and salinity/ sodicity problems. In addition to other measures like Irrigation System Rehabilitation, Command Water Management and On-Farm Water Management programs taken up by different government departments, WAPDA has completed 57 Salinity Control and Reclamation Projetcs (SCARPs) at a total cost of Rs. 26.48 billion covering a gross area of 7.81 million hectares. Projects worth Rs. 26.9 billion are also in progress.

Indus Basin

The Indus Basin Irrigation System comprises three major reservoirs, 16 barrages, 2 head-works, 2 siphons across major rivers, 12 inter river link canals, 44 canal systems (23 in

Punjab, 14 in Sindh, 5 in NWFP and 2 in Balochistan) and more than 107,000 water courses. The aggregate length of the canals is about 56,073 Km. In addition, the watercourses, farm channels and field ditches cover another 1.6 million Km

The Water Accord

In 1991, an agreement to share waters of the Indus River was reached between the four provinces in the form of the Water Apportionment Accord. This accord is based on the water supply of both, the existent and future needs of the four provinces and has two important features:

i. It protects the existing uses of canal water in each province.
ii. It apportions the balance of river supplies, including flood surpluses and future storages among the provinces.

Province	Provincial Water Share in Canal Withdrawals (1999-2000)		Average Provincial Canal Withdrawals for Kharif and Rabi (1990-2000)	
	MAF	%	Kharif (MAF)	Rabi (MAF)
Punjab	54.88	52.0	34.29	19.86
NWFP	3.45	3.3	2.31	1.52
Sindh / Balochistan	47.15	44.7	31.41	16.11

The total annual canal diversion during the last 10 years varied between 109.75 MAF in 1990-91 and 94.45 MAF in 1994-94.

2.2.4 Fisheries

Pakistan produced 665,000 metric tons (mt) of fish and related products in the year 2000 including 185,000 mt from inland waters and 480,000 mt from marine fisheries. Although the share of fisheries in the GDP is small its contribution to national income through exports is substantial. During the same period 84,693 mt were exported with a value of Rs. 7.9 billion.

Fishes are mainly classified as “freshwater” in Pakistan and are dependent on water quality for growth and sustainability. There are 156 species of freshwater fishes belonging to 68 genera, 22 families, 9 orders and 2 classes. These do not include the exotic species. On the basis of salt tolerance, the freshwater fishes are generally classified into three main categories: primary freshwater fish – having little or no tolerance, secondary freshwater fish – confined to inland water with slight salt tolerance and peripheral freshwater fish – marine but still spend some time in freshwater.

Fish stocks in most of the rivers have declined due to over harvesting and disposal of untreated industrial and municipal sewage. The reaches of rivers nearest the cities are

heavily polluted with municipal and industrial wastewater. The impact of pollution on aquatic life becomes acute during periods of low flow in the rivers, when dilution factors are low. Reasons for fish decline also include introduction of invasive species and limiting of river reaches due to barrages and dams, especially without properly functioning fish ladders.

2.2.5 Freshwater Ecosystems

The wetland ecosystems in Pakistan are predominantly of the following types:

- Riverside Ecosystems
- Coastal and Tidal Wetlands in The Indus Delta
- Mountainous Springs and Lakes
- Scattered Ecosystems and Lakes in The Plains and
- Man-Made Reservoirs Barrages and Dams

According to a recent study, there are 226 wetlands in Pakistan of which 118 are in the northern alpine and mountain region, 8 in the rest of the northern areas, 10 in Azad Jammu and Kashmir, 22 in Balochistan, 17 in NWFP, 19 in Punjab, 30 in Sindh and 2 in the Federal Capital Area.

Some wetlands act as navigational markers for migrating birds such as the Indus Flyway, which recorded more than 1.3 million waterfowl in 1991. Pollution in wetlands and their drying up decreases wintering areas on the flyway route. However, it has been observed that huge concentrations of wintering waterfowls are now found at the newly added, man-made wetlands such as Chashma, Taunsa, Rasul, Marala, Qadirabad and Hub reservoirs. Drying of relatively old wetlands and formation of new ones exerts strain on flora and fauna as they are not able to migrate to the new sites and, secondly, the resilience factor of the new wetlands is so low that sustainability of species is difficult.

Many wetlands in Pakistan have been protected by declaring them sanctuaries, game reserves or national parks. Nineteen wetlands in Pakistan are internationally recognised and have been registered under RAMSAR Convention, which is the international treaty of wetlands signed in Iran in 1971. This list includes: Astola Island, Hub Dam, Jiwani Coastal, Miani Hor and Omara Turtle Beaches in Balochistan; Ucchali Complex, Chashma Barrage and Taunsa Barrage in Punjab; Tanda Dam and Thanedar Wala in NWFP and Indus Dolphin Reserve, Drigh Lake, Haleji Lake, Jubho Lagoon, Kinjhar Lake, Runn of Kutch, Deh Akro II, Indus Delta and Nurri Lagoon in Sindh.

2.2.6 Hydropower

The total installed power generation capacity in Pakistan is 17,457 MW. This includes hydropower generation capacity of 5,013 MW, thermal power generation capacity of 12,169 MW and nuclear power generation capacity of 462 MW. Based on the present generation capacity the hydro : thermal/ nuclear mix in the country is 29 : 71.

The main sources of electricity generation in Pakistan are Hydel, Furnace Oil, Gas, Coal and Nuclear. Among these, hydel is the only renewable source; the others are mainly fossil fuels. Hydel power is also the least expensive form of electricity. The potential for hydropower generation is of the order of 40,000 MW.

Hydropower generation is dependent on hydrological variations and irrigation release requirements. In early summer the reservoir levels are generally low and the turbines operate at relatively low heads with consequently low power output. In flood season the reservoir levels are high and large discharges can be passed through the turbines for power generation to get the maximum generation. In winter the irrigation requirements are low and the discharges for power generation are limited resulting in lower power output.

3.0 Current Status

3.1 Water related Policies

Pakistan still lacks a well-defined water policy, however, in the absence of a consolidated policy, water development has been taking place through guidelines prepared in various government umbrella policy programmes.

GoP's 5-year Plans

Water sector development planning was done through mandates spelled out in the 5-year plans of the government of Pakistan until 2001. A total of seven Five Year Plans were implemented between 1955 to 1998.

During the first and second 5-year plans, the key emphasis was on increasing productivity through increased application of water and control of waterlogging and salinity, which were assuming alarming proportions at that time. Provision of inexpensive electricity to accelerate agricultural and industrial development was also one of the key objectives.

During the third and fourth 5-year plans, control of waterlogging and salinity continued to be the key element in addition to water conservation and use of groundwater for supplementary irrigation.

There was no 5-year plan between 1970-78 and development allocation was through Annual Development Plans (ADPs). This period is considered as the fourth 5-year plan.

During the fifth 5-year plan, water management and reduction of conveyance losses became the key objectives. The Plan also envisaged involvement of water users in the improvement of watercourses. These objectives continued with slight modifications in the subsequent Plans.

During the sixth and seventh 5-year plans, the key objectives were improved water management and involvement of farmers and stakeholders. Initiation of On-Farm Water Management Projects was also done during the same period.

During the eigth 5-year plan, the government's plan included formation of farmer's organizations and decentralization of the water management system through Area Water Boards. The Ninth Plan was not issued and, in September 2001, the Government approved a 10 year Perspective Development Plan 2001- 2011.

Other Policy Decisions

In the absence of a consolidated water policy a number of policy decisions are being implemented in the water sector as components of various policy programmes. These include:

- Adoption of a Hydel Policy to encourage private sector participation in hydropower generation. A Policy Framework and Package of Incentives for Private Sector Hydel Power Generation Projects in Pakistan was developed in May 1995.
- Institutional reforms in the irrigation and drainage sector through PIDA Acts, specifically the establishment of the Provincial Irrigation and Drainage Authorities, Pilot Area Water Boards and Farmer Organisations which are underway under the Institutional Reforms of Sindh Irrigation and Drainage Authority, the rest of the provinces will follow the same course of action.
- Enactment of the Environment Protection Act which was formulated in 1997.
- Adoption of a National Conservation Strategy which was developed in 1992 and its Mid-Term Review was conducted in 1999.
- Exploitation of groundwater in fresh groundwater areas to be performed entirely by the private sector which has led to over 550,000 tubewells in the country mostly in the private sector.
- Encouragement of beneficiary participation in operation and management of irrigation and drainage systems at tertiary canal level and for rural water supply and sanitation schemes which has led to approval of PIDA Act and formation of PIDAs.
- Improvement of cost recovery both in irrigation and drainage and in rural and urban water and sanitation schemes which has been partly achieved through system improvement.
- Transition of Salinity Control and Reclamation Project (SCARP) tubewells in fresh groundwater areas and their replacement with privately owned and operated community tubewells which is almost completed in Punjab through the Punjab Private Sector Groundwater Development Project.
- The transboundary policy for the Indus system is defined by the Indus Water Treaty signed between Pakistan and India in 1960. Several infrastructure projects have been planned and implemented in the water sector during the post-treaty period.

National Conservation Strategy

To address the water-related environmental issues, Pakistan adopted the National Conservation Strategy (NCS) in 1992 as its official policy on environment with the goal of transforming attitudes and practices and influencing consumption patterns and ensuring that the development is not destructive to the natural resource base on which it rests.

Vision 2025

The serious drought in the last three years has put additional focus on water resources development. Recently the Pakistan Government through WAPDA launched a

comprehensive integrated water resource and hydropower development Mega-plan, 'Vision-2025' for development of water reservoirs and hydropower generation. WAPDA's Vision 2025 is also included in the Ten Year Plan.

The Ten Year Perspective Plan

In September 2001, the Government approved a 10 year Perspective Development Plan 2001- 2011, which also includes a Three Year Development Plan for the period 2001 – 2004.

Due to drought, agriculture has already declined by 2.5% since the year 2000. Keeping in consideration the following conditions the Ten Year Perspective Plan comprises a macroeconomic framework, a public sector development programme and sectoral strategies for the water sector.

In addition to other sectors of the national economy, revitalizing agriculture, development of new water and power resources and a Rs 10 billion Drought Relief Programme are part of the growth strategy under the Ten Year Perspective Plan. The Ten Year Perspective Plan envisages reduction in incidence of food poverty. It also plans to improve the Human Development Index Rank and increase in the GDP growth rate.

The goals for the urban rural water supply sectors as defined in the Ten Year Perspective Plan include provision of safe drinking water to 96% of the urban and 75% of the rural population by the year 2011. Coverage for sanitation and sewerage is to be increased to 80% of the urban population and 50% of the rural population by 2011.

The Devolution Plan

Pakistan has started implementation of a Devolution Plan since August 2001 which envisages establishment of elected local governments at the union council, tehsil, town, district and city district level. The district governments headed by the District Nazims will be the key component of the new system as they will be responsible for planning, investment and control of municipal services including water supply, sanitation, solid waste disposal, etc.

National Water Policy Study

Currently, a water policy is under development through the National Water Sector Policy Study under the National Drainage Programme. The draft objectives of the Water Policy as defined in the on-going Water Sector Study include:

- Development of a comprehensive framework for designing water resources investments, policies and institutions.
- Adopting water pricing policies that would achieve equitable distribution, cost recovery, water conservation and better allocation as well as judicious utilization of water resources.

- Decentralization of water service delivery, involving users in planning and managing water projects and encouraging stakeholders to contribute towards policy formulation.
- Restoring and preserving aquatic eco-systems, improving water quality and guarding against over-exploitation of groundwater resources.
- Avoiding waterlogging and salinity problems associated with irrigated investments and adopting management practices to control water pollution.
- Establishing a strong legal and regulatory framework to ensure that social concerns are met, environmental resources are protected and monopoly pricing is prevented.

The Resettlement Policy

The Resettlement Policy of Pakistan has been developed and is currently in draft form for review and approval of the concerned authorities. It addresses the rights of landowners in areas where development projects have to be initiated.

3.2 Water related Legislations in Pakistan

Pakistan Penal Code

The Pakistan Penal Code of 1860 describes penalties for voluntarily corrupting or fouling public springs or reservoirs so as to make them less fit for ordinary use. The subject of toxic or hazardous waste pollution is also covered to some extent purely in qualitative terms. It is not effective, as it does not define corrupting or fouling.

Factories Act

The Factories Act of 1934 of the Ministry of Industries includes clause which deals with disposal of wastes and effluents from manufacturing processes and fines for polluters. This Act is also not enforced, hence there is limited potential for their implementation. Moreover, the penalties prescribed for various offences are so meager that potential offenders are not concerned.

The Indus River System Authority (IRSA) Act

The IRSA Act, formulated in 1992, implements the Water Accord which apportions the balance of river supplies, including flood surpluses and future storages among the provinces.

The Canal and Drainage Act

The Canal and Drainage Act of 1873 is the most comprehensive legislation aimed to control and regulate the entire irrigation and drainage system and to ensure the supply of irrigation water from the canal system to farmers. Under this law the field officers have been given the magisterial powers to control encroachments and to ensure equitable irrigation supplies.

The WAPDA Act

The Water and Power Development Authority was created at the Federal level in 1958 through the WAPDA Act. Its mandate is to undertake construction of large irrigation and drainage projects and for construction and operation of large hydropower projects. The Authority is also responsible for generation, transmission and distribution of power in the country.

Water User Ordinances

The Water User Ordinances was promulgated in 1982 to enable formation of Water User Associations (WUAs) for participation in water management at water course level. The WUAs made a good start by participating in improvement of more than 10,000 water courses but after the completion of improvement works became dormant.

The Provincial Irrigation and Drainage Authority Acts

The Provincial Irrigation and Drainage Authority Acts were enacted in all provinces in 1997. The purpose is to introduce institutional reforms in the water sector of Pakistan. The public sector institutions have not been able to recover even O&M costs because of inadequate assessment and collection of user charges. These Acts will initiate irrigation and drainage sector reforms to improve service delivery and sustainability. These Acts provide the legal framework for establishment of Provincial Irrigation and Drainage Authorities (PIDAs), Area Water Boards (AWBs) and Farmers Organizations (FOs).

Community Irrigation Farmer Organizations Regulation

Community Irrigation Farmer Organizations Regulation was approved in the year 2000 in pursuance to the implementation of provincial Irrigation and Drainage Authority Acts.

Pakistan Environmental Protection Act

The Pakistan Environmental Protection Ordinance (PEPO) was issued in 1983. It has been replaced with the Pakistan Environmental Protection Act, 1997. The Act is directed to provide a basic environmental policy and set up a management structure for pollution control. Proper enforcement of the Act will result in improved water quality in various water bodies as the disposal of untreated municipal and industrial wastes will be controlled.

National Environmental Quality Standards

The National Environmental Quality Standards (NEQS) which were enacted in 1993 to delineate allowable limits for 32 pollutants in effluents and industrial discharges along with other limits related to industrial and vehicular air emissions

Punjab Soil Reclamation Act

The Punjab Soil and Land Reclamation Act of 1952 provides legal basis for implementation of salinity Control and Reclamation Project (SCARP) to control the water logging and salinity. The act empowers the Department of Irrigation to license and control groundwater in any area notified as problem area by the government. The Department of Irrigation has the authority to exercise all the powers under the Act. The Act was later extended to cover the whole country.

The Sindh Irrigation Act

The Sindh Irrigation Act was approved in 1879 to be implemented for irrigation management by the Sindh Irrigation Department. The Act is not in practice anymore.

The Punjab Minor Canal Act

The Punjab Minor Canal Act was approved in 1905 by the government to be implemented by the Punjab Irrigation Department for the management of minor canals in the sub-continent.

The Canal and Drainage Act NWFP Amendment

Canal and Drainage Act NWFP Amendment 1948 provides legal authority to the provincial Department of Irrigation for allocation of canal water to farmers. The Amendment was for the improvement in irrigation system and is implemented by the NWFP Irrigation Department.

The Balochistan Ground Water Rights Administration Ordinance

Balochistan Ground Water Rights Administration Ordinance of 1978 provides detailed procedures for ground water extraction. The Ordinance makes provisions for defining water basins in different areas. It requires setting up of a district water committee to grant permission for drilling of tube-wells. But this law is poorly enforced. Balochistan Ground Water Rights Administration (Amendment) Ordinance of 2000 makes provisions for installation of water measuring devices on all the sources engaged in ground water extraction. No water meters have been installed yet but the department of Irrigation plans to install devices on the sources in Quetta valley.

3.3 Enforcement of Legislation

The Pakistan Penal Code 1860 and the Factories Act 1934 are quite old and very weakly enforced. The Indus River System Authority enforces the Water Allocation Accord quite rigidly. Still in periods of shortages problems arise on sharing of shortages and interpretation of the Accord. The Canal and Drainage Act 1873 is enforced by the Punjab Irrigation Department with certain limitations. The law is quite old and defines penalties which are no longer effective.

Mangla and Tarbela dams are under the control of WAPDA through the WAPDA Act 1958. The act defines the existence of WAPDA and is rigidly enforced.

Within the provinces also, water distribution follows the canal allocations and in the watercourse commands warabandi is strictly followed. Still there is inequity in the canal systems as generally upper users manage to get more water at the cost of users at the end of the systems. Big and influential landlords sometime tamper with the outlets and divert more than their share.

Recovery of water charges is often problematic in the irrigation and drainage sector. The shortfall between O&M expenditure and revenue is 72% mainly due to subsidized water rates and weak collection system. Institutional reforms in the irrigation and drainage sector are designed to address this aspect as revenue assessment and collection is being delegated to Farmer's Organizations.

Enforcement of Environmental Regulations relating to discharge of effluents into water bodies is not effectively enforced. Weak enforcement is due to the lack of technical staff as well as resources and skills among the available staff. Environmental tribunals were established in 1999 in Karachi and Lahore, each establishment serving two provinces. No significant change has so far been observed regarding implementation of legislation

3.4 Government Plans and Programmes

After the formation of WAPDA in 1958 and the initiation of green revolution in the agriculture sector in the 1960s, waterlogging and salinity emanated as a major threat to the nations' economy which mainly relied on agriculture produce. The Plans and Programmes of the Government of Pakistan directly addressed these problems and focused towards initiation of a number of Salinity Control and Reclamation Projects (SCARPs). Most of these projects were in Punjab and Sindh and the methodology for most of them was vertical drainage through installation of network of tubewells, however some SCARPs were developed for horizontal drainage through tile drains. In the same era, tubewells' installation grew tremendously by the private sector leaving little justification for similar projects to be conducted in the public sector. In the late 1970s and 80s, most of the SCARP tubewells got non-operational due to lack of maintenance, adequate funds, etc, hence, transition of SCARP tubewells and their replacement with privately owned and operated community tubewells was started in 1986. The Punjab Private sector Groundwater Development Project, envisages closure and replacement of 4,233 SCARP tube wells.

A strategy for institutional reforms in the water sector for beneficiary participation at different levels to improve service delivery in the irrigation and drainage sub-sector was adopted in 1995. The implementation of the institutional reforms started in 1997 and is being supported by the NDP. Four provincial projects are envisaged for institutional reforms in the irrigation and drainage sector. The project in Sindh is already underway.

A US$ 785 million, National Drainage Programme (NDP) is currently under implementation through WAPDA and provincial Irrigation Departments, which envisages reduction in drainage surplus and environmentally acceptable disposal of drainage effluent. A Drainage Accord between the provinces is also envisaged which will define an agreed strategy on disposal of drainage effluents. Work on the preparation of a National Water Policy and several other Policy and Sector Planning Studies is currently in progress under the NDP. In addition, the Flood Protection Sector Project is currently under implementation through the Federal Flood Commission which envisages upgrading of existing flood protection works and extension of protection to new areas.

The Government of Pakistan through WAPDA has launched a comprehensive integrated water resource and hydropower development Mega-plan known as 'Vision-2025'. This aims at the development of 64 MAF of new storage capacity and 27,000 MW of additional power generation capacity from hydropower and coal. Vision 2025 envisages an investment of about $50 billion over the next 25 years.

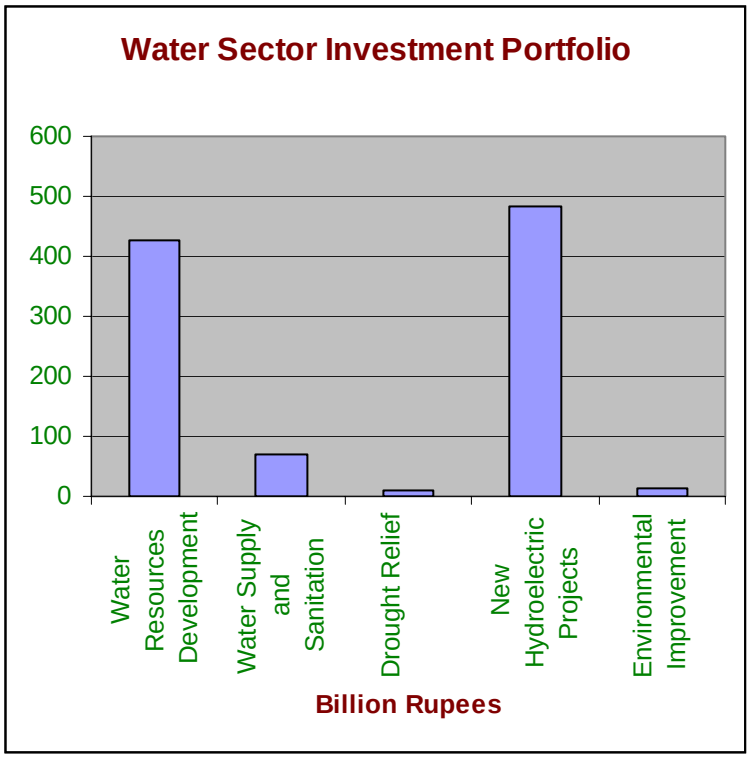
The Ministry of Water & Power has recently completed a Water Resource Sector Strategy Study through grant of the Asian Development Bank which has formulated a water sector profile, national water sector strategy upto 2025 and a mid-term investment plan.

The governments plans indicated in the Ten Year Perspective Plan expresses its commitments for the water sector. The objectives of water sector development include: overcoming scarcity of water through augmentation and conservation, restoring productivity of agricultural land through control of waterlogging, salinity and floods, managing quantity and quality of drainage effluent in an environmentally safe manner, groundwater management through tubewell transition, aquifer monitoring and management etc., implementing an integrated flood control and management programme, promoting beneficiary participation in development initiatives, enhancing performance of water sector institutions and implementing effective O&M mechanisms through institutional reforms and private sector participation and capacity building. The main objectives relating to water supply and sanitation include:

- To increase water supply coverage from the present 63% (83% urban and 53% rural) to 84% (96% urban and 75% rural) in ten years. An additional 55 million people will be served (27 million urban and 28 million rural).
- To increase the sanitation coverage from 39% (59% urban and 27% rural) to 63% (80% urban and 50% rural). An additional 54 million people will be served (28 million urban and 26 million rural).

- To resolve the acute drinking water shortage problems in some cities, especially Karachi and Quetta.
- To improve environmental conditions by installing sewage treatment plants in major urban centres.
- To encourage participation of the private sector in water supply systems of Karachi, Lahore and Islamabad for ensuring better cost recovery.
- To undertake projects to curtail water losses, rehabilitation of existing networks and initiate installation of water meters in major cities.
- To continue rural water supply and sanitation programmes ensuring participation of beneficiary communities in planning, design, implementation and O&M.
- To upgrade institutional capacity of various departments and beneficiary communities.

Moreover, the importance of water sector development can be seen from the respective allocations for the water sector in the Ten Year Perspective Plan estimated at Rs 2,540 billion. The Plan envisages an investment pattern such as:



The commitment of the Government of Pakistan for environment is indicated by the National Conservation Strategy (NCS) which was adopted in 1992.

The importance of water sector is obvious by the number of water-related projects among the fast-track projects launched on August 14, 2001. These include Raising of Mangla Dam, Mirani Dam Project, Gomal Zam Dam, Satpara Dam, Thal Flood Water Canal, etc

3.5 Water Availability & Distribution

The current sector-wise water distribution pattern of Pakistan is estimated to be as follows:

Sector	Total Quantity (MAF)	Estimated Surface water (%)	Estimated Ground water (%)
Drinking Water (in urban areas)	3.1	33	67
Drinking Water (in rural areas)	0.8	5	95
Industrial Water	1.2	2	98
Irrigation	143	80	20

A total of 154 MAF of surface water is available through the Indus and its tributaries and an additional 41.6 MAF of groundwater is also extracted, annually. Out of the 154 MAF available surface water, almost 40 MAF flows to the sea, less than 2 MAF is used for industrial and drinking supplies, 8-9 MAF is lost in the system and evaporation and the remaining 105.5 MAF is diverted for irrigation. In case of groundwater, more than 90% of the 41.6 MAF is used for irrigation, the remaining component serves the industrial and drinking water consumptions. It is important to note that although 143 MAF of surface- and groundwater is channeled for irrigation, the proper consumption is much less due to low irrigation efficiencies. Canal-head efficiency is estimated at about 79%, watercourse efficiency 60% and the farm efficiency at 75% providing an average efficiency of only 35.5%.

3.6 Water Supply Network System

In Pakistan, the water supply network system is in the domain of public sector, however, the network is limited in the urban areas. In rural areas, the water supply network is laid down by consumers who also own the tubewells for supply of water within their premises. Water and Sanitation Authorities (WASAs) have been established in several major urban centres such as Rawalpindi, Lahore, Faisalabad, Quetta, Multan. In case of Karachi it is called Karachi Water & Sewerage Board. In areas where WASA does not exist the Public Health Engineering Department (PHED) is responsible for water and sanitation schemes.

The water supply network, in most cases, is as old as the city and has deteriorated significantly. Repair and maintenance of the system has not been satisfactory due to shortage of funds. Most of the WASAs and PHEDs have developed large scale projects for rehabilitation of the existing networks.

Under the devolution plan, the provincial PHEDs which are meant to carry out planning, designing, construction supervision, evaluation and monitoring of rural water supply schemes has been remodeled. The Supertending Engineers and Executive Engineers who were incharge of field formations have been sent to District Government and Tehsil administration respectively under the control of concerned Nazims. The post of Chief Engineer has not yet been abolished but his primary duty as planner, carrying out inspection of works and guidance to lower formation is not being made use of.

Comparing water charges in Pakistan with rest of the world, it can be observed that the rates are quite low, even in this scenario, the cost recovery is low. Leakages, lack of water-meters and water thefts are the major reasons for low recovery. The government is planning to privatize the water supply network to improve both efficiency of service and cost recovery.

3.7 Urban and Rural Water Consumption Patterns

Pakistan has achieved an overall water supply coverage of 63% of the national population in the year 2001. Access to safe water for domestic purposes in the urban areas is limited to about 84% of the population. About 57% of the people have piped supply to their homes. The remaining population gets their supplies from hand pumps, wells, community taps or private water vendors. Those supplied by water vendors tend to be among the poorer people, raising the issue of equity in water supply.

In major urban centers cost recovery ratio is 62%. In intermediate urban centers service coverage is 32% of the population. The present water use for municipal and industrial supplies in the urban sector is of the order of 4.3 MAF. The incidence of non-revenue or unaccounted for water in the urban subsector is reported at 35% which is largely due to pipe leakage, illegal connections and losses through public stand posts.

Rural water supply coverage by pipe in Pakistan is 35.41% and Government of Pakistan has planned to raise it to 75% by year 2011. Punjab has 26.9% coverage, NWFP 75.2%, Sindh 10.63% and Balochistan has 72.4%. Similarly the coverage by drainage / sanitation is to be raised from 19.11 % to 51 % upto year 2011. Punjab has 11.2% coverage, NWFP 7.04%, Sindh 5.0% and Balochistan has no coverage

3.8 Institutional Mechanism

Development projects in Pakistan are approved through the provincial and federal governments. In provinces, the Planning & Development Departments (P&D Board in Punjab) act as Secretariat of Provincial Development Working Party (PDWP) and clearing house of development projects sponsored by various line departments costing from Rs.20 million to Rs.200 million.

Projects exceeding Rs.200 million are approved by the Central Development Working Party (CDWP) located at Planning and Development Division, Planning Commission, Islamabad. The projects are first reviewed by the provincial PDWP and are recommended to the CDWP for approval. Moreover, federal projects, costing between Rs. 40 million and Rs. 200 million require approval from the CDWP.

Both provincial and federal projects costing more than Rs 200 million are approved by the Executive Committee of the National Economic Council (ECNEC) chaired by the Finance Minister. In ECNEC the concerned federal ministries and all the provincial governments are represented at ministerial level. Projects which have more than 25% of the total cost in foreign exchange or foreign assistance are approved by CDWP/ECNEC irrespective of cost of the Project.

Coordination mechanism between the various water-related institutions is very weak. Decisions are taken within the respective departments without consent and approval of other related instituion. Delay in decisions and implementation occurs, in cases where consensus building is done through coordination. However, there is some degree of coordination between the Federal Ministry of Water & Power and the provincial Irrigation and Power Departments. Similarly, the Federal Environmental Protection Agency has a coordination mechanism with the Provincial Environmental Protection Agencies. At IRSA and the Federal Flood Commission the federal government and the provinces are represented.

In the private sector and NGOs, there are very few institutions working in the water sector which also do not coordinate with each other. In the donor's circle, the Asian Development Bank, the World Bank, Japan Bank of International Cooperation, UNICEF, Royal Netherlands Embassy and TVO are providing funds for water sector projects.

3.9 Water Supply Patterns

Currently, Water and Sanitation Agencies (WASAs) and municipal bodies are responsible for the management of water supply and sanitation services in the urban areas. Provincial PHEDs are responsible for the rural areas. The WASAs and municipal bodies are generally financially weak and do not generate capital for urgent rehabilitation, improvement and expansion of the existing infrastructure and facilities. There is increasing public pressure for better services at the same time. In the past efforts have been made to bring in the private sector for operation and management of urban water supply and sanitation facilities in Karachi, Lahore and Faisalabad. These efforts have however been unsuccessful. Major urban centers depending on surface water are Karachi, Hyderabad, Rawalpindi and Islamabad.

The total production capacity of the water treatment plants in Pakistan is 436 MGD, whereas the production of treated water is 415 MGD. The main capacity being as follows: CDA 42.4; RDA 88.8; KWSB 267 and HDA 40.4. Generally the water supplied

to consumers is chlorinated but due to lack of funds, unchlorinated water is also supplied for certain durations, annually.

The present water use for municipal and industrial supplies in the urban sector is of the order of 4.28 MAF. The present domestic water use in rural areas is estimated at 0.8 MAF. In major urban centers cost recovery ratio is 62% and in the intermediate urban centers, cost recovery ratio is 25%. The incidence of non-revenue or unaccounted for water in the urban subsector is reported at 35% which is largely due to pipe leakage, illegal connections and losses through public stand posts.

There are 12 major urban centers, which are administered either by development authorities or municipal corporations, whereas town committees administer more than 452 intermediate urban centres. Karachi Water and Sewerage Board administers the water supply and sewerage systems of the city of Karachi.

The national overall water supply coverage is 63% in the year 2001. Access to safe water for domestic purposes in the urban areas is limited to about 84% of the population. About 57% of the people have piped supply to their homes. In rural areas the national water supply coverage is of the order of 53%. The remaining population in the urban sector gets their supplies from hand pumps, wells, community taps or private water vendors. Most rural water is supplied from groundwater except in saline groundwater areas where irrigation canals provide the main source of domestic water.

Rural Water Supply is managed at village level by community based organizations (CBOs) or water committees or by the government through the provincial Public Health Engineering Departments.

Poor microbial quality of drinking water supplies is by far the dominant water quality issue for health in Pakistan. In most of the cities the municipal water is unsafe to drink as it does not meet WHO guidelines. In cities the quality of the water is generally compromised within the distribution system by inadequacy or lack of chlorination, cross-connections from sewage lines, poor maintenance and illegal connections. Many surface water treatment plants do not observe basic procedures to ensure water quality.

3.10 Water and Wastewater Treatment Facilities in Pakistan

The total annual quantity of wastewater produced in Pakistan is 975,771 MGD including 674,009 MGD from municipal and 301,762 MGD from industrial use. Information contained in the Urban Wastewater Treatment Master Plan for Pakistan 2003-23 gives a present total sewage treatment capacity of 339 Ml/d which represents less than 1% of total domestic sewage generated in urban areas. Municipal wastewater is normally not treated in Pakistan and none of the treatment plants have any biological treatment process except Islamabad and Karachi. Islamabad has three wastewater treatment plants but only one of them is functional which too is overloaded and partially treating some of the city's effluent. Karachi has two trickling filters but generally the effluents are subjected to only

screening and sedimentation before discharging into the receiving water body. Lahore has screening and grit removal systems in a few WASA outfall stations but they are hardly in working order. Faisalabad has a primary treatment plant only. In addition, the rural wastewater throughout the country is discharged without any treatment which either percolates to contaminate the groundwater or enters the nullahs and drains to finally meet the river system.

In urban areas sewage is collected both through piped sewers and open surface drains. The sewage is disposed of either to nearby water bodies, or to open depressions and fields. In areas where there is no collection system soakage wells are used which often contaminate the groundwater.

At present wastewater from the village is collected through open surface drains according to the local gradients. It often travels in three or more directions and is finally collected in 3-4 meter diameter sumps with similar depths in plain areas from where it is pumped up by Diesel Engine operated centrifugal pump fixed on trolley to the agriculture lands through earthen channel. In hilly terrain, wastewater flows by gravity to agricultural lands. This wastewater is consumed by landowners considering it to contain natural/bio-manure as no industrial effluent is mixed with it normally. During monsoon season landowner don’t require watering and as such wastewater have to be disposed off without treatment to nearby natural stream. At certain locations it is diverted to the village pond existing on the outskirts of the village creating environmental problems for the residents including de silting of sumps.

The lack of treatment of wastewater is caused by the lack of investment in the sector and non functioning plants are indicative of both institutional problems and inadequacy of O&M funds and shortage of trained staff to run the facilities.

4.0 Matrix of Implementation

Implementation Matrix		
No.	**Name**	**Implementation Status**
1	**5-Year Plans**	After independence, water sector planning and development was done through mandates spelled out in the 5-year plans of the government of Pakistan. Recently, the 5-year plan system has been changed and the GoP has announced its 10 Years Perspective Plan. During the 45 years of history of Pakistan when 5-year plans were the main policy declarations of the government, water sector was not given the due consideration at all times. The thrid and fourth 5-year plan emphasized on water-related issues especially water conservation, waterlogging and salinity. The sixth and seventh 5-year plans also provided mandates towards water management through stakeholders. The 5-year plans were implemented quite rigidly however, the plans were made for such long durations that there was excessive flexibility to delay them. Although Annual Development Plans were also made to support and facilitate the implementation of the 5-year plans still many critical activities and initiatives which were the need of the hour, were adopted and enforced much later than actual requirement. Moreover, due to lack of resources and lag between planning and implementation, several activities were pushed downwards in the subsequent 5-year plans. The 5-year plans were totally in the public domain and got victimized of the bureaucracy and political pressures, there were limited checks and almost no penalty for deviating or failing from the objectives and workplans.
2	**Balochistan Ground Water Rights Administration Ordinance**	Balochistan Ground Water Rights Administration Ordinance of 1978 provides detailed procedures for ground water extraction. The Ordinance makes provisions for defining water basins in different areas. It requires setting up of a district water committee to grant permission for drilling of tube-wells. Balochistan Ground Water Rights Administration (Amendment) Ordinance of 2000 makes provisions for installation of water measuring devices on all the sources engaged in ground water extraction. No water meters have been installed yet but the department of Irrigation plans to install devices on the sources in Quetta valley. The ordinance is negatively affected by the large land-holders who have political influences and are a lot of times, the tribal leaders as well, hence, the ordinance is poorly enforced. Moreover, the government lacks the functionary to enforce and monitor the implementation.

3	**Canal and Drainage Act**	The Canal and Drainage Act of 1873 is the most comprehensive legislation aimed to control and regulate the entire irrigation and drainage system and to ensure the supply of irrigation water from the canal system to farmers. Under this law the field officers have been given the magisterial powers to control encroachments and to ensure equitable irrigation supplies. The Canal and Drainage Act, which is enforced by the Provincial Governments, also prohibits fouling of canal water which may be used for domestic purposes in localities nearby. A fine of Rs. 500 or one month imprisonment or both is imposed. There remains a contradiction between the fines imposed by the Canal and Drainage Act and the proposed Pollution Charge Principle that calculates the amount of the fine based on the pollution load of an industry. The pollution charge of a medium sized industry may be several hundred thousand rupees and hence the Canal and Drainage Act promotes legal discharging of industrial effluents in the canals by enforcing negligible penalties. The law was effectively enforced until the 1980s but with the increased role of community and farmer's organizations for management of water, the law is loosing its force. Secondly, the formation of Irrigation Authorities from the earlier Provincial Irrigation Departments has changed the power structure which does not allow a lot of restrictions to be imposed. On top of the above, the Devolution Plan will not allow the government technocrats to assume the same powers and the whole perspective will change as the Nazims takeover the management.
4	**Community Irrigation Farmer Organizations Regulation**	Community Irrigation Farmer Organizations Regulation was approved in the year 2000 in pursuance to the implementation of provincial Irrigation and Drainage Authority Acts (PIDA Acts). This regulation mainly supports the provincial PIDA Acts for enforcement at the grass-root level. The Act has not witnessed enforcement and to-date is only present on the paper. However, it is too early to predict the fate of implementation which goes through its natural processing time before field results are observed.
5	**Devolution Plan**	Pakistan has started implementation of a Devolution Plan since August 2001 which envisages establishment of elected local governments at the union council, tehsil, town, district and city district level. The district governments headed by the District Nazims will be the key component of the new system as they will be responsible for planning, investment and control of municipal services including water supply, sanitation, solid waste disposal. Although, the present government has been using the devolution plan for its propaganda and at the same time, has been developing the system for enforcement; the plan is a major step towards breakdown of bureaucracy and creation of new administration mechanism. The present elections and the new government will also set a milestone towards the fate of the devolution plan.

6	**Environmental Policy**	The Pakistan Environmental Protection Agency has developed a Draft Environmental Policy which is still in the process of consensus building and improvement within the Ministry of Environment, Local Government & Rural Development. A comprehensive Environmental Policy is very much needed by the nation especially at a time when the national resources are spent at their highest rate and environmental awareness is on the rise.
7	**Factories Act**	The Factories Act of 1934 spelled out by the Ministry of Industries includes clause which deals with disposal of wastes and effluents from manufacturing processes and addresses fines for polluters. The Act has become almost dormant. There was limited potential for its implementation as the penalties proposed for various offences were so meager that potential offenders were not concerned.
8	**Hydropower Policy**	A Policy Framework and Package of Incentives for Private Sector Hydel Power Generation Projects in Pakistan was developed in May 1995. The purpose was to attract private investments for development of hydropower projects. The policy did not prove very effective compared to the earlier similar policy for power sector in 1994. Very few interested parties contacted the GoP and even those projects did not mature.
9	**National Conservation Strategy**	To address the water-related environmental issues, Pakistan adopted the National Conservation Strategy (NCS) in 1992 with the goal of transforming attitudes and practices and influencing consumption patterns and ensuring that the development is not destructive to the natural resource base. The NCS was followed by a mid-term review in 1998 which evaluated its performance. The NCS has been pointed as a theoretical policy, however, the recent World Summit on Sustainable Development which has been held in pursuance of the Rio Summit, has given a new direction to conservation issues in Pakistan. There are several projects which are executed for the development and implementation of NCS in the provincial and in ???????
10	**National Drainage Programme**	A US$ 785 million, National Drainage Programme is currently under implementation, which envisages reduction in drainage surplus and environmentally acceptable disposal of drainage effluent. A Drainage Accord between the provinces is also envisaged which will define an agreed strategy on disposal of drainage effluents. The National Drainage Programme had its mid-term review recently which indicated slow progress and implementation. The main cause of delay are the centre vs. provincial conflicts and the weak performance of consultancy.
11	**National Environmental Quality Standards**	The National Environmental Quality Standards (NEQS) which were enacted in 1993 delineate allowable limits for 32 pollutants in effluents and industrial discharges along with other limits related to industrial and vehicular air emissions. Provincial EPAs/ EPD are responsible monitoring and implementing the NEQS. Proper implementation and enforcement of the NEQS is lacking due to lack of resources, equipment, skilled staff as well as training and monitoring programmes.

12	**Pakistan Environmental Protection Act**	The Pakistan Environmental Protection Ordinance (PEPO) was issued in 1983. It has been replaced with the Pakistan Environmental Protection Act, 1997. The Act is directed to provide a basic environmental policy and set up a management structure for pollution control. Proper enforcement of the Act will result in improved water quality in various water bodies as the disposal of untreated municipal and industrial wastes will be controlled. Enforcement of the Act is still awaited. Although environmental tribunals have been established, proper implementation is still lacking.
13	**Pakistan Penal Code**	The Pakistan Penal Code of 1860 describes penalties for voluntarily corrupting or fouling public springs or reservoirs so as to make them less fit for ordinary use. The subject of toxic or hazardous waste pollution is also covered to some extent purely in qualitative terms. It is not effective, as it does not define corrupting or fouling.
14	**Provincial Irrigation and Drainage Authority Acts**	A strategy for institutional reforms in the water sector for beneficiary participation at different levels to improve service delivery in the irrigation and drainage sub-sector was adopted in 1995. The implementation of the institutional reforms started in 1997 and is being supported by the NDP. The Provincial Irrigation and Drainage Authority Acts were enacted in all provinces in 1997. The purpose is to introduce institutional reforms in the water sector of Pakistan. The public sector institutions have not been able to recover even O&M costs because of inadequate assessment and collection of user charges. These Acts will initiate irrigation and drainage sector reforms to improve service delivery and sustainability. These Acts provide the legal framework for establishment of Provincial Irrigation and Drainage Authorities (PIDAs), Area Water Boards (AWBs) and Farmers Organizations (FOs).
		One of the stated objectives of these Reforms is improved cost recovery and sustainability. Though the assessment and collection of water charges is expected to improve under this system, the transition to the formation of FOs has proceeded slower than expected. In the few of the FOs that have been formed, it is reported that revenue collection rates have increased to 60 – 80 % of the assessed charged.
15	**Punjab Minor Canal Act**	The Punjab Minor Canal Act was approved in 1905 by the government to be implemented by the Punjab Irrigation Department for the management of minor canals in the sub-continent. The Act is weakly enforced.
16	**Punjab Soil Reclamation Act**	The Punjab Soil and Land Reclamation Act of 1952 provides legal basis for implementation of salinity Control and Reclamation Project (SCARP) to control the water logging and salinity. The act empowers the Department of Irrigation to license and control groundwater in any area notified as problem area by the government. The Department of Irrigation has the authority to exercise all the powers under the Act. The Act was later extended to cover the whole country however, its implementation has been very weak.

17	**Resettlement Action Plan**	The Resettlement Policy of Pakistan has been developed and is currently in draft form for review and approval of the concerned authorities. It addresses the rights of landowners in areas where water development projects have to be initiated.
18	**SCARPs**	To address the growing menace of waterlogging and salinity, the GoP focused towards initiation of a number of Salinity Control and Reclamation Projects (SCARPs). In the same era, tubewells' installation grew tremendously by the private sector leaving little justification for similar projects to be conducted in the public sector. In the late 1970s and 80s, most of the SCARP tubewells got non-operational due to lack of maintenance, adequate funds, etc, hence, transition of SCARP tubewells and their replacement with privately owned and operated community tubewells was started in 1986. In 1997, the Punjab Private sector Groundwater Development Project was envisaged for closure and replacement of 4,233 SCARP tube wells. There is a SCARP Monitoring Organization (SMO) under WAPDA which monitors the groundwater table in SCARP areas and compiles the data.
19	**Sindh Irrigation Act**	The Sindh Irrigation Act was approved in 1879 to be implemented for irrigation management by the Sindh Irrigation Department. The Act has been superseded by the PIDAs and is not in practice anymore.
20	**Ten Year Perspective Plan**	In September 2001, the Government approved a 10 year Perspective Development Plan 2001- 2011, which also includes a Three Year Development Plan for the period 2001 – 2004. Besides several other objectives, the Ten Year Perspective Plan envisages reduction in incidence of food poverty. It also plans to improve the Human Development Index Rank and increase in the GDP growth rate. The goals for the urban rural water supply sectors as defined in the Ten Year Perspective Plan include provision of safe drinking water to 96% of the urban and 75% of the rural population by the year 2011. Coverage for sanitation and sewerage is to be increased to 80% of the urban population and 50% of the rural population by 2011. The Ten Year Perspective Plan has taken a smooth start by timely initiating projects especially in the water sector to revitalize the economy. The present government's fast-track project which comprise majority of water projects are part of the plan and many of them have already been launched.
21	**Vision 2025**	The GoP through WAPDA launched a comprehensive integrated water resource and hydropower development Mega-plan, 'Vision-2025' for development of water reservoirs and hydropower generation. WAPDA's Vision 2025 is also included in the Ten Year Plan. The plan has been criticized of a non-practical approach which doesnot have the mechanism linked with institutional arrangements. No specific progress has been performed so far.

22	**WAPDA Act**	The Water and Power Development Authority was created at the Federal level in 1958 through the WAPDA Act. Its mandate is to undertake construction of large irrigation and drainage projects and look after for construction and operation of large hydropower projects. The WAPDA constructed Mangla and Tarbela dams under this Act and is also looking after their releases, etc. Raising of Mangla dam also falls under the same Act. The Act is properly enforced and is the cause of existence of WAPDA.
23	**Water Accord**	The Water Accord is implemented through the IRSA Act of 1992. The Accord is an agreement to share waters of the Indus Rive between the four provinces. This accord is based on the water supply of both, the existent and future needs of the four provinces and apportions the balance of river supplies, including flood surpluses and future storages among the provinces. The Water Accord is strictly enforced, however some grievances still arise between the provinces, mainly due to political reasons..
24	**Water Resource Sector Strategy**	The Ministry of Water & Power has recently completed a Water Resource Sector Strategy Study through grant of the Asian Development Bank which has developed a direction of the water sector for the next 25 years by formulating a water sector profile, national water sector strategy upto 2025 and a mid-term investment plan. Actual implementation of the study depends on the ministry's future role and donor's inclination.
25	**Water Sector Policy Study**	Currently, a water sector is under development through the National Water Policy Study under the National Drainage Programme. The study is expected to be completed in 2003 when a detailed water policy will be formed for the first time in the country.
26	**Water User Ordinances**	In 1982 Water User Ordinances were promulgated to enable formation of Water User Associations (WUAs) for participation in water management at water course level. The WUAs have made a good start by participating in improvement of more than 10,000 water courses. In later stages of the Programme the WUAs have contributed up to 55% of the cost of civil works for improvement of watercourses both in cash, kind and in the form of labour, but they generally became dormant once the improvement works were completed.

5.0 List of Projects undertaken in the water sector

LIST OF PROJECTS IN THE WATER SECTOR	
	Public Sector Projects **Federal**
1	1988 Flood Damage Restoration Project
2	1992 Flood Damage Restoration Project
3	Chashma Hydropower Project
4	Command Water Management Project
5	Drainage IV Project
6	Drought Management Project
7	Flood Protection Sector Project I
8	Flood Protection Sector Project II
9	Ghazi Barotha Hydropower Project
10	Irrigation System Rehabilitation Project Phase-I
11	Irrigation System Rehabilitation Project Phase-II
12	Mangla Dam Watershed Management Project
13	Metropolitan Islamabad Water Supply Project Based on Khanpur Dam
14	Metropolitan Islamabad Water Supply Project Based on Simly Dam
15	National Drainage Program Project
16	On-Farm Management Project-I
17	On-Farm Management Project-II
18	On-Farm Management Project-III
19	Raising of Mangla Dam
20	Rural Water Supply and Sanitation Project for Sindh, Balochistan and AJK
21	Sector Policy Studies
22	Satpara Dam
23	Small Irrigation Schemes Project
24	Social Action Program Phase I
25	Social Action Program Phase II
26	Strengthening of Soil Survey of Pakistan
27	Tarbela Dam Watershed Management Project
	Balochistan
28	Akra Kaur Dam
29	Balochistan Community Irrigation Irriagation and Agriculture Development Project
30	Balochistan Minor Irrigation and Agriculture Development Project
31	Balochistan Water Supply Project
32	Flood Management of Murree Bhugti Hill Torrents
33	Groundwater Recharge of Quetta, Pishin, Mustung and Mangochar Valleys

34	Hairdin Drainage Project
35	Income Generating Project For Afghan Refugees Phase I, II & III
36	Mirani Dam Project
37	Quetta Gadar Potable Water Supply Project
38	Quetta Metropolitan Sewerage
39	Quetta Sewerage and Sanitation Project
40	Remodelling and Extension of Rabi canal R/S of Pat Feeder Canal
41	Remodelling of Patfeeder Canal System
42	Rural Water Supply and Sanitation Project
43	Strengthening of Balochistan Hydrometeing Network
	Sindh
44	1994 Flood Damage Restoration Project in Sindh Province
45	East Khairpur Tile Drainage
46	Ghotki Fresh Ground Water Project
47	Ghotki Fresh Ground Water Project
48	Greater Hyderabad Sewerage Project
49	Hyderabad Water Supply, Sewerage and Drainage Project
50	Karachi Sewerage Project
51	Karachi Special Development Project
52	Karachi Urban Development Project
53	Karachi Water Supply and Sanitation Project
54	Karachi Water Supply Improvement Project
55	Karachi Water Supply Project
56	Khairpur SCARP
57	Left Bank Outfall Drain Project
58	North Dadu Surface Drainage Project Phases I and II
59	North Rohri SCARP
60	Right Bank Outfall Drain Project
61	Second Karachi Water Supply and Sanitation Project
62	South Rohri FGW Project
63	Sukkur Right Bank (FGW)
	Punjab
64	Chashma Right Canal Project Phases I, II and III
65	Faisalabad Water Supply, Sewerage and Drainage Project
66	Flood Rehabilitation Project
67	Fordwah Eastern Sadiqia Lining Project
68	Fordwah Eastern Sadiqia Sub-Surface Drainage Project
69	Fordwah Sadiqia Remaining Project Phase I
70	Gojra Khewra Project Phases I & II
71	Khairwala Drainage Project
72	Khushab Drainage Project

73	Lahore Urban Development Project
74	Northern Lahore Drainage Project
75	On Farm Water Management, D G Khan Phase I
76	On Farm Water Management, D G Khan Phase II
77	Punjab Private Sector Groundwater Development Project
78	Punjab Rural Water Supply and Sanitation Project
79	Rawalpindi Urban Water Supply and Sanitation Project
80	Remodelling of Thal Canal
81	SCARP VI Project
82	Shorkot Kamalia (Saline) Project
83	Thal Flood Water Canal
	N W F P
84	Chashma Command Area Development Project
85	Gandialy Dam Project
86	Gomal Zam Dam
87	Mardan SCARP Project
88	Pehur High Level Project
89	Reconstruction of Benton Tunnel
90	Swabi SCARP
	OTHER PROJECTS
91	Assistance for Establishment of Federal Water Supply and Sanitation Sector Support Unit and Policy Implementation (UNDP)
92	Balochistan Water Supply-Phase II (European Economic Community)
93	Community Handpumps and Sanitation (UNICEF)
94	Community Water Supply and Sanitation (WHO)
95	Exploitation of Groundwater Resources in Balochistan (Government of Japan)
96	Integrated Community Water, Sanitation and Hygiene Education (UNICEF)
97	Integrated Water, Sanitation and Hygiene Education in Primary Schools (UNICEF)
98	Management & Rehabilitation of Saline & Waterlogged Soils (AUS Aid)
99	Punjab Rural Water Supply Sector Study (ADB)
100	Water & Environmental Sanitation (UNICEF)
101	Wetlands Project (WWF-Pakistan)

6.0 Institutional Framework

Attach Excel Table on Institutional Mapping

MAPPING OF WATER RELATED INSTITUTIONS					
S.No	**Institutions**	**Type**	**Mandates**	**Stengths & Weaknesses**	**Coordination and Capacity**
	FEDERAL				
1	Ministry of Water and Power	Govt.	Framing policies and plans for water resources. Coordinated development of irrigation, drainage and power resources	The functionaries of the agriculture and irrigation departments operate almost independently in the same areas	The ministry has maintained weak coordination with various bodies attached to it. There has been political distances between the provincial irrigation departments and WAPDA. Since WAPDA has become very huge compared to its Ministry, it has become difficult for the Ministry to control WAPDA with its limited capacity
2	Chief Engineering Adviser and Chairman Federal Flood Commission	Govt.	Assist the Ministry of W&P in the coordination of irrigation, drainage, flood control and power development.	Provides flood data to various departments. Delegates works and mainly coordinates with Consultants	Limited technical capacity to address large scale flood issues in Pakistan
3	Indus River Systems Authority	Govt.	Implementation of the Water Accord	IRSA has been effectively implementing the Water Accord which includes measurement of daily flows and their distribution, however, various studies which were supposed to be conudcted immediately after the Accord are still pending	Closely coordinates with Irrigation Departments. A member of each provice sits in Islamabd to ensure the rights of their share under the Accord

4	Pakistan Water and Power Development Authority	Govt.	Development of Water and Power Resources	Management of inter provincial projects including storages as well as generation, transmission and distribution of electricity	WAPDA is the execution wing of the Ministry of Water & Power according to the 1958 WAPDA Act. It coordinates with the Provincial Irrigation Departments for implementation of water related projects. It capacity has always been questioned with over 150,000 staff. Lately, power distribution has been privatized.
5	Commissioner of Indus Waters	Govt.	Monitoring of implementation of Indus Waters Treaty (1960)	The institution is weak in performing the various research studies needed to prepare a scientific response to water resource development on both sides of the border	Maintains a minimum of two meetings with his Indian counterpart - one each in Pakistan and India
6	Planning and Development Division	Govt.	Coordinated planning at national level. Approval and monitoring of development projects	The plans which are implemented are mostly adhoc, the regular 5 year plans have a history of falling short	A primitive system of coordination based on PC-1 exists. Coordination process has built-in delays such that the needs of the departments have usually changed at the time of decision in the Planning Division. Its capacity is huge but still does not meet the national requirements
7	Ministry of Finance and Economic Affairs	Govt.	Release of federal funds. Economic Affairs Division coordinates all internationally funded projects	Does not pro-actively calculate the funds required for each sector	Coordinates with all agencies/ departments

8	Ministry of Agriculture, Food and Livestock	Govt.	Coordinated development of agriculture, water management at farm level and livestock development	Main strength is annual compililation of Agricultural Statistics of Pakistan, which reports on the crop production, land use, irrigated area, input use, agricultural credit, mechanization, livestock, fisheries, forestry, agricultural trade, wholesale commodity prices, etc.	Has little or no coordination in providing feedback to the Ministry of Water & Power, etc. Its operates in all four provinces.
9	Ministry of Environment	Govt.	Planning & coordination of Environmental policies and projects at federal level	Ministry has been frequently changing its areas of attachment i.e. rural development, local government, etc. Has not been effective in developing and implementing policies and environmental regulations	Very little technical staff exists. Does not regularly coordinate with other institutions of the country to provide environment related inputs except its own attached bodies i.e. Federal EPA and ENERCON
10	Capital Development Authority Islamabad	Govt.	Provision of urban water supply and sanitation facilities to Islamabad and rural water supply and sanitary facilities to rural areas within the capital territory.	Ignores the rquirements and inter-connection effects on a major city like Rawalpindi only because it lies outside the federal territory	Coordinates with all federal agencies for planning and provision of water supply network
11	Fata Development Authority	Govt.	Provision of domestic water supply, sanitation facilities and flood control in federally administered areas.	Unable to provide adequate services	Independent in operations mainly due to the geographical legislation of that area
12	Pakistan Public Works Department	Govt.	Provision of domestic water supply, sanitation facilities and flood control in northern areas.	Limited understanding and addressing of some of the basic issues in the region such as flood management, etc. Lack of funds	Limited technical staff. Coordination with offices in Islamabad and provinces is weak
13	The Pakistan Council of Research in Water Resources (PCRWR)	Govt.	Principal research organisation at the federal level studying water availability, usage, quality and environmental effects etc.	It operates a Drainage and Reclamation Research Institute of Pakistan (DRIP)	Has maintained partial coordination with the Ministry oif Water & Power and WAPDA. Has been observing scarcity of both human and capital resources.

14	The Irrigation Research Institute, Punjab	Govt.	Conducts hydraulic model studies for the design of major hydraulic structures including dams, barrages, bridges and river training and flood protection works	Reputed for qualitative mathematical/hydraulic modeling	Strong coordination with WAPDA, Federal Flood Commission, Irrigation Departments. Very limited capacity and delay in work is frequently observed
15	Soil Mechanics and Hydraulics Laboratory, Sindh	Govt.	Conducts soil and hydraulic model studies for the design of major hydraulic structures	Reputed for qualitative modeling	Adequate coordination with concerned institutions. Has limited human resource capacity
16	The International Waterlogging and Salinity Research Institute (IWASRI) of WAPDA	Govt.	Conducts research on drainage related problems	Produced excellent research in the field and promoted several intiatives which have become the backbone projects in the country	Serious shortages of funds has pushed the institution towards dormancy
17	International Sediment Research Institute of Pakistan	Govt.	Researches on sediments in rivers and water bodies as an independent cell of WAPDA	Was active during the 80s. These days its research is neither accepted for direction-setting in the national scenario nor is it sizeable/qualitative	Little capacity compared to large-scale sedimentation issue
18	The Pakistan Atomic Energy Commission	Govt.	Conducts research in the major crops through Nuclear Institute of Biology (NIAB) at Faisalabad	No attempt is made to get benefits out of the findings. There are also other numerous research institutes at the provincial level in the areas of crops, soils, insects, diseases, livestock, fisheries, forestry, irrigation, and economics: 41 in Punjab, 10 in Sindh, 10 in Balochistan, and 6 in NWFP	Some coordination exists among research institions but no data or finding is passed on to decision-making institutions
19	Pakistan Meteorological Department	Govt.	Meteorological data regarding temperatures, humidity, pan evaporation, wind speed and direction, rainfall, etc is collected for a number of locations within the country	Data from the Pakistan Metrological Department is not easily available	An under-capacity institution with limited funds. The Department also lacks the state-of-the-art equipment necessray to scientifically predict metereological data

20	The Surface Water Hydrology wing of WAPDA	Govt.	Monitors discharges in the rivers and collects selected data related to sediment load and water quality on a daily basis at 50 locations on the River Indus, which is published annually	WAPDA also monitors groundwater depth and quality through the SCARP Monitoring Organizations (SMO). The Environmental Cell of WAPDA should ideally monitor the environmental status of WAPDA's projects. However, it is not performing this function and is only involved in a few selected projects.	Appreciable data exists which confirms the capacity and coordination of this wing
21	Federal Beareau of Statistics	Govt.	The Yearbook contains data on surface water availability at rim stations, canal withdrawals, escapages below Panjnad and Kotri, areas irrigated by different sources, areas with high water table, etc	The yearbook is not widely circulated. Mostly this data is inaccessible due to bureaucratic barriers	Socio Economic Data is collected and processed by the Federal Beareau of Statistics and has been published since 1952 in a Statistical Yearbook
	AZAD JAMMU AND KASHMIR				
22	Planning and Development Dept.	Govt.	Coordinated planning, approval and monitoring of development projects	Most of the projects are dependent on donor's interest which limits the development based on need	Lack of capacity of all essential categories of staff essential to promote equitable planning and development of all sectors
23	Public Works Department	Govt.	Provision of domestic water supply, sanitation facilities and flood control	Difficulties in access and coordination due to geoghraphical reasons	Shortages of funds
	PROVINCIAL (4 each)				
24	Provincial Irrigation and Power Departments	Govt.	Policy making, operation and management of irrigation and drainage systems in the province	Has been under-going political rifts within themselves and with the federal agencies. Most of the equipment is sitting idle due to lack of O&M funds	Weak coordination with the Ministry and WAPDA. Have historically maintained huge capacities in terms of equipment and human resource. Most of the equimment is now non-functional

25	Provincial Irrigation and Drainage Authorities	Govt.	Operation and management of irrigation systems in pilot areas and management transfer to Area Water Boards and Farmer's Organizations	Have not been able to acquire the powers from I&P Departments despite the approval of PIDA Acts.	Weak coordination with Area Water Boards and Farmer Organizations. Most of the PIDAs are still awaiting hiring of staff according to the plans for their establishment
26	Planning and Development Departments/P&D Board in Punjab	Govt.	Coordinated planning at provincial level, approval and monitoring of development projects	The instituions have been weakened by the fact that valuable projects have to get approved from the federal agencies due to ceiling of their budgets. Limited areas fall in the provincial jurisdiction by the constitution	Lack of development funds in the provinces does not allow many needed projects to take-off in the provinces. A vacuum of competent human resource also exists
27	Agriculture Departments	Govt.	Coordination of agriculture development, on farm water management & extension services	The setup can be used to improve the water delivery and agriculture. Research from various instituitons related to crops, agriculture, water management must be applied through the extension network	Huge extension networks exists but serious lack of coordination and management has restricted the benefits which were envisaged out of this institution. Most of the on-farm water management projects are not exhibiting the claimed efficiency
28	Environmental Protection Agencies/Department in Punjab	Govt.	Monitoring and implementation of environmental laws/regulations at provincial level	Have failed to implement any environmental regulation	Have been observing scarcity of funds since establishment. Does not have the capacity to implement the regulations
29	Public Health Engineering Departments and in case of Punjab - Physical Planning & Housing Department	Govt.	Provision of domestic water supply and sanitary facilities to cities and housing development schemes (other than major cities) and rural areas	Most of the schemes under these institutions were incomplete/ unoperational	These have been aborted or taken over by the District Governments

	URBAN				
30	Karachi Water and Sewerage Board	Govt.	Provision of urban water supply and sanitation facilities to Karachi	Has been able to balance its revenues and expenditures	Sizeable skilled staff is responsible for operation and maintenance of water supply network and treatment plants. The Board has little coordination with related institutions in the city and almost no coordination with sister institutions in other cities
31	Water and Sanitation Agencies (WASAs), Lahore, Rawalpindi, Faisalabad, Multan, Quetta and Gujranwala	Govt.	Provision of urban water supply and sanitation facilities to the respective cities	Have been observing huge deficits mainly due to their major revenues sbeing spent on energy	Weak coordination exists among all agencies. The agencies are under-capacity
32	Development Authorities, Town Committees and Municipal Committees	Govt.	Provision of urban water supply and sanitation facilities to the respective cities	These institutions use the offices of other institutions as there is no technical staff to address issues of water supply and sanitation	The coordination mechanism and capacities have changed according to the devolution plan
	OTHERS				
33	Centre of Excellence in Water Resources at Engineering University, Lahore	Academic	Water related research at academic level related to Pakistan	Has produced some of the excellent researches and produced renowned scientists in the country	Weak coordination in terms of both implementation and dissemination
34	Centre of Excellence in Marine Biology at Karachi University	Academic	Conducts research on marine ecology	Extensive qualitative researched have been produced. However, these are hardly known since no attempt is made to share/disseminate	Few faculty/staff supplement the capacity through students
35	National Institute of Oceanography	Academic	Researches on issues related to coastal zones	Has produced significant quality researches	Has been observing shortages of funds. Does not coordinate with major water supply and sanitation institutions

36	Pakistan Forest Institute	Academic	Carries out research on watershed management in addition to forestry	Renowned as a leading institution. Has recently been undergoing a constant decline due to lack of proper equipment and inefficient management	Researches are carried out in isolation to the mainstream water management institutions
37	The International Water Management Institute	NGO	Focuses on the sustainable use of water and land resources in agriculture and on water needs of developing countries	Mainstream research is on irrigation. No other sub-sector of water is considered	Research products are rarely disseminated. However, most of the departments/institutions liaise and access the findings of IWMI.
38	The World Conservation Union	NGO	IUCN's mandate includes issues related to freshwaters and ecosystems	Alongwith GoP, has formulated the National Conservation Strategy including water resources	Coordinates with both government and civil society organizations. Possesses limited capacity to address multiplex issues

7.0 Strategical Recommendations

7.1 Role of Private Sector

The role of private sector for the development of water sector is very crucial. In Pakistan, private sector involvement in development and management of water resources is at an early stage, but the Government aims to extend its role especially in the water sector. Although, it seems an almost impossible task, the Ten year Perspective Plan envisages a private sector financing of the order of 77.5%.

Water and sewerage services in Pakistan are provided as a public service, the cost of which is subsidized from Federal and Provincial government budgets. Tariff revenues do not, with one or two notable exceptions, cover operating costs. There is, however, an awareness, particularly in the larger WASAs, that this situation is unlikely to be allowed to continue in the longer term and efforts are being made to reduce the deficits. In the Districts where water supply has hitherto been the responsibility of provincial government Public Health Engineering Departments (PHEDs), the service has, for practical purposes, been provided wholly at government expense.

No routine financial provision is made to cover asset depreciation or infrastructure renewal. As a consequence, renewal of the infrastructure and operational assets can only be carried out, at government expense, as major capital projects. This also applies to investment needed to extend the systems to serve additional customers, to improve levels of service or to comply with environmental protection standards. Such investment can, at present, only be funded from government taxation revenues or by loans from external sources, thus adding to the country's debt servicing costs.

There has, to date, been no significant private sector investment in the water supply and sewerage sector. Service contracts for plant operation and revenue collections have been awarded to private companies in a small number of cases.

Since government finance is subject to many competing demands, funding constraints in the water sector have meant that levels of service are below customers' reasonable expectations and that public health and environmental compliance standards can not be met.

Present tariff levels, at least in the larger cities, should be adequate to cover the operational costs, at present service levels, given effective revenue collection and credit management. This would need to include efforts to regularize illegal connections. However, the tariff-setting procedure does not automatically take account of costs which are beyond the control of the water supply undertakers. As a result, the cost of electricity is a growing proportion of total operational expenditure and in some cases, exceeds the revenue being collected. In addition, non-payment of water and sewerage charges by government organisations is placing a financial burden on the water undertakers.

Even with improved revenue collection, present tariff levels are not sufficient to provide for the investment needed to increase coverage, raise service levels and improve environmental compliance. Neither are they adequate to attract private sector investment of financial or other resources which could result in improved outputs and efficiency.

The water supply and sewerage sector depends upon capital-intensive, long life assets for its operation. As such, it benefits from a systematic approach to the planning of outputs and the identification of costs on a long-term basis.

Privatisation transactions and the award of long-term (25-30 year) concessions for water undertakings have led to the evolution of a strategic planning processes which can usefully be applied in cases where no change of owner or operator is envisaged. Such process can enable the feasibility of policy objectives to be assessed against given pricing and financing assumptions.

The private sector can be attracted in the first phase by investing in water utility schemes such that they are responsible for both water supply and sewerage system of certain allocated areas. Private sector will be willing to invest in urban water supply projects which have concentrated customer base and constant demand. Since sewerage is relatively more expensive, it is necessary to combine the two systems as a package deal for private sector otherwise sewerage systems will be left in the public sector. Effective policies need to be framed for attracting private sector investment which will relieve the government with certain responsibilities and financial burden.

7.2 Need for Research, Education and Awareness

There are few research organizations in the country who are also facing shortages of funds and professional staff. Most of the developments in the water sector are based on primitive engineering knowledge and western research. There is an urgent need to develop local standards and practices based on research on indigenous and local conditions. A lot of projects advocate techniques and technologies which are not feasible in Pakistani conditions and also demand for heavy foreign exchange components. It is necessary to train the national experts in core water issues and use their knowledge base to develop a research network. Currently, some research institutions are contributing i.e. PCRWR, IWMI, etc. However, access to of information from the responsible agencies is often difficult and needs to be simplified. There is little coordination among the various agencies and there is no defined mechanism for exchange of information.

An effective water management plan cannot be implemented without the education and awareness of the community regarding benefits and limitations. The community has to be involved in planning, developing of the strategy and then actually implementing in the project area to transfer the ownership. Project planning should include stakeholder meetings which is also a part of the EIA procedure. It is recommended that EIAs should be conducted in a manner to incorporate stakeholder concerns at all levels.

7.3 Policy Development, Regulations and Monitoring

The water laws in Pakistan are quite comprehensive as far as the definitions of the objectives and legal provisions are concerned, except that extraction of groundwater needs to be regulated. However, sectoral policies are lacking both in terms of development and implementation. Water sector policy is still in the development phase which is supposed to be the driving force and backbone of all major initiatives. The environmental legislation also needs certain improvements.

Firstly, improvements are needed in the form of clarity and depth. Certain laws do not have detailed and in-depth implementation mechanisms to facilitate proper understanding and compliance and, moreover, they do not provide tangible checks to scale or quantify the amount of violation. Secondly, there is duplication in responsibilities among various government institutions which creates conflicts and confusion among them and subsequently affects the efficiency. Thirdly, certain new environmental legislation should be promulgated to back up and promote the existing regulations for such aspects as riverine water quality standards, irrigation water quality standards, sectoral environmental quality standards and groundwater recharge and quality standards. Fourthly, a proper monitoring mechanism is required for all legislation. No legislation can be effectively enforced without well-defined and sustainable monitoring measures.

7.4 Capacity Building

There is a definite need for capacity building in all public sector institutions of Pakistan. It is unfortunate that the decision-makers weather technocrats, bureaucrats or political people have little or no opportunities to undate and refresh their knowledge base. The government system does not promote training especially due to lack of funds. It is recommended that local training institutions should be further organized to have a more facilitating role.

There are some institutions in Pakistan such as the Pakistan Engineering Academy, WAPDA Training Centres and other training centers of large institutions who offer trainings which include components on water sector. Other institutions such as IWMI, Centre of Excellence, PCRWR, etc also train personnel but through short workshops. There is a need for concentrated full-time courses to be offered from time to time which have an intensive professional syllabus. These courses will also have to be revised to get updated and incorporate the current policies and programmes of the government.

7.5 Institutional Coordination and Management Improvements

There is little coordination between the ministries and departments both at federal and provincial levels, moreover, coordination between the center and provinces is also weak due to political and bureaucratic reasons.

Although there is some coordination between IRSA and the Federal Flood Commission, similarly, Ministry of Water & Power has certain linkages with the Irrigation Departments and the Federal EPA has a coordination network with its provincial establishments. However, an overall integrated approach is required to derive maximum benefits out of the limited resources which requires a proper coordination mechanism between all institutions related to water sector.

The government should orient its focus more towards development of umbrella projects which address specific needs at national level rather than adopting piecemeal approach and developing several projects with similar components to address the same issue.

Implementation of agriculture and irrigation activities is handled in separate administrative ministries and departments which have little interaction, both at the federal and provincial level. Agriculture extension is a large network in the country which can be utilized for training related to better management of water resources and efficient methods of irrigation. In actual practice, the real integration takes place only at the farmer's level in the vast irrigated plains.

Researches conducted at the PCRWR are seldom utilized for focusing towards national needs and development of water sector projects. There are also flaws in the training of professional manpower for irrigated agriculture. Engineering Universities do not provide the necessary biological background to the irrigation engineers and similarly, Agriculture Universities provide little background of irrigation to the agronomists. The personnel of the agriculture and irrigation departments also operate almost independently in the same areas. Thus there is poor co-ordination between the two main components of irrigated agriculture at academic, administrative and operational level. This issue demands for revision of syllabus at academic levels for proper professional training.

7.6 Water Conservation

Conservation, no doubt, should be the first step towards management of resources. In the water sector, conservation is more important due to the wasteful use practiced in Pakistan compared to other agrarian countries. Despite the overall shortages, the overuse of water in irrigation is a major problem in Pakistan. The impact of this is not only the wastage of water which could be directed to other sectors or expansion of agriculture, but it also leads to waterlogging and salinity. This, in turn, has led to a reduction in crop yields, lower overall agricultural productivity and loss of cultivable land. Increasing irrigation efficiency, therefore, will result in improved crop yield and overall agricultural productivity as well as reduced water use. There is also a need to reduce the water leakage and losses from the water supply systems.

As the total future water requirements of Pakistan are substantially greater than the total potential supply and the water use efficiency both in irrigation and water supply sub sectors are low, water conservation is critical to meet the needs of all water sub-sectors. This will require a concerted effort in watershed management to reduce degradation of upper catchments so that runoff is moderated and sedimentation is minimised. The greatest effort in water conservation should be made in the irrigated agriculture sub-sector because this is by far the greatest user of water. Even relatively modest improvements in irrigation efficiency will result in significant reductions in water use which can then be reallocated to other uses, primarily urban and rural domestic water supplies. Improved water management through institutional strengthening and increasing participation of water users in water management will likely have the greatest impact.

Conservation can also be adopted through developing a realistic pricing system. In Pakistan, water is highly subsidized, both in drinking water and irrigation sector, moreover, groundwater is a free commodity which should be managed as a national resource. Abiana and water charges are kept at a bare minimum due to political pressures and mass poverty. However, it is important to understand that consumers will only take the ownership of conserving water resource if they have to pay for non-conservation. It is recommended that water pricing structure should be such that the basic requirement per capita be kept at reasonably low rates to allow adequate usage and the basic facility to poors. However, the charges should increase in various slabs to discourage wasteful use of water. It is also recommended that groundwater regulatory frameworks be developed for all provinces and charges should be imposed in similar slab-structure to conserve the groundwater resource as well.

Another technique to improve water management and avoid waterlogging is rain harvesting which channelises rainwater from rooftops through drain pipes into a pit. The area around is sloped so that water from the environs also flows easily into the pit. The pit has layers of sand, pebbles and broken bricks for good filtration. While this in itself will improve the ground water table, open wells may be sunk, into which a PVC pipe can conduct water from the pit.

The terraces and roofs of houses and building complexes can be converted into catchment areas for rain water by this simple technique. Rain harvesting can also be introduced in public and community wells situated near slums and in villages, draining water from nearby rooftops and streets into them. Connecting storm water drain lines to tanks and rivers can greatly improve the water position of a city with little effort and maintenance.

7.7 Enhancement of Storage Capacity

The capacities of the three existing reservoirs of the Indus Basin, Tarbela, Mangla and Chashma, are declining due to sedimentation and the live storage capacity of the three reservoirs has been reportedly reduced by about 20%. WAPDA has recently announced plans for undertaking studies for a number of storage projects on the Indus and its

tributaries including the Bhasha dam as well as several off channel storages in the Vision 2025 programme which forms part of the Ten Years Perspective Plan of the Government

Augmentation of storage capacity is essential to a country like Pakistan which observes most of its rainfall during the three monsoon months. This water has to be stored for the rest of the nine months for irrigation, water supply and hydropower.

Additional storage capacity will also enhance the capacity of flood mitigation and energy development which are also national level problems in Pakistan. Last but not the least, political circumstances with India strongly recommend for augmentation of storage capacity which can use it as a strategic weapon by blocking and suddenly releasing to Pakistan on the downstream side.

Projects related to enhancement in storage capacity have not been initiated since the construction of Tarbela, however, recently, the government has initiated the Raising of Mangla Dam Project and has other similar options in its mega-plan for development of the water sector.

Experts recommend that there is an urgent need to provide for additional 12 MAF of storage capacity of the Indus river system. This recommendation is also a part of the Vision 2025.

7.8 Water Efficiency Improvement

About half of the country's workforce is employed in agriculture, it is unfortunate that such a large sub-sector of water is practicing misuse of resources. The main cause of misuse is lack of proper infrastructure, lack of lining in channels and poor knowledge of water management at the farmer's level. The current irrigation water efficiency is estimated at 35.5% in Pakistan which is low by all standards. It is important to note that efficiency improvement in such a large sub-sector will lead to large-scale water conservation and huge national savings. The current estimated irrigation efficiency of 35.5% is a compound of three efficiencies i.e. Canal-head efficiency, watercourse efficiency and farm efficiency.

Low efficiency also directly contributes towards waterlogging and salinity which is at alarming proportions in Pakistan. The unused or surplus water has no other option except to percolate to the groundwater and raise the levels to create waterlogging and salinity. In this situation, it is recommended to develop a drainage network in the country to allow the water applied to the crops as well as unapplied water to find its way back to the river system. The National Drainage Programme was initiated in 1997 with similar objectives but it has not been able to show any results due to weak enforcement, political conflicts between provinces and the center as well as inefficient technical and supervisory services.

It is also recommended that major watercourses should be lined to avoid seepage, the water delivery infrastructure must be improved and the farmers who are the main elements in using the irrigation water, should be made aware and trained on water management. This can be achieved through the wide network of agriculture extension personnel, however, a strategy needs to be formulated and coordinated integration of such programme is needed.

7.9 Crop Substitution and Saline Water Harvesting

The types of crops grown need to be rationalised to ensure that the crops grown are efficient in terms of water use and economic productivity. The traditional cropping pattern of rice and wheat has benefited from increased irrigation supplies and these two crops will remain important in Pakistan. However, sugarcane production, for example, has resulted in poor economic allocation of resources and wasteful over production that could not be efficiently marketed, resulting in a breakdown of the support price mechanism and major loss to the producers. Over-investment in the sugar industry and increased allocation of land and water to sugarcane has resulted in reducing resource availability to other crops.

It can be observed from agriculture patterns that the traditional cropping patterns are economically taxing. Modern research has shown several alternative cropping patterns that can raise productivity of existing farm systems. In the intensive agriculture systems there are ample opportunities to increase farmers' income from technologies such as zero tillage, introduction of high value crops like sunflower, pulses, vegetables and orchards etc.

The use of saline water for cropping is restricted to growing salt resistant crops. Such crops as grasses for fodder, bushes and trees such as eucalyptus have proved successful in other areas in providing a reasonable economic return from areas affected by saline soils or using saline water for irrigation. While this may not have a widespread benefit, there is likely a potential for local improvements in farmer income.

There are technique involves growing of salt tolerant plants using brackish water rather than reclaiming the land for growing conventional crops by using fresh water. The approach is evolution of highly salt tolerant species through breeding, wide hybridization and other biotechnological techniques.

7.10 Treatment of Water and Wastewater

As mentioned earlier, there are only a few water and wastewater treatment plants in the country. In fact, construction of wastewater treatment plant is a huge expense especially for developing economies who barely meet the necessities for survival. Pakistan has also been ignoring wastewater treatment plants due to lack of adequate funding and resources. A wastewater masterplan was developed for 24 major cities of Pakistan which provided

brief detail and design of primary treatment systems which may also generate most of their running and maintenance costs by capital generating activities, however, implementation of such project demand huge capital which is not available with the government of Pakistan.

Moreover, private sector or foreign investor is least interested in wastewater projects which have a long payback period and weak financial mechanism for revenue collection. Wastewater services are limited to collection from households in the urban sector only by the public departments. The sewerage is disposed of in nearby river system or nullahs. There is no mechanism for monitoring or testing the composition of wastewaters in the country. There is a crucial need to develop wastewater treatment plants to save the quality of water in the rivers and under the ground. This may be initiated by primary-level treatment systems made out of indigenous technology. Combined effluent treatment systems may also be designed such that industries pay a major component of the infrastructure for which they may receive certain savings on taxes.

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