



Technical Assistance Consultant's Report

PUBLIC

Project Number: 49048-001
December 2021

Islamic Republic of Pakistan: Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department

Prepared by Joint Venture of SMEC International Pty. Ltd., Rehman Habib Consultants Pvt. Ltd. and Engineering General Consultants, and in association with Asian Advisory Services
Punjab, Pakistan

For Punjab Irrigation Department

This consultant's report does not necessarily reflect the views of ADB or the Government concerned, and ADB and the Government cannot be held liable for its contents. (For project preparatory technical assistance: All the views expressed herein may not be incorporated into the proposed project's design.

Asian Development Bank



CDTA 9255-PAK: Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department

Punjab Water Vision 2050 and Investment Plan

December 2021

SUBMITTED BY JOINT VENTURE OF



IN ASSOCIATION WITH



Document Control

Document:	Water Vision 2050 and Investment Plan
File Location:	C:\AA Pakistan Irrigation\1. REPORTS\8. WATER VISION 2050\Final Report\
Project Name:	Institutional Transformation of Punjab Irrigation Department to Water Resources Department
Project Number:	5074031
Revision Number:	01

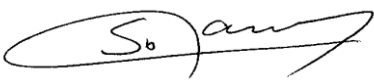
Revision History

REVISION NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED FOR ISSUE BY
0	19 November 2021	Silver Yance	Mani Manivasakan	Silver Yance
1	23 December 2021	Silver Yance	Mani Manivasakan	Silver Yance

Issue Register

DISTRIBUTION LIST	DATE ISSUED	NUMBER OF COPIES
Asian Development Bank (ADB)	24 December 2021	PDF via Email
Punjab Irrigation Department (PID)	24 December 2021	PDF via Email

SMEC Company Details

Approved by:	Silver Yance		
Address:	ITPID Project Office, Strategic Planning / Reform Unit (SPRU), Punjab Irrigation Department, Old Anarkali, Lahore, Pakistan		
Signature:			
Tel:	+92-42-3373-6702	Fax:	Click or tap here to enter text.
Email:	Silver.yance@wrema.com	Website:	www.smec.com

The information within this document is and shall remain the property of SMEC.

Click or tap here to enter text.

Important Notice

This report is confidential and is provided solely for the purposes of Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department. This report is provided pursuant to a Consultancy Agreement between SMEC International Pty Limited ("SMEC") and [Category], under which SMEC undertook to perform a specific and limited task for [Category]. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Asian Development Bank (ADB). Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

Table of Contents

ABBREVIATIONS AND ACRONYMS	V
EXECUTIVE SUMMARY	VI
1 INTRODUCTION	1
2 CURRENT SITUATION AND CHALLENGERS	2
2.1 Current Conditions and Issues.....	2
2.2 Challenges.....	2
3 THE VISION.....	4
3.1 What is a Vision Statement?.....	4
3.2 Purpose of this Document.....	4
3.3 Guidance	4
3.4 Provisional Vision Statement	7
3.5 Provisional Goals	7
3.6 Plan Impact.....	8
3.7 Enabling Environment.....	9
4 KEY RESULTS AREAS	10
4.1 KRA 1: Equitable water sharing and resilience climate change.....	10
4.2 KRA 2: Sustainable management of Doab irrigation land and water systems	11
4.3 KRA 3: River and environmental health	11
4.4 KRA 4: Reducing risks and impacts from floods.....	12
4.5 KRA 5: Sustainable management of watershed, hill torrent and desert areas.....	12
4.6 KRA 6: Reduce risk of waterborne disease	12
4.7 KRA 7: Improve Agricultural Productivity	13
5 ACTION PLAN.....	14
6 INVESTMENT PLAN	21
6.1 General	21
6.2 Context and Challenges.....	21
6.2.1 Punjab River Basin Water Investment framework.....	21
6.2.2 Private sector participation	21
6.2.3 Sustainable financial management and administration	21
6.3 Investment Requirements	21
7 REFERENCES	27
Appendix A: Vision 2050: Water Supply Sanitation and Hygiene (WASH).....	26

List of Tables

Table 5-1: Action Plan Water Availability – KRA 1	14
Table 5-2: Action Plan for Water Quality – KRA 2, KRA 3, KRA 6	14
Table 5-3: Action Plan for Groundwater – KRA 1, KRA 2	15
Table 5-4: Action Plan for River and Environmental Health – KRA 3, KRA 6	17
Table 5-5: Action Plan for Flood Management – KRA 4.....	18
Table 5-6: Action Plan for Hill Torrents and Desert Areas KRA 5, KRA 7	19
Table 5-7: Action Plan for Sustainable Management of Doab Irrigation – KRA 2, KRA 7	20
Table 6-1: Punjab Province Overall Investment Plan to Implement Water Vision 2021-2050	22

List of Figures

Figure 1-1: Hierarchy of Plan Vision Elements.....	1
Figure 3-1: Balance Use vs Conservation	6
Figure 3-2: Enabling Environment.....	9

ABBREVIATIONS AND ACRONYMS

ABBREVIATION/ ACRONYM	DESCRIPTION
ADB	Asian Development Bank
BCM	Billion cubic meter
CDTA	capacity development technical assistance
DRM	Disaster risk management
FAO	Food and Agriculture Organization
GDP	Gross domestic produce
GOPu	Government of Punjab
ha	hectare
IBS	Indus Basin System
IRSA	Indus River System Authority
ITPID	Institutional transformation of Punjab Irrigation Department
IWRM	Integrated water resource management
lps	Litre per second
KRA	Key Reporting Areas
MAF	Million acre foot
MCM	Million cubic meter
mm	Millimetre
NDC	National development consultants
OFWM	On-farm Water Management
PAD	Punjab Agriculture Department
PHED	Public health engineering department
PID	Punjab Irrigation Department
PWD	Public works department
TP	Trimmu Punjnad
WAPDA	Water and Power Development Authority
WRD	Water resource department
WASA	Water and sanitation agency

EXECUTIVE SUMMARY

Introduction

The purpose of this report is to develop a preliminary Water Vision for Punjab for the year 2050 for review and refinement by stakeholders. Water Vision 2050 will establish what the stakeholders would like to achieve by the year 2050 in terms of managing the water resources of Punjab and provide a roadmap on how the vision can be achieved. Water Vision 2050 includes:

- A vision statement that summarises the overall objective;
- A list of goals which if achieved will contribute to fulfilling the vision;
- Identification of key result areas (KRA's) and strategies which will provide the means to achieve the goals;
- Outline of actions to implement the strategies.

What is a Vision Statement?

The Vision Statement is intended to describe the ambitions of the government and people of Punjab through improved management of the water resources of the province and represents a shared vision. The Vision Statement should provide inspiration by highlighting a desirable future that everyone would like to achieve. It is important that the people who manage, use or impact the water resources (surface and groundwater) of the Province embrace the Vision Statement as something they would like to achieve. The Vision Statement will guide the development of goals, strategies and actions required to achieve the ultimate objectives.

Typically, a Vision statement for managing water resources attempts to capture the following key objectives, but in the words of the key stakeholders:

- Sustain human and economic development
- Maintain essential functions of our water ecosystems

The purpose of this document is to provide a provisional Vision Statement and a corresponding set of goals, strategies and actions required to achieve the Vision. The Vision Statement, goals, strategies and actions can be subsequently refined in consultation with the stakeholder representatives.

The provisional Vision Statement and goals provided in this document have been developed taking into account the Punjab Water Policy (December 1918), Punjab Water Act (December 2019) and the Pakistan Vision 2025 (2014).

Provisional Vision Statement

A number of potential or provisional Vision Statements are provided below.

Option 1

"The Vision is to provide adequate quantity and acceptable quality water for all uses and all users for current and future generations; protect riverine, floodplain and groundwater dependent ecosystems; manage water related risks associated with flooding, drought and disease to minimise the impact on welfare and to minimise economic impact."

Option 2

"The Vision is for an economically prosperous, socially developed, and environmentally sustainable Indus River Basin."

Option 3

“The Vision is to achieve sustainable use of water resources for the welfare and benefit of the Indus River Basin’s people while protecting and where possible improving the environmental conditions of the basin and downstream communities.”

Option 4

“The Vision is to ensure the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water related risks to people, environments and economies.”

Provisional Goals

Provisional goals and sub-goals are provided below. The goals are grouped into 5 categories.

1. Adequate Water Supply and Equitable Water Sharing (including resilience to drought and climate change)

- Provide reliable irrigation supplies.
- Provide water in an equitable manner (improve supply to tail-end irrigators).
- Improve irrigation water use efficiency by 20%.
- Improve Governance of water supply systems and improve trust amongst stakeholders.
- Pursue opportunities for recycling/reuse of water.
- Provide safe drinking water to urban communities.
- Manage groundwater extractions to match recharge.
- Introduce adaptation measures for agriculture and urban settings to cope with climate change.
- Improve community resilience to climate extremes

2. Improved Water Quality and Environmental Condition

- Manage discharge of sewerage and industrial effluent and disposal of solid wastes to reduce impacts of water quality of surface and groundwater systems.
- Establish environmental flow rules to protect riverine and floodplain environments.
- Set water quality targets for rivers with different standard depending on environmental significance.

3. Improved Flood Risk Management and Drainage

- Minimise impact of floods reducing risks to human life and reducing flood damages.
- Minimise annual monsoon flooding in urban areas to reduce health risks.

4. Reduce Risks of Disease

- Manage discharge of sewerage effluent to reduce risk of water borne disease.
- Provide suitable treatment to ensure safe drinking water (responsibility of HUD and PHE).

5. Improve Productivity

- Improve agricultural productivity (WRD to contribute).
- Improve irrigation infrastructure and operational efficiency.
- Provide efficient drainage to reduce water logging.

6. Adaptation to climate change

- Introduce adaptation measures for agriculture and urban settings to cope with climate change.
- Improve community resilience to climate extremes.

Enabling Environment

The Action required to achieve the Vision are more likely to be successful when an appropriate enabling environment is provided which entails the following:

- Institutions, Policies, Government Cooperation
- Data and Knowledge Management
- Stakeholder participation and Awareness Raising
- Sustainable Funding Streams
- Integrated Water Resource Management Framework

Key Result Areas

The Indus River Basin Plan Draft Report identified five key results areas (KRA) which are listed below and which will be adopted for the Vision Statement for consistency:

- KRA 1: Equitable Water Sharing and Resilience to Climate Change
- KRA 2: Sustainable Management of Doab Irrigation Land and Water systems
- KRA 3: River and Environmental Health
- KRA 4: Reducing Risks and Impacts from Floods
- KRA 5: Sustainable Management of Watershed, Hill Torrent and Desert Areas

However, the above KRA's fail to address two other key result areas namely reducing the risk of disease and improving productivity. Therefore, two additional KRA's have been added as below:

- KRA 6: Reduce Risk of Water Borne Disease
- KRA 7: Improve Agricultural Productivity

A short comment on each KRA is provided in the following section.

Action Plans

A series of Action Plans have been developed to address the issues associated with the KRA's described in **Section 4**. It is not feasible to implement these actions immediately or all at once, as government resources are limited. As a result, a measured approach is required. The actions have been selected based on an initial assessment of needs with some to be implemented immediately whilst others are to be implemented over the long-term.

Investment Plan

The Punjab Province overall investment plan to implement the Water Vision 2021-2050 are estimated at about US\$ 25.44 Billion, that is equivalent to about US\$ 848 Million of investment per year.

1 INTRODUCTION

The purpose of this report is to develop a preliminary Water Vision for Punjab for the year 2050 for review and refinement by stakeholders. Water Vision 2050 will establish what the stakeholders would like to achieve by the year 2050 in terms of managing the water resources of Punjab and provide a roadmap on how the vision can be achieved. It shall include:

- A vision statement that summarises the overall objective;
- A list of goals which if achieved will contribute to achieving the vision;
- Identification of key result areas (KRA's) and strategies which will provide the means to achieve the goals;
- Outline of actions to implement the strategies.

The hierarchical relationship between the vision, goals, KRAs, strategies and actions is shown in **Figure 1-1**, which will be reflected in the higher level Provincial Plans and budgets and in the business plans of the different departments.

The work plan is organised into strategically related KRA's, where specific actions for implementation are identified. The KRAs are the important issues which need to be addressed urgently in order to achieve the Plan's vision and goals.

Each KRA identifies important strategies and activities for the next 5-10 years and identifies the agency responsible for each strategy and action. The Actions identified in the Plan are included in the 5 yearly and annual work plans of the relevant government agencies. The Provincial Water Resources Department would be the lead agency for coordination and implementation of the Plan, under the auspices of the Provincial Water Resources Council in cooperation with various line agencies.

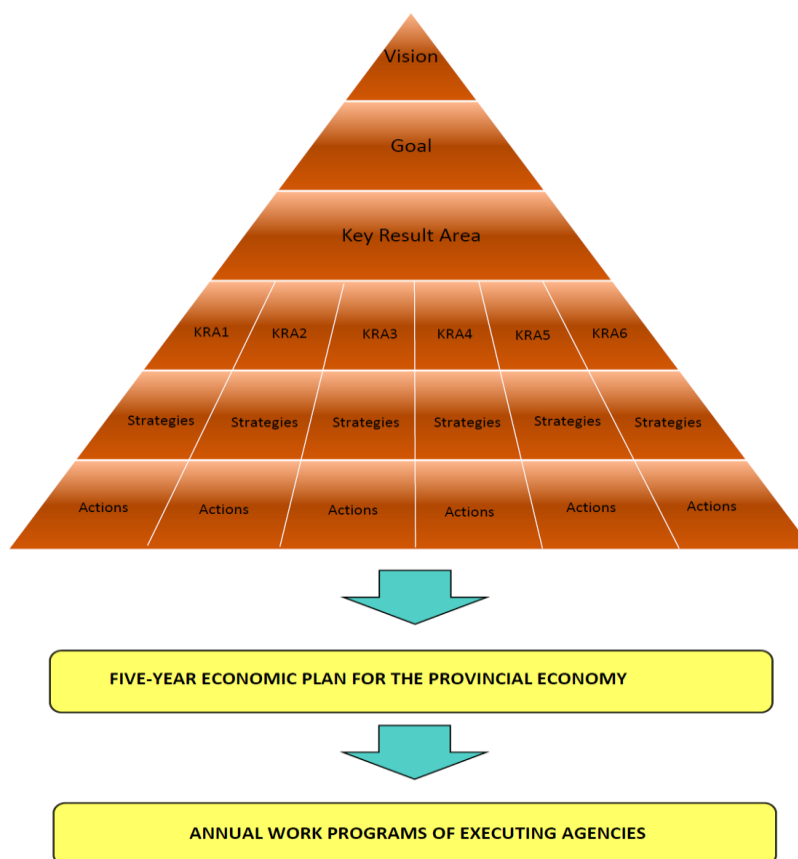


Figure 1-1: Hierarchy of Plan Vision Elements

2 Current Situation and Challenges

2.1 Current Conditions and Issues

The current situation is characterised by the following:

Water Availability/Supply

- All available water is fully committed, and additional future water requirements will most likely need to be met by demand management, achieving water use efficiencies, reducing losses and investments to harvest flood waters.
- Current groundwater extraction exceeds the rate of recharge and will need to be reduced for long term sustainability.
- Farmers at the tails of systems do not have equitable access to water and typically receive 30-40% less water than those at the head of the system. (This is a critical issue for PID to address).

Water Quality

- Water quality is declining.
- Seepage of contaminate surface water has contaminated groundwater, especially near large urban areas.
- The discharge of sewerage and industrial effluent and disposal of solid wastes to drains and waterways has negatively impacted surface water quality particularly near large urban areas.
- Some of the groundwater being extracted for irrigation has elevated salinity, which impacts the river water quality due to irrigation runoff.

Demand

- The population is growing at a rate of 2.4% per year leading to increased urban demand for potable water and increased effluent discharge which threaten water supply security and water quality.
- Migration from rural areas to cities intensifies urban water demand.

Infrastructure and Efficiency

- Existing flow and water quality monitoring data collection and management systems are inadequate to allow for efficient operation of the system.
- Much of the existing infrastructure is old and poorly maintained, with reducing efficiencies.

Water Related Risks

- Flood risks and flood damages are increasing despite significant investment in flood management, mainly due to uncontrolled development on the floodplains i.e. new development is occurring in flood liable floodplain areas increasing the number of people and property at risk.
- Uncontrolled or poorly planned development on the floodplain also increases flooding risk by impeding flows and removing flood storage.

2.2 Challenges

Challenges include:

- Climate change will increase flows over the next 50 years due to glacial retreat, following which flows will decline.
- The growing population will increase the demand for potable water.

- The growing population will put more pressure on water quality, as a result of increased sewerage and industrial effluent production and generation of solid waste.
- There are likely to be no significant new sources of water other than new storages to harvest excess river flows and MAR schemes to harvest flood waters.

3 The Vision

3.1 What is a Vision Statement?

The Vision Statement is intended to describe the ambitions of the government and people of Punjab through improved management of the water resources of the province and represents a shared vision. The Vision Statement should provide inspiration by highlighting a desirable future that everyone would like to achieve. It is important that the people who manage, use or impact the water resources (surface and groundwater) of the Province embrace the Vision Statement as something they would like to achieve. The Vision Statement will guide the development of goals, strategies and actions required to achieve the ultimate objectives.

It has been suggested that the process used to develop the Vision Statement is as important as the Vision Statement itself. Specifically, the process used to develop the Vision Statement should include the key stakeholders, to ensure that the stakeholders embrace the Vision Statement and strive to achieve it.

The stakeholders include all people who manage, use and impact the water resources of the Province or who are impacted by flooding, which is effectively everybody as this list includes: urban residents who require drinking water and generate sewerage effluent; industries who require water for their industrial processes which typically generate effluent that is modified in water quality; irrigators who use water to grow crops, but also generate runoff that may be high in nutrients and agro-chemicals; residents located on floodplains; government agencies responsible for managing water supply, flooding or the environmental.

It is generally recommended that representatives of each stakeholder group be invited to participate in the development of the Vision Statement via one or more workshops.

Typically, a Vision statement for managing water resources attempts to capture the following key objectives, but in the words of the key stakeholders:

- Sustain human and economic development
- Maintain essential functions of our water ecosystems
- Ensure sustainability of the resource for present and future generations.

3.2 Purpose of this Document

The purpose of this document is to provide a provisional Vision Statement and to develop a corresponding set of goals, strategies and actions required to achieve the Vision. The Vision Statement and subsequent goals, strategies and actions can be subsequently refined in consultation with the stakeholder representatives.

3.3 Guidance

The provisional Vision Statement and goals provided in this document have been developed taking into account the Punjab Water Policy (December 1918), Punjab Water Act (December 2019), the Pakistan Vision 2025 (2014) and the Strategic Directions for ADB Water 2030.

Pakistan Vision 2025

Pakistan Vision 2025 represent the aspirations of all the people of Pakistan and provides a guide for future development of every aspect of the economy and life, as outlined in the excerpt below.

“Pakistan Vision 2025 is designed to represent an aspirational destination. It will serve as a critical guide-post for the development of an effective strategy and road-map to reach our national goals and aspirations. It is not meant to represent the resultant strategy and programme itself. The Vision will be realized through strategies and programmes defined in associated five-year and annual plans.”

Pakistan Vision 2025 incorporates seven pillars, including Pillar Number 2 “Energy, Food and Water Security”. Regarding water resources, Pakistan Vision 2025 has identified the following key issues:

- Unsustainable use of groundwater
- Pollution for urban and industrial waste
- Pollution from agricultural runoff/seepage
- Unsustainable exploitation of water resources
- Falling water tables
- Aging water infrastructure
- Lack of laws for water use
- Growing contamination
- High and increasing sediment loads
- Salinity
- Growing populations leading to increased demands for water and generation of effluent.

Vision 2025 aimed to provide access to adequate supplies of water for agricultural, industrial and domestic users as a priority and recognised the need to correct the imbalance between supply and demand. The following five goals were established:

- Increase dam storage capacity from 30 days to 90 days.
- Improve agricultural water use efficiency by 20%
- Enable more effective allocations (to water users)
- Establish institutions to manage water more effectively
- Provide access to suitable water for all people

Punjab Water Policy

The Punjab Water Policy identified the following water sector challenges:

- The population growth of 2.4% per year poses a threat to water supply security.
- Sewerage and industrial effluents are a threat to water quality.
- Groundwater extraction exceeds recharge.
- Despite investment in flood protection flood damages are increasing due to uncontrolled development on the floodplain.
- Current agricultural practices provide poor water use efficiency and low crop yields.
- Poor governance for irrigation water supply has resulted in a lack of trust by irrigators.
- Asset management is ad hoc and inadequate.
- Inequitable supply to irrigators on tail reaches as losses are not accounted for in releases.
- Insufficient income streams to maintain or improve water supply and sanitation services.

- The current knowledge database is inadequate – require more monitoring data, improved water balances calculations, development of numerical models to inform operations and options assessment.

The Punjab water policy identified a need for strategy to focus on the need to balance productivity, development and supply against Conservation, environmental health and demand as illustrated in **Figure 3-1**.

The Water Policy concluded that strategy should focus on:

- Adapting to climate change
- Achieving financial sustainability
- Harnessing information technology
- Increasing stakeholder participation in planning and operations
- The Water Policy concluded that it was essential to adopt an Integrated Water Resource Management Approach in order to improve the management of Punjab's water resources and achieve the objectives of the Policy.

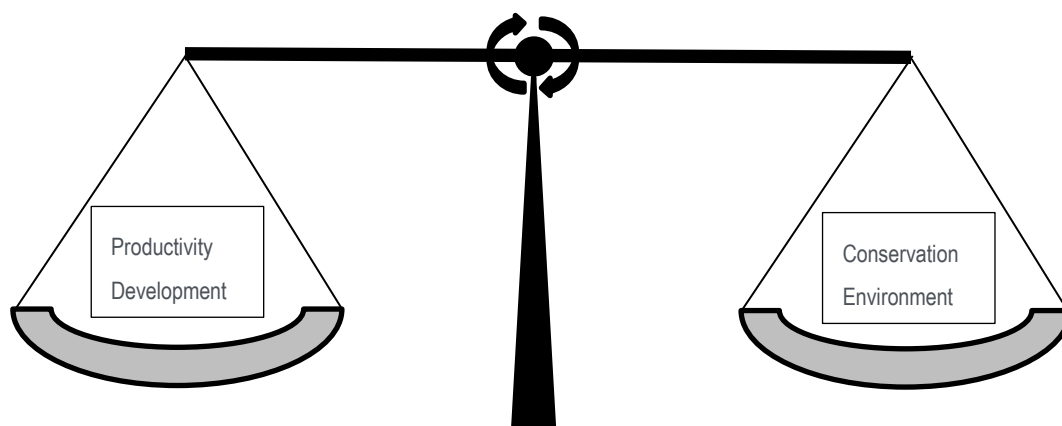


Figure 3-1: Balance Use vs Conservation

The Water Policy identified the following objectives:

- Increase water availability
- Management groundwater abstractions
- Enforce drinking water and sanitation standards
- Adapt to climate change
- Improve water quality (surface and groundwater)
- Manage floods and droughts
- Pursue demand management and water use efficiency
- Improve water governance
- Ensure financial sustainability
- Develop knowledge database and water informatics

- Awareness raising and capacity building.

It was recognised that increasing competition for water in the future would require changes to existing water allocations. The policy established the following priorities for water supply during periods of scarcity:

1. Drinking water and sanitation
2. Irrigation
3. Livestock, fisheries and wildlife
4. Hydropower
5. Industry and mining
6. Environment, river system, wetlands and aquatic life
7. Forestry
8. Recreation and sports
9. Navigation

Strategic Directions for ADB Water 2030

The Vision for ADB's water activities is to achieve a water secure and resilient Asia and the Pacific based on five integrating principals:

- i. Building resilience and adaptive capacity;
- ii. Promoting inclusiveness;
- iii. Embracing sustainability;
- iv. Improving governance; and
- v. Fostering innovation.

3.4 Provisional Vision Statement

A number of potential or provisional Vision Statements are provided below.

Option 1

"The Vision is to provide adequate quantity and acceptable quality water for all uses and all users for current and future generations; protect riverine, floodplain and groundwater dependent ecosystems; manage water related risks associated with flooding, drought and disease to minimise the impact on welfare and to minimise economic impact."

Option 2

"The Vision is for an economically prosperous, socially developed, and environmentally sustainable Indus River Basin."

Option 3

"The Vision is to achieve sustainable use of water resources for the welfare and benefit of the Indus River Basin's people while protecting and where possible improving the environmental conditions of the basin and downstream communities."

Option 4

"The Vision is to ensure the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water related risks to people, environments and economies."

3.5 Provisional Goals

Provisional goals and sub-goals are provided below. The goals are grouped into 5 categories.

1.0 KRA 1: Adequate Water Supply and Equitable Water Sharing (including resilience to drought and climate change)

- Provide reliable water supplies to all users.

- Provide water in an equitable manner (improve supply to tail irrigators).
- Improve irrigation water use efficiency by 20%.
- Improve Governance of water supply systems and improve trust amongst stakeholders.
- Pursue opportunities for recycling/reuse of water.
- Provide safe drinking water to urban communities.
- Manage groundwater extractions to match recharge.
- Improve resilience to droughts and climate change

2. KRA 2: Sustainable Management of DOAB Irrigation Land and Water Systems

Develop and implement integrated land and water management plans for DOABS to use water more efficiently, balance groundwater usage to recharge, reduce export of agro-chemicals and improve agricultural productivity.

3. KRA 3: Improved Water Quality and Environmental Condition

- Manage discharge of sewerage and industrial effluent and disposal of solid wastes to reduce impacts of water quality of surface and groundwater systems.
- Establish environmental flow rules to protect riverine and floodplain environments.
- Set water quality targets for rivers with different standard depending on environmental significance.

4. KRA 4: Improved Flood Risk Management and Drainage

- Minimise impact of floods reducing risks to human life and reducing flood damages.

5. KRA 5: Sustainable Management of Water Shed, Hill Torrent and Desert Areas

- Develop and implement Integrated Watershed Management Plans to better manage runoff and floods, to reduce erosion, and improve water availability.

6. KRA 6: Reduce Risks of Disease

- Manage discharge of sewerage effluent to reduce risk of water borne disease
- Provide suitable treatment to ensure safe drinking water.

7. KRA 7: Improve Productivity

- Improve agricultural productivity.
- Improve infrastructure and operational efficiency.
- Provide efficient drainage to reduce water logging.

3.6 Plan Impact

The impact from a successfully implemented plan will be substantially improved social/economic and environmental conditions. Social benefits will include improved health, improved equity (access to water and access to sanitation services) and improved prosperity, whereas environmental benefits include improved condition of river, wetland and groundwater ecosystems. Specifically impacts of a successful plan will include:

- Equitable access and enhanced security of water resources in Punjab for all current and future users;
- Safe drinking water and sanitation services for all residents;
- Improved water quality for surface waters and ground water;

- Improved aquatic ecosystem health including rivers, lakes, wetlands and floodplains;
- Reduced risk of flooding, drought and disease;
- Improved water use efficiency;
- Improved agricultural productivity;
- Sustainable use of water resources including balancing abstractions of groundwater to recharge;
- Improved drainage to reduce water logging.

3.7 Enabling Environment

The likelihood of developing and implementing a successful plan is enhanced by providing a suitable enabling environment which involves 5 key result areas as illustrated in **Figure 3-2**.

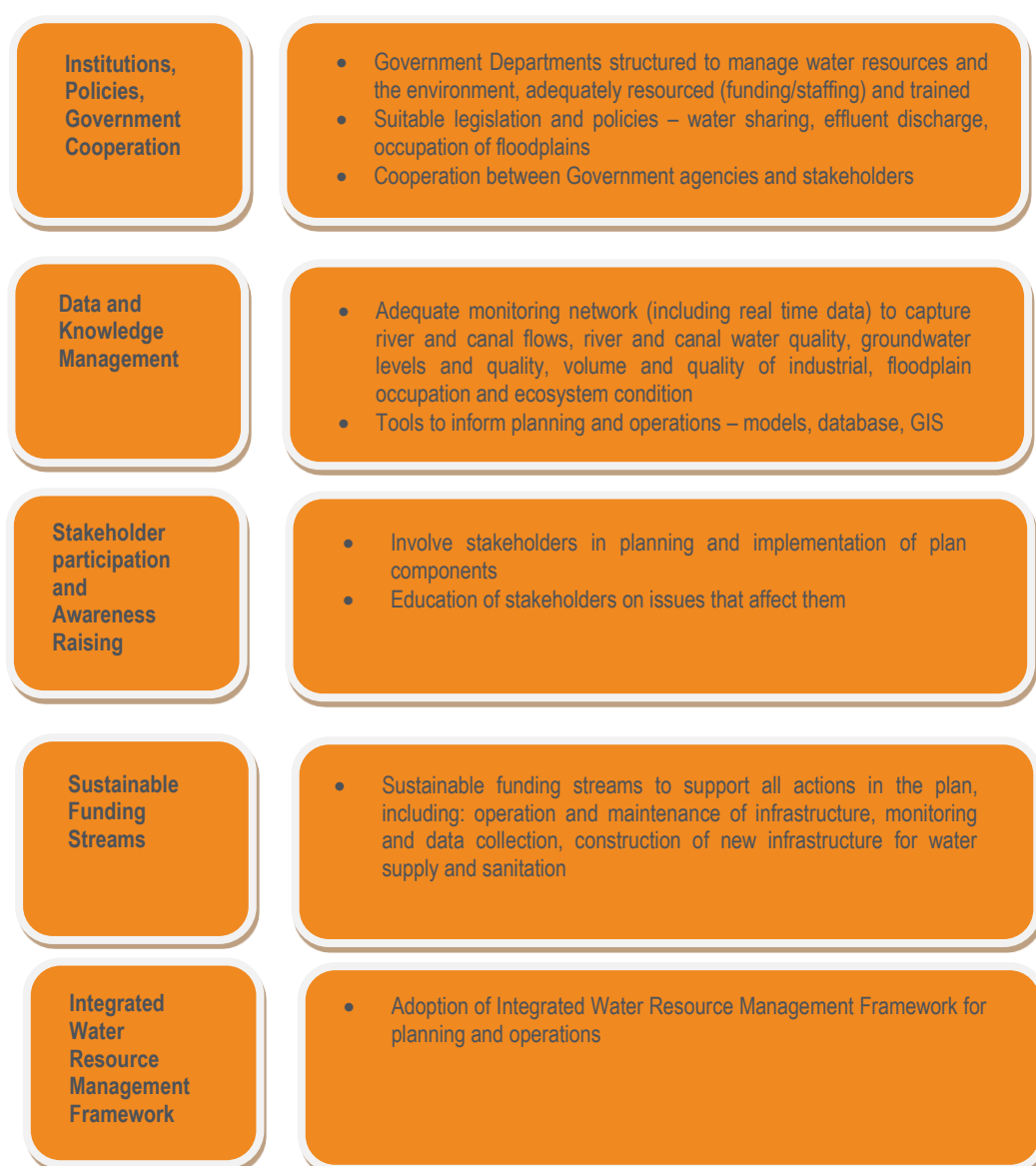


Figure 3-2: Enabling Environment

4 Key Results Areas

The Indus River Basin Plan Draft Report identified seven key results areas which are listed below and which will be adopted for the Water Vision 2050 Statement for consistency:

- KRA 1: Equitable Water Sharing and Resilience to Climate Change
- KRA 2: Sustainable Management of Doab Irrigation Land and Water systems
- KRA 3: River and Environmental Health
- KRA 4: Reducing Risks and Impacts from Floods
- KRA 5: Sustainable Management of Watershed, Hill Torrent and Desert Areas

However, the above KRA's fail to address two other key result areas namely reducing the risk of disease and improving productivity. Therefore, two additional KRA's have been added as below:

- KRA 6: Reduce Risk of Water Borne Disease
- KRA 7: Improve Agricultural Productivity

A short comment on each KRA is provided in the following section.

4.1 KRA 1: Equitable water sharing and resilience climate change

Foundation: There is an urgent need to improve water planning, including re-assigning surface water entitlements to achieve equitable access to water and to meet the needs of high priority uses. This requires an improved water allocation process in Punjab. Issues include:

- Urban centres are running out of groundwater,
- Some irrigation commands have an abundance for water (surface and groundwater) compared to others where groundwater is being depleted,
- Some rivers have little or no flow which affects or prevents river uses and degrades environmental conditions.
- Mid-season water allocations are based on forecasts which need to be improved ,
- The population is increasing, requiring additional drinking water and increased food production
- Climate change will reduce water supply, increase crop water demand and in some cases exceed crop temperature tolerances. These will have a significant impact on Punjab water users and adoption of best adaptive measures is required
- Reservoir sedimentation is reducing storage and this needs to be factored into water allocations
- The Punjab water grid (rivers and link canals) provides considerable scope for moving water to high priority uses. The value of additional link canals and associated infrastructure to improve water delivery should be assessed
- Options to improving water use efficiency to address shortages are required.

Actions:

- (i) Develop and utilise a model of the Punjab part of the Indus Basin with support from international consultants.
- (ii) Review the current hydrological monitoring data networks and develop an improved monitoring program to enhance data coverage with support from international and national consultants as needed.
- (iii) Undertake scenario studies to improve water planning to improve water supply for the different sectors and to improve flood management, including resilience to change.

4.2 KRA 2: Sustainable management of Doab irrigation land and water systems

Foundation: The Doab land areas Punjab are interconnected by link canals and the rivers themselves. Groundwater and water balance studies show a heavy reliance on groundwater for irrigation (50% of gross supply), over extraction of groundwater, locations with secondary salinity and poorly managed drainage systems.

Climate change will affect the irrigation industry by reducing the surface water supply and increasing crop water demand, which will most likely require a change in water management and crop selection.

Participatory, integrated Land and Water Management Plans that address surface and groundwater management are the key instrument for the sustainable management of Doab irrigation areas to control groundwater use, manage salinity, drainage, conjunctive use, consider options for real water savings to improve water use efficiency and productivity, assess options for water harvesting and groundwater recharge and consider the impacts and adaption strategies for climate change.

Actions:

- (i) Develop participatory integrated Land and Water Management plans (LWMPs) for Doabs commencing with the Bari Doab utilising groundwater and other appropriate models.
- (ii) Implement participatory, integrated LWMPs on a pilot basis in priority locations and implement lessons more widely.
- (iii) Introduce regulation of groundwater use in two pilot critical areas.
- (iv) Develop and implement a groundwater monitoring plan.
- (v) Plan and implement managed aquifer recharge projects in urban and rural locations.

4.3 KRA 3: River and environmental health

Foundation: Rivers and their wetlands and floodplains are an important element of the landscape which provide many services including water supply, fishing, recreation, aesthetic and ecological. In good condition, they also have an assimilative capacity for improving water quality. The rivers, floodplains and wetlands of Punjab are in poor health due to abstractions which reduce flows, regulation by dams which changes flow patterns and poor water quality from sewerage and industrial effluents and agricultural drainage. In Punjab, river health is not considered in any formal way. There are a few disconnected and ad-hoc water quality assessments and riverbank erosion control projects. There are no recognised environmental flows.

Actions:

- (i) Review water quality monitoring data, networks and data processing. Compile a provincial database of information from the relevant agencies and institutions. Design and implement a surface water quality monitoring network across the rivers of Punjab.
- (ii) Identify significant point and nonpoint pollution sources and report to PWRC.
- (iii) Develop and enforce effluent discharge standards for industry.
- (iv) Develop methodology from international experience for assessment of river health and uses.
- (v) Undertake rapid, pilot assessment of the river health and uses of the Chenab River and recommend river flow requirements for inclusion in water allocation.
- (vi) Undertake rapid assessments of the remaining rivers and recommend river flow requirements.
- (vii) Develop a prioritised river health management plan and actions for each river including setting water quality and flow targets.

4.4 KRA 4: Reducing risks and impacts from floods

Foundation: The frequency of major flooding has increased with five consecutive extreme flood events in 2010, 2011, 2012, 2013 and 2014. The severe Indus Basin flooding in 2010 resulted in loss of life, a very large number of affected villages and high flood costs of \$10 billion. This is consistent with the expected impacts of climate change. A more comprehensive and systematic risk management approach is required for flood management.

Actions:

- (i) Based on international experience, develop a comprehensive flood risk management approach for Punjab.
- (ii) Build a strong information database including flood models, develop flood maps, develop flood management plans based on a flood risk management approach.
- (iii) Update and implement improved flood preparedness, protection, forecasting, warning and recovery systems

4.5 KRA 5: Sustainable management of watershed, hill torrent and desert areas

Foundation: Non irrigated areas cover about 40% of Punjab and are home to 19 million people. In general, these areas are poor, suffer low productivity and land degradation and are neglected by government. From a river basin perspective, the Pothohar and hill torrent areas are subject to flash flooding, erosion and downstream sedimentation. The hill torrent areas make use of spate irrigation. For Pothohar and the hill torrent areas, watershed management plans are needed to capture and better manage runoff, currently only 3% is captured. In the Cholistan desert area, watering ponds, plantation strips and aquifer recharge are options to improve local conditions.

Actions:

- (i) On a pilot basis, develop and implement participative, integrated 'watershed/land and water' management plans in each area.

4.6 KRA 6: Reduce risk of waterborne disease

Foundation: Major waterborne disease outbreaks are common due to poor drinking water quality and lack of sanitation. Water quality is a significant issue in urban areas with 49% of the water contaminated. According to UNICEF 20%–40% hospitals in Pakistan have patients suffering from waterborne diseases such as cholera, typhoid, dysentery, hepatitis, giardiasis, and cryptosporidiosis and guinea worm infections. Around 80% of all diseases including polio, diarrheal diseases, jaundice, typhoid, malaria, dengue viral fever and cholera are attributed to unsafe water supply and poor sanitation. The Pakistan National Conservation Strategy estimates that deaths due to water contamination result in a loss of approximately 0.6-1.44% of Pakistan's GDP. Rural households relying on distant sources of unsafe water (e.g., uncovered wells, rivers, and rain-fed/canal-fed ponds), generally transported by women and children, suffer significantly from waterborne diseases.

The key to reducing the risk of disease is to provide safe drinking water and sanitation which involve treatment of drinking water and treatment/disposal of sewerage effluent. The Punjab Drinking Water Policy was established in 2009 to address this issue. Subsequently Punjab has developed "Vision 2050: Water Supply Sanitation and Hygiene (WASH)" which includes a list of goals and actions to ensure the provision of safe drinking water and sanitation. Details of the WASH Action Plan are provided in Appendix A. The Action Plan for this project will support the WASH Action Plan.

Actions:

- (i) Develop and enforce water supply water quality standards.
- (ii) Develop and enforce effluent discharge standards for industry.

- (iii) Undertake water quality test to verify the water treatment and sewerage treatment plants comply with the standards.

4.7 KRA 7: Improve Agricultural Productivity

Foundation: Agriculture is responsible for 21% of the GDP of Punjab and approximately 47% of employment. Irrigated agriculture is particularly important but is typified by low water use efficiency, low crop productivity and low value crops. Improved agricultural practices and different cropping patterns can: improve water use efficiency making water available for other uses; improve crop yields and improve income levels. Improved and equitable access to water will provide greater opportunities for low income, disadvantaged people to prosper.

Actions:

- (i) Implement pilot projects to trial various approaches to improve water use efficiency and crop yields.
- (ii) Use the pilot projects to underpin education of landholders on improved farming practices.

5 Action Plan

A series of Action Plans have been developed to address the issues associated with the KRA's described in Section 4. It is not feasible to implement these actions immediately or all at once, as government resources are limited. As a result, a measured approach is required. The actions have been selected based on an initial assessment of needs with some to be implemented immediately whilst others are to be implemented over the long-term.

Table 5-1: Action Plan Water Availability – KRA 1

SR. NO	PROJECT/ACTIVITY	YEAR 0-2	YEAR 2-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
1)	Improve streamflow, rainfall, groundwater and climatic data measurement	✓	✓		PID/WRM	PID
2)	Set up water accounting framework	✓	✓		PID/WRM	PID
3)	Undertake more holistic water balance analysis using water balance models such as WEAP or Source		✓	✓	PID/WRM	PID
4)	Enhance existing WRMIS capability to analyse and prepare water balance and availability reports for the entire system down to farm outlet level	✓	✓		PID/WRM	PID
5)	Develop policies and action plans for the management of storm water (urban and rural) and treatment of sewage and industrial effluents		✓	✓	PID/WRM	EPD, WASA /Local governments
6)	The PID/WRD will need to develop policies and action plans to separate sewage from stormwater and stock water ponds. Alternative treatment measures include construction of artificial wetlands for sewage treatment and landscaping around stock ponds to reduce sediment inflows.		✓	✓	PID/WRM	PID

Table 5-2: Action Plan for Water Quality – KRA 2, KRA 3, KRA 6

NO	PROJECT/ACTIVITY	YEAR 0-2	YEAR 2-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
1	Field surveys for recording information about industries & WASA discharging effluent into irrigation channels/drains (as per table 12)- District wise (Duration: 1 to 1.5 year)	✓	✓		Irrigation Department	Environment Protection Department, Punjab, WASA
2	Preparation of comprehensive report on water sector industrial and municipal pollution in Punjab based on collected information (refer Sr. No 1) (Duration: 6 months)		✓		Irrigation Department	

NO	PROJECT/ACTIVITY	YEAR 0-2	YEAR 2-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
3	Development of surface water quality monitoring network across Punjab on the basis of field surveys (Sr. No 1) and GIS mapping		✓		Irrigation Department	Environment Protection Department, Punjab, WASA
4	Surface water sampling and analysis from established monitoring points across Punjab canals/ivers		✓		Irrigation Department	Environment Protection Department, Punjab. WASA
5	Preparation of comprehensive report on surface water quality of canals/ivers of Punjab		✓		Irrigation Department	Environment Protection Department, Punjab. WASA
6	Characterization of drains, canals and river waters on the basis of industrial/urban pollution within each river basin.		✓		PID	EPD, WASA /Local governments
7	Setting pollution discharge limits for each point source pollution location as a function of applicable maximum contaminant level at each discharge point.		✓		EPD	PID
8	Formulating environmental management plan for each river basin for ambient water quality.		✓		PID	EPD
9	Implementation & monitoring of environmental management plan for river basin.		✓	✓	PID	EPD, WASA
10	Environmental auditing and law enforcement		✓	✓	EPD	

Table 5-3: Action Plan for Groundwater – KRA 1, KRA 2

PROJECT/ACTIVITY	YEAR 0-2	YEAR 3-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
Strengthen Groundwater management institutions					
Establish a strong GW management division within WRD	✓	✓	✓	WRD	
Strengthen regulatory arrangements					
Develop a GW Legal/ Regulatory Framework (GWRF) for Punjab	✓			WRD	WASA, EPA, Consultants (Legal and Technical)
Implement GWRF on a Pilot Scale in at least two critical areas to study its effectiveness.	✓			Monitoring Agency	WRD, WASA
Implement the GWRF to the whole Province		✓	✓	WRD, Monitoring Agency, Undertakers	Consultants

PROJECT/ACTIVITY	YEAR 0-2	YEAR 3-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
Develop and Implement GW Management Plans					
Development of GW management plans for each sub basin that are accepted by the local community and the government.	✓	✓	✓	WRD	WASAs, EPA, Consultants, etc.
Groundwater management plan for Bari DOAB		✓		WRD	Consultants
Plan and implement conjunctive use projects for a more integrated approach which includes reducing soil salinity and drainage outflows?		✓	✓	WRD	Consultants, WUAs, Farmers, etc.
Plan and implement rainwater harvesting projects in urban areas	✓	✓	✓	WRD	WASA, Consultants
Strengthen Groundwater Information and Knowledge Management					
Develop a detailed GW monitoring plan and improve institutional setup	✓			WRD, Monitoring Agency	Consultants, WASA, EPA
Implement the monitoring network as per plan and start data collection	✓	✓	✓	WRD, Monitoring Agency	WASA, EPA
Expand the monitoring network as required		✓	✓	WRD, Monitoring Agency	Consultants, WASA, EPA
Develop GW models for selected critical areas and study management options	✓	✓	✓	WRD	Consultants
Implement Managed Aquifer Recharge Projects					
Plan and implement mar projects in rural catchments		✓		WRD	Consultants
Plan and implement mar in urban catchments		✓		WRD	Consultants
Community and Stakeholder Awareness Raising and Participation					
Community participation and raising water user awareness campaigns	✓			WRD	WASAs, EPA, Local Govts, Farmers

Table 5-4: Action Plan for River and Environmental Health – KRA 3, KRA 6

PROJECT/ACTIVITY	YEAR 1-2	YEAR 3-5	YEAR 5-15	LEAD AGENCY	INVOLVED AGENCIES
Develop methodology and undertake pilot study to determine flow requirements for Punjab rivers to improve ecological condition and river other uses ¹	✓	✓	✓	WRD	FWFD, PID, EPD, stakeholders who use or are impacted by the river, local governments
Incorporate river flow requirements into water allocation plans			✓	WRC	WRD, PID
Develop river health assessment, index of stream condition (ISC) indicators, standards and methodologies	✓			FWFD/WRD	EPD, WWF-Pakistan, PID, EPD
Conduct and report river health survey and ISC for a complete year (Chenab River)	✓	✓		FWFD/WRD	WWF-Pakistan,
River health survey and ISC reports for Indus, Jhelum, Ravi and Sutlej rivers		✓	✓	FWFD/WRD	PID, WWF-Pakistan, PID
Preparation of river health assessment and ISC reports			✓	FWFD/WRD	WWF-Pakistan, PID, EPD
Assessment of rivers for riverbank erosion, develop prioritized plan of protection and implement to restore them,		✓	✓	WRD	PID
Training and capacity building for WRD, PID, FWFD and EPD staff on river health		✓		FWFD/WRD	PID, EPD

WRD = Water Resources Department, PID = Punjab Irrigation Department, EPD= Punjab Environmental Protection Department;

Table 5-5: Action Plan for Flood Management – KRA 4

PROJECT/ACTIVITY	YEAR 0-2	YEAR 2-5	YEAR 6-15	LEAD AGENCY	INVOLVED STAKEHOLDERS
Strengthening of FRAU					
Review and update a compressive mandate for flood management within IWRM for FRAU	✓			PID	WAPDA
Recruitment of staff with required technical skills	✓	✓		PID	WAPDA
Provision of resources to enable FRAU to execute its duties including training of the FRAU staff at international level	✓	✓	✓	PID	WAPDA
FRAU prepare a business plan for its strengthening and priority projects to strengthen flood management in Punjab	✓	✓		PID/FRAU	WAPDA, PMD, local governments, universities and institutes, civil society
Develop innovative flood management approaches based on international best practice and by conducting research	✓	✓		PID/FRAU	WAPDA, universities and institutes
Prepare best practice notes and guidelines, and standards for operational agencies	✓	✓		FRAU	WAPDA, PID, district governments
International and national flood management specialists to assist PID and frau implement a comprehensive and effective approach to flood management	✓	✓	✓	PID/FRAU	Consultants
Data and Information					
Strengthen the hydrometeorological and river discharge monitoring network		✓	✓	PID/FRAU	PMD, WAPDA
Undertake flood mapping studies			✓	FRAU	WAPDA, consultants
Develop and apply flood models for flood planning and flood warning		✓	✓	FRAU	WAPDA, consultants
Integrated Flood Planning					
Prepare a proper risk based provincial flood management plan	✓	✓		FRAU	WAPDA, district governments, civil society, consultants
Develop and implement a spatial (zoning) system with community participation		✓	✓	PID/FRAU	WAPDA, district governments, civil society, consultants
Develop and implement rural and urban drainage plans with input from local government and communities			✓	PID/FRAU	PID, district governments, civil society, consultants/contractors
Incorporate climate change into flood planning	✓	✓	✓	PID/FRAU	WAPDA, district governments, civil society
Flood Preparedness					
Develop and implement an efficient emergency communications approach with other flood management agencies		✓	✓	PID/FRAU	WAPDA, Disaster Management Authority, District governments, civil society
Develop and implement an awareness raising program for the community and civil society		✓	✓	PID/FRAU	WAPDA, district governments

PROJECT/ACTIVITY	YEAR 0-2	YEAR 2-5	YEAR 6-15	LEAD AGENCY	INVOLVED STAKEHOLDERS
Involve community in different elements of flood planning and management		✓	✓	PID/FRAU	WAPDA, district governments
Strengthen flood forecasting and warning					
Update flood forecasting and early warning system and coordinate with WAPDA and PMD	✓	✓	✓	PID/FRAU	PMD, consultants
Flood Protection					
Prepare operational rules for reservoirs and barrages		✓	✓	PID/FRAU	WAPDA
Prepare and implement a climate adaptive asset management database and plan and ensure effective O&M		✓	✓	PID/FRAU	District governments
Undertake rehabilitation and strengthening of priority flood infrastructure		✓	✓	PID	WAPDA and district governments
Implement flood plans			✓	PID	WAPDA and district governments
Flood Recovery and Warning					
Provide detailed flood management reports annually		✓	✓	FRAU	WAPDA and district governments
Provide recovery reports after each flood event, including a programme for rehabilitation of damaged infrastructure and related budget needs and timelines for civil works execution		✓	✓	PID	WAPDA, District governments, national government
Arrange financing for repair of damaged infrastructure, for homeowners, and public infrastructure.	✓	✓	✓	Punjab government, PID	WAPDA, District governments, national government

Table 5-6: Action Plan for Hill Torrents and Desert Areas KRA 5, KRA 7

PROJECT/ACTIVITY	YEAR 0-2	YEAR 3-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
Community participation and awareness raising water users' campaigns.	✓			WRD	EPA, Local Govts, Farmers
Development of a management plans for each hill torrent accepted by the local community and the government.	✓	✓	✓	WRD	EPA, Consultants, etc.
Trainings for capacity building of staff and farmers of the Pachad area.	✓			WRD	EPA, Consultants (Legal and Technical)
Rehabilitation of existing dispersion structures, WAHS and restoration of flood damages in Pachads.	✓			Monitoring Agency	WRD,
Construct new dispersion structures in the remaining torrents.	✓			WRD Monitoring Agency	Consultants EPA

PROJECT/ACTIVITY	YEAR 0-2	YEAR 3-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
Install flood forecasting and warning system	✓			WRD	
Design and implement integrated watershed management projects.	✓	✓	✓	WRD	EPA,
Design and construct storage dams.		✓	✓	WRD	Consultants, Funding Agency
Utilizing new developments in technology to improve irrigation efficiency in Pachad areas		✓		WRD	PAD,
Design and implement GW recharge projects		✓		WRD	EPA
Conjunctive use projects for a more integrated approach which includes reducing soil salinity and drainage outflows.		✓	✓	WRD	PAD, EPA
Introduce rainwater harvesting techniques to rural community.	✓			WRD	EPA, Social, Local Gov.

Table 5-7: Action Plan for Sustainable Management of Doab Irrigation – KRA 2, KRA 7

SR. NO	PROJECT/ACTIVITY	YEAR 0-2	YEAR 3-5	YEAR 6-15	LEAD AGENCY	INVOLVED AGENCIES
	Strategic Irrigation System Modernisation Plan- Develop in the next 12 months and implement in years 2-5.	✓	✓		PID	PID
	Strategic Asset Management (asset replacement, renewals and maintenance)	✓	✓		PID	PID
	Demand Management (Delivery to match demands)	✓	✓	✓	PID	PID
	Enhance existing WRMS and include DSS to improve irrigation system operations		✓	✓	PID	PID
	Enhance rainfall and flood harvesting new infrastructure: village ponds, small dams and large storages Existing infrastructure: Desilt dams		✓	✓	PID	PID
	Upgrade IRI to support modernisation and support modernised assets		✓	✓	PID	PID

6 Investment Plan

6.1 General

This section on financial management is a key cornerstone of the Punjab Basin Action Plan. Having the necessary financial resources in place, together with the necessary systems, structures and processes, will enable the implementation and progress monitoring of the Action Plan. Financial management must thus provide for the financial resource needs identified in the other chapters.

6.2 Context and Challenges

6.2.1 Punjab River Basin Water Investment framework

To facilitate effective and timely investment, the Punjab Government shall initiate development of a comprehensive investment framework that will inform budgeting and integrated planning based on a life-cycle approach, which includes planning and construction costs, operation and maintenance, financing costs and the costs of sustainable and integrated water resources management.

6.2.2 Private sector participation

The private sector should be mobilized to finance the economically viable portion of water resource development; that is water supplies to users who can afford to repay loan finance, such as industries, mines and power generation and domestic users receiving high levels of water services. The private sector should be encouraged to contribute towards the social component of infrastructure investment where they use water from the same infrastructure. Irrespective of the funding model adopted, the ownership of major water resource infrastructure should always reside in an organ of State or Federal Government.

6.2.3 Sustainable financial management and administration

Ineffective financial management and poor cost recovery has impacted negatively on the financial viability of water infrastructure and water management and water services institutions in Punjab Province. The PID are at present, not recovering all their costs from water users and they are therefore not able to break even.

In order to address the above, the following measures should be undertaken:

- i. The Punjab Province Water Resources Department will compile an accurate database of registered and licensed water users and install appropriate water meters for all consumers of supplied water;
- ii. The Punjab Province Water Resources Department will correct and update all water billing information (where applicable) and adopt a clear debtor management strategy including enforcement of payment of all outstanding bills;
- iii. Undertake a basin wide study on urban water tariff setting & structures and implement recommendations upon agreement with relevant stakeholders;
- iv. Undertake a study on Operation & Maintenance (O&M) costs for public funded irrigation schemes and review all irrigation water tariffs to cover at the minimum the full O&M costs;
- v. Lobby with Pakistan Central Government to include provisions in the Water Bill that enable financial assistance (in the form of grants, loans or subsidies) to the vulnerable and marginalized groups who may not afford the revised water tariffs; and
- vi. Lobby the Pakistan Central Government to fast-track enactment of the new Water Bill.

6.3 Investment Requirements

The Punjab Province overall investment plan to implement the Water Vision 2021-2050 are estimated at about US\$ 25.44 Billion as shown in the **Table 6-1**, that is equivalent to about US\$ 848 Million of investment per year.

Table 6-1: Punjab Province Overall Investment Plan to Implement Water Vision 2021-2050

TASKS	MAIN COST ITEMS	TENTATIVE COST (US\$)
WATER AVAILABILITY (\$3.0 BILLION @ \$100 MILLION/YR) ALL COST OF INFRASTRUCTURE	<ul style="list-style-type: none"> Improve storages, wetlands and regulation Improve surface water conveyance system and reduce unaccounted flows Reduce unaccounted flow in WASH Recharge groundwater and regulate Reallocate and divert canal water for drinking water use 	<ul style="list-style-type: none"> \$2.0 billion (\$66.0 million a year) Covered under irrigation Covered under WASH. Covered under groundwater \$1.0 billion (\$33.3 million a year)
IRRIGATION WATER MANAGEMENT (\$4.573 BILLION @ \$152.4 MILLION/YR) COST OF: INFRASTRUCTURE = \$4.5 BILLION NON-STRUCTURAL = \$73 MILLION	<ul style="list-style-type: none"> Improve/modernize irrigation network and reduce inefficiency linking it with water productivity Expand irrigation when opportunities exist Policy, institutions and capacity building Develop Strategic Irrigation System Modernisation Plan. Enhance existing WRMS including DSS for improved irrigation system operations Identify and promote Innovativeness and knowledge solutions including rationalizing canal water allowance Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$3.5 billion (\$116 million a year) \$1.0 billion (\$33 million a year) \$50.0 million (\$1.33 million a year) \$3.0 million \$10.0 million \$5.0 million \$5.0 million
DRAINAGE AND PROTECTING LAND DEGRADATION INCLUDING WATERLOGGING AND SALINITY (\$2.105 BILLION @ \$70.2 MILLION/YR) COST OF: INFRASTRUCTURE = \$2.0 BILLION NON-STRUCTURAL = \$105 MILLION	<ul style="list-style-type: none"> Develop Punjab's drainage plan Improve productivity of saline land with communities Infrastructure network and safe and effective disposal Storm-water network and disposal Safe use of marginal quality water/drainable surplus Introduce communal management of waterlogging and salinity Improve policy, planning and institution Capacity building and upgrading of the institutions Identify and promote Innovativeness and knowledge solutions including rationalizing canal water allowance Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$5.0 million \$20.0 million \$1.0 billion \$1.0 billion \$20.0 million \$50.0 million \$5.0 million \$5.0 million \$5.0 million \$5.0 million
WATER QUALITY MANAGEMENT	<ul style="list-style-type: none"> Review, improve and develop water quality standards for all uses and type of waters Enforce water quality regulations 	<ul style="list-style-type: none"> \$5.0 million \$10.0 million

TASKS	MAIN COST ITEMS	TENTATIVE COST (US\$)
<p>(\$5.106 BILLION @ \$170.2 MILLION/YR)</p> <p><i>COST OF:</i> <i>INFRASTRUCTURE</i> <i>= \$5.0 BILLION</i> <i>NON-STRUCTURAL</i> <i>= \$106 MILLION</i></p>	<ul style="list-style-type: none"> Develop water quality management plan Water quality monitoring and data management Laboratory upgradation Conduct rivers health survey (ecological and morphological) and assess minimum flow requirement Wetland development Policy, institution and capacity building Assess, aware, search funding source and manage wastewater from all sources and treat for minimum accepted standard before disposal in rivers Create awareness and educate people on WQ 	<ul style="list-style-type: none"> \$5.0 million \$10.0 million partly covered under groundwater \$10 million for EPD (partly covered under WASH & Irrigation/Agriculture) \$3.0 million \$50 million \$3.0 million \$5.0 billion (\$166.67 million a year) \$10 million
<p>HILL TORRENTS, POTHOKAR AND DRYLAND MANAGEMENT</p> <p>(\$1.467 BILLION @ \$48.8 MILLION/YR)</p> <p><i>COST OF:</i> <i>INFRASTRUCTURE</i> <i>= \$1.4 BILLION</i> <i>NON-STRUCTURAL</i> <i>= \$67 MILLION</i></p>	<ul style="list-style-type: none"> Communal management of watersheds including rainwater harvesting and livelihood opportunities Water storage and regulation, if feasible Improve spate irrigation including farmers support Improve livelihood and reduce degradation in deserts Establish Desert Research Centre and build capacity Capacity building and upgrading the institution Identify and promote Innovativeness and knowledge solutions Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$100 million (\$3.3 million a year) \$1.0 billion (\$33.3 million a year) \$200 million (\$6.6 million a year) \$100 million (\$3.3 million a year) \$50 million \$5.0 million \$5.0 million \$5.0 million
<p>GROUNDWATER MANAGEMENT</p> <p>(\$239.5 MILLION; @ \$8.0 MILLION/YR)</p> <p><i>COST OF:</i> <i>INFRASTRUCTURE</i> <i>= \$141.5 MILLION</i> <i>NON-STRUCTURAL</i> <i>= \$98 MILLION</i></p>	<ul style="list-style-type: none"> Resource Monitoring and Data Analytics including farmers organizations Resource Management <ul style="list-style-type: none"> Priority canal command areas Non CCA areas Ecosystem Monitoring and Management <ul style="list-style-type: none"> Survey of groundwater pollution Monitoring bores in trace metals areas Specialised monitoring and analysis Water Productivity and Conjunctive Management <ul style="list-style-type: none"> Improved irrigation application efficiency and reduce unaccounted losses 	<ul style="list-style-type: none"> \$31.5 million (\$1.05 million a year) \$10.0 million \$10.0 million \$5.0 million \$15.0 million \$15.0 million Covered under Irrigation/ Agriculture

TASKS	MAIN COST ITEMS	TENTATIVE COST (US\$)
	<ul style="list-style-type: none"> - Improve water productivity 	<ul style="list-style-type: none"> o Covered under Irrigation/ Agriculture
	<ul style="list-style-type: none"> • Groundwater use management under WASH <ul style="list-style-type: none"> - Reduce unaccounted flow - Efficient operational management of abstraction - Introduce smart metering. 	<ul style="list-style-type: none"> o Covered under WASH o Covered under WASH o Covered under WASH
	<ul style="list-style-type: none"> • Artificial groundwater recharge (MAR) <ul style="list-style-type: none"> - Rainwater harvesting and recharge - Floodwater harvesting and recharge 	<ul style="list-style-type: none"> o \$20.0 million (\$0.65 million/year) o \$90.0 million (\$3.0 million/year)
	<ul style="list-style-type: none"> • Water quality management (urban) <ul style="list-style-type: none"> - Water quality monitoring - Laboratory upgradation - - Data management 	<ul style="list-style-type: none"> o \$10 million o Covered under WASH, EPD and Irrigation/Agriculture o Covered under WASH, EPD and Irrigation/Agriculture
	<ul style="list-style-type: none"> • Groundwater Allocation, Licensing and Policy <ul style="list-style-type: none"> - Community engagement to set acceptable allocation limits for stressed groundwater zones - Capacity development in licensing and implementing regulation 	<ul style="list-style-type: none"> o \$5.0 million o \$5.0 million
	<ul style="list-style-type: none"> • Institution and capacity building <ul style="list-style-type: none"> - Establish groundwater institution, equipment and training - Establish, equip and train community-based organizations 	<ul style="list-style-type: none"> o \$10.0 million o \$10.0 million
	<ul style="list-style-type: none"> • Cross-sectoral coordination <ul style="list-style-type: none"> - IWRM: coordination with the main stakeholders (departments and agencies) - Dispute resolution - Evaluation, planning and implementation 	<ul style="list-style-type: none"> o Covered under IWRM o \$1.0 million o \$2.0 million
FLOOD RISK MANAGEMENT (\$3.525 BILLION @ \$117.5 MILLION/YR) COST OF: INFRASTRUCTURE = \$3.5 BILLION NON-STRUCTURAL = \$25 MILLION	<ul style="list-style-type: none"> • Develop basin-based plans, strategy and guiding principles for reduced flood risks • Improve flood related infrastructure, develop wetlands and clear flood channel ways • Introduce conducive land use planning and improve flood drainage including clear river ways • Improve storm-water management & innovativeness • Improve forecasting and early warning mechanisms • Improve institutions and introduce institutional coordination mechanism for FRM 	<ul style="list-style-type: none"> o \$5.0 million o \$1.5 billion (\$50.0 million a year) o \$1.0 billion (\$33.3 million a year) o \$500 million (\$16.67 million a year) o \$ 5.0 million

TASKS	MAIN COST ITEMS	TENTATIVE COST (US\$)
	<ul style="list-style-type: none"> Develop and manage flood emergency and recovery programs Identify and promote Innovativeness and knowledge solutions Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$ 5.0 million \$500 million as contingency plan \$ 5.0 million \$ 5.0 million
WATER SUPPLY, SANITATION AND HYGIENE (\$5.195 BILLION @ \$173.0 MILLION/YR) COST OF: INFRASTRUCTURE = \$5.115 BILLION NON-STRUCTURAL = \$80 MILLION	<ul style="list-style-type: none"> Review and upgrade WASH plan Enforce water conservation practices to all Improve infrastructure and reduce water consumption Manage water supply for all and reduce hazards Introduce appropriate water pricing including metering Monitoring, evaluation and coordination Mainstream and implement the promised SDGs Capacity building and upgrading three departments Identify and promote Innovativeness and knowledge solutions Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$5.0 million \$10 million \$1.0 billion (\$33.3 million a year) \$4.050 billion (\$135.0 million a year) \$50.0 million (\$1.6 million a year) \$10.0 million \$10.0 million (the cost of infrastructure already included as above) \$50.0 million (\$1.67 million a year) \$5.0 million \$5.0 million
AGRICULTURE DEVELOPMENT (\$47.1 MILLION @ \$1.6 MILLION/YR) COST OF: INFRASTRUCTURE = \$25 MILLION NON-STRUCTURAL = \$22.1 MILLION	<ul style="list-style-type: none"> Institutional support for development of high yielding staple food varieties and promoting production of fruits and vegetables, including value addition. Support for development of technical bulletins, establishment and strengthening of Agricultural Training Centres. Development of GW management plans for each sub basin. Design and implement Managed Aquifer Recharge schemes (ponds, wells, abandoned land) Capacity building and upgrading the institution Identify and promote Innovativeness and knowledge solutions Communication, knowledge sharing, advocacy and awareness raising 	<ul style="list-style-type: none"> \$5.8 million \$0.8 million \$0.5 million \$25.0 million \$5.0 million \$5.0 million \$5.0 million
IMPLEMENTATION OF IWRM FRAMEWORK (\$26.5 MILLION @ \$0.9 MILLION/YR)	<ul style="list-style-type: none"> Operationalize institutions, policies, and intergovernmental cooperation Prepare water resource management plans Introduce data, Information, and Knowledge Management Involve stakeholders 	<ul style="list-style-type: none"> \$20.0 million \$0.5 million \$0.5 million \$0.5 million

TASKS	MAIN COST ITEMS	TENTATIVE COST (US\$)
<i>ALL NON-STRUCTURAL COST</i>	<ul style="list-style-type: none"> • Introduce Doab and Irrigation Management • Ensure rivers health and environmental protection • Watershed, hill torrent, and desert area management • Integrated flood risk management • Urban WSS and Environment 	<ul style="list-style-type: none"> ○ \$0.5 million ○ \$1.5 million ○ \$1.0 million ○ \$0.5 million ○ \$1.5 million
INSTITUTION AND CAPACITY BUILDING (\$41.0 MILLION @ \$1.4 MILLION/YR) <i>ALL NON-STRUCTURAL COST</i>	<ul style="list-style-type: none"> • Implement the PID Transformation into WRD • Upgrade IRI to support modernization • Institutional support to EPD for monitoring and enforcing the water quality standards • Institutional development for decision support system: hydrological and meteorological monitoring updates and design. • Institutional Support for implementing Water policy and Water Act at basin and sub-basin levels • Institutional Support for stakeholder consultations, political dialogue and advocacy 	<ul style="list-style-type: none"> ○ \$10.0 million ○ \$15.0 million ○ \$5.0 million ○ \$10.0 million ○ \$0.5 million ○ \$0.5 million
SUMMARY	<ul style="list-style-type: none"> • Total estimated cost = \$25.44 billion • Average annual cost = \$848 million • Cost for infrastructure = \$24.68 billion • Cost of non-structural measures = \$758.5 million 	

7 REFERENCES

Amir and Habib 2015. Estimating the impacts of climate change on sectoral water demand in Pakistan.

Punjab Water Policy Framework, Annexure-I Punjab Water Resources – Current State and Projections, Punjab Irrigation Department February 2016.

Government of Pakistan (2018) 'National Water Policy' (April 2018), available at https://ffc.gov.pk/wp-content/uploads/2018/12/National-Water-Policy-April-2018-FINAL_3.pdf

Government of the Punjab (2019) 'The Punjab Water Act 2019'

Government of the Punjab/Irrigation Department (2018) 'Punjab Water Policy' (December 2018)

Government of the Punjab/Services and General Administration Department (2011): 'Punjab Govt Rules of Business 2011'

Asian Development Bank (2021). CDTA 9255-PAK: Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department. Indus River Basin Plan, 8 November 2021.

Asian Development Bank (2021). CDTA 9255-PAK: Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department. Integrated Water Resources Management (IWRM) Framework and Implementation Road Map, 8 November 2021.

Asian Development Bank (2021). CDTA 9255-PAK: Institutional Transformation of the Punjab Irrigation Department to a Water Resources Department. Punjab Groundwater Management Plan, 12 November 2021.

Appendix A: Vision 2050: Water Supply Sanitation and Hygiene (WASH)

Vision Statement and Roadmap Framework

Punjab's Drinking Water Policy (2009) shows a vision statement as "provision of safe drinking water of an adequate quantity at an affordable cost through equitable, efficient and sustainable services to all citizens by 2020. The policy intends to cover the drinking water. Although strongly linked with the domestic water supply, but the sanitation and water borne diseases related issues were not properly covered. Punjab, however, has taken up those issues under implementation of SDG 6. In view of above facts, the Punjab's water supply and sanitation vision can be defined as "Water of adequate quantity and acceptable quality is available for all for drinking and sanitation and safe disposal of wastewater is ensured". This vision statement can be used with modifications for water as a whole "Adequate and good quality water is available for all uses and users and safe disposal of marginal quality water is ensured".

To translate the vision into reality, following roadmap framework is suggested.

1. Reduce Water Demand

- Reduce unaccounted water from 30% to 10%.
- Reduce the water demand from 75 gpcd to 45 gpcd

2. Manage Water Supply and Hazards and Provision of Latrines

- Treat and recycle all the sewage water, which is assessed as about 90% of the water supply.
- Provision of proper latrines for all.
- Protect all source of water and manage them before they become hazardous.
- Regulate groundwater and supplement it with surface water when feasible

3. Implement Appropriate Water Pricing

- Value the water as resource introduce the resource cost.
- Recover full cost of the services delivery.

4. Conducive Policy and Institutions

- Policy for equitable access to water and addressing all kinds of disparities in accessing safe drinking water.
- Prioritize allocation of water for drinking purposes over other uses, like agriculture, industry, etc.

5. Capacity building

- Launch water campaign
- Organize community-based organizations to manage the community level water.
- Develop regulatory and legal framework when applicable
- Develop proper management tools, guidelines and manual of best practices and trained the staff, community organizations and end users.

6. Monitoring, Evaluation and Coordination

- Develop monitoring and quantifiable key indicators preferably following pattern of SDGs.
- Monitor the progress on each indicator.
- Evaluate and provide feedback for improved plan and design.

Table A1: Investment Plan to Implement Vision 2050 for Water Sanitation and Hygiene

TASKS	MAIN COST ITEMS	TENTATIVE COST
REDUCE WATER DEMAND	<ul style="list-style-type: none"> Regulate flow as per demand Upgrade infrastructure to ensure water availability in peak hours Introduce/enforce water saving practices 	<ul style="list-style-type: none"> Covered under capacity building \$1.0 billion Covered under capacity building and policy
MANAGE WATER SUPPLY AND HAZARDS AND PROVISION OF LATRINES	<ul style="list-style-type: none"> Replacement of outdated and damaged infrastructure (pipelines and associated fixtures) Ensure water quality standards (laboratories upgrade and empowerment) Recycle the entire sewage gradually Enforce provision of Latrines in all houses (Public & Private) 	<ul style="list-style-type: none"> \$1.5 billion \$50.0 million \$2.0 billion \$ 500.0 million
INTRODUCE APPROPRIATE WATER PRICING	<ul style="list-style-type: none"> Reduce unaccounted flow (pricing every unit of water) Agree on water pricing per unit of water use (price of supply and resource) Introduce smart metering. 	<ul style="list-style-type: none"> \$50.0 million Covered under policy \$200.0 million
CONDUCTIVE POLICY AND INSTITUTIONS	<ul style="list-style-type: none"> Integrating the actions under different provisions and policies Conduct need assessment and fill in the required expertise positions Capacity building of the institutions 	<ul style="list-style-type: none"> Non-cost item \$5.0 million Covered under capacity building
CAPACITY BUILDING	<ul style="list-style-type: none"> Upgrading laboratories and equipment and training of staff and end users 	<ul style="list-style-type: none"> \$100.0 million
MONITORING, EVALUATION AND COORDINATION	<ul style="list-style-type: none"> Cross-departmental coordination unit (IWRM!!!) Monitoring of resource and resource use Evaluation, planning and implementation 	<ul style="list-style-type: none"> Non-cost or low-cost item \$10.0 million \$2.0 million
TOTAL		\$5.417 billion say \$5.5 billion (on an average \$183 million a year)

TABLE NOTES:

(I) THIS INVESTMENT PLAN (IP) IS BASED ON AND PROJECTED FROM PUNJAB SECTOR DEVELOPMENT PLAN 2014-2024 FOR DRINKING WATER, SANITATION AND HYGIENE.

TASKS	MAIN COST ITEMS	TENTATIVE COST
(II) THIS IP COVERS THE LOCAL GOVERNMENT & COMMUNITY DEVELOPMENT (LG&CD) DEPARTMENT, HOUSING, URBAN DEVELOPMENT & PUBLIC HEALTH DEPARTMENT AND WATER AND SANITATION AGENCIES (WASAS) IN FIVE MAJOR CITIES OF LAHORE, FAISALABAD, RAWALPINDI, MULTAN AND GUJRANWALA.		
(III) PUNJAB PLANNED AND ACTUAL SPENDING FOR YEAR 2017-2018 WERE EQUIVALENT \$593 MILLION AND \$386 MILLION, RESPECTIVELY, INCLUDING DEVELOPMENT AND NON-DEVELOPMENT EXPENSES		

**local people
global experience**

SMEC is recognised for providing technical excellence and consultancy expertise in urban, infrastructure and management advisory. From concept to completion, our core service offering covers the life-cycle of a project and maximises value to our clients and communities. We align global expertise with local knowledge and state-of-the-art processes and systems to deliver innovative solutions to a range of industry sectors.