



USPCAS-W
Mehran University



National Research Agenda on Water 2016-25



Pakistan Council of Research in Water Resources (PCRWR)
US-Pakistan Center for Advanced Studies in Water (USPCAS-W)
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National Research Agenda on Water 2016-25

**Pakistan Council of Research in Water Resources (PCRWR)
US-Pakistan Center for Advanced Studies in Water (USPCAS-W)**

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Foreword

We would like to present, with great pleasure, “The National Research Agenda on Water 2016-25”. This document is first of its kind and an initiative on national scale, to define the direction of research in water sector for Pakistan. On global scale, government has committed to Sustainable Development goals 2030; agenda for sustainable development. Likewise, Government of Pakistan has laid out “Pakistan's Vision 2025” for national development. Both of these commitments engulf bringing improvements in human life and wellbeing of the society.

Water is a fundamental element to sustain life on the planet earth. This resource is precious and there is no substitute for it. Infact scientists, researchers, planners, national and international agencies have served their best to protect, and prevent this vital resource. In Pakistan as well, scientists and researchers from industry, academia, public and private sector institutions, and international development support agencies have been producing quality knowledge and techniques for enhancing water availability and its better use. Increase in population, urbanization, industrial and agricultural activities and associated climate change impacts have brought this resource under great stress. Considering these current and future challenges, it is the responsibility of the researchers and scientific community to undertake an assessment of national research, information and capacity needs.

In this regard, Pakistan Council of Research in Water Resources (PCRWR) and US-Pakistan Centre for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology initiated a national level consultation process in January 2015 for developing “National Research Agenda on Water 2016-2025”. This agenda was finalized on 23-24th May, 2016 during final consultation meeting held in Islamabad with the financial support of Higher Education Commission of Pakistan. The “National Research Agenda on Water 2016-2025” is developed around carefully

outlined five thematic areas of research in water resources. This research agenda has not only identified key priority areas of research but also contain sufficient way forward for policy makers to mould future policies in water sector. This document has also synthesized knowledge, capacity and policy gaps in country's water sector which if addressed will result in a water secure Pakistan. This national agenda has also segregated critical issues in water sector alongwith immediate actions needed for their solution.

We hope that this document will serve as guidelines for the research institutions. We appreciate the contribution of the scientists, researchers and professionals who have participated in these consultations. We are thankful to the Dr. Muhammad Aslam Chaudhary and Dr. Tariq Banuri from the University of Utah for their help in shaping this research agenda. Moreover, we are also thankful to Mr. Fazal Abbas Maken, Secretary Ministry of Science and Technology for his continued support in the development of this important document.

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EXECUTIVE SUMMARY

Pakistan is heading towards becoming a water scarce country as per capita water availability has sharply declined from 5000 m³ in 1950 to about 1000 m³ in 2015, primarily because of non-development of new water resources, population growth and resultant socio-economic developments. Given the complexities of water challenges confronting the country, a more informed and coordinated priority setting is needed towards sustainable problems solving. Therefore, developing a National Research Agenda was deemed essential particularly in the backdrop of a non-existent national water policy, multitude of overlapping R&D works being done by different organizations, persistently unresolved technical issues, etc. The draft National Water Policy (Section 20.1) also stresses for development of a National Research Agenda on Water to act as a blueprint for national action plan.

In the light of above, PCRWR in year 2015 started a country level consultation process towards developing a “National Research Agenda on Water 2016-2025” with the main objectives of; identification of priority research areas; setting goals for each area in the short, medium and long term perspective; and developing line of action to achieve the set goals by respective institutions. The major partners besides PCRWR were US-Pakistan Center for Advances Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Higher Education Commission and Riphah International University whereas all other national and provincial R&D organizations, development institutes and academia were involved in the consultation process. The research agenda developed as an outcome of the entire consultation process will help the country in: (i) meeting its commitments towards SDGs in general and SDG-6 (Water) in particular, (ii) realizing the goals spelled out in Pakistan Vision 2025, and (iii) addressing key water sector challenges.

Five research themes evolved during the continuous consultation process are:

Theme 1: Optimizing water resources planning and management;

Theme 2: Increasing water productivity in agriculture sector;

Theme 3: Improving water quality;

Theme 4: Responding to climate change; and

Theme 5: Strengthening water governance.

In addition to theme-specific research issues, due attention was given to cross cutting issues such as: financing, applications of science and technology, gender, tools and models, capacity building, monitoring, climate change and scaling up of best practices. As a result of all the consultation and discussions, the researchable areas have been prioritized along with the needs and responsible institutional engagements, wherein the linkages with Vision 2025 and SDGs 2030 have also been aligned.

Acronyms

ACIAR	Australian Center for International Agricultural Research
BARI	Barani Area Research Institute
CEWRE	Center of Excellence in Water Resources Engineering
CPNC	China National Petroleum Company
DALY's	Disability Adjusted Life Years
EPD's	Environmental Protection Departments
ERRA	Earthquake rehabilitation & Reconstruction Authority
FAOSTAT	Food and Agriculture Organization's Statistics
GCISC	Global Change Impact Studies Center
GDP	Gross Domestic Progress
HEC	Higher Education Commission
IRSA	Indus River System Authority
IWMI	International Water Management Institute
ICARDA	International Center for Agricultural Research in Dry Areas
ICIMOD	International Center for Integrated Mountain Development
IUCN	International Union for Conservation of Nature
IT	Information Technology
LIDAR	Light Detection and Ranging
MAF	Million Acre Feet
MoCC	Ministry of Climate Change
M/o FS&R	Ministry of Food Security and Research
MUET	Mehran University of Engineering and Technology
NDWP	National Drinking Water Policy
NDC	National Development Complex
NESPAK	National Engineering Services Pakistan
NGO's	Non-government organizations
NIO	National Institute of Oceanography
NUST	National University of Science and Technology

NRSP	National Rural Support Programme
OFWM	On Farm Water Management
PARC	Pakistan Agricultural Research Council
PCRWR	Pakistan Council of Research in Water Resources
PHED	Public Health Engineering Department
PID's	Provincial Irrigation Departments
PINSTECH	Pakistan Institute of Nuclear Science and Technology
PMD	Pakistan Meteorology Departments
RIU	Riphah International University
RS/GIS	Remote Sensing/ Geographic Information System
TAC	Technical Advisory Committee
SACAN	South Asian Network for Conservation Agriculture
SDG	Sustainable Development Goals
SMEC-ECG	SMEC-Engineering General Consultants
SUPARCO	Space and Upper Atmosphere Research Commission
TPPL	Total Parco Pakistan Limited
UAF	University of Agriculture, Faisalabad
UET	University of Engineering and Technology
UNICEF	United Nations Children's Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN	United Nations
USA	United States of America
USPCASW	United States-Pakistan Center for Advance Studies in Water
WASA's	Water and Sanitation Authorities
WAPDA	Water and Power Development Authority
WWF	World Wildlife Fund

1. Rationale

Water plays a pivotal role in every sector of the national economy but water sector itself is facing severe quantitative and qualitative issues that are becoming complex day by day. These issues need to be addressed on war footing through research to clearly identify and determine the root causes and recommending appropriate and practical solutions. In Pakistan, the issues faced by the water sector are multi-facet and therefore, require concerted efforts along with strong leadership commitment through stakeholders' involvement towards sustainable solutions.

Developing research priorities in the water sector, like in any other sector, is more than a matter of summing up the priorities of various institutions and stakeholders involved in dealing with different aspects of water resources planning, development, management, and service delivery. Simple reason is that each institution has its own agenda directed by its mandate and mission. However, in addition to being flexible and adaptable to emerging issues and challenges, the research agenda must support efforts aimed at realizing the Sustainable Development Goals (SDGs) which are further in conformity with the Pakistan's Vision 2025 (GOP, 2012). Drawing distinction between long and short-term priorities is therefore, important to achieve the objectives of such commitments.

Given the complexities of water challenges confronting Pakistan, a more informed and coordinated priority setting process is needed, such as organizing an expert and stakeholder consultation. With the advent of the 21st Century, different groups think differently but with almost similar objectives about the challenges of water resource management and development in the coming decades, and about the role of science in addressing those challenges.

In the light of above, PCRWR in year 2015 started a country level consultation process towards developing a “National Research Agenda on Water 2016-2025” with the main objectives of; identification of priority

research areas; setting goals for each area in the short, medium and long term perspective; and developing line of action to achieve the set goals for respective institutions. The major partners in the lead role besides Pakistan Council of Research in Water Resources (PCRWR) were US-Pakistan Center for Advances Studies in Water, University of Engineering and Technology, Jamshoro, Higher Education Commission and Riphah International University whereas all other national and provincial R&D organizations, development institutes and academia were also involved in the consultation process. The first consultation workshop was held at Islamabad on 20th January 2015 followed by at Lahore on 20th May 2015; and finally at Islamabad on 23-24 May 2016. The research agenda was also discussed and necessary recommendations were made by the Technical Advisory Committee of PCRWR on 30th September, 2015. The research agenda developed as an outcome of the entire consultation process will help Pakistan in: (i) meeting its commitments towards SDGs in general and SDG-6 (Water) in particular, (ii) realizing the goals spelled out in Pakistan Vision 2025, and (iii) addressing key water sector challenges summarized in the next section.

2. Water Resources – Situation Analysis

Freshwater resources of the country have been estimated as 176 million acre foot (MAF), hence the per capita water availability became around 1,000 m³ based on current population. Direct correlation of freshwater availability and per capita exists even for non-agriculture based economies as the former ensures sanitation, hygiene and health which in turn serve as fuel for economic activities. According to Falkenmark et al. (1992), a country is termed as water scarce when water shortage hampers health and well-being of the people for which the threshold limit is 1000 m³/capita/annum and Pakistan has almost approached that. It may therefore, be categorized as water insecure, which has been defined as, “capacity of a population to safeguard access to adequate quantities of water of acceptable quality for

sustaining human and ecosystem health on a watershed basis, and to ensure efficient protection of life and property against water related hazards – floods, landslides, land subsidence and droughts” (UNESCO, 2012).

Pakistan has the fourth largest irrigated area of the world (19.49 Mha) after India (60.85 Mha), China (57.78 Mha) and USA (22.39 Mha) and the largest contiguous irrigation system. The country being 27th largest economy of the world, has declining contribution of agriculture to the national GDP as 23%, which was 53% at the time of independence. Though agriculture's contribution to national GDP is diminishing due to number of reasons yet it remains to be its mainstay, employing more than 45% of its population. Similarly, it is one of the largest producers of buffalo milk (2nd), chickpeas (3rd), apricot (3rd), cotton seed (3rd), onions (4th), dates (5th), sugarcane (5th), mangoes (6th), wheat (10th), rice (11th) etc. (FAOSTAT, 2008). In contrast, about 60% of the Pakistani population has been categorized as food insecure. Food security is defined as “when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life” (FAO, 1996). The underlying reasons for food insecurity are social disparities and low water productivity (kg/m³ of water applied), in fact one of the lowest in the world. For instance in irrigated areas, the water productivity of rice is 55% below Asian average and for wheat 24% below World average. The situation of rainfed areas is even worse. The food insecure population however, has been envisaged to be reduced to 30% as per Pakistan Vision – 2025.

The main factor behind worsening water availability and food security situation in the country is exponential population growth. In addition, climate change is causing recurrence of extreme events, by which frequent flooding and droughts are confronted. This is mainly due to inadequate storage facilities. The water storage capacity is just for 30 days of river inflows (9% of the average annual flow against 40% of world's average).

The Pakistan Vision-2025 envisages a target of 90 days of storage by 2025. Moreover, storage capacity of existing reservoirs is reducing due to sedimentation at a rate of 0.2 MAF/annum. In the backdrop of low water availability, the country should be having an efficient irrigation system which consumes more than 90% of water. However, the irrigation efficiency is below 40% and over 60% irrigation water is lost during conveyance and application in the field. The Pakistan Vision 2025 envisages to improve efficiency of uses in agriculture by 20%. Other constraints include lack of centralized water resources database as it leads to inappropriate policy and agenda formulations at the national level.

Waterlogging, salinity, brackish groundwater and seawater intrusion are the major constraints in the Lower Indus Plain. Large generation of wastewater and non-implementation of environmental protection laws lead to its unsafe disposal. The wastewater irrigation and indiscriminate pumpage result in surface and groundwater deterioration and depletion. In turn, it gives rise to water-borne and water-related diseases like cholera, typhoid, fever, dysentery infectious hepatitis, *etc.* which gives an annual blow of Rs.112 billion to national exchequer, besides loss of national DALYs (disability adjusted life years) and life expectancy rate (NDWP, 2012). Presently, 65% of the population has access to improved drinking water supplies, whereas Pakistan Vision 2025 envisages increasing this access to all citizens. However, it is a gigantic task as “Safe” means that complying with National Drinking Water Quality Standards and “Access” means supply of 45 - 120 liters per day (NDWP, 2012).

Safe drinking water quality therefore, has become a serious problem due to outdated infrastructure of water supply schemes, breakage in distribution system, inadequate technical capacity of water supply agencies, lack of awareness on quality issues, improper disposal of municipal, industrial and hospital solid waste and wastewater. The national level water quality monitoring carried out by PCRWR in 24 major cities have revealed that the access to safe drinking water in urban areas is only 15% and in rural areas is

18%. These studies have also identified the four major water quality contaminants in drinking water sources of Pakistan i.e. bacteriological contamination (68%), arsenic (24%), nitrate (13%) and fluoride (5%). The excessive use of pesticides, insecticides and herbicides, unprotected water sources and intermittent water supply are aggravating the situation. The water shortage and increasing competition for multiple uses are other factors which have adversely affected the quality and availability of water.

3. Water Sector Issues and Challenges: Synthesis

- I. Pakistan is heading towards becoming a water-scarce country as per capita water availability has sharply declined (reduced from 5000 m³ in 1950 to about 1000 m³ in 2015), primarily because of inadequate storage and population growth
- ii. Infrastructure efficiency has reduced considerably due to poor operation and maintenance, while harvesting and storage facilities are increasingly becoming deficient
- iii. Groundwater resources are depleting in all freshwater zones, and uncontrolled mining of the resource continues
- iv. Water quality of both surface and ground water is deteriorating due to increased pollutants load, and the increased number of people living in areas with high risk of water pollution
- v. Agricultural land and water productivity is one of the lowest in the world because of low irrigation water use efficiency and poor water management practices
- vi. Majority of population do not have access to safe drinking water and sustainable sanitation services
- vii. Data on water quantities and qualities across different scales in Pakistan is both scattered and lacking, in addition to being poorly synthesized for use in decision and policy making
- viii. Water logging and salinity have already affected around 4.4 million

hectares of agricultural land, and this trend continues to worsen

- ix. Both the irrigation and drinking water systems are marked with several inequities
- x. Water remains highly undervalued and readily used without much concern for its value to others
- xi. Institutional responsibilities for regulating water management and service delivery are scattered through plethora of institutions both at federal and provincial levels with very little coordination, if any
- xii. Informed decision making is constrained by evidence-based analysis and information. Finally, in the absence of a national water policy, the things are getting from bad to the worst

4. Objectives

The main purpose to develop the water sector research agenda was to contribute towards addressing issues and challenges mentioned above, realizing the goals spelled out in Pakistan Vision 2025, as well as the targets established under the water related SDGs. Therefore, the research agenda addresses the following specific objectives;

- To draw attention of the public and policy makers to the urgency of key water sector issues and challenges which must be researched upon without further delay;
- To synthesize the knowledge, capacity and policy gaps with regard to each research area/issue;
- To prioritize key thematic areas and corresponding research issues to be examined under these areas in short-and long-run, including delineation of institutional responsibilities.

5. Methodology

PCRWR being the national apex organization of the country took up the initiative to develop a national research agenda on water. PCRWR developed a draft document in 2015 demarcating the water research needs of the country for the next decade. The agenda document was based upon the goals set up by the Government of Pakistan in the Vision-2025 (Annexure-A) and UN Sustainable Development Goals-2030 (Annexure-B).



Moreover, all the national approved policies like National Drinking Water Policy 2009, National Climate Change Policy 2012 etc. were consulted. The draft National Water Policy (Section 20.1) was also reviewed.



Group Discussion of National Consultative Workshop at Islamabad



Participants of the Final National Consultative Workshop at HEC, Islamabad

It was therefore deemed essential to build up a national consensus and consultations before being launched at the national level. For this purpose, the national consultation process was started in the form of Regional and National Consultative Workshops of the water experts and stakeholder organizations. The 1st Consultative workshop was held at PCRWR Headquarters, Islamabad on 20th January 2015, following by a Regional Workshop at Lahore on 20th May 2015. The same document was also reviewed by PCRWR Technical Advisory Committee (TAC), comprising eminent professionals across the country, in its meeting held on 30th September 2015. The document was updated in the light of discussions held and suggestions made in all those workshops. During the TAC meeting, it was decided that PCRWR, MUET and HEC will further work on it before finalization.

The final Consultative Workshop was therefore, held from 23-24 May 2016 at Higher Education Commission, Islamabad, involving national and international experts. The consultative workshop consisted of two plenary sessions (opening and closing), and parallel consultations in small groups organized under five different themes identified through earlier

consultations. Each group was consisting of 10-15 experts, and its discussions were facilitated by a competent moderator. For each theme, a background paper was also prepared to facilitate the interactive dialogue. Accordingly, thematic groups' discussions were structured to find answers to the following questions.

- i. What is the baseline situation with regard to issues, challenges, and opportunities under each theme?
- ii. What are the knowledge, capacity, policy and technological gaps under each thematic area?
- iii. What should be the research priorities in the short- and long-term? Here the intention is not to develop a long generic list, but to identify research areas with significant multiplier effects.
- iv. What governance arrangements in the form of policies, institutions, and monitoring needs to be put in place to realize the prioritized research agenda?
- v. What factors can influence transition towards innovative applied policy research and its accelerated implementation?
- vi. What role private sector, civil society and women can play in advancing the implementation of water research agenda?



The participants of PCRWR Technical Advisory Committee



Meeting of Technical Advisory Committee at Islamabad



2nd Consultative Workshop at Lahore



Participants of 2nd Consultative Workshop at Lahore



Participants of 1st Consultative Meeting at Islamabad

6. Research Themes

It was well understood that the proposed research agenda might have been influenced by the expertise and experience of those engaged in this process. For example, priority list from hydrologists would focus on hydrological processes, priority list by environmentalists would aim at securing integrity of ecosystems, and priority lists by economists would emphasize issues related to efficiency and sustainability etc. However, such subject-specific research perspectives might fail to take into account linkages across different economic sectors. This often leads to missed opportunities for integrating environmental, engineering and social implications of a particular issue being studied. A more reasonable approach therefore, was to identify and understand research issues within the context of a broader narrative such as water-development and -management nexus. This narrative is also supported by the internationally agreed Sustainable Development Goals framework. Against this background, proposed expert consultations was organized around the following five research themes evolved during the continuous consultation process.

- *Theme 1: Optimizing water resources planning and management:*

This theme includes: resource assessment and management, groundwater, balancing water supply and demands, allocation among different uses, storage issues, integrated modeling from policy perspective, conflict management etc. This directly relates to the Goal 6 of the Sustainable Development Goals (SDGs) which says “Ensure availability and sustainable management of water and sanitation for all”

- *Theme 2: Increasing water productivity in agriculture sector:*

This theme includes: irrigation system and constraints, agricultural water-use efficiency, irrigation technologies, barriers to technological adaptation, farming system practices for enhancing water productivity, agricultural pricing structures, incentives, integrated land and water management, waterlogging and reclaiming irrigated lands, etc. This is a great challenge on which most of the research in 21st century has been focused and comes

under the SDG 2 i.e. “End hunger, achieve food security and improve nutrition and promote sustainable agriculture”.

- *Theme 3: Improving water quality:*

Major area under this theme include: population growth and urbanization, wastewater management, seawater intrusion, industrial discharges, impact of farming practices, climate change effects, water borne pathogens, water-health nexus, drinking water security, efficiency of water transport and distribution systems, low cost water supply and treatment systems, protection of water sources, wastewater reuse, disinfection and advanced oxidation processes, efficiency of water utilities/service providers, improvements in regulations and standards, actual or potential human health effects etc. This area of research has been emphasized in the SDG 3 which states, “Ensure healthy lives and promote well-being for all at all ages” and the SDG 1 which says “End poverty in all its forms everywhere”.

- *Theme 4: Responding to climate change:*

It includes: vulnerability assessments, possible climate resilient regimes, watershed management, technological options for adaptation, geo-informatics applications and models, analysis of threshold limits and impacts, and feasibility analysis of adaptation strategies etc. The SDG 13 directly relates to this research area i.e. “Take urgent actions to combat climate change and its impacts”.

- *Theme 5: Strengthening water governance:*

This is a cross-cutting theme and may include: water policy, water diplomacy, water rights, water pricing, institutional development and coordination, capacity building, stakeholders' engagement, water sector monitoring, technology transfer and knowledge sharing etc. Water governance is mandatory for its sustainable management and is linked to the SDG 6 as narrated above and indirectly under SDG 15, “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt bio diversity loss”.

In addition to theme-specific research issues outlined above, due attention was given to cross cutting issues such as: financing, applications of science and technology, gender, tools and models, capacity building, monitoring, and scaling up of best practices. As a result of all the consultation and discussions, the areas prioritized along with the needs and institutional engagements are listed in Table-1 wherein the linkages with Vision 2025 and SDGs have also been aligned.

Table 1: Priority Areas with Objectives, Identified Projects, Needs and Linkages with Vision 2025 and SDGs

Theme 1: Optimizing water resources planning and management

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Determining climatic, trans-boundary and water rights implications in the national water flow balance and future projections	<ul style="list-style-type: none"> • Resource assessment and management • Water supply and demands for different uses • Integrated modeling from policy perspective • Conflict management etc. • Spatial variation in water demand and supply 	<ul style="list-style-type: none"> • Characterizing the impact of snow and glacial hydrology on water resources • Forecasting runoff resulting from snow covered area, through remote sensing and ground observations • Changing glaciers pattern in the upper Indus basin in response to climate change and its implications • Improving flow forecast in the Indus river 	<ul style="list-style-type: none"> • Trans-boundary inflow data • Rivers and canal flow data • Reservoir level data, number of storages and their capacity • Number of on-going storage, canal projects and their capacity • Meteorological Data 	<ul style="list-style-type: none"> • National database for surface water and groundwater • Transfer of technology on the prospects of climate change assessment on future water flows 	Ministry of Climate Change, PMD, PCRWR, WAPDA, PARC, Universities, NESPAK.	Climate change target i	Goal 6

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Intra and Inter-Basin Storage/ Transfer of water projects	<ul style="list-style-type: none"> • Economical options for flood water • Environmental flow requirements • Social and economical implications 	<ul style="list-style-type: none"> • Evaluating diversion and storage options for flood waters • Evaluating the environmental flow requirements and ecosystem needs for different water bodies • Evaluating the social and economic implications of linking or separating water and land rights • Assessment of current flow measurement techniques and further studies to improve flow measurement at barrages and canal head works 	<ul style="list-style-type: none"> • Flood and meteorological data • Hydro-geological data • Potential for development and use of diverted flood water 	Training of human resource on suitable modeling tools for flood management	Irrigation departments, WAPDA, PMD, FFC, PCRWR, Universities	Water target i	Goal 6

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Developing and Managing Groundwater Resources	<ul style="list-style-type: none"> • Groundwater depletion in quantity and quality • Lack of suitable recharge techniques 	<ul style="list-style-type: none"> • Delineation of groundwater aquifers and water balance studies • Identification areas under severe stress for groundwater depletion • Understanding surface-groundwater interaction and its implications on irrigation and drinking water quality. • Identification of areas for groundwater recharge • Developing mechanisms to control groundwater abstractions • Rooftop rainwater harvesting in urban areas • Evaluating rainwater 	Water table depths and water quality data, Aquifer properties, Recharging zones data Satellite data	Institutional capacity building in latest techniques especially remote sensing and satellite hydrology	PCRWR, Irrigation Departments, Local Governments, Universities, NGOs	Water target iv	Goal 6

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		harvesting potential and their impact on soil moisture, groundwater recharge and downstream water rights <ul style="list-style-type: none"> • Exploring the potential of hill torrents and its effective utilization • Assessment of useful life of small and medium dams, • Exploring water options for large cities besides the Indus water 					
Enabling environment for implementing water related research agenda	Lack of centralized data resources for water resources planning	<ul style="list-style-type: none"> • Development of a database for national and provincial organizations working in the water sector • Developing a repository for sharing hydrologic and climatologic data 	Water related data (hydrologic, climatologic, soil, etc.)	<ul style="list-style-type: none"> • Development of information and management system (hardware and software) • Training of human resources 	PCRWR, WAPDA, PMD, PARC, Irrigation Departments, Universities, NGOs	Water target iv	Goal 6

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		<ul style="list-style-type: none"> • Exploring innovative ways to finance water infrastructure projects • Capacity building of the water-related institutions 					
Improving water use efficiency and crop productivity (irrigated, non-irrigated areas)	<ul style="list-style-type: none"> • Low agricultural water use efficiency 	<ul style="list-style-type: none"> • Reducing losses in water channels to have better water conveyance efficiency • Improving application efficiency of irrigation water at field level • Adoption of High efficiency irrigation systems 	Cropping intensity of various irrigated districts, Agricultural statistics, Annual canal flows, GIS-based crop data	<ul style="list-style-type: none"> • Strengthening and capacity building of Area Water Boards and FO's. • Transfer of innovative and cost effective cultivation techniques • Developments of tools to support high efficiency irrigation • Optimization of renewable resources use in agriculture 	PCRWR, PARC, M/o FS&R, Provincial Irrigation Department, Provincial Agricultural departments, Universities of Agriculture	Water target ii	Goal 2 & Goal 6

Theme 2: Increasing water productivity in agriculture sector

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Strengthening research, extension and adaptation mechanisms	<ul style="list-style-type: none"> Barriers to technological adaptational 	<ul style="list-style-type: none"> Accelerating adaptation and promotion of promising water management practices at the field level Review and assessment of agro-climatic zones and cropping patterns 	Documentation of data generated by Farmer's field experiences	<ul style="list-style-type: none"> Training of Extension workers and farmers Farmer-Researcher-Extension interactive workshops A separate Radio and TV channel for Farmer's support An integrated communication network for farmers 	PCRWR, PARC, M/o FS&R, Provincial Irrigation Department, Provincial Agricultural departments, Universities of Agriculture	Water target ii	Goal 2 & Goal 6
Controlling waterlogging and salinity to maximize crop productivity of affected lands	<ul style="list-style-type: none"> Water logging and salinity etc. 	<ul style="list-style-type: none"> Promotion of on-farm drainage systems and re-use of drainage effluent Rationalizing the irrigation practices to minimize drainage requirements 	Mapping of Natural and anthropogenic water-logging and Salinity	<ul style="list-style-type: none"> Demonstration of land reclamation practices to farmers Promotion of saline agriculture Development of tillage tools 	PCRWR, PARC, M/o FS&R, Provincial Irrigation Department, Provincial Agricultural departments, Universities of Agriculture	Water target ii	Goal 2 & Goal 6

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
				specific to waterlogged and saline areas • Introduction of salt tolerant cash crops to farmers			
Creating an enabling environment for implementing water-related research agenda at national, provincial and local levels.	• Water pricing	• Strengthening the existing extension services covering water component	Cost and benefits for adaptive agricultural practices for famers and researchers alike	• Development of corporate agriculture model • Conceptualization of virtual water trade for farmers and researchers alike	M/o FS&R, Provincial Irrigation Department, Provincial Agricultural departments, Universities of Agriculture	Water target iv	Goal 2 & Goal 6
• Improving drinking water quality etc. • For remote areas: a) access to water (short term)	• High risk contaminants • Lack of strategies and implementation for safe drinking water	• Review of existing national water quality standards/laws to identify the gaps and formulation of guidelines to make tap water as safe drinking water • Development of	All policy documents related to water quality standards, international water quality standards, policies, groundwater	• Capacity building on water policy and law • Higher education on water policy and law	PCRWR, M/o Climate Change, RIU, Provincial WASAs and Local Government, PHEDs, Irrigation departments, Health practitioners,	Water Target iv, v, vi.	Goal 6.1, Goal 6.2

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
b) access to improved water supplies (medium term) c) access to safe drinking water (long term)		Groundwater Regulations for drinking purpose <ul style="list-style-type: none"> • Development of standards for surface water quality 	level and quality data				

Theme 3: Improving water quality

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Monitoring and improving groundwater quality	<ul style="list-style-type: none"> • High risk contaminants • Lack of strategies and implementation for safe drinking water 	<ul style="list-style-type: none"> • Investigation of source • Mobilization and spatial/ temporal behavior of high risk contaminants • Prospectus of artificial groundwater recharge through rainwater harvesting especially urban areas • A comprehensive study on Seawater intrusion 	<ul style="list-style-type: none"> • Population Census • Aquifer monitoring data (pre and post monsoon), data of precipitation rates/ forecast • Ten daily discharge downstream Kotri, • Sea level rise, bathymetric studies information. 	<ul style="list-style-type: none"> • Lab equipment for identifications of high risk contaminants. • Capacity building and training of water quality experts • Technological alignment of key partners involved • Sharing of knowledge and transfer of technology. 	PCRWR,PIDs, WAPDA, , SUPARCO, MUET, NIO, PINSTECH, local governments	Water targets iii to vi.	Goal 6.1, Goal 6.3, Goal 6.6.
Reducing water pollution by adopting economical wastewater treatment,	<ul style="list-style-type: none"> • Lack of surveillance system for water bodies • Lack of wastewater treatment 	<ul style="list-style-type: none"> • Assessment and characterization of Country-wide Wastewater Management and Development of Strategic National 	<ul style="list-style-type: none"> • Industrial pollutant data load, industrial characterization (quantity, quality 	<ul style="list-style-type: none"> • Mobile quality testing lab for industrial site investigation. • Hazard database development 	Provincial EPD's, Industrial Associations, PARC, PCRWR, local governments	Water target v and vi.	Goal 6.3, Goal 6.6, Goal 6.a.

Research Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
including through strict enforcement of regulations.	systems <ul style="list-style-type: none"> • Lack of low cost technology of wastewater treatment transfer of technology • Lack of knowledge about wastewater reuse 	Action Plan <ul style="list-style-type: none"> • Cost effective, indigenous/innovative methods for wastewater treatment • Evaluation of trans-boundary (international, national) impacts on water quality 	treatments) primary treatments (if existing). <ul style="list-style-type: none"> • Industrial water effluent standards, • Aquifer properties • Recharging zones data 	for industrial pollutants. <ul style="list-style-type: none"> • Environmental engineers/ water quality experts/agricultural engineers. 			
Creating an enabling environment for implementing water resources research agenda at national, provincial and local levels.	<ul style="list-style-type: none"> • Lack of capacity to implement R&D programs • Lack of databases/information management systems 	<ul style="list-style-type: none"> • Mass awareness through educational institutions (school, collage, university level) • Invoking public awareness social, print and electronic media • Establishing academia-industry-research institution linkages 	Contemporary information.	Teachers/ Instructors (Kindergarten to university level). Data warehouse, web development.	PCRWR, MUET, RIU, M/o Water and Power, Ministry of Climate Change, Ministry of Health Regulations, HEC.	Water target iii and v.	Goal 6.5, Goal 6.a, Goal 6.b

Theme 4: Responding to climate change

Research Objectives	Key Issues	Identification of 1-2 Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Developing adaptation strategies and mechanisms	<ul style="list-style-type: none"> Assessment of climate change impacts Vulnerability assessments Climate change affects Adaptation strategies Watershed management programmes Increase of water requirements due to population increase 	<ul style="list-style-type: none"> Synthesis of existing knowledge and to identify gaps relating to climate change assessment Assessment of impact of climate change scenarios on major crops/livestock Development of predictive tools for quantitative assessment of extreme events and Synthesis of best practices as an adoption strategy Determination of climate change effects on water availability, quality, flow pattern and extreme events Adoption of best practices/strategies in various 	<ul style="list-style-type: none"> Data on climate, crop data, livestock, Hydro-meteorological data Data on future water requirements for all sectors 	<ul style="list-style-type: none"> Numerical modeling Remote sensing expertise Numerical Modeling, m calibration and validation of remote sensing data Hydrological modeling, bathymetry 	PMD, PCRWR, PARC, GCISC, MoCC, WAPDA, NESPAK, SUPARCO, Academia, Provincial Departments, International Collaborators	Climate change target i to iv	Goal 13

Research Objectives	Key Issues	Identification of 1-2 Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		ecologies for the mitigation of climate change					
Mitigating the impacts of drought and floods.	<ul style="list-style-type: none"> • Integrated reservoir operations • Enhancing groundwater storage • Identification /map ping of water resources • Rainwater harvesting ponds • Lack of watershed management resulting into flash floods 	<ul style="list-style-type: none"> • Development of strategy for optimum reservoir operation under changing climatic conditions • Development of national atlas of deserts for land and water resource mapping • Integrated hydro-meteorological monitoring and modeling for droughts & flood forecasting and mitigation • Bathometric survey of the major rivers for reliable numerical modeling • Exploring innovative water use mechanisms under drought 	<ul style="list-style-type: none"> • Reservoir operating procedures, hydro-meteorological data, model prediction/ forecast • Land use/ Land cover, Soil classes, climatic data • Observed data, Remote sensing data & modeling tools RS data 	<ul style="list-style-type: none"> • Satellite altimetry, numerical modeling • Remote sensing/GIS • Numerical modeling • Sonar, LIDAR, Drone 	PCRWR, SUPARCO,PMD, IRSA, PARC, GCISC, MoCC, WAPDA, NESPAK, Academia, Provincial Departments, International Collaborators	Climate change target i to iv	Goal 13, Goal 6.4

Research Objectives	Key Issues	Identification of 1-2 Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		scenarios <ul style="list-style-type: none"> • Identification and development of new reservoirs (small, medium & large) based upon climate change trends • Flood risk mapping at community level for flood mitigation 					
Improving aquatic, soil and livestock resources by increasing carrying capacity of the deserts/rangelands by reliable water supply and fodder.	<ul style="list-style-type: none"> • Burden on existing water resources 	<ul style="list-style-type: none"> • Development and adoption of rainwater harvesting technique to enhance groundwater storage in the urban and arid areas • Impact of reduced area under water for groundwater recharge to reduce the flooding peaks • Assessment of deforestation/afforestation 	<ul style="list-style-type: none"> • Rainwater assessment, watershed delineation, aquifer characteristics • Land use data, water table information • RS data, reports, 	<ul style="list-style-type: none"> • RS, GIS, Watershed Modeling • Groundwater modeling / hydrological modeling using RS/GIS 	PCRWR, PARC, WAPDA, NESPAK, Academia, Provincial Departments, International Collaborators		Goal 6

Research Objectives	Key Issues	Identification of 1-2 Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		<p>promotion of appropriate fruit trees/orchards</p> <ul style="list-style-type: none"> Developing innovative strategies for wetland conservation under changing climate 	case studies				
Creating an enabling environment for implementing water-related research agenda at national, provincial and local levels	<ul style="list-style-type: none"> Capacity development programs Databases/information management systems 	<ul style="list-style-type: none"> Institutional capacity building and development of water resources information system Allocation of specific indigenous type scholarship programs for PhD students Capacity building of vulnerable community Multi-disciplinary group for evaluating impact of climate change on water resources Improving link between research 	<ul style="list-style-type: none"> Water and climate related data sets Flood inundation maps, community level household data 	<ul style="list-style-type: none"> Database/IT Mobile applet development Capacity building of professional, awareness approaches for communities 	PCRWR, WAPDA, PARC, PMD, Ministry of Water and Power, Planning Commission, HEC, MoCC, HEC NESPAK, SUPARCO, Provincial Departments, International Collaborators, Universities,	<p>Water target iii and v.</p> <p>Water target iv</p>	<p>Goal 6.5, Goal 6.a, Goal 6.b</p> <p>Goal 6 (directly) and Goal 15 (indirectly)</p>

Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
		and industry, <ul style="list-style-type: none"> • Public private partnerships • Improve capacity within research institutions to compete for open calls. • Address access to data and unpublished literature. • Correcting incentives that lead to perverse arrest brain drain 					

Theme 5: Strengthening water governance

Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Strengthening main pillars of water sector governance	<ul style="list-style-type: none"> • Lack of institutional analysis • Water policy, rights, allocation • Leakages in the water system and water sector performance 	<ul style="list-style-type: none"> • Research in governance of municipal and industrial water and wastewater • Research in governance of flood institutions – plethora of institutions, coordination and standard operating procedures do not align • Research in governance of irrigation and agriculture – past attempts yielded mix results, coordination between irrigation and agriculture is weak • Research in the relationship between regulation and implementation 	<ul style="list-style-type: none"> • Existing national policies on water, Indus Water Accord 1991, • Indus Water Treaty 1960 	<ul style="list-style-type: none"> • Master's level courses in Universities • Introduction of Water Laws into legal system of Pakistan • Crash courses for employees in water sector institutions 	IRSA, Provincial Irrigation Departments, Ministry of Planning Development and Reforms, Ministry of Water and Power, WAPDA, PCRWR, universities	Water target iv	Goal 6 (directly) and Goal 15 (indirectly)

Objectives	Key Issues	Identification of Priority Projects	Data and Information Needs	Capacity and Technological Needs	Planning and Implementation Partners	Interface with Water Vision (Goals/Targets) ¹	Interface with SDGs ²
Developing groundwater legislation/regulatory framework	<ul style="list-style-type: none"> • Transboundary studies • Groundwater regulatory framework • Enforcement of laws and regulations <p>National drinking water quality database</p>	<ul style="list-style-type: none"> • Design/development of a regulatory framework and legislation. (participatory consultation, literature review) • Enhance knowledge and understanding of groundwater aquifer 	Groundwater quantity and quality data	Capacity building on groundwater modeling tools	Irrigation departments, PCRWR, universities	Water target iv	Goal 6 (directly) and Goal 15 (indirectly)

Annexure A: Pakistan Vision - 2025

Water

- i. Increase water storage capacity, applicable to the requirements of each province, in line with defined strategic needs and international benchmarks: from currently 30 days to 45 days by 2018, and 90 days by 2025.
- ii. Invest in proven methods and technologies to minimize wastage (e.g. in the agricultural sector), promote conservation and gain efficiencies through rationalization of pricing.
- iii. Enable more effective allocation with direct reference to national & provincial priorities and related social and economic considerations.
- iv. Establish institutional mechanisms (e.g. a National Water Commission) to effectively manage all sources of water (surface, subsurface, rain) and their sectoral and regional allocations (agriculture, industry, urban).
- v. Provision of access to a minimum baseline of suitable water to every person in Pakistan.

Food Security

- i. Protect the most food-insecure segments of the population through effective relief measures, including long-term arrangements and adaptation mechanisms.
- ii. Create a modern, efficient and diversified agricultural sector – aligned with associated water and energy infrastructure –that can ensure a stable and adequate provision of basic food supplies for the country's population, and provide high quality products to its industries and for export.
- iii. Optimize production and supply mix in line with current and projected needs by leveraging our unique strengths.

- iv. Ensure that the entire supply-chain related to food security is geared towards provision of stable and affordable access to adequate, nutritious and safe food for a healthy life.
- v. Use the resource base in an efficient and sustainable manner—with outcome-based benchmarks agreed in line with regional and global standards.

Climate Change

- i. Design water, food and energy security policies and plans of the country with specific reference
- ii. to the profound challenges posed by climate change.
- iii. Explicit recognition of the relevant risks (and associated economic and social costs and implementation of well-defined mitigation and adaptation strategies / measures.
- iv. To promote long term sustainability, conservation and protection of natural resources.

Annexure B: Sustainable Development Goals (SDGs.) – the 2030 Agenda for Sustainable Development

Goal 6: Ensure availability and sustainable management of water and sanitation for all

- 6.1:** By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- 6.2:** By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- 6.3:** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- 6.4:** By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- 6.5:** By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- 6.6:** By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- 6.a:** By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- 6.b:** Support and strengthen the participation of local communities in improving water and sanitation management

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- 2.1:** By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round
- 2.2:** By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons
- 2.3:** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
- 2.4:** By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality:
- 2.5:** By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed
- 2.a:** Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock

gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries

- 2.b:** Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round
- 2.c:** Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility

Goal 3. Take urgent action to combat climate change and its impacts

- 13.1:** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- 13.2:** Integrate climate change measures into national policies, strategies and planning
- 13.3:** Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
- 13.a:** Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
- 13.b:** Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

**Annexure-C: List of Professionals, Institutions and Organizations
Involved in the Consultative Workshop on 23rd-24th May, 2016**

Sr. No.	Name/Designation	Organization	Location
1	Syed Mehar Ali Shah, Joint Secretary	M/o Water & Power	Islamabad
2	Mr. Qurban Hussain, Director	PARC	Islamabad
3	Mr. Reza Shah	UNESCO	Islamabad
4	Dr. Talat Qazi	Federal Flood Commission	Islamabad
5	Malik Shahrukh Latif	NESPAK	Lahore
6	Mr. Fazal-ur-Rehman Kashif	NESPAK	Lahore
7	Mr. Usman Tarrar	NESPAK	Lahore
8	Dr. Jamal Khan Khattak, Director	University of Agriculture	Peshawar
9	Dr. Munir Ahmad, Director	NARC	Islamabad
10	Dr. Munawar Kazmi	ACIAR	Islamabad
11	Dr. Muhammad Tariq, Director	BARI	Chakwal
12	Dr. Azmat Hayat, Director	PMD	Islamabad
13	Dr. M. Afzal, Deputy Director	PMD	Islamabad
14	Mr. Muhammad Karim	Deptt. of Water Management	Quetta
15	Mr. Iqbal Chohan	Deptt. of Water Management	Rawalpindi
16	Dr. Sher Jamal Khan, Head of Deptt. Environmental Engineering	NUST	Islamabad
17	Mr. Muhammad Arfan	WWF	Bahawalpur
18	Mr. Sohaib Waseem Anwar	WWF	Lahore
19	Mr. Kamran Naeem	UNICEF	Islamabad
20	Mr. Siddiq Khan	Water Aid	Islamabad
21	Mr. Sohail Nazir	Water Aid	Islamabad
22	Mr. Abu Rehan	Water Aid	Islamabad
23	Mr. Suwaibah Mansoor	Water Aid	Islamabad

Sr. No.	Name/Designation	Organization	Location
24	Dr. Abdul Wahid Jasra	ICIMOD	Islamabad
25	Dr. Zia ur Rehman Hashmi	GCSIS	Islamabad
26	Dr. Saima Shafique	MoCC	Islamabad
27	Mr. Rao Irshad, Chairman	IRSA	Islamabad
28	Mr. Sahibzada Alamgir, Director	KP Irrigation Department	Peshawar
29	Mr. Nasibullah Bazai	Balochistan Irrigation Department	Quetta
30	Dr. Ashfaq Ahmad Sheikh, DG	PCRWR	Islamabad
31	Mr. Arshad Jamil	Education Innovation	USA
32	Mr. Zameer Ahmad Soomro, RD	PCRWR	Islamabad
33	Ms. Lubna Naheed Bukhari, DG	PCRWR	Islamabad
34	Dr. M. Aslam Chaudhry, Research Professor	USPCAS-W, University of Utah	USA
35	Dr. Sajjad Ahmad, Professor	University of Nevada Las Vegas	USA
36	Dr. Bakhshal Khan Lashari, PD	USPCAS-W, MUET	Jamshoro
37	Dr. Muhammad Ashraf, Chairman	PCRWR	Islamabad
38	Dr. Arif Anwar	IWMI	Lahore
39	Dr. Rashid Aftab	Riphah University	Islamabad
40	Dr. Manzoor Ahmad Malik	PCRWR	Islamabad
41	Engr. Faizan ul Hasan	PCRWR	Islamabad
42	Engr. Ahmad Zeeshan Bhatti	PCRWR	Islamabad
43	Mr. Naveed Iqbal	PCRWR	Islamabad
44	Ms. Saiqa Imran	PCRWR	Islamabad
45	Dr. Khalid Riaz, Dean	Faculty of Management Science, CIIT	Islamabad
46	Dr. Fateh Khan Mari	Water Sector Improvement Project, Govt. of Sindh	Karachi

Sr. No.	Name/Designation	Organization	Location
47	Mr. Nazir Essani, M.D.	Sindh Irrigation & Drainage Authority	Hyderabad
48	Mr. Rafique Chandio	USPCAS-W, MUET	Jamshoro
49	Mr. Zarif Khoro	Sindh Irrigation Department	Hyderabad
50	Mr. Muhammad Azam, Director	PCRWR	Islamabad
51	Mr. Iftikhar Bhatti	SUPARCO	Islamabad
52	Mr. Sherjahan, Director	OFWM	Gilgit-Baltistan

**Annexure-D: List of Participants of Consultative Meeting on National Water
Resources Research Agenda 2016-25 held at PCRWR
Regional Office, Lahore on 20th May, 2015**

Sr. No.	Name/Designation/Organization
1	Dr. Arif Anwar, IWMI
2	Dr. Muhammad Aslam, IWMI
3	Dr. Muhammad Arshad, UAF
4	Engr. Mushtaq Ahmed Gill, SACAN
5	Mr. Shahrukh Latif, General Manager, NESPAK
6	Mian Saleem Ullah, Water Well Consultants
7	Dr. Habib UR Rehman, UET
8	Dr. Ghulam Nabi, CEWRE
9	Mr. Amir Munir, PHED, NESPAK
10	Mr. Ubaid Ullah, SMEC-EGC
11	Mr. Shafqat Niaz, LDA
12	Mr. Riaz Nazir Tarrar, Project Manager, Basha Dam
13	Mr. Ejaz Javed, IWASRI
14	Dr. Muhammad Nawaz Bhutta, NDC
15	Dr. Maqsood Ahmad, OFWM
16	Mr. Ammar Nazir, WAPDA
17	Mr. Arshad Muhammad Baig, WAPDA
18	Mr. Ali Hamid, NESPAK
19	Mr. Manzoor Ahmad, WAPDA
20	Mr. Abdul Qadeer Khan, WASA
21	Mr. Masood Qadir Waqar, Agriculture (Punjab)
22	Mr. M.S. Shafique, TPPL
23	Ms. Sarah Ephrain, WWF
24	Mr. Milan Varver, King's College London
25	Mr. Hamid Hashmi, Orient Electronics

**Annexure-E: List of Participants of PCRWR Technical Advisory Committee
Meeting held on 30th September, 2015**

Sr. No.	Name/Designation/Organization
1	Dr. Abdul Majid, Country Manager, ICARDA, Islamabad (Member)
2	Dr. Abdul Majeed, Representing, IUCN
3	Mr. Karamat Ali, Pakistan Water Partnership (Member)
4	Syed Muhammad Raza Shah, NPO, UNESCO (Member)
5	Prof. Dr. B.K Lashari, Director, IWREM, MUET, Jamshoro (Member)
6	Prof. Dr. M. Jamal Khan, Chairman, Agriculture University, Peshawar (Member)
7	Mr. Abdul Wahab Kakar, Director General, OFWM, Quetta (Member)
8	Mr. Sherjahan, Director, On Farm Water Management, Gilgit (Member)
9	Syed Yousaf Ali Shah, Progressive Farmer, Kalar Kahar (Member)
10	Mr. Zameer Ahmad Soomro, Regional Director, PCRWR, Lahore (Member)
11	Dr. Muhammad Ashraf, Chairman, PCRWR , Islamabad (Member)
Besides the following officers of PCRWR attended the meeting:	
1	Dr. Ashfaq Ahmad Sheikh, Director General
2	Engr. Muhammad Azam, Director General
3	Mrs. Lubna Naheed Bukhari, Director General
4	Dr. Manzoor Ahmad Malik, Director
5	Engr. Faizan-ul-Hasan, Deputy Director
6	Mrs. Saiqa Imran, Deputy Director
7	Engr. Ahmad Zeeshan Bhatti, Assistant Director

**Annexure-F: List of Participants of National Water Resources Research
Agenda 2016-25 held at PCRWR Headquarters,
Islamabad on 20th January, 2015**

Sr. No.	Name/Designation/Organization
1	Dr. Hassan Abbas, COMSATS Institute of Information Technology, Islamabad
2	Dr. Abdul Majid, Country Manager, ICARDA, Islamabad
3	Dr. Muhammad Ashraf, Chairman, PCRWR, Islamabad
4	Engr. Muhammad Saleem, NARC, Islamabad
5	Mr. Irshad Ramay, CNPC, Islamabad
6	Mr. Ghazanfar Ali, Global Change Impact Study Centre, MoCC, Islamabad
7	Mr. Ahmad Ali, SUPARCO, Islamabad
8	Dr. Muhammad Anwar, NUST, Islamabad
9	Dr. Nadeem Amjad, Chairman, PARC, Islamabad
10	Syed Zaheer Gardezi, DG ERRRA, Islamabad
11	Rana Arsalan-ur-Rehman, WWF, Islamabad
12	Malik Fateh Khan, NRSP, Islamabad
13	Mr. Fayyaz-ul-Hasan, COMSATS Institute of Information Technology
14	Dr. Saira Butt, PINSTECH, Islamabad
15	Mrs. Saiqa Imran, PCRWR, Islamabad

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About PCRWR



PCRWR is an apex body of Ministry of Science and Technology and is the only research organization in water sector at federal level. It is mandated to conduct, organize, coordinate and promote research on all aspects of water resources including irrigation (surface and groundwater), drainage, soil reclamation, drinking water, rainwater harvesting, etc. Accordingly, the Council has three main areas of expertise including Water Management (crop water requirements, water conservation, groundwater investigations, watershed management, recharge of depleted aquifers, drainage and land reclamation), Rainwater Harvesting and Desertification Control (rainwater harvesting, sand dune stabilization, rangeland management, grassland development, saline agriculture), Water Quality (water quality assessment and management, simple and low cost analytical solutions for water quality monitoring, innovative water treatment technologies). With its headquarters at Islamabad along with NWQL (National Water Quality Testing Laboratory), it has 7 Regional Offices located at Lahore, Karachi, Quetta, Bahawalpur, Peshawar, Tandojam, Gilgit and Muzafferabad besides 24 water quality testing laboratories and 8 research and demonstration farms across the country.

About USPCAS-W



This Center has been established at the Mehran University of Engineering and Technology (MUET) Jamshoro under the Cooperative Agreement signed with USAID on December 12, 2014. This is a world class education and applied research center dedicated to resolving Pakistan's water crises through applied research, developing specialist human resource and technologies; academia-industry collaboration; and policy formulation. The center will generate cost-effective and sustainable solutions to Pakistan's challenges related to water and educating the next generation of scientists, engineers, and policy makers through innovative academic programs in water that are focused on applied research to solve Pakistan's contemporary problems. The center is undertaking Masters/Ph.D. programs in four areas, tentatively designated as: (i) Hydraulics, Irrigation and Drainage (ii) Integrated Water Resources Planning and Management (iii) Environmental Engineering and (iv) Water, Sanitation and Hygiene. In this program, 7 laboratories with state of the art facilities are being established. This will assist in conduct good applied research projects and forming linkages with industry and the private sector. With this program, MUET's aim is to become a leading center of excellence in the water sector.