

**Climate Adaptation and Resilience
(CARE) for South Asia Project**

**Water Governance in
Pakistan for Climate-
inclusive Irrigation Water
Management and Food
Security**

TECHNICAL NOTE

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Executive Summary

The Ministry of Planning, Development, and Special Initiatives, Government of Pakistan and the Asian Disaster Preparedness Center, with the support of the World Bank, organized a National Workshop on Water Governance in Pakistan for Climate-inclusive Irrigation Water Management and Food Security in Islamabad on 12th August 2021. The workshop had participation from federal and provincial government organizations, international organizations, and academia. It discussed three main themes: (i) National Water Policy 2018, (ii) climate-informed irrigation water management, and (iii) water institutions. The technical note documents the theme-wise deliberations, conclusions, and way forward based on participants' perceptions and science-based evidence.

Theme 1 focused on **National Water Policy (NWP) 2018** and how the policy can be a driver for formulation of provincial water policies. The discussion focused on NWP 2018 which articulates that water resource management is a "national responsibility" and provinces are responsible for irrigation, water supply, and wastewater treatment. The provinces are also responsible to prepare action plans and water strategies and establish groundwater authorities. The efforts by provincial governments to develop policies, plans and strategies were acknowledged by the participants as the implementation steps of the NWP 2018. The major conclusions of the thematic session were

- i) The implementation of the NWP 2018 is hindered by several challenges however, weak institutional set up and insufficient financing for the major infrastructure projects are the major barriers,
- ii) agriculture Sector being major user of the water resources is lacking the representation in planning, regulation, development coordination and management institutions like; National Water Council and the Steering committee on water. Participation of agriculture sector in these apex institutions are essential to create an enabling environment to promote broader multi-stakeholder participation,
- iii) the NWP 2018 reflects very limited roles of women and has overlooked women's contribution in the water management and governance. Collection of sex- disaggregated data and where relevant undertaking social and gender analysis to ensure social equality and enable gender mainstreaming, and
- iv) limited water resources are being used extensively due to lower water pricing, thus a rational mechanism and legal framework is essential to regulate water pricing.

Theme 2 focused on **Climate-informed Irrigation Water Management**, where the discussion centered around the fact that irrigation is a major source of water for the agriculture sector. Over 90 percent of Pakistan's water resources are used for irrigation. As surface water (including local rainfall) cannot satisfy crop water demands, a vast amount of groundwater is also used to achieve 40–60 percent of irrigation needs. In many cases, water used in agriculture exceeds the actual crop water requirement. Rationalization of cropping pattern is required in accordance with the demand and value of the crop. Rainwater harvesting and groundwater recharge options are required to be explored for resource optimization. It was emphasized that the lack of a data sharing mechanism among institutions is one of the obstacles to achieving science-based development, generally in all sectors, and particularly in agriculture. The major conclusions were:

- i) establishment of agro-ecological zones are urgently needed to enhance agricultural efficiency and sustainable development by adoption of cropping systems including climate-resilient crop varieties,
- ii) adaption of water conservation technologies is need of the hour e.g. sensor-based irrigation controller, rainfall shutoff devices etc.,
- iii) watershed management with strategy to develop check dams as well as groundwater recharge, and

- iv) allocation of funds by the Ministry of Water Resources for relevant research studies as per guidelines of National Water Policy 2018.

Theme 3 focused on **Water Institutions** and how these can be strengthened for better management of the water resources in the country. The institutions require strengthening both in terms of resources and manpower to deal with extreme events e.g. floods and drought, management of groundwater aquifer as well as deal with serious challenges arising due to climate change. The institutions also require strengthening to support provincial governments to implement the NWP 2018 effectively. The major conclusions were

- i) capacity enhancement to introduce resource conservation-technologies in water sector,
- ii) introduction of capacity building programs for farmers for adapting proper cropping pattern, latest farming technologies with a goal to enhance the overall crop productivity,
- iii) enhance capability of institutions to carry out M&E of projects to improve assessment and implementation plan, and
- iv) strengthen coordination between federal and provincial water resource department /institutions with scope of restructuring and strengthening selected directorates under Ministry of Water Resources to bring about inter departmental synergy.

The three thematic sessions brought forward recommendations which would enable better irrigation water management in the light of changing climate in particular, but also a way forward to effectively implement National Water Policy 2018 and the need for institutional strengthening. The role of the agriculture sector as an integral part of water resources policies and strategies is an important aspect which came to light, for consideration. The technical note will enable the water sector stakeholders to include suggested recommendations in future policies / plans / guidelines for enhanced water governance of the country, in order to achieve food and water security.

1. Background and Context

Pakistan is considered a water insecure country, as its per capita water availability, since 1947, has declined from over 5,000 cubic meters to less than 1,000 cubic meters per person per year. The declining per capita water availability may have serious implications on the food security and livelihoods of small farmers. In forthcoming years; water shortages are likely to affect crop yields, resulting in reduced agricultural production and shrinking farm incomes. Reduced water availability is mainly attributed to high population growth. Currently, the country is home to nearly 220 million people and ranked the fifth most populous country in the world. The projected trend indicates that population may reach 230 million by 2025 (Fatima et al., 2021)

Pakistan is highly vulnerable to climate change. According to the Global Climate Risk Index (CRI) 2020, Pakistan is affected by recurring climate change-induced hazards, and thus is ranked amongst the most affected countries both in the long-term index as well as in the index for the respective year. According to the World Bank, decadal analysis of past and current climate indicate that the mean surface temperature of the country has increased by 0.47°C; the mean rainfall in the arid plains and the coastal belt of Pakistan has decreased by 10-15 percent since 1960. The projected increase in temperature in Pakistan is significantly higher than the global average and significant uncertainty surrounds projections of future precipitation rates.

Pakistan has an agrarian economy wherein; about 70 percent of the population is directly or indirectly associated with the agriculture sector. Planning and management of water resources is emphasized as an important resource for national food security. At the national level; use of surface water has already surpassed its consumptive limits and now groundwater from many aquifers is over-exploited to supplement irrigation. Historically, much of the production gains in agriculture had been achieved by expanding the planted area. However, in future additional food production is expected to come

from higher yields through efficient use of water; including zero tillage, laser land leveling, and furrow & bed planting.

The Ministry of Planning, Development and Special Initiatives (MoPDSI), Government of Pakistan and Asian Disaster Preparedness Center, Thailand organized a one-day National Workshop on **Water Governance in Pakistan for Climate Inclusive Irrigation Water Management and Food Security**. The workshop was organized under the regional project Climate Adaptation and Resilience (CARE) for South Asia funded by the World Bank on 12th August 2021 at Islamabad. The workshop discussed the government actions needed to effectively implement the National Water Policy 2018 (NWP 2018) under the following three themes; i) National Water Policy 2018, ii) Irrigations Water Management, and iii) Water Institutions.

This **Technical Note** provides a consolidated information on the theme-wise deliberations, conclusions and way forward based on the participant's perceptions and science-based evidences. **The Technical Note** is expected to contribute to the accomplishment of water sector development objectives in the CARE for South Asia project.

2. Theme 1: National Water Policy 2018

The National Water Policy 2018 (NWP) provides guidelines for planners and developers on the water scarcity concerns of the country including Irrigation Water Management (IWM). It encourages the provinces to develop their water policies, strategies, and action plans matching with the food production requirements with probable less water available for the sector. National Food Security Policy (2018) also highlighted the shrinking water and land resources. Inefficient water use, low agricultural water productivity and weak groundwater management in agriculture are the major challenges. Effective implementation of the NWP 2018, matching with food security requirements of the country, needs enabling institutions, clear roadmap, appropriate capacity of the staff and farmers. It was discussed that there is lack of innovation and effective solutions in IWM and related research. A vibrant institutional and organizational structure is needed to meet the future challenges of IWM and food security.

National Water Council (NWC), chaired by the Prime Minister, is to meet once in a year for review and coordinate implementation of the water policies and sectoral strategies with periodic updating. The Steering Committee chaired by the Minister of Water Resources is to assist the NWC by ensuring inter-provincial coordination and reviewing policy papers and monitoring reports before submission to NWC and has to meet twice a year or more. It was pointed out that both the institutions require frequent engagement. Whereas; the government has to prioritize the water governance, which is possible by the legislation, implementation of the legislation and updating the legislation.

The implementation of the NWP 2018 is pivotal for water resource management and reforms at the national scale. However, the implementation of the NWP 2018 is hindered by several challenges. It was speculated that amongst others, weak institutional setup for implementation of national water policy and insufficient financing of the major infrastructure projects are two major barriers to implement targets of the NWP 2018.

2.1 Implementation of National Water Policy 2018 by Provinces

The NWP 2018 articulates that water resource management is a “national responsibility” and provinces are responsible for irrigation, water supply, and wastewater treatment. The provinces are also responsible to prepare action plans and water strategies and establish groundwater authorities. The participants of shown the comfort on the keen steps by provincial governments to develop policies, plans and strategies according to their social and cultural values.

Punjab has approved its water policy in 2018, which strikes the strategy of balance between the productivity & conservation and the supply & demand. It also prioritized the association with information technology and adaptation to climate change hazards. The Punjab Water Act approved in 2019 for comprehensive management and regulations in alignment of conservation and sustainability of the water resources in the province. Punjab Water Resources Commission has been established in the chair of Chief Minister of the province. The commission is mandated to conserve, redistribute, augment and allocate the water resources for various sectors of the province (domestic, agricultural, ecological, industrial or other purposes). The commission is responsible to ensure the proper use of water resources in the Punjab. Punjab Water Services Regulatory Authority has also been established to ensure the water governance and implementation of the Water Act 2019 or any other law for the time being in force.

The government of Khyber Pakhtunkhwa (KP) has approved Water Act in 2020; known as; "The Khyber Pakhtunkhwa Water Act 2020". The Act provides comprehensive management of all water resources of the province and regulate in the beneficent of conservation and sustainability. KP has also developed the Integrated Water Resources Management (IWRM) Strategy in line with the National Water Policy 2018. The Provincial Government recognizes the competing demands for water from various sectors including drinking, sanitation, agriculture, irrigation, industry, environment & ecosystems and hydropower. The strategy considers all competing uses of water, respective challenges and attempts to suggest necessary measures that may lead to equitable access of water resources by all sectors. Khyber Pakhtunkhwa Water Resources Commission has been established in the chair of the Chief Minister of the province. The Commission is mandated to conserve, redistribute augment, allocate the water resources for various sectors of the province (domestic, agricultural, ecological, industrial or other purposes). The Commission is responsible to ensure the proper use of water resources in the province. The Khyber Pakhtunkhwa Water Services Regulatory Authority has also been established to ensure the water governance and implementation of the Water Act 2020 or any other law which are in force.

In Balochistan, the water resources are managed under the Balochistan IWRM Act 2006 approved by Balochistan Provincial Cabinet; highlighting fifteen thrust areas for the IWRM Policy including; water resources monitoring, conservation, demand management for water user sectors and its recovery, etc. The IWRM Policy 2006 realize the fact that new water resources in future would largely come from managing the water demand and saving of the existing losses. As such, effective public participation, awareness and education programs at Universities, Schools and Madrassas be initiated including water resource management courses in the curricula.

The Government of Sindh has finalized the comprehensive draft water policy to regulate the water resources of the province. The draft policy prioritized the legitimate regulations and strategy to manage the water scarcity leading to food security of the ever-increasing population of the province. The policy realized that fact that; water resources available for the province are very scarce with mean annual rainfall 100 to 200 mm. Groundwater in most of the areas is saline. Water resources management faces the combined effect of socio-economic development, changes in water use patterns, and the impacts of climate change in addition to heritage of unresolved problems.

2.2 Outcome of Deliberations

National Water Policy 2018 is a comprehensive and well-drafted document, lays out the vision, objectives, and framework in detail. However, the policy document has no reference to gender consideration and women's roles and responsibilities in water use, governance and management. The entire document has a statement about the promotion of women's participation in domestic water supply and water hygiene. The National Water Policy 2018 has overlooked women, as one of the key stakeholders in building adaptive capacity and community resilience, and their contributions towards water conservation and management. Women accounts for 49 percent of the country's population, and make up 22.96 percent of the labor force. The Labor Force Survey 2018-19, Pakistan indicates that women constitute 69.8 percent of the labor force in agriculture-based economy of the country (GoP, 2020). With limited information and in absence of gender analysis and sex-disaggregated data it is challenging to have social and gender inclusive perspectives in

water resources and irrigation management debates and policy planning.

National Water Policy 2018 guided the provinces to prepare their action plans and strategies. However, in Pakistan, mostly the cultural values vary from province to province and gender roles and responsibilities are set in culturally and locally appropriate context. The KP IWRM strategy provided safeguards to ensure equitable distribution of water resources among different stakeholders and social groups. Similarly, the Punjab Water Policy and draft Sindh Water Policy reflect the role of social groups. And, the recently drafted Nationally Determined Contributions (NDC) 2021 has laid out gender perspectives in the objectives, proposed actions and potential indicators for water and disaster risk management sectors under gender mainstreaming actions and potential targets section.

It was also highlighted that; PCRWR and UNESCO have launched Integrated Water Resources Management Implementation Guidelines for Pakistan in 2021 (Fatima *et al.*, 2021). The IWRM guidelines highlight the analysis of acts, policies at national and provincial level and provided the gap analysis. The recent development in provinces regarding policies has embraced IWRM concept principally. Thinking process of senior managers regarding IWRM implementation is a major breakthrough. The IWRM approaches elaborate the water utilization across all the sectors while keeping in view disaster management. The guidelines also offer an opportunity to the users for implementing IWRM process even at district scale. It helps to understand the needs of water across the users and to prioritize water resources management practices for sustainable management of land and water resources.

2.3 Conclusions and Way Forward

- i. The implementation of the National Water Policy 2018 is pivotal for water resource management and reforms at the national scale. However, the implementation of the Policy is hindered by several challenges. It is speculated that amongst others; weak institutional set up for implementation of NWP and insufficient financing for the major infrastructure projects are the barriers to implement targets of the NWP 2018.
- ii. Agriculture Sector is major user of the water resources of the country but there is limited role of the Agriculture Sector in the National Water Policy 2018, especially lacking the representation in planning, regulation, development coordination and management institutions: National Water Council and the Steering committee on the water. In the interest of creating an enabling environment to promote broader multi-stakeholder participation and integrated water resources management with due considerations, the agriculture sector may be included in apex institutions of the NWP 2018.
- iii. Inclusion of social and gender concerns are being overlooked in the NWP 2018, reflecting only women's roles only in water hygiene and domestic water supply.
- iv. Provisions of streamlining gender inclusivity in the water sector policy, plans and implementation framework in the wake of climate change impacts should be prioritized. Equally important is to recognize and include, the gender specialists besides water professionals as the key stakeholders of the policy planning process and Sex-disaggregated data need to be maintained in the water and irrigation sector departments with an appropriate institutional mechanism to ensure the social and gender equality concerns are mainstreamed
- v. Managing (agriculture) water demand is closely linked to water pricing. However, there is no rational mechanism and legal framework to regulate water pricing. Unregulated and low water price has led to intensive use of the limited water resources. As such, the conventional water-use allocations for agriculture need to be revisited based on economic returns in terms of financially more viable and have higher productivity. Besides low pricing, recovery on existing rates is also not satisfactory. According to latest statistics, recovery in Punjab is 74 percent, Sindh 40 percent, KP 64 percent and Balochistan only 8 percent. It is required to sensitize and motivate the farmers for payment of reasonable water charges. Farmer is ready

to invest considerable amount on pumping of the groundwater but un willing for least cost on delivery of surface water.

3. Theme 2: Irrigation Water Management

Over 90 percent of Pakistan's water resources are used for irrigation. The surface water including local rainfall cannot fulfil crop water demands of the agriculture, therefore a vast amount of groundwater is used to achieve 40–60 percent of the irrigation needs. Pakistan's irrigation system and practices are affected with many serious issues. Considerable amounts of the water are lost in channels and field due to poor conveyance efficiency of the irrigation system and lavish practices. The concepts of water conservation, efficiency, and equity (CEE) are not well adapted.

The crop water requirement in central Punjab for wheat, rice, sugarcane, sunflower, berseem and sorghum is 421, 500, 1543, 479, 669, and 342 mm respectively (Soomro *et al.*, 2018). However, due to the misconceptions, farmers apply many times more water as compared to the actual crop water requirements. For example; in rice crop more than 3000 mm water is applied, which is 6 times more than the actual crop water requirement (Ashraf *et al.*, 2010). With the series of experiments; the myth has been broken that rice doesn't needs standing water but likewise other crops, it has specific water requirement (Soomro *et al.*, 2015).

Use of *Laser Land Leveling* (LLL) and *Drip Fertigation System* (DFS) prevail as bright spots in irrigation practices. Despite its wider uptake in the last 10-15 years, many areas of the country are still not using LLL. Similarly, DFS has established its technical feasibility but the financial viability without subsidies needs careful assessment, without which DFS cannot not be adopted at large scale. Likewise, other cultural practices, i.e., paradoxical agriculture, zero tillage, bed plantation of wheat and *Direct-seeded Rice* (DSR) have demonstrated significant potential and need to be adopted at a wider scale to conserve water and soil and raise crop productivity.

The cropping pattern is required to be rationalized in accordance to demand and value. For example, rice crop consumes two to three times more irrigation water as compared to other countries. Its production is twice to the domestic demand and exported at very low-value. It is a poor economic option for a water scarce country. Food security can be achieved by water management in irrigated (surface and ground waters), and non-irrigated systems (spate, rain-fed, water harvesting and supplemental irrigation). Scientific approaches are required to manage the spatial and temporal water variations for improved reliability and equity, improved water productivity and productivity of the fragile environments.

Groundwater is major water source, contributing for equity and high-water productivity in agriculture sector, fulfil the municipal water supply, sanitation, industrial requirements and food production. It is a reliable resource and a buffer against drought and complete crop failure. It offers supplemental uses and crop yield stabilization. However, the groundwater is a neglected subject in the country, lacking the framework of monitoring and management. Drainage is an integral part of the irrigation system, without addressing the drainage problem; the water and agricultural productivity cannot be increased, the resource degradation cannot reduce, the damage cost cannot be minimized and the health hazards cannot be effectively managed.

There is also a need to look into new options like rainwater harvesting in urban (rooftop, roadside, parks) and rural (micro- and macro-catchments: ponds, hillsides, mini dams) context. Rainwater harvesting potential is available in even low rainfall areas like deserts (Figure 1), foot hills etc. The federal government can complement to provinces like; guidelines for aquifer recharge practices (Figure 2), sustainable water harvesting, and assistance for water policies, capacity building and institutional transformation, establishment of monitoring and independent evaluation mechanisms, and promoting research-based development and management culture. Major challenges likely to be faced in future such as; competing water uses will trigger the reallocation among the water use sectors and reduced share of irrigation water is unavoidable, and the significant adjustments will be

needed in infrastructure and institutions vis-à-vis associated financing. It is needed to revisit the review and approval processes based on conceptual framework in water sector. The planning and approval processes were designed when resource was in abundance and development potential was high. Now resources are scarce and degradation is high.



Figure 1: Rainwater harvesting System in Cholistan desert (Source: PCRWR)



Figure 2: Aquifer Recharge wells (Source: PCRWR)

The federal government can also play an effective role in improving water governance by putting the science into practice (evidence-based research drives development), the development of a water strategy and action plan, and, adopting guidelines to integrate climate change impacts into agriculture production system, hydrology and sedimentation, flood forecasting, dryland and wetland environment. More importantly, this is needed to improve the water productivity of irrigated and rain-fed agriculture, deal with drylands (hot and cold), land degradation, and the delta area.

The lack of a data sharing mechanism among the Institutions is one of the obstacles to achieving science-based development, generally in all sectors and particularly in agriculture. Therefore, a systematic data-sharing framework is required in public sector organizations, one which can be easily accessed by scholars, researchers and academia to develop science-based development in agriculture.

3.1 Outcome of Deliberations and Way Forward

- i. Climate change is significantly affecting crop productivity, the development and identification of climate-resilient crop varieties, with enhanced tolerance to heat, drought, flooding, chilling, and salinity stresses are essential to sustain and improve crop yields to cope with the challenges of climate change. The establishment of agro-ecological zones is urgently needed to enhance agricultural efficiency and sustainable development planning because the successful adoption of cropping systems and crops in a specified region heavily depends on critical analysis and assessment of agro-climatic norms and available resources for crop production. Irrigation systems needs to be developed in accordance with the available cropping system.

- ii. Water conserving to protect the environment, the conservation technologies may include: water sense labeled irrigation controllers, soil moisture sensors, rainfall shutoff devices, rain sensors, sprinkler heads, micro-irrigation. The conservation agriculture such as minimal soil disturbance (through reduced or no-tillage) to preserve soil structure, soil fauna, and organic matter, permanent soil cover (cover crops, residues, and mulches) to protect the soil. Further, agro-forestry, planting trees, shrubs, and grasses along the edges of the fields to add as a conservation buffer can help prevent any runoff.
- iii. The water damages include the flood, drainage, water quality, health impacts, drought, salinity, waterlogging, erosion, etc. The watershed management through the development of check-dams strategy would help to control pollution of the water and other natural resources in the watershed by identifying the different kinds of pollution present in the watershed. Rainwater harvesting can help to recharge the groundwater. PCRWR has identified few methods to re-charge groundwater. The rainwater harvesting utilities may reduce peak demands during summer months, saving treated water for more important and appropriate water uses.
- iv. As per guidelines of National Water Policy 2018, 10 percent of the Public Sector Development Projects (PSDP) budget be allocated for water sector. Out of the total budget allocation for water sector, 1 percent is to be allocated for the research on water related issues. However, the research allocation is not visible. Ministry of Water Resources is required to allocate the funds for relevant research studies especially on climate informed irrigation system.

4. Theme 3: Water Institutions

The provincial irrigation departments are considered important institutions for irrigation water management; which are about 100 years old. Institutions are neither set up nor properly staffed to deal with important aspects, i.e., flood, drought, and aquifer management. Institutional reforms and recalibration are required to enable water institutions to deal with serious challenges posed by climate change and to implement NWP 2018 effectively.

National water policy 2018 guides to develop strategies and policies planning at provincial level. However, there is need of appropriate institutions, staff expertise, clear key goals and farmer capacities. The major water resources management institutes at federal level are; Indus River System Authority (IRSA), Ministry of Water Resources, Ministry of Climate Change, Ministry of Science and Technology, Federal Flood Commission and Water and Power Development Authority (WAPDA). Whereas at provincial level, Irrigation Department, Agriculture Department, PIDA (AWB and FOs), Public Health Engineering Department and WASAs are water service providers.

Major water resources framework actions for implementation of NWP 2018 are; i) Water Resources Development (WRD) to deal with multi-purpose storages, wetlands, groundwater, rainwater, hygiene, and stock water, ii) Water Resources Management (WRM), refers to river basin, groundwater, flood & drought, water logging & salinity, and water pricing management at each level and, iii) Water Use in all Sub-sectors, there is need of sectors reforms such as improving canal delivery, efficient irrigation practices, enhanced recovery of water fee, water metering, improve water for health & hygiene, and availability of safe domestic water supply. The water sector department and ministries at federal and provincial level have likely to implement those actions.

There is need to organize the technical think tank with representation of water related key sectors from different geography for equitably harnessing the benefits of water. The Government of Khyber Pakhtunkhwa, Department of Irrigation constituted two water governance bodies in 2021 i.e. Water Resources Commission (deals with policy and regulatory framework consisting of political, bureaucratic, and technical official) and Water Resources Authority to implement policies and reforms.

Pakistan's water resources are shared and mostly dependent on transboundary waters, regulated under Indus Water Treaty, which doesn't cover the groundwater related issues. Though there is Pakistan Commissioner for Indus Waters (PCIW), part of the Permanent Indus Commission which is a bilateral commission consisting of officials from Pakistan and India, to implement and manage the goals, objectives and outlines of the Indus Waters Treaty. However, the role of the commission is limited to deal with the transboundary related impacts on water pollution, groundwater and environmental flows etc. It is needed to either establish a dedicated institution or any existing institution be mandated to support the PCIW with scientific data and or restructure and empower Pakistan Indus Water Commission with broader scope and extent with technical expertise to deal with transboundary water related issues and consequences.

The Civil Society Organizations (CSOs), academia, and related research organizations can play role for advocacy, and raising awareness in pursuance with the objectives of the NWP 2018. The international organizations may be knowledge partners and building capacity of the local institutions. The CSOs fostered by RSPs in addition to official recognition such as WUAs may be involved in operational project at federal and provincial level. The farmer participation in decision making be ensured for water application efficiency related policy reforms at provincial irrigation and agriculture projects.

4.1 Outcome of Deliberations and Way Forward

- i. The tendency towards innovation requires considerable enhancement, otherwise it would lead to slowing down the process to introduce resource conservation-based technologies in the sector. Major technology innovations in the space have focused on areas such as indoor vertical farming, automation and robotics, livestock technology, modern greenhouse practices, precision agriculture and artificial intelligence, and block-chain. The capacity building of farmers, including female farmers and sharecroppers (the last mile in agriculture sector) for adapting proper cropping pattern along with the advanced technologies with specific goal would enhance the overall crop productivity is essentially needed.
- ii. Mostly in the projects, development targets are achieved, but the objectives of project are not being achieved in the spirit of their design. The monitoring and evaluation are also limited to achieve the quantitative targets of the project. The mechanism of M&E for post-project implementation strategies needs to be strengthened. Monthly, quarterly, and annually M&E mechanism should be developed by the funding agencies to ensure the achievement of project objectives and delivery of designed results and outputs. The associated departments should improve their assessment and implementation plan.
- iii. Research and development (R&D) organizations are operated by government, business, academia, and independent institutes. Therefore, an effective assessment mechanism should be developed by each department, keeping in view the goals and objectives of the project. Every department should devise an independent evaluation mechanism. M&E system would not only help systematically monitor and evaluate the key issues but would also be timely, reliable, and tailored to meet their own special needs of improving the quality, relevance, and coverage in a particular sector.
- iv. Restructuring and strengthening of Ministry of Water Resources is essential with specific directorates inter-departmental coordination at national level in consensus of the provinces to strengthen coordination between federal and provincial water department for implementation of policies and to avoid inter departmental duplicity.

The three thematic sessions brought forward the recommendations which would enable better irrigation water management in light of changing climate in particular but also the way forward to effectively implement the National Water Policy 2018 and the need for institutional strengthening. The role of agriculture sector as an integral part of water resources polices and strategies is an important aspect which came forward for consideration. The technical note will enable the water sector stakeholders to include the suggested recommendation in future policies / plans / guidelines for an enhanced water governance of the country to achieve food and water security.

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