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Climate Change Technical Note

Sindh Water and Agriculture Transformation Project (P167596)

Climate and Disaster Vulnerability Context: Pakistan ranks among the 10 countries worldwide most affected by climate change in a form of increased frequency and intensity of heatwaves, heavy precipitation events, droughts, and cyclones. Pakistan is also ranked among the top 10 countries in the world most heavily impacted by the loss of biodiversity and ecosystem services. The combined risks from intensifying climate change and environmental degradation are set to compound Pakistan's structural macro-economic fragility[1]. The recent 2022 floods described in the Project Appraisal Document are stark reminders of these increasing extreme weather events and the vulnerability of the population to disasters. The June 2022 floods were preceded by an extreme heatwave which started as early as April, saw temperatures continuously above 45°C for several days in large parts of the country, resulting in crop losses, power outages, and forest fires.[2]

Pakistan faces some of the highest disaster risk levels in the world, ranked 18 out of 191 countries by the 2020 Inform Risk Index. Pakistan has high exposure to flooding including riverine, flash, and coastal, as well as some exposure to tropical cyclones and their associated hazards and drought[4]. Disaster risk in Pakistan is also driven by its social vulnerability. Between 1992 and 2021, climate- and weather-related disasters in Pakistan resulted in a total of $29.3 billion of economic losses (inflation-adjusted to 2021 dollars) from damage to property, crops, and livestock, equivalent to 11.1 percent of GDP (2020)[3].

Climate Trends: Warming in Pakistan was estimated at 0.57°C over the 20th century, slightly less than the average for the South Asia region of 0.75°C. Warming has accelerated more recently, with 0.47°C of warming measured between 1961–2007. The warming is also strongly biased towards the more southerly regions, with Punjab, Sindh, and Balochistan all experiencing winter warming in the region of 0.91°C–1.12°C over the same period. The early 20th century was characterized by a prolonged decline in annual rainfall, but since 1960, a slight increasing trend has prevailed. The number of heavy rainfall events has increased since 1960, and the nine heaviest rains recorded in 24 hours were recorded in 2010.[4] From mid-June until the end of August 2022, large parts of Pakistan experienced record-breaking monsoonal rainfall, Sindh receiving more than 700% more rainfall than its August average.

Climate change projections: Global climate projections show a significant warming of Pakistan's already hot climate at a rate considerably above the global average. By the end of the century, annual mean temperature is projected to increase by 0.2–1.0°C under the SSP1-1.9 scenario, 2.1-3.3°C under SSP2-4.5, and 4.0-5.5°C under SSP3-7.0. The number of days with a heat index greater than 35°C is projected to rise by 9–13 days under the SSP1-1.9 scenario, 16–30 days under SSP2-4.5, and 21–39 days under the SSP3-7.0 scenario. However, the projections in rainfall remain highly variable, with a likely more variable monsoon regime, and likely more intense storm and cyclone events, which will result in floods and induce landslides.[1] The probability of meteorological drought is projected to increase under all emissions pathways, and with very strong increases. While uncertainty is high, the CMIP5 ensemble projection would suggest that severe drought conditions (Standardized Precipitation Evapotranspiration Index <−2) may be experienced with an annual probability of 25%–65% across Pakistan.[4]

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[1] Pakistan Country Climate and Development Report Version 1, 2022

[2] Pakistan 2022 Floods Preliminary Economic and Poverty Impacts World Bank.

[3] EM-DAT, CRED/UCLouvain, Brussels, Belgium. www.emdat.be. Data accessed on April 08, 2022

[4] World Bank Pakistan Climate Risk Country Profile, 2021

Intent to address the identified vulnerabilities: The project intends to improve agricultural water productivity to obtain more value from water supplies affected by climate change, induced disasters. By improving the institutional framework for IWRM, the project will improve the capacity of Sindh to better cope with extreme hydro-climatic events, such as floods and droughts. It will also help in the allocation of increasingly scarce water resources among competing uses such as agriculture, urban, and the environment. The promotion of climate-smart agriculture will contribute to the reduction of greenhouse gas (GHG) emissions and contribute to mitigation goals. The project is designed to help Sindh province proactively manage climate risks with a focus on the water and agricultural nexus.

The specific adaptation and mitigation activities that will be considered and discussed with the client under the Program are tabulated below:

Table 1: Adaptation and Mitigation Activities under the Program

Component	Adaptation Action	Mitigation Action
Component 1: Water Resources Management. (US$ 17.3 million, of which IDA US$ 15.0 million)		
Sub-Component 1.1: Institutional development for IWRM. *Sub-Component 1.2: Technical assistance for the development of a Sindh Strategic Water Plan (SSWP).* *Sub-Component 1.3: Support for a Hydro-Agro Informatics (HAI) program.* <u>*Activities:*</u> - Developing New Sindh Water law - Transforming the Irrigation Department into Irrigation and Water Resources Department. - Establishing Hydro-Agro Informatics Program. - Sindh Irrigation Department water pricing study	***Vulnerability context:*** *Refer above* **Intent to address identified vulnerabilities:** The overall objective is to improve the institutional framework for water resources management to better monitor and respond to climate change induced extreme weather events and improve agricultural productivity. **The explicit link between identified climate change risks and specific project activities:** The Policy and Institutional reforms are intended to create the necessary legal framework and organization to adaptively manage water resources and respond to climate change-induced hazards like droughts, floods, and ground water depletion. The Sindh Strategic Water Plan (SWP) will focus on strategic planning at the provincial level to adaptively manage water and related resources. This includes development of provincial drought and flood management plans. In the planning process, multiple climate change scenarios will be considered and analyzed to develop appropriate climate change adaptation plans as part of the SWP. This component will also significantly enhance data and information management through the Hydro	The institutional capacity building activities will extend to identification of climate mitigation measures. Trainings on Climate Smart Agriculture (CSA) will contribute to reducing greenhouse gas (GHG) emissions by and contribute to mitigation goals. The CSA trainings will allow farmers to look beyond their over reliance on synthetic fertilizers and take a more sustainable approach like integrated soil fertility management. The Hydro-Agro Informatics Center will also monitor and assess the impact of mitigation measures. This will allow for a more accurate GHG estimation and monitoring in Sindh - Actual evapotranspiration (with separation between Evaporation, Transpiration, and interception), - Seasonal crop map (covering all major crops), - Biomass production, and yields for major crops, - Agro-Meteorological variables such as Precipitation, Reference evapotranspiration, - Crop vegetation indices (e.g. NDVI)

	Informatics Center. This will allow comprehensive water and agricultural monitoring using remote sensing and ground data to monitor climate-induced changes as well as monitor the impact of adaptation and mitigation measures taken in Sindh. The HAI center will also produce knowledge products that will look at trends and changes in climate, water availability, ground water levels, water quality. In addition, the Flood and Drought Assessment Report will monitor agronomical, metrological, hydrological, and agricultural hazards, including droughts and floods. The HAI center will closely coordinate with the National Drought Monitoring Center and other agencies to improve forecast accuracy by exchanging data.	
Component	**Adaptation Action**	**Mitigation Action**
Component 2: Water Service Delivery (US$128 million, of which IDA US$115.5 million)		
Sub-Component 2.1: Integrated development of approximately 15 FO areas. *Sub-Component 2.2: FO, AWB, and SIDA Capacity Building.* *Sub-Component 2.3: Left Bank main canal upgrading.* *Sub-Component 2.4: Right Bank studies* <u>*Activities:*</u> - Irrigation and agriculture investments in the Ghotki, Nara,	***Vulnerability context**: Refer above* **Intent to address identified vulnerabilities:** This component will focus on improving the efficiency and flexibility of canal water delivery through improvements in infrastructure and operations. This will allow the Area Water Boards (AWBs) and Farmers' Organizations (FOs) to better manage water during droughts, and adaptively respond to climate change. In addition, the improved canals will reduce the risk of scouring and breaches during floods. **Explicit link between identified climate change risks and specific project activities:** Under Sub-Component 2.1 the project will finance a package of synergistic irrigation and agriculture	The results of the GHG analysis using EX-ACT conducted for this project showed a net carbon sink of 460,680 etCO2 equivalent over 30 years emissions due to the project. i.e -1,954,396 etCO2 without the project vs - 2,415,076 etCO2 with the project. This is a **24%** reduction in total emissions. The project will improve crop land of about 292,000 ha (721,500 acres) in canal commands, whereat about 5.8 percent increase in cropped area is assumed. For the GHG accounting, the increased cropped area of 18,340 ha (45,320 acres) is considered under land use change. The core investment that will ensure

and Left Bank AWBs - Akram Wah Canal physical works. - Establishing two new AWBs on the Right Bank of the Indus River. - Training and development of tools for improving canal operations and irrigation service delivery. - *Financing incremental operating costs for SIDA & AWBs*	investments to improve agriculture water productivity in the Ghotki, Nara, and Left Bank AWBs. Irrigation-related investments will include, as appropriate: new structures for better water control and water flow measurement, canal reshaping and lining, improving drainage canals, and canal ancillary structures such as footpaths and bridges. This component is closely linked and a required pre-investment for Subcomponent 3.1, which is implemented by the Agriculture Department, and will finance agriculture related activities such as on-farm water investments and the promotion of climate smart agricultural activities in the same 15 FOs (see Sub-component 3.1 below) In addition, upgrading of Akram Wah canal, a 116-kilometer multipurpose canal on the Left Bank of the Indus River providing water to 187,000 has of agriculture land and multiple cities, will also be part of this component. These investments will improve the climate resilience of farmers to droughts and floods by providing better management of water during extreme periods as well as improve productivity during average climate conditions. This will be further strengthened by the capacity building activity promoting participatory irrigation management, introducing better water control management practices, improved irrigation scheduling, and increasing accountability of the AWB and FOs to provide adequate service to	adequate water supply to be made in timely manners and allow better irrigation management is the irrigation infrastructure upgrading in subcomponent 2.3 and subcomponent 2.1. This which accounts for 100% of cropped area increased due to the availability of additional water through saving in water losses and better management of irrigation water.

	farmers.	
Component	**Adaptation Action**	**Mitigation Action**
Component 3: Targeted Agricultural Incentives and Investments (*US$65.5 million, of which IDA US$55 million)*		
Sub-Component 3.1: Integrated development of the same 15 FOs supported under Component 2.1. *Sub-Component 3.2: Financing smart subsidy payments to targeted farmers.* *Sub-Component 3.3: Improving the agricultural information and technology base.* *Sub-Component 3.4: Developing the agriculture value chain.* *Sub-Component 3.5: Agriculture Delivery Unit (ADU) support.* <u>*Activities:*</u> - Financing agriculture-related investments at the WCA level within the Selected FOs - Smart subsidy payments to farmers. - Improving Sindh Crop and Market Monitoring System. - Supporting the start-up of the ADU.	***Vulnerability context:*** *Refer above* **Intent to address identified vulnerabilities:** This component is designed to facilitate the shift from water thirsty to water thrifty crops to help Sindh better cope with potentially reduced future water supplies. The component will help farmers implement climate smart agriculture practices and build climate resilience by producing more from less water. **Explicit link between identified climate change risks and specific project activities:** This component will provide support, which could include subsidized seeds for selected crops and direct income, to small farmers growing water-thrifty crops. This will increase productivity, reduce water use, enhance the climate resilience of the agriculture sector, and contribute to food security for Pakistan. *Sub-Component 3.1* will finance agriculture-related investments at the WCA level within the FO, such as on-farm water management improvements, selective use of high-efficiency irrigation systems (HEIS), land leveling, drainage improvements, and training on climate smart agriculture practices. These practices include ridge sowing, crop rotation, green manuring, use of biological control agents, raised bed cultivation, alternate wetting and drying, use of	Studies have shown 18 per cent of the GHG emission in the agricultural sector in Sindh is from synthetic fertilizers, and 14 per cent is from manure left on pasture. The planned on-farm interventions will reduce the use of fertilizers and the open decomposition of manure in the pasture. Climate-smart agriculture (CSA) that will be implemented under Sub-Component 3.1, combined with community-based disaster risk reduction (DRR) measures, present opportunities to mitigate the risks of natural hazards and extreme events by reducing GHG emissions whilst simultaneously promoting production gains and resource use efficiency in both hazard and non-hazard situations.

	improved/certified varieties, mulching including retaining of crop residue, zero tillage, integrated soil fertility management, inter-cropping etc. These interventions are also recommendations of the Sindh Drought Needs Assessment Report and are aimed at increasing productivity with less water use, hence a climate change adaptation measure that will strengthen the response of Sindh's agriculture to climate shocks and climate change.	
Component	**Adaptation Action**	**Mitigation Action**
Component 5: Agricultural Flood Emergency Rehabilitation Component (*AG-FERC, US$107 million****)***		
	Vulnerability context: *Refer above* **Intent to address identified vulnerabilities:** This component will provide financial support to small and medium-sized farmers affected by the 2022 floods to reestablish their agricultural production, with an emphasis on the 2022-2023 Rabi crop. It will also finance supporting services provided by NGOs and consultants, as well as the incremental operating costs incurred by the Agriculture Department. The Rabi crop is usually sown in winter and harvested in the spring.	