ISSRA

SPECIAL REPORT

WATER SECURITY

AS THE CORNERSTONE TO ASSURED SUSTAINABLE ENERGY AND FOOD SECURITY DOMAINS

INSTITUTE FOR STRATEGIC STUDIES RESEARCH & ANALYSIS (ISSRA)
NATIONAL DEFENCE UNIVERSITY ISLAMABAD

Content

SPECIAL REPORT

WATER SECURITY

AS THE CORNERSTONE TO ASSURED SUSTAINABLE ENERGY AND FOOD SECURITY DOMAINS

Author: Mr. Adnan Pasha Siddiqui, Member – HBL Executive Committee and Head – Development Finance and Alumnus of Institute of Strategic Studies Research and Analysis (ISSRA), National Defence University (NDU), Islamabad

Introduction

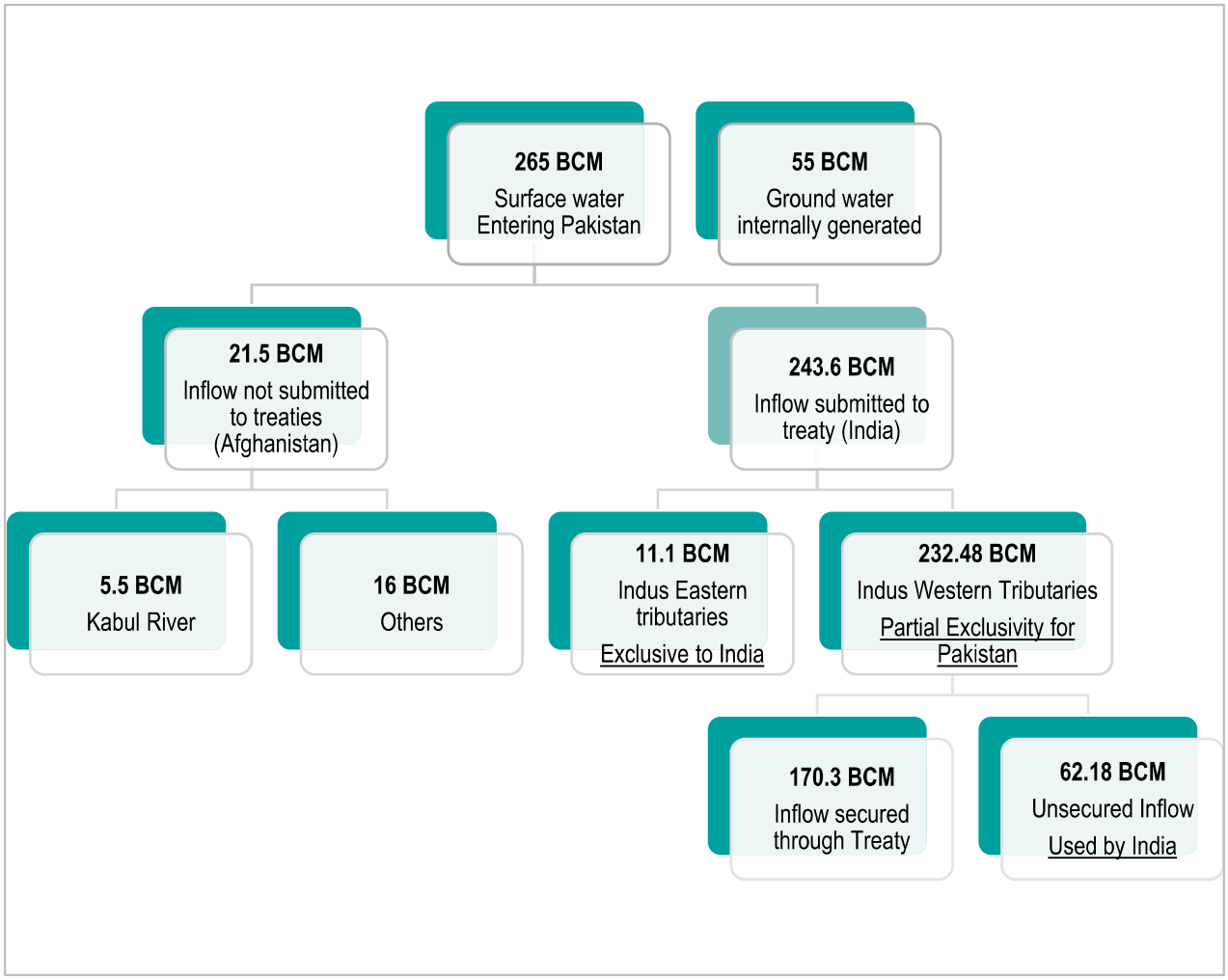
The foundation of **food security** rests on the availability of fresh water for irrigation, and hence the sustainability of agriculture is inextricably linked to water security.

Pakistan is considered a **water-stressed** country i.e., a country where the per capita availability of water stands at approx. **1000 m3**[1]. Without a dedicated initiative in the National Action Plan, the country is rapidly headed towards a "**water-scarce**" status by 2025[2].

The issue of **water security** has created *a compounded national challenge*; on the one hand, there is significant stress on freshwater resources, and on the other hand, significant pressure is put on the cultivation of Agricultural commodities, primarily the 4 strategic crops (Rice, Wheat, Cotton, and Maize) which itself can cause a national food security crisis.

Nature of the water security issue

Pakistan receives 265 Billion Cubic meters (BCM) of surface water via river flows from its bordering countries each year as shown in Figure 1. Of these total inflows, 246.8 BCM is the amount of



[1] Ashraf et al "Water Scarcity in Pakistan" – 2018
[2] Water Crisis in Pakistan: Manifestation, Causes and Way Forward – PIDE 2022

surface water via river flows from its bordering countries each year entering Pakistan. Submitted to an international treaty and of this amount, 170.3 BCM is secured through the Indus Water Treaty[3]. The detailed breakdown is shown below.

Note that Pakistan also has 55 BCM of groundwater that is generated internally through the Indus Basin Irrigation System and annual rainfalls. Most of this groundwater then flows back via base flow into the rivers. As such, there is an overlap of 47.6 BCM between the groundwater reserves and the surface water flowing in the form of rivers.

The total availability of renewable surface water in Pakistan is 191.8 BCM annually which constitutes 170.3 BCM of annual inflow secured through the Indus Water Treaty and 21.5 BCM of flow coming in from Afghanistan and not submitted to any treaties.

Combining the 191.8 BCM of annual renewable surface water and 55 BCM of annual renewable groundwater, the total availability of **renewable water resources** stands at **246.8 Billion Cubic Meters** (BCM). Figure 2 below shows the breakdown of resources as well as the key usage areas[4]:

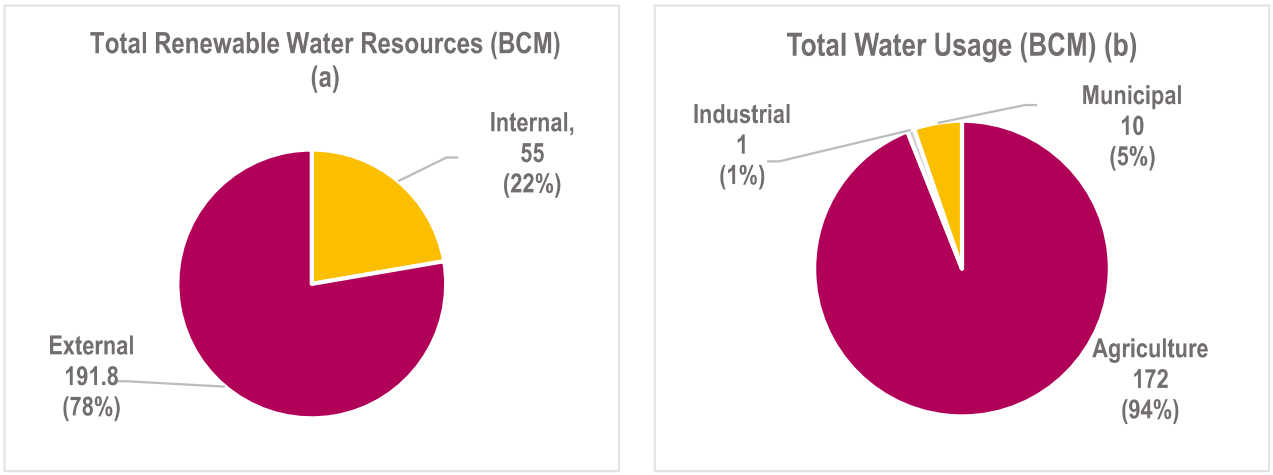


Figure 2. Total Renewable Water Resources (a) and Total Water Usage (b).

Figure 2 also clearly shows that Pakistan is mostly reliant on external renewable water (78%) i.e., the water coming from tributaries of the Indus (both Eastern and Western Tributaries) as well as rivers flowing in from the Northern side (including Kabul River).

Water Security for Pakistan – A "hostage-like" situation

Although the Indus Water Treaty (IWT) agreed upon in 1960 between Pakistan and India has certain areas of improvement required such as linking the flow of water into the lower riparian areas which have a food security dimension, there is no treaty or agreement in place for the 9 rivers and

[3] Country Profile – Pakistan – FAO AQUASTAT Report 2011
[4] FAO AQUASTAT – 2020

waters that flow from Afghanistan. Moreover, the components of the IWT itself contain evident inequities. Hence, there exist 3 major risks to water security exist at the moment:

- Eastern Tributaries of the Indus River – The eastern tributaries of the Indus River – Ravi, Sutlej, and Beas – are reserved exclusively for India's use. Around 11.1 BCM of flow enters Pakistan from these 3 rivers combined. The Sutlej River, irrigation water to key Agricultural zones in Central Punjab. As such, any blockage to the existing flow by India shall be detrimental to agricultural productivity within these key zones.
- Western Tributaries of the Indus River – Unlike India's exclusive reservation of the eastern tributaries, Pakistan does not hold exclusivity for the western distributaries Jhelum and Chenab i.e., out of the 232.5 BCM of water that flows in these rivers, Pakistan has exclusive rights to 170.3 BCM with the remaining 62.2 BCM being reserved for use by India. This represents a significant inequity in water allotment rights between both countries.
- Rivers flowing in from Afghanistan not secured – The 21.5 BCM of water that enters Pakistan from Afghanistan is not secured as part of any treaty and as such, there is no guarantee of continued water supply to Pakistan. Should Afghanistan choose to construct dams or other storage structures on these waters (including the Kabul and Kunar rivers), Pakistan may face significant disruptions in the water supply coming in from these rivers thereby further starving the Indus River System – and by extension, the Indus Aquifer – leading to an exacerbated water shortage.

Only 22% of the renewable water resources in Pakistan are internal i.e., groundwater in various aquifers, the largest of them being the Indus Aquifer. These groundwater sources are themselves primarily reliant on external freshwater from the Indus River System, to be recharged yearly.

On the other end, total usage stands at a startling 74%. On a deeper inspection, Agriculture stands out at the top, comprising 94% of the total freshwater usage. Municipal (5%) and Industrial (1%) usage comprise the remainder of the consumption.

Furthermore, the efficiency of Agricultural water usage stands at approx. 40% which means that for every 10 liters of water supplied, only 4 liters end up being used by the crop, with the remaining 6 liters being wasted along the way, owing to a variety of reasons.

While an initial assessment leads to the apparent conclusion that Pakistan's water security issue is a purely resource constraint, in reality, the actual reason is inefficient water management. Since Agriculture constitutes the bulk of water usage, it is also the primary area that leads to the greatest loss of fresh water. The Indus Basin Irrigation System comprises over

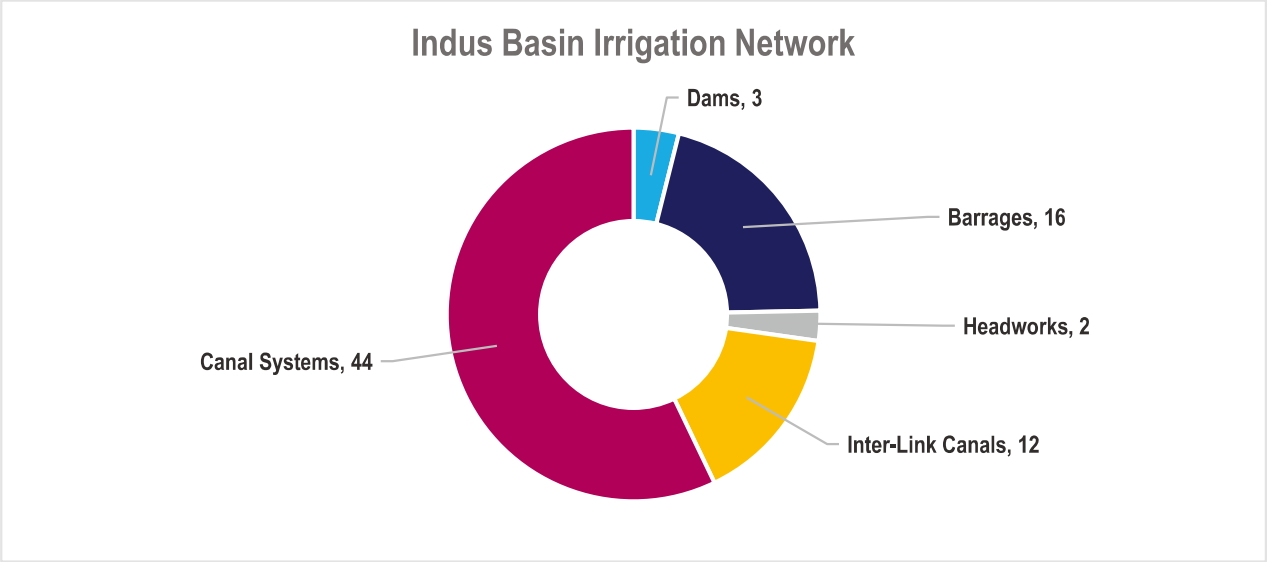


Figure 3. The details of the Indus Basin Irrigation System.

56,000 km of Canals and 1.6 million km of Watercourses as shown in Figure 3. The core components of this system are shown below[5]:

Neither the main Canals nor the inter-link Canals that constitute the bulk of the irrigation water flow are lined. This has led to significant seepage of freshwater i.e., out of the 143 BCM of freshwater available in this network (as of 2018), only 78 BCM (54.5%) ends

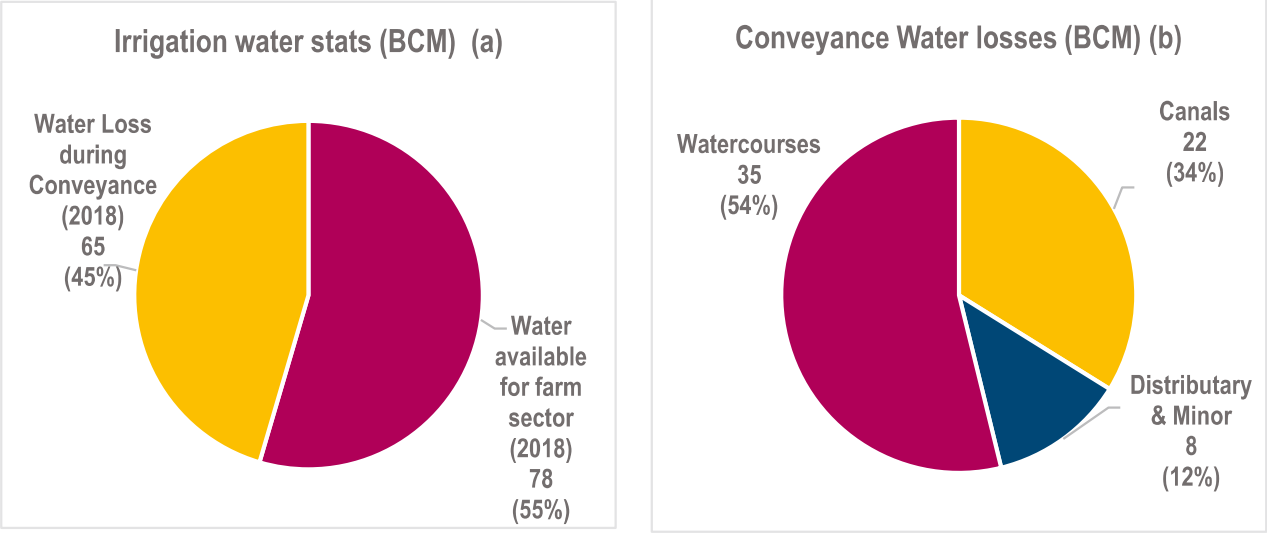


Figure 4. The details of Indus water Stats (a) and conveyance water losses (b).

[5] Simi Kamal, Conference on the Future of Water for Food – University of Nebraska Lincoln – 2009

At the Farm gates as shown in Figure 4(a). The remaining 65 BCM (45.5%) is lost in conveyance along the canal network (Figure 4b). A more detailed breakdown of the overall losses is also shown in Figure 4[6].

This reveals the true nature of water security problems in Pakistan; it is an efficiency issue rather than a resource constraint. Furthermore, losses at the field level are primarily due to improper land leveling and inequity in water distribution with more water going towards the farms located at the beginning of the watercourses and a limited water supply at the tail ends of the canal network.

In response to the supply reductions caused by water seepage, farmers rely more on Tube wells to pump enough water for proper crop irrigation. This comes with its issues mainly in the form of rapid depletion of the groundwater level and increased soil salinity.

Actions needed to address the challenge of Water Security

Given the preceding analysis on the nature of water security within Pakistan, certain actions need to be implemented in the immediate future to ensure that the problem is not exacerbated further.

- **Implementation of a comprehensive, real-time online water monitoring system –** It is crucial to establish an inventory of existing surface and groundwater resources with real-time monitoring of water flow along the Indus River System as well as the Canal Network. This will allow for accurate and real-time assessment of water losses throughout the system and identification of key areas where such losses occur, leading to more targeted remediation measures.
- **Reduction of wastage along the Canal Network –** A major effort has to be mobilized to ensure that the existing canal network is lined and maintained – mainly the Canals, Link Canals, Distributaries, and Watercourses – promptly to prevent further seepage of fresh water.
- **Regulation surrounding the installation and use of Tube Wells –** A regulatory framework needs to be drafted surrounding the use of Tube Wells with rigorous monitoring of the groundwater table along the Canal Network to ensure that an adequate level is maintained and the salinity of the soil does not increase beyond defined thresholds. It is expected that with the increased lining of the Canal System leading to lower seepage rates, the supply of surface water to farmlands will increase, leading to lower dependence on tube wells, except where farms are further away from the heads of canals.
- **Ensuring Laser Levelling as a Mandatory Requirement and Subsidization of Laser Levelling Services –** Laser leveling of land should be made a requirement for farming purposes for farms larger than [100] acres, and the cost of such services should be subsidized primarily for subsistence and below-subsistence level farmers i.e., farmers with land holdings

[6] Ashraf et al "Water Scarcity in Pakistan" – 2018

of less than 10 acres (Owned land + Leased Land). Proper Laser Levelling will allow for efficient water delivery to crops and better water drainage, leading to lower water logging and soil salinity levels.

- **Enhancing existing water storage capacity through the creation of an organized water storage system alongside riverine and in torrential hills –** Rainwater constitutes an additional and yet, un-tapped source of freshwater for Pakistan. Currently, the country receives an average annual long-term rainfall of 393 BCM p.a[7]. This amount alone constitutes more water than what is currently available throughout the Indus River System and the Indus Basin Aquifer. By creating more natural storage mechanisms alongside the riverine and the torrential hills (which often tend to get flooded during the monsoon season), the country can become more adapted to the expected extreme Climate Change events such as floods and droughts. During prolonged droughts, water stored within these sources can be utilized for crop irrigation and municipal supply to households, public sanitation, and industries.

Increasing the water productivity of Agriculture

The current population of Pakistan, which stands at 240.5 Million, is expected to grow to 403 Million by 2050[8]. Given this ticking time bomb of population growth, ensuring higher Agricultural productivity is paramount if Pakistan is to avert an impending food security crisis.

However, to ensure food security, Pakistan needs to ensure water security that can be further fine-tuned through water efficiency in agricultural use since agricultural productivity is inextricably linked to water security.

To illustrate the above, a dollar value "per-drop" analysis in Figure 5 shows the major crop inefficiencies in the way the current agricultural setup operates in Pakistan[9].

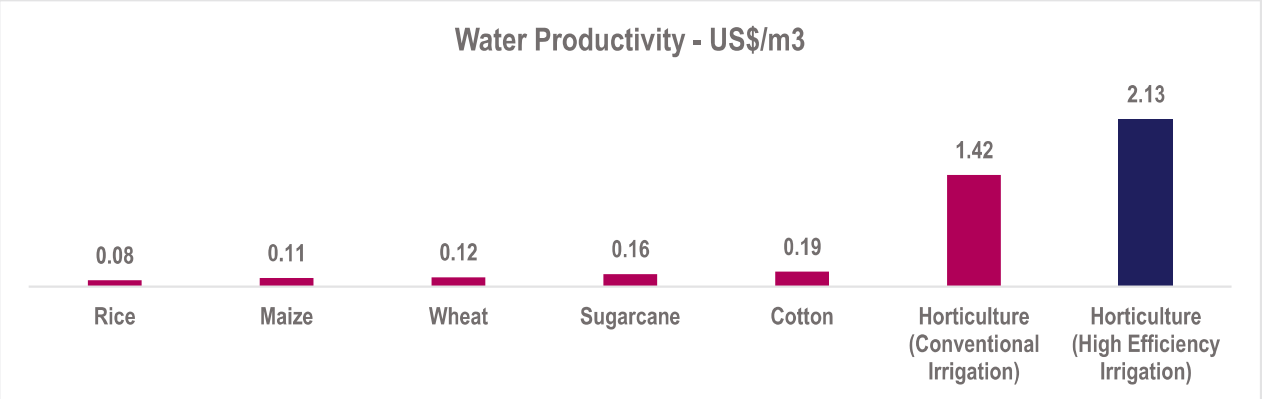


Figure 5. crop inefficiencies impacting agricultural setup in Pakistan.

[7] FAO AQUASTAT 2020
[8] UNFPA 2023
[9] The State of Pakistan's Agriculture – PBC 2023

Figure 5 also shows that sugarcane is of significantly lower value in comparison to cotton and horticulture (legumes, etc.). It is also the latter two crops that bring significant export potential in the form of value-added exports.

As such, targeting the root causes of these inefficiencies is of prime importance in restoring water balance and alleviating the stress on the current renewable water resources of Pakistan; while also increasing agricultural productivity and exportability.

Recommended actions for enhancing Agricultural productivity

- **Disincentivization of Sugarcane Cultivation –** Sugarcane is neither a food staple of strategic importance nor an export driver like Rice as such measures should be taken to de-incentivize its cultivation.
    a. Sugarcane causes significant damage to the soil – repeated cultivation in the same soil can exhaust soil nutrients,
        i. Replacing Sugarcane with sugar beet is a good option as it has a 6-month crop cycle with a similar yield
        ii. Intercropping with legumes (which have a crop cycle of 4 months) for restoration of soil nutrients.
    b. Excessive consumption of Sugar leads to an elevated risk of Diabetes which is an area where Pakistan ranks significantly higher than the world average (Pakistan's prevalence of the disease is 30.8% vs. the global average of 9.8%)[10]
- **Introduction of Farming Preferences as a National Mandate –** Farming preferences should be mandated at a national level (as water and food security are strategic matters of paramount importance) and thereafter, disseminated across Provinces, Divisions, Districts, Tehsils, and ultimately at the Village Council level. These Farming preferences should be based on the impact of the crop on National Food Security with crops such as Wheat, Maize, and Rice being given strategic preference. Once the required Acreage for ensuring food security has been allocated, cropping preferences on the surplus acreage should be assessed from their relative Dollar value potential that can be generated in the form of Exports (including value-added exports) per unit of water consumed. In addition to this, Taxes can be introduced at the processor level with the aim of de-incentivizing the production, sale, and processing of high water-intensity and low-export-value crops.
    a. Rice is exportable and commands a premium for Basmati varieties hence Non-Basmati varieties should only be grown in areas where water availability from canals is higher

[10] Diabetes Atlas, International Diabetes Federation – 2021

b. Horticulture should also be given due importance as it holds significant potential both in terms of higher water productivity and in significant exportability in the form of value-added products.

- **Overhauling the value chain for core crops like Wheat and Cotton –** Through the use of better-quality seeds, a more efficient storage mechanism, and a stronger focus on the marketing setup, significantly more value can be derived from these core crops, while also ensuring national food security in the case of Wheat.
- **Redirection of government spending towards more equitable support for farmers and investment into key areas impacting Agricultural productivity –** Agricultural Subsidies should be more effectively targeted towards subsistence farmers i.e., farmers with land-holdings of less than 5 acres and who cultivate primarily on leased land. At the same time, structured investment into agronomic research, cold storage supply chains, and food quality/safety is a must if this sector is to be revamped for greater productivity and enhanced economic value in the long run.

INSTITUTE FOR STRATEGIC STUDIES RESEARCH & ANALYSIS (ISSRA)
NATIONAL DEFENCE UNIVERSITY ISLAMABAD