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OCCASIONAL PAPER



Future Climatic Impacts on Water: Policy Options for Ensuring Food Security in Punjab

LEAD Pakistan

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Acknowledgement

LEAD Pakistan developed this research brief as part of its efforts to draft a provincial climate change policy for Punjab, aligned with the National Climate Change Policy of 2012. This study was carried out through the support of Oxfam Novib . The paper is part of a series of studies on key sectors that are ancillary documents to the Climate Change Policy Punjab. Planning and Development Department (P&D) and Environment Protection Department (EPD) of the provincial government provided support in systematically executing this project, through a participatory approach, ensuring consensus among all key stakeholders.

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List of Abbreviations and Acronyms

DRR	Disaster Risk Reduction
GOP	Government of Punjab
NCCP	National Climate Change Policy
PDMA	Provincial Disaster Management Authority
PGS	Punjab Growth Strategy



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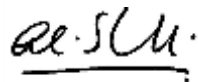
Foreword

This research brief is part of a series of research studies conducted by LEAD Pakistan, through support of Oxfam, to help better understand climate response related sector specific needs, with a special focus on the province of Punjab, Pakistan. The research aims to produce add-on information to complement the process of climate change policy development in the sectors most relevant to and critical for effective climate change response in the Punjab province. It aims contributing to development of Provincial Climate Change Policy, aligned with the National Climate Change Policy of 2012.

The series includes the studies titled Food insecurity under self-sufficiency: The Climate-Food-Tenure Nexus; Resilient and sustainable urbanization in Punjab; Disaster risk reduction strategies and the climate change policy Punjab; Future climatic impacts on water: Policy options for ensuring food security in Punjab; Role of government in making a transition to climate compatible development; Embedding Sustainable Development Goals in Punjab's Climate Change Policy and Impacts of climate change on the energy sector of Pakistan: With focus on Punjab.

This research brief titled 'Future climatic impacts on water: Policy options for ensuring food security in Punjab' outlines the nexus of food, water and climate change in the context of policy decisions relating to climate change. The link between climatic impacts, water scarcity and food security is the most pronounced in Punjab. With its growing population and its rising needs for water and food, the province risks vulnerability with a future marked by climate unpredictability and water insecurity. The paper attempts to highlight the impacts of climate change on Punjab's water resources, the intrinsic link between climate change, water and food security for Punjab and potential tradeoffs arising through stresses from multiple uses of water, such as urban, energy, environment, agriculture and health etc.

Informed policy options for ensuring food security in Punjab, in perspective of future climatic impacts on water has become an essential prerequisite to help ensure food security, despite climate change impacts and water scarcity – for it can help cope with the challenge.



Ali T. Sheikh
CEO, LEAD Pakistan



Abstract

The National Climate Change Policy (NCCP) of Pakistan stipulates, as one of its main objectives, 'to ensure water security, food security and energy security of the country in the face of the challenges posed by climate change'. According to NCCP, 'Water resources are inextricably linked with climate; this is why the projected climate change has such serious implications for Pakistan's water resources'. More than 95% of Pakistan's fresh water resources are used in agriculture (ADB, 2007). Climate change induced impacts on water significantly affect Pakistan's agricultural productivity and food security, due to predominant use of water in agriculture sector. The link between climatic impacts, water scarcity and food security is highly visible in Punjab. With its growing population and rising needs for water and food, the province risks vulnerability with a future marked by climate unpredictability and water insecurity. Findings of the literature review and situation analysis conducted as part of this research study highlight the likely impact of climate change on Punjab's water resources, the intrinsic link between climate change, water and food security for Punjab and the potential tradeoffs arising through stresses from multiple uses of water. It also suggests a way-forward in the form of a set of policy options for the Government of Punjab.

Background

This research paper outlines the nexus of food, water and climate change in the context of policy decisions relating to climate change. In the case of Pakistan, the emerging water crisis emanating from climate change impacts has transformed into a core climate change challenge. According to NCCP, 'Water resources are inextricably linked with climate; this is why the projected climate change has such serious implications for Pakistan's water resources'.

In terms of numbers, Punjab hosts 74.1% of the total irrigated land of Pakistan and supplies more than 50% of Pakistan's total agriculture output (Punjab Development Statistics, 2014). A large portion of Indus River basin, main source of fresh water and key irrigation artery across Pakistan, runs in Punjab. This province, employing a complex and extensive surface irrigation system, uses most of its fresh water available for irrigation purposes; and is the major contributor towards national agricultural output. Since Punjab contributes to a significant proportion of the food related requirements of a majority of the country's population, it is known as 'breadbasket' of Pakistan.

However, irrigation efficiency of farming practices in Punjab is one of the lowest in the world ('Pakistan's water economy running dry' by John Briscoe and Usman Qamar World Bank 2006).

Our water situation is severely threatened by climate change, as it is due to inefficient use of water in the agriculture sector and water pollution.

Problem Statement

Water resources of Pakistan are mostly

glacial fed (Ali et al., 2009). A rise in temperature or changes in snow and precipitation cycles, that fuel our glaciers, will be devastating for Pakistan (Farooqi et al., 2005). In terms of water use, agriculture commands the major share. On top of exploiting the foremost share of available water resources, irrigation practices in Pakistan are highly inefficient. Overall, irrigation efficiency in Pakistan is approximately 40%, and agricultural productivity is one of the worst globally (Amir, 2005). With a bulging population and demands from multiple uses – such as energy, urban, environment, health, industry etc. our present situation of copious agriculture water use is untenable, at best. Moreover, to make matter worse, climate change induced uncertainty is projected to seriously and adversely impact Pakistan's water resources and agriculture productivity (Laghari et al., 2012; Zhu et al., 2013). However, remedial measures, such as introduction of water efficiency in our agriculture systems (from conveyance systems to on-farm irrigation practices) can significantly contribute to offsetting this impact.

The link between climatic impacts, water scarcity and food security is most pronounced in Punjab. With its growing population and its rising needs for water and food, the province risks vulnerability with a future marked by climate unpredictability and water insecurity. The paper attempts to highlight the impacts of climate change on Punjab's water resources, the intrinsic link between climate change, water and food security for Punjab and potential tradeoffs arising through stresses from multiple uses of water, such as urban, energy, environment, agriculture and health etc.



Global Context

The global demand for water has tripled since the 1950s and at the same time the supply has become unpredictable due to a changing and increasingly uncertain climate (Gleick, 2003). Climate change impacts on water resources, water cycle and affiliated water related hazards and disasters are affecting development globally. Changes in water availability and occurrence of extreme

events, such as water related disasters, will adversely impact agriculture and will translate into global food insecurity (Hanjra & Qureshi, 2010). A staggering 80% of all globally available fresh water resources are devoted to irrigation (Molden et al., 2007). With such a massive allocation, water scarcity and its impacts on agriculture have already emerged as a major challenge globally (Fedoroff et al., 2008).

Water Scarcity is Among the Greatest Challenge faced by Pakistan

The looming threat of water scarcity is an issue that is rarely talked about in Pakistani politics. Yet it constitutes one of the biggest challenges to Pakistan's survival. With a projected population of 263 million in the year 2050 (United Nations 2012), Pakistan needs to put serious thought into how it will provide adequate water for agriculture, industry, and human consumption in the face of rapidly dwindling reserves. The Himalayan glacier, whose ice melt replenishes the Indus River's annual freshwater, is receding by about one meter - the approximate equivalent of 3.3 feet - per year, due to global warming (Kamal 29). This phenomenon has had a staggering impact on Pakistan's water availability. In just 1950, Pakistan had around 5,000 cubic meters (m³) per capita per year of freshwater resources. In 2002, its supplies shrunk to only 1,500 m³. To put that number in perspective, around 1,000 m³ is when a country is declared water scarce.

However, other factors, such as terrain, development status and priorities also count for, in region specific situations. For example, Balochistan has over 2000 cubic meter per capita per year of available water. However, water situation in that part of the world is much worse than Punjab, which has the lowest water per capita in Pakistan.

<http://www.americanpakistan.org/#!pakistans-biggest-challenge/cai3>.

Despite the importance of water for global food security, the agriculture uses of water are coming under increased scrutiny (Brown and Funk, 2008). A continued increase in the non-agricultural uses of water, such as for urban, industrial, environmental consumption and health are raising very real questions of tradeoffs regarding competing water uses in an era of climate change induced water scarcity.

Gender, Water Security and Climate Resilient Development

Gender equality and women's empowerment goals are part of the cornerstones of the principles for improved water security and climate resilient development. Women are the most likely to suffer from climate change impacts, such as floods and droughts. But they are also the most capable of creating change and adaptation within their communities. Women play a pivotal role in the provision, management and safeguarding of water and these roles need to be reflected in the policy and institutional, arrangements for the development and management of water resources.

(http://www.gwp.org/Global/About%20GWP/Publications/CDKN%20publications/SF_WaterSecurity_FINAL.pdf)

Situational Analysis

Review of Government of Punjab Policies/Plans/Strategies

The impacts of climate change on water and in turn on agriculture and food security are real and based on well-founded research and evidence. South Asia in particular is highly vulnerable to the impacts of climate change (Sivakumar and Stefanski, 2011). Various studies, including Akhtar et al. (2008), Ali et al. (2009), Immerzeel et al. (2010) and Tahir et al. (2011) document the impacts of climate change on Pakistan's water resources. Both minimum and maximum temperatures have increased (Afzaal et al., 2009; Rasul et al., 2012). This rise in temperatures is also triggering intense and frequent heatwaves, and increasing the demand for water for human consumption and agricultural use. Climatic stressors on water in Pakistan translate into negative impacts on agriculture, and immense affects on the irrigation systems (Sultana et al., 2009).

Punjab contributes to around 57.3% of Pakistan's agricultural cultivated land and 74.1% of total irrigated area (Punjab Development Statistics, 2014). Accordingly, Punjab has a significant share in the key agriculture outputs of Pakistan – wheat (76.8%), rice (62.8%) and cotton (73.1%), thus putting Punjab at the center of Pakistan's food security prospects (Punjab Development Statistics, 2014).

To plan for Punjab's water and food needs in a changing climate, there is a need to develop a comprehensive, over-arching climate change policy aligned with the National Climate Change Policy (NCCP) and integrated with a policy on agriculture water-use efficiency. As a prerequisite for informed policymaking, it is essential that we understand the impacts of climate

change, based on empirical evidence, as to how it relates to water availability and agriculture productivity and for that matter food security.

In Pakistan, most of the climate change related research is carried out at the macro level. Alongwith studies on macro level impacts of climate change in Pakistan, there is a growing need for research at the sub-national level, with an added focus on impact of climate change on water and food security in Punjab. Pioneering work by Hanif et al. (2010) and Sajid et al. (2014) on Punjab supports the argument that climate change will have a considerable negative impact on agriculture productivity. Furthermore, according to Mahmood et al. (2012) and Ahmad et al. (2014a; 2014b), under these broader climatic impacts, rising temperature and the decreasing availability of water are significant factors affecting production and productivity of major crops, such as rice and wheat in Punjab. The rise in temperature can result in decline in productivity by affecting the growing patterns of the crops.

At present, there is no climate change policy in Punjab, and at best, climate change has been given sparse attention in various provincial policies, growth plans and strategies. The Punjab Environmental Protection Act, 1997 (Amended 2012) somewhat considers topics related to environment, pollution, emissions, water, atmosphere, ecosystems and damage to biodiversity. However, the phrase 'climate change' is not even used once in this document. Nonetheless, other official documents, such as the Punjab Growth Strategy 2018 and Draft Punjab Environmental Policy, 2015 do have specific references to climate change. Following is the summarized outcome of the review of

aforementioned documents:

The Punjab Growth Strategy 2018 does bring the government's focus on climate change to the fore. According to the Punjab Growth Strategy 2018, the Punjab government will focus on 'improving land resources and environment by tackling water logging, improving soil quality, and mitigating the impact of climate change'. The link between climate change, water and agriculture is also highlighted. In the section on issues and challenges, the strategy document recognizes food security as a major challenge, and mentions water security and climate change as an integral part of any strategy addressing food security (Punjab Growth Strategy, 2018). Moreover, under the section titled: 'Improving Agricultural Productivity and Market Access', there are sub-sections titled 'Improving Land Resources and Environment and mitigating the impact of Climate Change' and 'Adapting to Climate Change' (Punjab Growth Strategy, 2018). Under these sections, the Punjab Growth Strategy, 2018 recommends agriculture and water related initiatives, such as accurate weather forecasts, investigates changes in cropping patterns, researches crop varieties, and promotes high efficiency irrigation system, prudent water demand management, expansion of water storages and rain water harvesting.

Climate change discussion features prominently in the Punjab Environmental Policy Draft, 2015, as well. In its preamble, the draft policy stipulates, 'The Punjab Environment Policy 2015 provides an overarching framework for addressing the environmental issues facing Punjab, particularly pollution of fresh water bodies, air pollution, and lack of proper waste management, deforestation, loss of

biodiversity, desertification, water logging, natural disasters and climate change.' Furthermore, explicit reference to climate change is made in topics, such as 'Key Environmental Challenges: Causes and Impacts, Desertification and Climate Change and Ozone Depletion.'

Moreover, specific actions are mentioned in the Draft Punjab Environmental Policy, 2015 such as:

- Devise and implement the Punjab Climate Change Policy and Action Plan
- Identify key vulnerabilities of the province and areas to be affected by climate change, in particular impacts on water resources, forests, agriculture and health.
- Assess the need for adaptation to future climate change, and the scope for incorporating these in relevant programmes, including watershed management, forestry management, agricultural technologies, practices, and health programmes.

Identification of Key Players

In Punjab, there are 42 government departments, dealing with various sectors and sub-sectors. The subject of climate change, being a cross cutting theme, cannot be restricted to a particular department or sector. As discussed in the previous sections, climate change will increase stress and induce uncertainty in Punjab's available water resources, thus creating a situation of water insecurity in the face of multiple demands. These multiple demands necessitate the inclusion of multiple stakeholders in devising an inclusive climate change policy, from water and food security perspective.

Following are some of the players/departments in the Government of Punjab (GOPb), which needs to be engaged

as key stakeholder in the climate change policy formulation process:

- Agriculture
- Irrigation
- Disaster Management (PDMA)
- Environment Protection
- Food
- Planning and Development
- Housing, Urban Development and Public Health Engineering
- Forestry and Wildlife
- Livestock and Dairy Development
- Health and Public Health Engineering
- Science and Technology

Policy Options

Allocate Budget Line Items to Ensure Water and Food Security: There is an urgent need to allocate resources for climate resilient development in Punjab, commensurate with its vulnerability to the emerging water and food crises. Water is a cross-cutting issue and needs to be integrated into the planning and sub/sectoral actions across the board. Whereas, devising an informed provincial climate change policy is a starting point, detailed action plans and specific budget allocations alone will demonstrate political will and ensure implementation and envisaged outcome of climate change policy and strategies.

Policy options should include policies, which financially benefit the farmers (biggest users of water), if they adopt efficient means of irrigations. Unless a policy outcome has an economic engine to pull it, such an outcome will not remain sustainable. Policy outcomes, therefore,

should be linked to an economic model, which will drive it into future.

Improve Distribution of Water Related Information: Information is the key. It enables farmers to make well-founded and logical crop plantation decisions. Current sources of information dissemination related to climatic impact in water are not effective. Information flow should be efficient, widespread and information needs to be available at zero cost (Mahmood et al., 2012). Investing in accurate information generation, dissemination and creating awareness will facilitate adaptation to climate change. Development of web portal can help facilitate dissemination of such information.

Develop Institutions to Foster Water Security: Poor countries and their citizens will be



most impacted by climate change due to a lack of strong institutions (Madzwamuze, 2010). As such, a strong institutional base for research, policy formulation and implementation is required (Iqbal et al., 2014) to implement key enabling features, such as access to credit, water pricing, land tenure systems and legal frameworks, which are essential for developing resilience to climatic impacts on water and food security. Furthermore, any institutional development and implementation should be preceded by collaboration and consensus building among all relevant stakeholders (Aberman et al., 2013).

Integrate Drainage and Irrigation to Control Salinity and Water Logging: Vast stretches of land are lost to salinity and waterlogging in Punjab, making it one of the biggest impediments to increasing crop production and attaining food security. Absence of proper drainage system chokes the Indus Basin's massive irrigation structure, through water logging and salinity (Qureshi et al., 2008). Adding to the problem, largely inefficient irrigation practices result in extensive usage of groundwater, to supplement surface water supplies, thus upconing saline groundwater (Shah, 2007). There is a need to integrate an extensive drainage system with our irrigation system. Furthermore, according to Qureshi et al., 2008, farmers need to be educated on these aspects, through extension education service. They also need to be equipped with the skills to reclaim salt affected lands, through physical, chemical, and biological

approaches. Projects worth billions had been implemented to improve drainage (aka SCARP Projects). These projects only treat the symptoms (water logging) and ignore the cause (over irrigation). Investments in irrigation methods/technologies which prevent deep drainage are the only viable and sustainable options to get rid of water logging and salinity on permanent bases.

Invest in Female Education: Education enhances the capacity of women to improve management of water. Integrating a gender perspective is thus an important consideration, while devising Punjab's climate change policy.

Develop Early Warning System(s)-EWSs: There is an urgent need to introduce early warning system related to climate change, on issues such as droughts, flooding and food insecurity. This will enable stakeholders to take necessary measures in advance to minimize associated risks.

Research Options

Improve Water use Efficiency and Agriculture Productivity: Despite the extremely high consumption of Pakistan's available fresh water resources in irrigation, only 40% of the requirement is met by the Indus River Basin.

The rest is filled by precipitation and extensive groundwater pumping (Ringler and Anwar, 2013). Inefficient irrigation system is the root cause of this high water use. This situation is not tenable, in the face of rising demands and

climate change induced water shortages. We need to invest in research to improve water efficiency and agricultural productivity (Zhu et al., 2013), instead of focusing on building dams, in order to meet water and food requirements of the province.

Develop Heat and Drought Resistant Varieties:

There is evidence of temperature and precipitation changes negatively impacting agriculture. Development of heat and drought resistant varieties of cultivated crops will build resilience to climate change (Hanif et al., 2010). Research and development is needed to evolve more responsive; heat tolerant crop varieties, which can economize water intake; and are resistant to biotic and abiotic stresses; and less prone to viral attack (Ahmad et al., 2014a; 2014b).

Develop Water Centers of Excellence In

Universities: Evidence based research on climate change, water and food security, as identified in the National Climate Change Policy 2012, needs to be conducted in the provincial universities. The research should have a provincial focus, where context specific vulnerabilities are identified and required strategies are devised to build adaptive

capacity. An efficient coordination and collaboration mechanism needs to be forged in this regard, among relevant development, academic and research institutions. The centers of excellence on water must be fully integrated with other disciplines, such as sociology and economics, to develop holistic perspectives on water issues. A multi-disciplinary team, thus can be more productive.

Develop Compensation and Support Strategies

for Farmers: Financial support and access to financial markets is needed in a non-disaster context to aid adaptation in a long term sustainable development perspective, and in a disaster context to help the disaster risk management, by supporting prevention, preparedness and resilience (pre-disaster perspective), and to help the emergency response, reconstruction and recovery (post-disaster perspective). Research is needed to develop compensation strategies, including disaster insurance mechanisms, as a safety net to improve farmers' resilience to water related disasters. Cash transfers for social protection of the vulnerable is an option in this regard.

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