



RESEARCH PAPER

Climate Change Vulnerabilities in South Asia: Prospects of Water and Food Security

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PAPER INFO	ABSTRACT
<p>Received: June 26, 2021</p> <p>Accepted: September 15, 2021</p> <p>Online: September 20, 2021</p> <p>Keywords: Climate Change, Food Security, International Security, Nexus of Climate-Water-Food South Asia, Threat Multiplier, Water Security</p> <p>*Corresponding Author: iramkrc.polsc@pu.edu.pk</p>	<p>Climate change is an emerging battlefield for international security. It has not just affected national security, rather endangered collective security of all states. It is a 'threat multiplier' which, after interacting with existing pressures, further complicates the problem. The nexus of climate-water-food security has unique importance in the most vulnerable South Asian region having approximately one fourth of the world population. The inappropriate handling of water and food security has become further sensitive due to continuous changes in the climate of the region. The long standing trans-boundary water conflicts and food deficiencies in the regions are further aggravated by rapid changes in industrialization, urbanization and economic growth. A qualitative approach to research is adopted in this study to assess the impact of climate change on water and food security in South Asia. Reports of different international, regional and national organizations have been used for analysis. The projections show that approximately 75% of the Himalayan glaciers are on retreat and will melt down by 2035. Thus, nexus of food insecurity and the non-availability of clean water will be explosive for under-developed and developing states in the region. The scarcity of resources demands adoption of integrated solutions for optimal utilization of available resources. The analysis of data shows that despite the understanding of complementary nature of water and food security, the governments in South Asia have tried to deal with these challenges in isolation and failed to address the problems. Therefore, besides strengthening the capacity of regional governments, regional cooperation is required to take initiatives to secure and improve water and food supplies and to mitigate the threats posed by climate change.</p>

Introduction

Climate change has emerged as the most significant global problem in the recent decade. The changes in climatic conditions have transformed the physical as well as biotic process of climate indicators. It is considered as one of the most significant security issues

of 21st century. It has more security implications than any other threat today. Impacts of this phenomenon are already apparent and intensity of effects is increasing rapidly in different parts of the world.

Profound changes happening due to climate change include a rise in sea level, famine, droughts, displacements, climate induced migration, floods and threats to critical infrastructure. In 20th century, the average temperature of earth has risen up by 1.4^oF and forecast for the next century shows a further rise of approximately 11.5^oF (IPCC, 2014). This climate change and global warming is caused by natural phenomena and human activities including the burning of fossil fuels such as oil and coal, CO₂ emissions, deforestation and agriculture (IPCC, 2015)

Climate change is attributed as a threat multiplier. It compounds the effect of challenges posed by increased urbanization, industrialization and other socio-economic issues. The projections show that due to changes in climate, this crowded and fast evaporating planet is going to face escalation in demand for scarce natural resources and supply of fresh water is top of the list (WEF, 2011). According to National Intelligence Council (2012), demand for water and food is expected to increase up to 40% and 35% by 2030. The irony is that poor regions of the world are the least contributors in the determinants of climate change but major sufferer of the climate effects because of their meagre resources (Mertz et al., 2009).

Water and food security plays a vital role in the achievement of sustainable development goals (Rasul, 2014; Rasul & Sharma, 2016). This issue, complementary in nature, has remained under discussion at research and policy forums due to continuous changes in climate and increasing trends in population growth (Pahl-Wostl, 2019). South Asia is the region with approximately one fourth of the world population, which is increasing by 1.5% per year. There is widespread poverty and human deprivation in the region as 46% of world's poor and 35% of the mal-nourished population lives in this region (Rasul, 2014; Rasul et al., 2019). More than 200 million residents are facing a shortage of food (FAO, 2017). Thus, scarcity of water and food due to changes in weather patterns are expected to exacerbate the existing socio-economic difficulties of the region.

The nexus of climate-water-food security can cause inter and intra state conflicts. These overlapping challenges interact and aggravate the severity of one another. Thus, this nexus has the capacity to intensify already existing tensions between and within states over depleting natural resources and growing population. The scarcity of food and water undermines basic quality of life and compounds social tensions, leading to conflicts and socio-political grievances. For example, the scarcity of water and food due to changing patterns of weather conditions spurred by changes in climate can escalate existing disputes; even turn violent in some scenarios. This threat multiplier role of climate change induced water and food scarcity can be especially dangerous for already fragile states having established history of conflicts and politicization over access and control of natural resources, as is the case of South Asian region.

The challenges posed by climate change cannot be mitigated by the efforts of any single country with whatever resources. Therefore, the world need to join hands together to take collaborative measures against this problem knowing no national boundaries (Adger et al., 2005; Duan et al., 2019). This study makes important contributions by

highlighting the interdependence of water and food security, and offers policy guidelines to manage this daunting challenge. Treating climate-water-food security as complementary nature of relationship is important, particularly in the context of an already vulnerable South Asian region. This research aims to answer the following questions.

- Why climate change should be considered as a security risk for South Asia and how it can cause conflict within and between different countries of the region?
- What are the future challenges to South Asian region in terms of water and food security?

Climate Change in South Asia

South Asia is the most densely populated region of the world. Other than vulnerability to climate change, this region is well known for its increasing population, degradation of natural resources, increasing poverty rates and human deprivation (Rasul et al., 2019). These challenges compounded by climate change make it the most vulnerable region in the world. The climate of South Asia is characterized by increasing frequency and intensity of extreme weather events.

According to United Nations Environment Program, South Asia is the most vulnerable region for climate change induced disasters and arming in South Asia will accelerate in 21st century. The climate forecasts for this region are extremely heterogeneous in nature, showing famine, prolonged droughts in some areas and floods in others. The five most acute issues related to climate change, that stand out in national vulnerabilities with security implications in South Asia include: the availability of freshwater resources, agricultural output, loss of territory because of rising sea levels, access to strategic minerals and climate induced migration (Mirza, 2011; Reuveny, 2007). These issues are deteriorating bilateral and multilateral political interactions among countries and creating different inter and intra state conflicts.

The effects of different climatic changes, explained in Table 1, show that natural resources including water are negatively affected. The recent conflict between two nuclear powers, India and Pakistan, based on control and distribution of water resources is an example of the sensitivity of water security (Hanjra & Qureshi, 2010). In addition, the occurrence of natural disasters due to climate change is expected to increase in the future and this will cause destabilisation in already feeble states of South Asia. Climate induced non-availability of clean water and access to food will be explosive for fragile South Asia countries.

Table 1
Impact of climatic changes in South Asia

Climatic Events	Observed Changes
Heat Waves	In recent years the frequency and duration of heat waves has increased causing significant increase in deaths due to heat stress
Intense Rains and Floods	Recurrent floods in Bangladesh, Nepal, and northeast states of India during 2002-04, floods in Surat,

	Barmer, and Srinagar of India during summer monsoon season of 2006, floods in southern region of Sri Lanka were triggered by 730mm rain.
Droughts	The El Nino event are responsible for more than 50% of droughts. The consecutive periods of droughts in 1999 and 2000 resulted in decline in water tables in Pakistan. Similarly, droughts in India in 2000 and 2002 affected crop yield and endangered more than 11 million people with starvation.
Cyclones/Typhoons	The change in climate have reduced the frequency of monsoon and cyclone formation in the Bay of Bengal and Arabian Sea since 1970, however, the increase in intensity of monsoon is causing severe flooding and damaging life and property.

Source: adopted from Sivakumar and Stefanski (2010)

Conceptual Framework and Methodology

This research revolves around the dilemma that humanity is facing in the current era due to major shifts in climate change. The changes in global climate are proving to be a security threat to not only the ecosystem but to the very existence of life on this planet. Security, in present times, not only means military security, but also human security. The broader view of human security, along with military security, takes up political, economic, societal and environmental challenges as responsibility of the state. This study strives to explain the significance of human security with respect to water and food challenges, particularly in South Asian region.

The concept of human security was incorporated in the field of international relations after the global Human Development Report in 1994 (Gómez & Gasper, 2013). This report raised concerns about the threats that are emerging in the interdependent factors of food, environment, politics, society and economies of a state to ensure their survival with dignity. People are the nucleus of the concept of human security, therefore, it is conceived as a universal issue, not restricted to regional boundaries. It is a way through which a threat is assessed before it becomes a crisis to humanity and requires a combined effort from every entity in the international community to ensure its prevention (Shinoda, 2004). Human security is thus defined as protection from chronic threats such as diseases, hunger, repression and emergence of any event affecting the daily life of people.

The changing global climate strikes hard on the human security. Massive destruction and loss of life due to bushfire in Australia is the most recent example of how explosive climate change could be. Moreover, from massive floods and hurricanes to end of water in Cape Town and from famine to droughts in African and Central Asia region, climate change induced water and food security has emerged as a challenge and threat to international community. South Asia is considered as one of the most fertile regions of the world and huge ranges of mountainous glaciers are the primary sources of water. The countries in this region are primarily agrarian communities. However, as a result of global climate change the speed of glacial melting has increased and weather patterns have become unpredictable.

This research is aimed at finding the challenges posed by water and food security under changing climatic conditions in South Asia. Qualitative research methodology is adopted to critically evaluate existing condition of the nexus of climate-water-food security. Statistical facts are obtained from different reports by international organizations working on climate change. Assessment reports from the Intergovernmental Panel on Climate Change (IPCC), UN-Water, the United Nations Framework Convention on Climate Change (UNFCCC), the Asian Development Bank, the World Bank, the World Economic Forum and several governmental documents are used for analysis in this research. The arguments are established on the basis of factual data in these reports. The findings of this study are expected to make significant contribution in explaining how to manage the challenge of water and food security in the most vulnerable region of the world. Moreover, this study will improve understanding about dealing with the threats of climate change in general.

Food Security in South Asia

The population of countries in South Asian region is approximately 1.86 billion and UN estimates suggest an increase of 25% by 2030 and a further 10% increase by 2050 (United Nations, 2019). The challenges of meeting the food demands—grain, dairy and meat—of the increasing population is a daunting task in South Asia. This task becomes stiffer in presence of hindrances occurring because of changing climate.

It is highly important to study food security in South Asia because 30% of the population facing food insecurity in the world is living in this region (WEF, 2011). The estimates of the World Bank suggest that 702 million people in the region are living in conditions of extreme poverty and even higher number—793 million people—is malnourished (World Bank, 2018). The issue of climate change will aggravate the problem of food security by creating water shortage, changing patterns of monsoon and increasing the frequency of extreme weather conditions. Therefore, countries in South Asian region should be ready to face the daunting challenges. The efforts should be made to slow down the changes in the climate conditions, however, governments should stay prepared for this challenge as climate change is inevitable and cannot be stopped. FAO (2017) has grouped effects of climate change on food security into four dimensions:

Food Availability

It means that the quantity and quality of food available will be negatively affected by climate change. The rising temperature has already negatively affected the staple crops yield. Thus diminishing crop yield and quality is expected to become more severe. The control over scarce food resources could be used as a strategic manoeuvring tool by states, thus compounding the severity of existing conflict.

Food Access

In addition to increase in food demand due to increasing population, the negative effects of climate change on the yield and quality of crops will disturb the supply and demand balance and decrease access to food. The increase in demand with decreasing supply of food will result in increased prices of major crops. Thus, in South Asia—a region with high poverty rates—the poorest people will have to spend more income to secure food

and meet their nutritional needs. Therefore, climate change is expected to significantly negatively affect the access to food.

Food Utilization

The regions which are already facing a shortage of food due to rising population and conversion of agricultural land into urbanization will reduction in availability and access to food. Rising population with compounded negative effect on food security will face reduction in calorie intake. Climate change is therefore expected to negatively affect the nutrition through food shortage and diversity in dietary patterns.

Food Stability

Increase in frequency and intensity of extreme weather events, due to climate change will make it difficult to strategize and meet the targets of food production. The prolonged droughts and variable precipitation is expected to negatively affect the availability of food. It will be difficult for countries to correctly project crop yield due to uncertain changes in weather. Growing population and uncertainty about food supply is expected to disrupt stability in supply of food.

South Asia has relied on its agriculture for a long time, but owing to the negative effects of climate change, the importance of this sector has started to decline not only with respect to GDP contributions but also in terms of labour force engaged in this sector (see Table 2 for details) (Douglas, 2009; Rasul & Sharma, 2016). The inability of countries in the South Asian region to combat the challenges of climate change has made it one of the most threat prone regions of the world (Mani et al., 2018). Moreover, industrialization as an engine of economic growth has also resulted in relative decline agriculture. Agricultural land is consumed for housing due to increased urbanization and households depending on income from farming only are now looking for diversification in sources of income. These changes have negatively affected the food productivity. However, still a huge set of population in South Asia depends on income from agriculture employment. Therefore, South Asia is expected to suffer in all these dimensions of food security.

Table 2
Food security and agriculture dependence in South Asia

Agriculture and Food Security Indicators				
Countries	Contribution of Agriculture to GDP (in percent)	Ag. Labour force as percentage of total labour force	Poverty headcount ratio at US\$2 a day (PPP)	Percentage of undernourished population
Afghanistan	40	59.8	-	-
Bangladesh	19.1	45.21	81.33	27
Bhutan	21.9	96.71	49.49	NA
India	19	55.75	75.59	21
Maldives	6	15.33	NA	NA
Nepal	32.9	87.73	77.57	16
Pakistan	20.4	41.33	60.31	26
Sri Lanka	13.2	47.27	39.74	19

Source: The data from World Development Indicators Database and UNCTAD handbook is used for these estimates.

The agriculture yield depends heavily on weather conditions. Climate change induced rise in temperature has resulted in an increase in dryness level and negatively affected wheat and rice production of South Asia. According to Sultana and Ali (2006), agriculture revenue is expected to decrease by 8.4% due to 2°C increase in temperature and 7% decrease in precipitation rate in India. Similarly, a 1°C rise in temperature will decrease wheat yield in India by 6-9%. In Sri Lanka a 0.5°C increase in temperature is expected to decrease the rice yield by 6%, whilst significantly negatively affecting the production of cash crops like coconut and tea. The projections in a study on Bangladesh agricultural yield by Shahid (2011) suggested that increase in temperature is expected to decrease the rice production by 8% and wheat yields by 3.2% by the end of year 2050. Similarly, a 0.5–1.5°C increase in temperature in India is expected to decrease the wheat and maize yield by 2-5%. The agriculture sector in Pakistan is already operating at temperature threshold and increase in temperature is expected to decrease the crop life cycle. According to reports of IPCC (2014), yields of cash crops including wheat, sugarcane, cotton and mango are relatively more vulnerable to changes in climatic conditions in comparison to rice.

The temperature threshold levels are already very close to maximum limit, therefore, even a minor increase can affect severely. A change in pattern of monsoons is expected to negatively affect the three-fifth rain dependent cropped area of South Asia. The poor people in the region are more severely affected because agriculture is their sole source of earning. According to Immerzeel, Ludovicus and Marc (2010), weather changes have negatively affected the crop yield in different states of Asia and such events of unexpected weather changes are likely to increase, thus increasing the risk of water and food supplies. Decline in food productivity and availability is the greatest challenge, which South Asia is facing right now. As a matter of fact, water and food are the first basic necessities of life without which life is not even possible. Malnourished hungry population is itself a threat to national and international security. Thus, existing inequalities in South Asian region will grow because of uneven effects of weather changes with comparatively severe effects on the widespread poor population.

Water Security in South Asia

According to UN Water (2013), water security can be defined as “the capacity of a population to safeguard sustainable access to adequate quantities of, and acceptable quality of water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability” (Un Water, 2013, P.7). The forecasts by World Meteorological Organization have suggested that by 2025 approximately 2/3 of the global inhabitants will be facing water stress. The variations and unpredictability of climate change is likely to escalate the frequency of extreme climate circumstances in the form of floods and prolonged droughts. Moreover, the water consumption is expected to increase due to the increasing population.

Thus, water security becomes even more pressing concern for vulnerable regions like South Asia. Even if the challenges posed by climate change are ignored, rise in urbanization, increasing population, poor management of water resources and lack of maintenance of infrastructure used for water supply are other significant reasons

demanding initiative for water security in a regions with one fourth of the world population. In this case, climate change will act as a threat multiplier and aggravate the intensity of this issue through variations in rainfall patterns, groundwater and freshwater shortage.

The challenge of water security grows even bigger in the pretext of agriculture dependence of South Asian countries (Khalid & Khan, 2016). The water resources here are overexploited by the farmers. Even without the effects of climate change, 15% of the groundwater in India is over exploited. Extraction of groundwater is also increasing in the region. More recently, in Hyderabad-India, the government banned digging wells to control the water extraction and overexploitation. Similarly, according to Reuters, a drop in groundwater level by three meters has been observed in the past 6 years in Pakistan. The farmers in Sri Lanka are facing similar problems.

A report by the World Bank with title 'South Asia's Hotspots' has identified the geographical regions where fresh water resources will be adversely affected by the environmental conditions in the region (Mani, et al., 2018). The megacities including Mumbai, Karachi, Kolkata, Dhaka and Chennai are identified as 'hot spots' due to changing weather patterns.

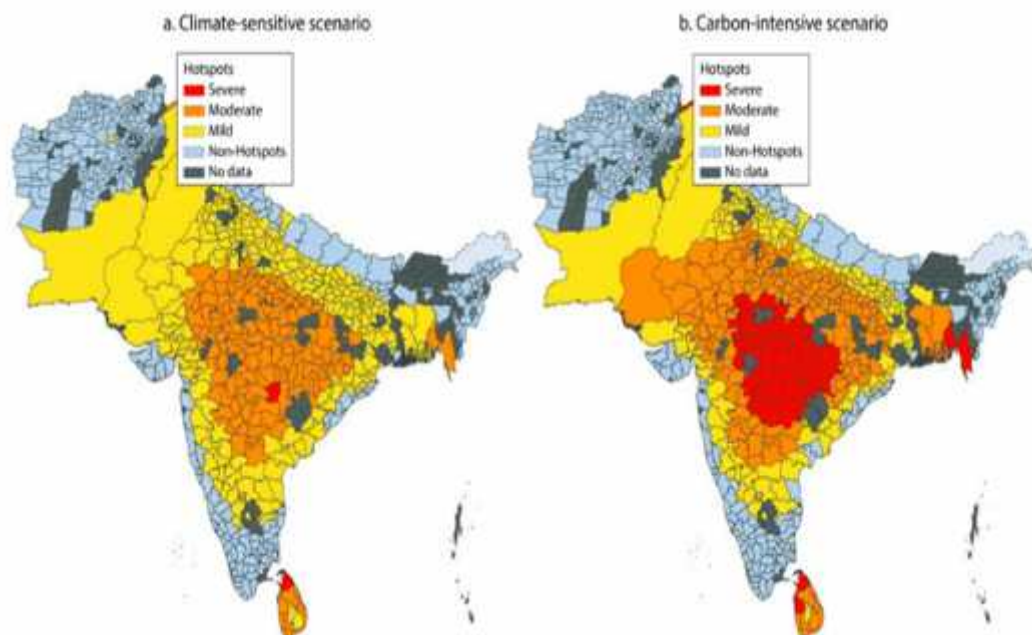


Figure 1: Hot Spots in South Asia by 2050 Source: adopted from Mani et al., (2018)

Glacial melting is a source of water supply in the dry season and a vast majority of agriculture based population of South Asia depends on it, especially arid areas with no access to deep ground water and water reservoirs. Therefore, changes in rainfall patterns due to changing temperatures are expected to have a profound impact on the water resources (Mirza, 2011).

The nine largest rivers, which are a source of water supply for more than 50% of the population of the world, depend on the ice mass in the mountain ranges of Himalaya-Hindu Kush (Khalid & Khan, 2016; Rasul, 2014). The accelerated glacial melt has filled the glacial lakes beyond their capacity in both Nepal and Bhutan and has resulted in Glacial Lake Outburst Floods. In Nepal, 20 glacial lakes have been reported as filled beyond their capacity, thus, a potential threat of Glacial Lake Outburst Floods (IPCC, 2014).

On the other hand, countries like Maldives which rely mainly on ground water to fulfil their fresh water needs are more vulnerable to water security due to changing climatic conditions. The rise in sea level is expected to increase the proportion of salt in fresh water in the low-lying islands of Maldives. Thus, regions with limited access to water resources are expected to face the greatest backlash of changes in climate. It has been reported by a number of studies that water resources in South Asia are depleting rapidly (Khalid & Khan, 2016). Therefore, especially during the El Nino event the effects of floods and prolonged droughts are expected to be more aggravating (Vogel, 2005).

Threats for South Asia, as reported in Table 3, show that dynamics of climate change are becoming more complicated over time. Reports suggest that reserves of blue gold are depleting at an alarming pace and this situation will trigger wars and conflicts between the states of this region. With a history of poisoned relation, this water scarcity challenge has potential to cause conflicts between India-Pakistan, India-Bangladesh and Pakistan-Afghanistan, which is a big threat to international security as this South Asian region is home to two nuclear powers (Ali, 2015).

Similar to what mentioned about the challenge of food security in South Asia, the changes in climate and increasing stress on water resources in the region shows that change is inevitable. Therefore, governments will have to deal with it, no matter what measures to slow down the rate of climate change are envisaged. This does not mean to discourage the efforts aimed at mitigating the rate of climate change, however, we should remain alert and ready to adapt for optimum utilization of available resources, whatever changes may happen as a result of climate change.

Table 3: Threat for South Asian countries due to climate change

	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Sea-level rise	-	✓	-	✓	✓	-	✓	✓
Glacier retreat	✓	✓	✓	✓	-	✓	✓	-
Temperature increase	✓	✓	✓	✓	✓	✓	✓	✓
Floods more frequent	?	✓	✓	✓	✓	✓	✓	?
Drought more frequent	✓	✓	?	✓		?	✓	?

Likely: ✓, Not Present: - Unknown: ?

Source: adopted from the World Bank (2009)

Main Findings

The temperature forecasts show that as compared to 20th century the climate of South Asia will be hotter in 21st century frequency of extreme weather conditions will

increase. Variations in precipitation will make it difficult to forecast the length and effects of monsoons in South Asia. The effects of climate change will be different with respect to location and human activity. Thus, frequency as well as severity of undesirable implications of climatic change will increase in the coming decade.

The increase in temperature levels in tropical regions of South Asia, already on the brink of temperature tolerance threshold, will directly affect the water reserves and groundwater besides indirectly affecting food security through changing moisture levels in the soil and increasing the likelihood of pests and other crop diseases. These changes will have significantly negative effects on agricultural activity and relatively more severe for rain-fed farmers with small parcels of land, and such farmers are in plenty in South Asia. Their lack of financial resources and limited technical capacity will make them vulnerable to the effects of changes in climate.

The Brahmaputra-Indus-Ganges-Jamna-Meghna delta could add volatility to the South Asian region, as most of the states in this region rely on these fertile and largest deltas for water supplies in rivers. This issue is more important because South Asian states already have issues on water sharing from these deltas. Although some intergovernmental agreements exist for water sharing but these accords are prone to conflict and clash due to lack of commitment and cooperation. Indus Water Treaty and Joint Rivers Commission are examples of it, but the durability and endurance remains uncertain. With water scarcity, depletion of fresh water resources and unavailability of water for agricultural purposes, South Asia can face severe human security issues in the near future.

It is important for the most vulnerable regions like South Asia to understand that negative effects of climate change on water and food security can aggravate the intensity of conflicts and trigger further instability, especially in threat-prone states. According to Mani et al. (2018) more than 50% of the South Asia population will be living in severe 'hotspots' by 2050. It is important to note that most of the 'hotspot' regions identified in this research were inland areas which are extremely vulnerable for inter and intra state conflicts over water and food supplies. Thus, climate change has the potential to add undesirable pressure to an already belligerent region. Therefore, instability in the region is more probable, if a joint action to curb the outcomes of climate change is not ensued. Our continued ignorance of impacts of climate change will make the conditions dire.

This research paper is a call for policymakers to think about the people living in 'hotspot' regions and follow the 'climate-sensitive' approach by taking collaborative actions to cope with the challenges posed by changing climate. Without a delay, it is needed to improve the understanding, of poor people living in marginal areas, about the effects of climate change. Moreover, training for adaptation to the changing climate should also be ensured to mitigate its effects. These steps will help in mitigating the issue for short term. However, the collaborative effort by all the countries in the region is the only long-term solution to mitigate the devastating impacts of this challenge knowing no boundaries.

Conclusions and Recommendations

The huge population, widespread poverty, agriculture dependence, arid and semi-arid land and lack of resources to cope with climate change are the main reasons why South Asia is under threat of disasters caused by climate change. A large poor population in the

region is facing a severe shortage of food and water. Governments need to understand the diverse and multiplying nature of the threats generated by this phenomenon. The interconnected nature of climate change, water and food security can increase the severity of existing socio-economic problems of the South Asian countries. Policy recommendations to mitigate the challenges of climate-water-food security nexus are given below:

- There is an urgent need to use multi-track diplomatic efforts to build an understanding about common benefits *vis-à-vis* costs of cooperation or non-cooperation among South Asian countries. The threat of climate change knows no boundaries, therefore states have to trust each other and take collective action for mutual benefits.
- The weaknesses of water management institutions in South Asia are evident in their lack of capability to develop and implement long-term plans. Deficiencies in technical, human and financial capability to adopt multi-sectoral, comprehensive plans to mitigate the effects of water shortage has compounded the nexus effect of climate-water-food security. Thus, institutional development at national and regional level is highly critical to the development of coordinated and planned actions against this issue of vital importance.
- Private business community, research organizations, NGOs, think tanks and civil society need to join hands with policymakers to decide way forward for interdependent challenges of climate-water-food security challenges at local, national and regional level. The only way to survive devastations of the nexus of climate-water-food security is collaboration and coordination.

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