Australia Pakistan Water Security Initiative – A review on “how to Build Climate Resilient Communities”
## LIST OF Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>Climate Change</td>
</tr>
<tr>
<td>GW</td>
<td>Groundwater</td>
</tr>
<tr>
<td>LG</td>
<td>Local Government</td>
</tr>
<tr>
<td>MS</td>
<td>Municipal Sector</td>
</tr>
<tr>
<td>RP</td>
<td>Rapid Response</td>
</tr>
<tr>
<td>TNC</td>
<td>Twin Cities Neighborhood Council</td>
</tr>
<tr>
<td>UWS</td>
<td>Urban Water System</td>
</tr>
<tr>
<td>VUC</td>
<td>Viable Urban Communities</td>
</tr>
</tbody>
</table>

## Summary

This report aims to address the impacts of climate change on the Twin Cities' water system and community-based adaptation strategies. It covers various biophysical factors and makes recommendations for building climate-resilient communities.

## Introduction

### 3.1. Climate Change and Its Impacts

### 3.2. Water System in the Twin Cities

### 3.3. Community-Based Climate Change Adaptation

## Biophysical Factors Affecting the Twin Cities Under Changing Climate

### 4.1. Groundwater Levels

### 4.2. Livelihoods and Economic Systems

### 4.3. Basic Urban Services and Infrastructure

## Recommendations to Build Climate-Resilient Communities in Twin Cities

### 5.1. Promote Rapid and Inclusive Growth as Means of Laying Strong Foundations

### 5.2. Assist Individuals and Corporations in Carrying Out Their Responsibilities

### 5.3. Establishing Linkage at Different Tiers of Government

### 5.4. Climate Change Sensitive Planning

### 5.5. Law Enforcement and Regulatory Structures

### 5.6. Support a Community-Based Disaster Management Structure to Boost Community Resilience in Twin Cities

### 5.7. To Address Gender Inequality’s Structural Underpinnings, Climate Change Solutions Must Be Gender Sensitive and Transformative

### 5.8. Investing in Cross-Learning Opportunities for a Greater Impact

## References
## 1. List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>APWASI</td>
<td>Australia Pakistan Water Security Initiative</td>
</tr>
<tr>
<td>CBA</td>
<td>Community Based Adaptation</td>
</tr>
<tr>
<td>CCA</td>
<td>Climate Change Adaptation</td>
</tr>
<tr>
<td>CCVI</td>
<td>Climate Change Vulnerability Index</td>
</tr>
<tr>
<td>CDA</td>
<td>Capital Development Authority</td>
</tr>
<tr>
<td>DRR</td>
<td>Disaster Risk Reduction</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GOP</td>
<td>Government of Pakistan</td>
</tr>
<tr>
<td>IWMI</td>
<td>International Water Management Institute</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PDCCC</td>
<td>Provincial Disaster and Climate Change Committee</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>WASH</td>
<td>Water Sanitation and Hygiene</td>
</tr>
<tr>
<td>WDM</td>
<td>Water Demand Management</td>
</tr>
</tbody>
</table>
2. SUMMARY

This report provides an overview of building climate resilient communities, the challenges these communities face, and possible ways forward to tackle the challenges of drought and floods, growing water supply competition for various sectors, exploitation of groundwater, seasonal shortage of water, etc. In an ideal world, climate resilient community should assist the underserved people to foster community and resilience to climate change through innovative climate smart water solutions. It is also of paramount importance to build the climate resilient communities that can assist the country’s innovation and economic growth. The scientific evidence proves that climate change is one of the most pressing issues that communities are dealing with in floods and droughts throughout the year. The sea level rising and diminishing ice of the Arctic Sea affect climate change, leading to severe occurrences such as hot nights and days may become more common. Climate change is the main challenge that must be treated in a cross cutting manner globally. Climate change also threatens urban, ecological, and social settings within the communities. Climate change is thought to be the biggest hazard to citizens’ improvements, life quality, sustainability, and economic competitiveness. In the near future, it is necessary to act against climate change. Section 3 of this report describes the risk projections from climate-induced shocks and community engagement. The risk projections are slightly different for urban and rural communities because poverty is also involved.

Section 4 of the report describes the climate change vulnerability assessment and resilience and its adaptive capacity in detail. In light of the expected climatic scenarios, historical climate-related disaster events and trends, and community reports of past events and observations presented in this section, a collaborative process can be used to evaluate the city’s susceptibility, sensitivity, and adaptation potential. The section further describes that when deciding on the best adaptation activity for a given situation, it’s critical to consider the consequences for adaptation and mitigation and the cost, efficacy, and public acceptance.

Section 5 of this report describes the interface between adaptation and mitigation. This section emphasises that climate change adaptation should be encouraged alongside mitigating actions to slow global warming. These actions should include promoting the buildings and infrastructure that are safer and more environmentally friendly, replanting trees and restoring harmed ecosystems, crop diversification and investigations on developing novel approaches to natural disaster prevention and management. Further, this section describes what action strategies for climate emergencies are being developed.

Section 5 mainly describes the uncertainty in observation and what can further be done to build climate-resilient communities in the twin cities of Islamabad and Rawalpindi. The section emphasises a need to create and execute best plans and best practices to proactively develop climate resilience solutions and fortify joint effort among government institutes, individuals and other stakeholders. The section describes the actions, perceiving the significance of traditional knowledge and carrying out a cooperative, science-based methodology to inform Pakistan’s future. The case studies from Pakistan will help to not reinvent the wheel for the APWASI project.
3. INTRODUCTION

3.1. Climate change and its impacts

Climate change is the “defining concern of our time,” with far-reaching consequences for international peace and stability and the health and well-being of society (UN Security Council Press Statement, 2021). The Intergovernmental Panel on Climate Change (IPCC) and the National Aeronautics and Space Administration published that climate change seriously impacts global development (IPCC, 2018; NASA, 2019). Although Pakistan contributes less than 1% to global greenhouse gas emissions, the Global Climate Risk Index reports it is one of the most vulnerable countries to climate change (GOP, 2016; Eckstein et al., 2019). Pakistan is the fifth country on the list which is most vulnerable to climate change and adverse events, including natural disasters. Climate change and natural disasters are already causing a $14 billion/year loss to Pakistan’s economy, which costs around 5% of the GDP (LEAD, 2015). Further, climate change has caused Pakistan significant socio-economic damage, especially during the last two decades (GOP, 2016; Eckstein et al., 2019). Pakistan is especially vulnerable due to its primarily dry geographical characteristics and scarcity of resources. Over the last 75 years (1929-2005), the catastrophe return period has shrunk from 56 years between 1929 and 1982 to 5 years since 2005. Landslides, floods, droughts, and cyclones are all potential risks to the country.

Pakistan’s vulnerability to hydro-meteorological hazards has serious economic consequences, as well as causing and contributing to rapid environmental degradation (Eckstein et al., 2019). The monsoon rains alone triggered major flooding in 2010, killing nearly two thousand people, affecting more than 20 million, creating food shortages for at least 7.8 million people, and causing economic losses of more than US$ 16 billion. At the same time, the losses caused by large-scale flooding far outweighed the 5% of GDP invested annually in flood prevention and adaptation efforts. Assessing Pakistan’s vulnerability and level of risk is a very ambitious goal. It is projected that, due to extreme weather events and other losses, climate change will cost the economy just $14 billion a year, which is almost 5% of the GDP (LEAD, 2015). Such disasters are expected to become more common in Pakistan, according to the country’s National Climate Change Policy. The cost of responding to climate change is estimated to exceed 10% of GDP over the next 40 years, ranging from US$13-14 per capita. With Pakistan on track to have a 50% urban population by 2030, cities, towns, and urban regions are poised to dominate the national agenda to promote economic growth and mitigate the adverse effects of climate change.

Current projections demonstrate that the global average temperature will continue to rise until around 2050. Additional local warming occurs due to urbanisation-related activities (Rosenzweig et al., 2018). Furthermore, urbanisation amplifies the dangers associated with hazardous events such as heatwaves and heavy rainfall events caused by climate change. As populations become more concentrated in community settings, communities are a critical focus for improving climate change resilience in Pakistan and around the world.” According to the World Economic Forum (2015), water scarcity is the most serious global threat posed by climate change. Water scarcity is becoming apparent at this time. Climate change has caused changes in the hydrological cycle (Gosling and Arnell, 2016; Schlosser et al., 2014), as well as rising economic and demographic demands, all contribute to water scarcity (Mekonnen
and Hoekstra, 2016; OECD, 2012). Domestic water consumption will rise by 30% globally by the 2050s (OECD, 2012). Water Demand Management (WDM) is a long-term water security strategy (White et al., 2007).

The global climate change crisis is inextricably linked to water. The latest Intergovernmental Panel on Climate Change (IPCC) report again highlighted that human influence had warmed the climate across the globe at an unprecedented rate in at least the last 2000 years. Key climate change predictions for South Asia, including Pakistan, are:

- Glaciers are declining, and permafrost is thawing. Seasonal snow duration, glacial mass, and permafrost area will decline further by the mid-21st century (high confidence).
- Glacier runoff in the Asian high mountains will increase up to mid-21st century (medium confidence), and subsequently, runoff may decrease due to the loss of glacier storage.
- Heatwaves and humid heat stress will be more intense and frequent during the 21st century (medium confidence).
- Both annual and summer monsoon precipitation will increase during the 21st century, with enhanced inter-annual variability (medium confidence).

Climate change is increasing the variability of the water cycle, resulting in extreme weather events, deterioration of water quality, and jeopardising global development, biodiversity, and human rights to safe drinking water and sanitation. The demand for energy-intensive water pumping, transportation, and treatment grows in tandem with the world’s population. Water management, particularly sanitation, is a critical component of successful climate mitigation and adaptation strategies, as outlined in the 2015 Paris Agreement. Water is required for the goals and targets outlined in Transforming our World: The 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015–2030. Thus, climate-resilient water management can be used to connect these global frameworks.

The research is clear: global climate change is increasing water cycle unpredictability, diminishing water availability and demand predictability, impacting water quality, intensifying water shortages, and jeopardising global sustainability (Kumar, 2016). Poor and vulnerable communities are disproportionately affected by population growth, unmanaged migration, land-use change, diminished soil health, accelerated groundwater extraction, widespread ecological degradation, and biodiversity loss. Increased demand for water for energy, agriculture, industry, and human use has resulted in more challenging trade-offs for this limited and important resource, particularly in water-scarce areas of the world. Climate change is generally assumed to be most visibly seen through water for these reasons.

### 3.2. Water system in the twin cities

Islamabad, Pakistan’s Capital Territory, is currently confronted with several major water-related concerns, including inadequate water supply, sanitation, and hygiene. These issues contribute directly to high rates of childhood stunting and undermine human development. To maximise the potential of urban regions, it is necessary to institutionalise processes for cooperation, planning, and accountability with all stakeholders at all levels. However, this city’s administration suffers serious capacity issues in providing necessities and addressing hazards due to a lack of knowledge and awareness of the links between poverty, environment, and
services. Islamabad’s primary water resources (surface and groundwater) serve a combined population of 1.61 million. Simly Dam and Khanpur Dam are Islamabad’s two primary surface water resources.

Along with surface water, the Capital Development Authority (CDA) supplies Islamabad with several tubewells. Private and municipal wells are also used to provide for the city’s water needs. However, human population pressure and climate change have significantly diminished the city’s groundwater resources. CDA statistics indicate a concerning trend, with several tubewells recently drying up, and the rate of depletion is growing. The United States Agency for International Development (USAID), the United States Department of State, and the Government of Pakistan conducted a study on a paper titled “environmental geology of the Islamabad Rawalpindi area, Northern Pakistan” (GoP). According to this study, the main streams that drain the area are the Soan and Kurang Rivers. Their major tributaries are the Ling River, which flows northwestward into the Soan, the Gumreh Kas, which flows westward into the Kurang from the area between the Kurang and the Soan, and the Lei Nala, which flows southward into the Soan from the mountain front and urban areas. The Kurang and Soan Rivers are dammed at Rawal and Sambli Lakes to provide water to the twin cities. The Kurang and Soan River headwaters include substantial forest reserves, which help to improve the quality and amount of the supply.

In Islamabad, Nestle Pakistan Limited did a study on groundwater systems. According to the research, groundwater in Islamabad is gradually being drained. Figure 1 depicts a decrease in groundwater levels (1986-2015). This sharp groundwater depletion is linked to unsustainable water usage, increased groundwater extraction, and decreased water percolation in the soil due to urbanisation and rapid population growth in the twin cities.

![Decline of Groundwater Levels in Islamabad (1986-2015)](image)

*Figure 1: Declines of Groundwater Levels in Islamabad (1986-2015; Source: HESC, 2018)*

Groundwater is produced principally from Quaternary alluvial gravels by a supplemental network of municipal and private wells reaching depths of up to 200 metres (m). The water table drops from roughly 600 metres near the Margala Hills to less than 450 metres near the
Soan River, resulting in a saturated zone of 2–20 metres below the natural ground surface (Ashraf and Hanif, 1980; Sheikh et al., 2007).

According to Nestle’s research, groundwater is draining at a pace of 1.7 metres per year on average. In Gulshanabad Mohallah, the groundwater level dropped by up to 20 metres. According to another study, Khalid and Mushtaq (2014) discovered a 50-foot drop in the water table between 1986 and 2001. Reservoirs fall short of meeting the demands of the Federal Capital. A decade ago, groundwater was found at 50-100 feet depth, and now it is way after 250-300 feet of drilling (Statistics of Capital Development). The density of the spread of wells in the area corresponds positively with the reduction in groundwater levels. This makes groundwater extraction more difficult and reduces ecosystems’ ability to use groundwater for survival in and around Islamabad and the Islamabad Capital Territory (UN-Habitat, 2014). Climate change severely impacts freshwater ecosystems by affecting streamflow and water quality, providing a risk to drinking water even when treated with standard methods. Increased warmth, sediments, fertilisers, and pollutant loadings due to excessive rains, and lower dilution of pollutants during droughts are the origins of the danger.

3.3. Community-based climate change adaptation

Pakistan is a victim of climate change and therefore adaptation to the adverse affect of climate change is compulsory for its economic and social growth. The Ministry of Climate Change took several steps for mitigation and adaptation against climate change. Other than agriculture, energy, water resources, etc., governments should emphasise town planning to mitigate and adapt to climate change effects (Lin and Ahmad 2017). According to the Intended National Determined Contributions (INDC), Pakistan requires approximately 14 billion US dollars per year to adapt to climate shocks. Recently, around one billion trees are planted under the Green Pakistan Program to adapt and mitigate the climatic shocks (GOP 2017–18). Further rainwater harvesting, storm harvesting, and groundwater recharge are preferred technologies suggested to cope with climate shocks (Ministry of Climate Change 2017).

Community-based adaptation aims to increase community capacity to understand climate risks and solutions, ensure that community members have a voice and a seat at the decision-making table, respond to community needs, and involve community members, practitioners, and government officials in the development of current and future-based adaptation solutions. Community-based adaptation has a track record of effectiveness and should be prioritised in the battle against climate change.

Unless the basic root causes of poverty and vulnerability are addressed, climate change adaptation efforts will fail to offer long-term outcomes. Power imbalances among governments and communities, which promote conflict and violence, must be addressed as part of the adaptation process. Access to and ownership of assets, both of which are inextricably influenced by existing power dynamics, are invariably influenced by existing power dynamics. It determines a person’s ability to progress from merely coping to adapting. Adaptation efforts, particularly those carried out as part of a community-based adaptation (CBA) programme, should address current development challenges and close adaptation gaps. Only after existing demands have been met can be the task of creating long-term resistance to climate change impacts. As a result, separating adaptation and development at the
community level is impossible; in fact, when functioning at the community level, doing so is often harmful. As a result, while some CBA project actions may appear to be development activities, they should be viewed as part of a larger strategy to strengthen the community’s long-term resilience in the face of a changing environment.

Adaptation is becoming more significant in worldwide climate change negotiations and among multilateral and bilateral organisations, donors, and international governance and financial institutions like the World Bank. Adaptation funding is becoming more readily available. However, until recently, the majority of efforts to help countries adapt were focused on national planning and top-down approaches based on climate change modelling. For decades, little attention has been paid to how poor people have managed with environmental fluctuation and extremes.

One of the interventions aimed at improving community water resource management could be linked to and built on existing WASH programme efforts, such as holding awareness workshops on handwashing, water storage and safety, the development of water committees, and the efficient use of water resources. These activities could have both development and adaptation outcomes if they were aligned with current climate change science and knowledge of climate projections, building human capacity and enabling communities to take adaptive action to mitigate the effects of water shortages and water-borne diseases.
4. Biophysical factors affecting the twin cities under changing climate

Several biophysical factors are affecting the twin cities under changing climate. Details of these factors are described below:

4.1. Groundwater levels

Groundwater levels in the twin cities of Islamabad and Rawalpindi are depleting at a rapid speed. According to recent estimates, groundwater levels are depleting at a pace of 1.7 metres per year on average. Groundwater levels have plummeted by around 20 metres in both cities. Groundwater level lowering is positively correlated with the density of tubewells in a given area. This makes groundwater extraction more difficult and affects ecosystems’ ability to use groundwater for survival in the twin cities.

4.2. Livelihoods and economic systems

Extreme climate events severely impact the peri-urban settings in the twin cities due to substandard housing and a lack of essential services. Furthermore, working days for wage labourers and sellers during extreme weather events become very difficult. Similarly, the availability of fuel (wood) and water for daily uses are becoming more difficult in extreme weather conditions. Islamabad’s urban poor have a number of characteristics that make them particularly vulnerable to climate change e.g., drinking water and sanitation. Livestock and dairy farming provides a living for about half of the rural population in the Islamabad Capital Territory. The service sector, daily wage earners, and real estate are some of the other sources of income. Floods, droughts, heat stress, poor air quality, and dwindling freshwater supplies have the most immediate and severe impact on people living in twin cities. Reduced food availability leads to rising prices, which disproportionately affect the poor, women, and low-wage earners. Similarly, power outages significantly influence the Islamabad area’s cottage industries, which largely employ the urban poor and range from honeybee keeping to embroidery. Extreme weather events also have an impact on schooling and health care in these twin cities.

4.3. Basic urban services and infrastructure

The sensitivity of people, communities, and institutions to climate change is influenced by the quality and capacity of infrastructure and fundamental services. In the twin cities, the quality of drinking water varies substantially. Drinking water in some locations has been contaminated by industrial and hospital waste. Many sources of drinking water are unfit for human consumption. Similarly, natural waterways, such as streams, have long served as a source of drainage for the twin cities. However, as streams grow, drainage becomes a more pressing concern. Because streams in the Nullah Lai’s catchment region are being interrupted by commercial and residential development, flood frequency and intensity are anticipated to increase. The urban sections of Islamabad and Rawalpindi have superior sanitation than the peri-urban ones. The Development Authorities of the twin cities collects more than 80% of all municipal solid garbage. A considerable amount of the city’s solid waste is collected and sold as fuel to the cement industry. Flooding is extremely damaging to housing in slums, temporary settlements, and other highly inhabited regions. Because these regions are cheap or empty, the poor are frequently driven to flood-prone locations. Even residents of planned
urban settlements within and outside the Nullah Lai’s immediate lower basin are likely to be affected by extreme floods, such as in 2001.

In Islamabad, the rising number of respiratory, skin, and eye ailments and water-borne diseases like diarrhoea, malaria, and dengue fever suggest that climate change is having a severe impact on human health. Areas with poor health infrastructure, such as the rural outskirts of Islamabad, are typically the hardest affected. Heatstroke and dehydration, which can lead to death and inflict a bigger social and economic burden on the poor, are also becoming more common due to temperature extremes. Extreme weather events, including storms, are becoming more common and severe, increasing the potential of hazardous floods, notably in the Nullah Lai and its basin areas as far as Rawalpindi. Several factors influence the impact of climate change on human health. The effectiveness of a community’s public health and safety programmes; the affected population’s behaviour, age, gender, and economic status; population sensitivity; the extent and duration of exposure to climate change dangers; and society’s overall ability to adapt to change are all important factors to consider. Weather extremes are resulting in injuries and rare cases of death. Children, the elderly, those with impairments, and the needy are the most vulnerable during a heatwave. Extreme weather events restrict the amount of fresh food and water available. Communication, utility, and healthcare services are also disrupted by severe weather.
5. **Recommendations to build climate-resilient communities in twin cities**

The recommendations are aimed to build climate-resilient communities in twin cities. As climate risks cannot be eliminated, communities in twin cities along with local governments have to act quickly to assist businesses and individuals in managing them. To do so, planning and proactive actions are required, which will reduce climate risk and accelerate growth and alleviate poverty. The recommendations captured in this report will support building climate-resilient communities in twin cities.

5.1. **Promote rapid and inclusive growth as means of laying strong foundations**

Poverty and a lack of basic requirements, including infrastructure, financial services, health care, and social protections in twin cities are key markers of climate change vulnerability. To put it in another way, a community’s poverty makes it more sensitive to climate change. No adaptation approach will succeed unless high-vulnerability populations have access to the institutional, financial, and technical resources they require to adapt.

5.2. **Assist individuals and corporations in carrying out their responsibilities**

Many households and organisations in the twin cities have incentives to adopt, but they require assistance in overcoming hurdles such as initial investments and access to markets. The local government can disseminate climate risk information, clarify obligations and liabilities, promote innovation and access to cutting-edge technology, and ensure that money is available, particularly for solutions with significant upfront costs. They will also need to provide direct aid to the world’s poorest people, who cannot afford to invest in adaptation but are the most exposed to climate change’s devastating repercussions.

5.3. **Establishing linkage at different tiers of government**

There should be strong coordination among different government institutes for effective emergency response and preparing for the management and mitigation of future disasters and climate shocks. Different compartments of the government should continuously monitor and evaluate the impact of their policies and operations to address any difficulties and make required adjustments.

5.4. **Climate change sensitive planning**

Dedicated climate change units with dedicated officers should be established at the community levels in both the cities, and climate change sensitive planning experts should be designated in public administration and relevant institutions to address climate change concerns within existing institutions. Dedicated climate change units with dedicated officers should be established at the district and local levels. Climate change sensitive planning experts should be designated in public administration and relevant institutions to address climate change concerns within existing institutions.

5.5. **Law enforcement and regulatory structures**

Unfortunately, twin cities have no water legislation, like other cities in Pakistan, to cope with the climate shocks and adopt preventive measures against climate change. Regulatory frameworks and legislation, especially for construction codes, pollution control, environmental protection, and land use and zoning, are paramount.
5.6. Support a community-based disaster management structure to boost community resilience in twin cities

By assisting in forming and strengthening community-level committees in the twin cities and providing members with the necessary technical expertise, communities can effectively incorporate climate change adaptation (CCA) and disaster risk reduction (DRR) into local development planning and budgeting processes. To guarantee that effective capacity is maintained and strengthened, ongoing help for committee management and community participation is essential. Members of the Provincial Disaster and Climate Change Committee (PDCCC) are expected to follow up regularly, give technical expertise on DRR and CCA, and continue to help in risk reduction and awareness initiatives.

5.7. To address gender inequality’s structural underpinnings, climate change solutions must be gender sensitive and transformative

Climate change affects men and women differently. Because women’s traditional household and community duties are more exposed to environmental conditions in both cities, most women are more sensitive to the consequences of climate change than men. Women’s livelihoods are growing more reliant on an increasingly volatile environment, and they are responsible for supplying water, food, and fuel for their families, yet they are facing obstacles as ecosystems deteriorate. Women often have a wealth of knowledge and experience that may be applied to climate change adaptation and disaster risk reduction, but they confront social, economic, and political constraints that limit their ability to cope and influence key decision-making forums.

5.8. Investing in cross-learning opportunities for a greater impact

Helping the most vulnerable people better understand disaster and climate risks and providing them with the skills needed to construct locally relevant adaptation plans and actions should be prioritised. While the strategy must address the requirements of a specific set of people, it is equally vital to guarantee that the outputs can be scaled up to support national planning and policies and reach a much larger audience. If there are more chances for social learning, the complexity of identifying answers to climate change can be decreased or at the very least shared. By exposing community members to a varied collection of stakeholders’ points of view, knowledge-sharing hubs can help them better comprehend the linked nature of climate change and the breadth of viable adaptation strategies.
References


Kumar, M. Impact of climate change on crop yield and role of model for achieving food security. Environ Monit Assess 188, 465 (2016).


Innovative water solutions for sustainable development

Food • Climate • Growth

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health. Headquartered in Colombo, Sri Lanka, with regional offices across Asia and Africa, IWMI is a CGIAR Research Center and leads the CGIAR Research Program on Water, Land and Ecosystems (WLE).

International Water Management Institute (IWMI)
127 Sunil Mawatha, Pelawatte,
Battaramulla, Sri Lanka
Mailing Address: P.O. Box 2075,
Colombo, Sri Lanka
Tel: +94-11-2880000
Fax: +94-11-2786854
Email: iwm@cgiar.org
www.iwmi.org