



# *Regional Report*

## Regional Process Commission

### Region: Asia-Pacific

# ANNEX

**Theme: Climate**

**Coordinator: Asia-Pacific Water Forum**



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## Theme: Climate

### Climate change, disasters and water related adaptation

**Theme Leader: International Centre for Integrated Mountain Development (ICIMOD)**

#### Contents

1. Introduction .....	3
Objectives.....	4
Methodologies.....	4
2. 3 key messages .....	5
3. Case studies.....	5
3.1. Case study 1: Community Based Flood Early Warning System .....	5
3.2. Case study 2: Regional flood outlooks for reduced flood risks .....	6
3.3. Case study 3: Reviving drying springs in Indian Himalayas .....	7
3.4. Case study 4: Adoption of solar powered irrigation pumps (SPIP) in Nepal as an adaptation cum mitigation strategy .....	8
3.5. Case study 5: Application of System of Rice Intensification (SRI) in Addressing Climate Change. CASE STUDY OF INDONESIA.....	9
3.6. Case Study 6: Improving emergency preparedness and response in Fiji .....	10
4. The lessons learns from the case studies .....	11
5. Actions and Sub-actions to overcome the problems and achieve the solutions .....	11
References.....	12

#### Abstract

The “**Climate**” theme was led by International Centre for Integrated Mountain Development (ICIMOD) and focused on “**climate change, disasters and water related adaptation**”. The report firstly looks at the extent of climate change in the region and its impact on water resources and water-related disasters. Secondly, it presents case studies of successful adaptation practices – both community-based adaptation and ecosystem-based adaptation. Through the lessons from the case studies, it highlights the necessary to promote the integration of scientific and engineering approaches and local and traditional knowledge in implementing the water-related assessment. It also emphasizes the importance to implement water-related disaster risk management and adaptation measures with locally tailored technological innovation and capacity building for local communities. Adaptation will be promoted through regional cooperation, partnership development with trust building and continuous engagement.

### 1. Introduction

The Asia Pacific region is undergoing rapid change, driven by twin megatrends of climate change and urbanization, which threaten their crucial water-provisioning services for over a billion people across Asia and undermine quality of life, economic development, and environmental sustainability within the region. This region comprises of several vulnerable geographies – such as mountains, coasts, islands and arid regions – where impacts of climate change are likely to be higher than elsewhere given the inherent nature of these fragile geographies. Disasters, water related and other natural disasters, are also very frequent in the region. A study by German Watch collated all incidences of extreme weather related loss events between 1996 to 2015 and found that of the 10 countries most affected by extreme weather events and related loss of lives and property, as many as 6 (Myanmar, Philippines, Bangladesh, Pakistan, Vietnam and Thailand) were in the Asia Pacific region (Kreft, Eckstein and Melchior, 2016).

This region is home to the Hindu Kush Himalayas – also called the Water Tower of Asia or the Third Pole as this region is the third largest repository of ice and snow after the two Poles. The HKH is referred to as the water towers of Asia the ten major rivers of Asia, namely, the Amu Darya, Indus, Ganges, Brahmaputra (Yarlungtsanpo), Irrawaddy, Salween (Nu), Mekong (Lancang), Yangtze (Jinsha), Yellow River (Huanghe), and Tarim (Dayan) originate here. These ten large Asian river systems provide water, ecosystem services, and the basis for direct livelihoods to a population of around 210.5 million people in the HKH. Additionally, these rivers support downstream irrigation systems, provide urban water supply and ecosystem services, and control sediment processes and salinity dynamics while contributing to energy and food security for 1.3 billion people who live in these ten river basins. The region has 54,252 glaciers with a total area of 60,054 km<sup>2</sup> and estimated ice reserves of 6,127 km<sup>3</sup> (Bajracharya and Shrestha, 2011) which are significantly impacted by climate change that disproportionately affects the high-elevation cryosphere (Shrestha et al. 2015). Coupled with this, demographic changes such as urbanization and outmigration (predominantly male) in turn are affecting the ways in which water, energy and food are produced, consumed, and managed now and in the future. While it is certain that the HKH region is undergoing rapid change in climate, the exact extent of it is not known. However, we can recognize three overarching trends. These are: a) a near universal agreement that temperatures are increasing, disproportionately so in higher altitudes (Bhutiyan et al. 2007; Lu et al. 2010); b) variable future patterns of precipitation, which may increase, remain constant, or decrease, depending on the HKH sub-region (Palazzi et al. 2013); and c) some unanimity that higher rainfall intensity will occur in the core monsoon zone (Sharmila et al. 2015), while heavy precipitation events will increase in the Karakoram and western Himalayas due to increase in strength and frequency of winter westerly disturbance (Cannon et al. 2015). These trends are expected to lead to increases in extreme discharges in rivers (Soncini et al. 2015). Overall, this means that there will be more intense rainfall over lesser number of days and this will mean increase in frequency and severity of water related disasters (Vinke et al. 2017).

The arid Central Asia is already seeing record high temperatures. Existing climate projections shows that mean temperatures can rise by up to 6.5 degrees compared to the pre-industrial era by the end of current century. This rise in temperature will lead to changes in precipitation, occurrence of frequent events of heat extremes and increasing aridity and resulting drought. Similar to HKH, increased temperature will lead to increasing rates of glacier melt, leading to

greater river runoff in the short term, but also making river flows more seasonal than before and finally leading to decreasing water availability in the medium to long term. Changes in volume and timing of water availability will lead to conflicting water demands between agriculture and hydropower sectors (Reyer et al. 2017; Siegfried et al. 2012).

Southeast Asia has also been experiencing climate change like the rest of the Asia Pacific. Here, average temperature has increased at a rate of 0.1–0.3°C per decade and sea level has risen at 1–3 millimeter (mm) each year over the last 50 years or so. The region also experienced a downward trend in precipitation during 1960–2000. The increasing frequency and intensity of extreme weather events such as heat waves, droughts, floods, and tropical cyclones in recent decades are also evidence that climate change is already affecting the region. Climate change is worsening water shortages; constraining agricultural production and threatening food security; and causing forest fires, coastal degradation, and greater health risks (ADB, 2009). Another new study by the Asian Development Bank (ADB) shows that the impacts of climate change in Southeast Asia may be larger than previously estimated and possibly account for 1/10<sup>th</sup> of the gross domestic product by 2100 (Raitzer et al., 2015).

Climate change and sea level rise has been a major concern of the Pacific Island countries and they have been a part of the international dialogues on climate change since the very beginning – as early as 1980s when the issue gained prominence in international discourse. While the most graphic depiction of climate change impacts on islands has been that of sea level rise and literal drowning of entire islands, equally important and currently felt impacts are increasing incidence of droughts and tropical cyclones and storm surges (Ash and Campbell, 2016). Global climate models have predicted greater aridity for island states leading to stress on its already precarious fresh water reserves (Karnauskas, Donnelly and Anchukaitis, 2016). Climate induced migration is likely to increase in these island states (Locke, 2009).

### Objectives

There are three main objectives of this report:

1. To understand the magnitude of climate change in the region, with a special focus on vulnerable geographies like the mountains, coasts, and islands.
2. To understand the extent and consequences of water related disasters and share some of the best practices around DRR in the region
3. To document some of the best practices for water related adaptation, including community based and ecosystems based adaptation.

### Methodologies

As a theme leader on this topic, ICIMOD will leverage all its partnerships in generating and disseminating relevant information with close partnership with all sub-regional partners who are interested in the theme of climate change and water related adaptation. ICIMOD is a repository of a large number of knowledge products on issues of climate change in the HKH region and is in the process of compiling all available evidence in the form of an assessment called HIMAP (<http://www.icimod.org/himap>). HIMAP has 16 chapters related to various aspects of HKH, of which at least 4 chapters (those on climate change, cryosphere, water and disasters) are directly relevant to this topic. In addition, three ICIMOD staff members and 5 ICIMOD partners are also involved in IPCC's Special Report on Oceans and Cryosphere to be

released in 2019. ICIMOD and its partners participated actively in the 3<sup>rd</sup> APWS in Myanmar and presented an initial version of the thematic paper for wider consultation.

## 2. 3 key messages

- The entire Asia Pacific region and especially, the mountains and the small island developing states (SIDS) are facing severe consequences of climate change which is affecting crucial water services and threatening the overall quality of life and environmental sustainability within the region.
- The Hind Kush Himalayas (HKH) is the water tower of Asia and is often called the Third Pole as this region is the third largest store of snow and ice after the North and the South Pole. Climate change is severely affecting the water provisioning services offered by the HKH. Climate change is also exacerbating the frequency and severity of all disasters, especially, water related disasters.
- Water induced disasters cause significant damage to life and property in the Asia Pacific region and poorer countries are particularly vulnerable. These damages can be reduced drastically through the right technologies and institutional arrangements that is inclusive and community centered.

## 3. Case studies

### 3.1. Case study 1: Community Based Flood Early Warning System

**(Contributed by Dr. Neera Pradhan, ICIMOD)**

The Hindu Kush Himalaya (HKH) is prone to natural hazards. Floods and flash floods are major natural hazards and are catastrophic to downstream communities. To build resilience and adaptive capacity of the local communities to flood risks in the river tributaries, ICIMOD is piloting community-based flood early warning system (CBFEWS), an integrated system of tools and plans in which upstream communities, upon detecting flood risk, disseminate the information to vulnerable local communities downstream to take early action. It is based on people-centered, timely, simple and low-cost technology, which uses wireless/telemetry and solar powered transmitter and receiver stations, and SMS to disseminate information. ICIMOD's experience on CBFEWS started from 2010 in Assam, India. In 2012, CBFEWS was introduced by ICIMOD integrating the community component. In 2014, ICIMOD won the UNFCCC's Momentum for Change 2014 Lighthouse Activity Award for showcasing immediate impact on the ground. In 2016, CBFEWS was out scaled in Afghanistan, India, Nepal and Pakistan. In 2017, cross border community based flood early warning system (CBFEWS) was successfully showcased in Ratu river of Koshi basin between Nepal and India.

Flood early warning systems are one of the most effective non-structural ways to minimize the loss of life and property. During 2013 September, the CBFEWS installed in the Jiadhah River successfully informed community members in Dihiri, Assam, of the pending flood providing them at least one and a half hour of time for preparedness, and helping them save assets, including cattle and pigs, worth approximately USD 3,300. Adopting a gender sensitive early warning system approach with appropriate policies in place will help in reducing the disaster



mortality of women and contribute to reducing the adverse impact of flood disasters. A gender-sensitive approach that not only recognises the vulnerabilities of women, but also works towards enhancing their resilience and strengthening their ability is needed to respond effectively to disasters through awareness raising and capacity building initiatives is of critical need.



“My fellow villagers like me because I am the source of all the information. I feel important now and panchayat also listens to me.” *Mrs. Hoonmoni Doley, Caretaker, Dihiri, India*

### 3.2. Case study 2: Regional flood outlooks for reduced flood risks

(Case study contributed by Dr. Mandira Singh Shrestha of ICIMOD)

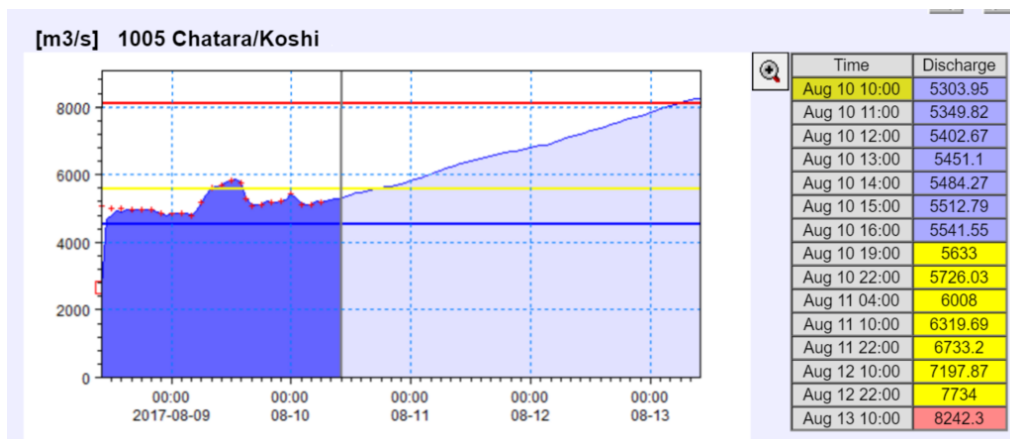
Every year devastating floods inundate large areas of the Indus, Ganges, and Brahmaputra basins, crossing national borders. The floods result in loss of lives and livelihoods as well as in the displacement of millions of people, threatening achievement of the United Nations Sustainable Development Goals. This calls for effective cooperation between the countries Afghanistan, Bangladesh, Bhutan, China, Nepal, India, and Pakistan. However, the bilateral river treaties and data sharing agreements currently in place are not sufficient to avert flood catastrophes on a transboundary scale.

Regional cooperation in hydrometeorological data collection and sharing is necessary, to enable effective and timely forecasting of floods for better preparedness as well as flood management at the regional level. In 2010, the International Centre for Integrated Mountain Development (ICIMOD), the World Meteorological Organization (WMO), and ICIMOD’s partner countries, Bangladesh, Bhutan, China, India, Nepal, and Pakistan initiated the development of the Hindu Kush Himalayan Hydrological Cycle Observing System (HKH HYCOS). The project’s overall objective is to minimize the loss of human lives and property damage.

The project helped to strengthen the capacity of hydromet agencies. A total of 38 hydromet stations (9 in Bangladesh, 9 in Bhutan, 12 in Nepal and 8 in Pakistan) were upgraded to share real-time data. In addition, an automated regional flood information system was established and facilitated the transboundary exchange of real-time data, information and know-how. The system allows the visualization of real-time data from the hydrometeorological stations to any geographical location by providing information on the river-water levels and amounts of rainfall.

A regional flood outlook has been developed for the Ganges Brahmaputra basin using the real-time data available from the region, satellite based products and weather forecasts. The regional flood outlook provides real-time information pertaining to the threat of potential large-scale flooding to the national hydrometeorological agencies to support and enhance national flood forecasting and warning services. These products are used by partners to forewarn communities of increasing river water levels, helping to reduce risks. In August 2014 and 2017 for example, the flood outlook was used by the Department of Hydrology and Meteorology of Nepal as one of the inputs to issue a flood warning. It did so by means of a flood bulletin which was widely disseminated through the website and emails to key stakeholders.

Through the capacity building and knowledge sharing activities of HKH HYCOS there was an improvement in the hydrometeorological skills of partners that has attracted larger investment in modernization of hydromet networks in the region. Investments in effective modern early warning systems can prevent flood disasters and loss that in the long term pay off the initial investments. This reduces people’s vulnerabilities, leading to more sustainable development. It has led to promoting regional cooperation and building trust and confidence which is a long-term process requiring continued dialogue and engagement.



Flood outlook for the Koshi at Chatara on 10<sup>th</sup> August 2017

### 3.3. Case study 3: Reviving drying springs in Indian Himalayas

**(Case study contributed by Arghyam – a civil society organization in India)**

Springs are the dominant form of groundwater in the Himalayas, Eastern and Western Ghats and are the main source of water for about 200 million people who live in scattered and remote hamlets across these mountain ranges. They are critical to mountainous ecosystems, and feed streams and rivers, almost all non-Himalayan Rivers and many Himalayan rivers originate in the form of thousands of springs in the catchment areas. Many of these springs have cultural significance - with shrines of worship constructed at the origin or as sacred groves. If managed well, springs can provide a steady, safe source of water for mountainous communities for lifeline and livelihood needs and provide critical support to the ecosystem. Science based spring revival has shown quick results and promises to be the best way to

ensure water security in our mountainous regions. These interventions help reduce drudgery of women and children who otherwise spend almost their entire day battling arduous slopes in search of water and help sustain our river systems.

Arghyam facilitated work across various NGOs in India. The Indian springs initiative is a rapidly expanding coalition of 19 members who have been at the forefront of ushering in radical change in the way springs are perceived and managed across India. In response to the deterioration of springs the Initiative's members are giving spring protection renewed focus at various scales. The Government of Sikkim and Meghalaya have initiated statewide programmes to inventorise, monitor, protect and rejuvenate springs. The Government of West Bengal has also taken up work in 3 districts through its MGNREGA department to adopt the spring water management approach. NGOs in all major mountainous regions have also developed successful spring programmes, many of which are now being emulated by local government at block and district levels. The Central Himalayan Action and Research Group (CHIRAG) and People's Science Institute (PSI) have well established spring protection programmes in Uttarakhand and Himachal Pradesh. Similar initiatives have independently developed in the Eastern and Western Ghats. The work is now spread across 10 states (See Figure 5) - Andhra Pradesh, Himachal Pradesh, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal. In fact, through ICIMOD, the approach has now spread beyond India to other Himalayan countries like Nepal and Bhutan. Springs Initiative partners have several years of experience in implementing the spring water management work. This includes the entire lifecycle from strengthening supply through appropriate recharge interventions; improving access by establishing cost-effective water supply systems with appropriate solutions for improving water quality using government funds to reduce drudgery and improve health outcomes for mountainous habitations. They are also conversant with methods to monitor and visualise impact and advocate this to policy. Core partners of the Springs Initiative have experience in capacity building various actors: Communities, so they understand their water balance and design and adopt appropriate water security plans and management protocols; NGO/ CSO staff in new geographies who can then become stand-alone resource centres for their regions and state governments that have adopted springshed management at scale to train field staff to implement spring water management along with communities.

#### **3.4. Case study 4: Adoption of solar powered irrigation pumps (SPIP) in Nepal as an adaptation cum mitigation strategy**

**(Case study contributed by Dr. Aditi Mukherji of ICIMOD)**

Nepal's Terai has an estimated renewable dynamic groundwater reserve of 8800 million cubic meters (MCM) of which only 1053 MCM (12%) has been tapped so far for irrigation, industrial and drinking water purposes. In spite of abundant water resources in the plains, farmers face water scarcity due to lack of affordable and clean energy to pump water. Lack of access to affordable and reliable irrigation means that farmers often leave a large part of their land fallow. Solar Powered Irrigation Pumps (SPIPs) have been tested widely in the region and has been found to be a technically proven and workable solution for all categories of farmers – men and women. This new technology can prove to be instrumental in addressing food security through increased agricultural production. So far, 23 SPIPs have been installed, of



these 12 are owned and operated by women farmers. These pumps have so far irrigated over 50 hectares of land, avoided emission of 12,500 kilos of carbon because of lesser use of diesel and have led to higher incomes for farmers from twin benefits – one of diesel saving and another of growing more crops, including fish.

### 3.5. Case study 5: Application of System of Rice Intensification (SRI) in Addressing Climate Change. CASE STUDY OF INDONESIA

**(detailed case study in Annex 1)** Written by Adhitya Wirayasa; Edited by Rahayu Ning Tyas and Fany Wedahuditama, Global Water Partnership Southeast Asia

The origin of SRI methodology was invented back in the early 1980s by Fr. Henri de Laulanié, S.J., who working with Malagasy farmers to improve their rice production, since rice is the staple food in Madagascar. In Indonesia, the SRI farming method was introduced in 1999 by Ministry of Agriculture's Agency for Agricultural Research and Development (AARD). The progress of implementing SRI method in Indonesia between year 2010-2014 can be seen at the below table. Ministry of Agriculture's Agency for Agricultural Research and Development (AARD)

TABLE 1 THE PROGRESS OF SRI IMPLEMENTATION IN INDONESIA BETWEEN 2010-2014

Year	Number of Province	Number of Regency	Area (Ha)
2010	13	24	
2011	27	137	
2012	20	101	
2013	29	269	
2014	29	247	
Total			

Source: Agriculture Department (2014)

The preeminent of SRI in Indonesia compared to other farming methods are listed below.

1. Improved land productivity. Several researches were conducted and the results as follows:
  - In average, during 2002-2006, the productivity increased by 78% when tested in the Eastern Region of Indonesia (several areas in Nusa Tenggara and Sulawesi). [Sato *et al.*, 2011]
  - In addition, using 3 variety of seeds, the SRI method able to increase productivity by 40-43% compared to the conventional method. (Gani *et al.*, 2002)
  - Under dry season period, the SRI method was tested in 8 provinces, and the result shown increased productivity between 7.1 -33.3 % at various location. (Gani *et al.*, 2002)
  - The SRI method was carried out in the terraces field in Central Java and the result shown the productivity improved by 5.4-9%. (Arif *et al.*, 2015) and (Toriyama and Yokohama, 2014).

2. Better water efficiency. In the Western Region of Indonesia, SRI practice was capable to save 37.6% of water for irrigation and in the Eastern Region 40%. (from various researches)
3. Reduced greenhouse gas emission. The methane ( $\text{CH}_4$ ) is produced under anaerobic condition during the decomposition of organic matters. Methane ( $\text{CH}_4$ ) emission was reduced by 26.5 - 46.5% in various sites and under numerous field condition. (from various researches)
4. reduce dependency on inorganic fertilizers. Reduced the use of inorganic fertilizer by 50% with complementary organic fertilizer. (Sato *et al.*, 2011)
5. increase economic benefits. The production costs can be deducted by 20% due to reduced number of seeds, fertilizers and pesticides. (Sato *et al.*, 2011)

### 3.6. Case Study 6: Improving emergency preparedness and response in Fiji

**Source:** Pacific sub-region contribution to Asia Pacific reporting to 8<sup>th</sup> World Water Forum

Fiji's population of just over 900,000 is scattered across some 333 Pacific islands. With increasing urbanization, informal settlements in flood plains and densely populated coastal areas, the proportion of Fiji's population affected by emergencies caused by flooding and cyclones is increasing. In recent years Fiji has made preparedness a priority - building capacity to deal with disasters and provide safe and sustainable water supply and sanitation systems as well as effective hygiene promotion. Modelled on global best practice, a cluster approach for humanitarian response in emergencies was endorsed by the Government of Fiji following the impacts of a major cyclone in 2012, and strengthened over subsequent years. The approach includes the establishment of a Water, Sanitation and Hygiene (WASH) cluster, ensuring better coordination of partner efforts to deliver WASH interventions during disasters and emergencies. The WASH cluster approach was put to full use in Fiji's response to the impacts of the record breaking Tropical Cyclone Winston that struck the nation in 2016, and was instrumental in coordinating the suite of WASH-related interventions required during the response and recovery phases.



**Figure: The Fiji WASH Cluster has been instrumental in coordinating water and sanitation recovery efforts in the aftermath of 2016's Tropical Cyclone Winston (SPC)**

#### **4. The lessons learned from the case studies**

- Technological innovations are very important and will help in adaptation and mitigation – as exemplified by case studies on SPIP and Regional Flood Information Systems.
- Community based adaptations are equally important as exemplified by the case of Community Based Flood Early Warning Systems
- Coordinated governmental and non-governmental efforts is necessary to devise and implement effective disaster preparedness and emergency response as exemplified by the case of Fiji.
- Fragile areas like mountains have their own particular needs, for example, drying of springs affects millions of people in the mountains and local solutions for spring revival are needed. Here partnerships across sectors is needed as exemplified by the Spring Revival in India.
- Agronomic practices like SRI can help farmers adapt to climate change and for that to happen, policy support is required.

#### **5. Actions and Sub-actions to overcome the problems and achieve the solutions**

- 1.** Derive consensus about climate change and its impact across all stakeholders in the region
  - a. Contribute and support studies that unpack the varied impacts on climate change on water resources and various other aspects such as agriculture,

- hydropower, ecosystems etc.
- 2.** Provide special attention and assistance to vulnerable geographies like mountains, islands and coastal regions.
    - a. Contribute to, and use the findings from IPCC's ongoing Special Report on Cryosphere and Oceans in a Changing Climate (SROCC) for informing public policy discussions.
  - 3.** Promote good practices of adaptation – both community and ecosystems based adaptations
    - a. Use existing platforms, like the World Water Forum and UNFCCC to document “best practices” and lobby for its adoption in similar geographies.

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