



# HI-AWARE

Himalayan Adaptation, Water and Resilience Research

HIGHLIGHTS 2014-2018



## **HI-AWARE Consortium Final Technical Report 2018**

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**Strategic Partner Institutions:** CEDAR, India; Future Water, The Netherlands; LEAD Pakistan; MPA, India; Practical Action, Nepal; TMI, India

**Submitted:** 12 November, 2018

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Himalayan Adaptation, Water and Resilience (HI-AWARE) Research

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## Contributing to climate change adaptation in the HKH



David Molden  
Director General, ICIMOD  
Chair of HI-AWARE Steering  
Committee

“HI-AWARE’s research has impacted National Adaptation Plans, university curricula, as well as the IPCC, which is really the pinnacle of contribution to adaptation research.”

It has been a very exciting last year with HI-AWARE and its partners. I have seen the project grow over the past five years and there are many things to be proud of. This report is a testimony to the efforts and achievements of HI-AWARE in generating not just scientific but also socio-cultural, political and gender-sensitive knowledge on climate change adaptation in the Hindu Kush Himalaya (HKH) and its communities; putting this research to effective use; testing adaptation options on the ground along with communities; and developing and strengthening research capacity in the region. Together, these concerted efforts across four countries of the HKH – Bangladesh, India, Nepal and Pakistan, and three river basins – Indus, Ganges and Brahmaputra, have surely helped chart a way forward for resilience building.

Throughout the project period, there has been extensive focus on stakeholder engagement across levels so that the project and its research and interventions grow in a holistic and balanced way. HI-AWARE’s research has reached National Adaptation Plans, university curricula, as well as the IPCC, which is really the pinnacle of contribution to adaptation research.

A number of consultations, trainings, and exposure visits, were conducted to identify knowledge gaps, co-design interventions with communities, and relay that to policy makers. Cases in point are the number of adaptation pilot interventions that were implemented across the three basins and the policy engagement around it.

HI-AWARE has also done very well in the production of evidence in the form of high quality publications, something it continues to do even as it is coming to a close. What is of tremendous value is also the intention and effort to build regional research capacity. HI-AWARE has supported multiple Master’s and PhD students, not just in their thesis building, but also in network building through multiple HI-AWARE Academies.

As the project draws to a close, I would like to congratulate the consortium on a successful partnership and wish all the partners continued association and the very best for the future.

## Foreword

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More than one billion people live in deltas, semi-arid lands, and glacier-dependent river basins, 'hot spot' regions that are the most vulnerable to climate change. As part of the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAS), HI-AWARE was one of four consortia that sought to build resilience in these hot spots, supporting research that informs adaptation policy and practice.

Beyond its focus on the headwaters in the Hindu Kush Himalaya, HI-AWARE is unique for working across four neighbouring countries. In fostering a landscape view, HI-AWARE identified how local people in different countries face similar challenges, and provided evidence on how changes in the mountains and plains impact river basins downstream. HI-AWARE is also unique for combining the strengths of an intergovernmental organization, think tank, research institute, university, government agency, and civil society. As a partnership, these institutions achieved more together than they could working in isolation, engaging stakeholders in all four countries to inform local adaptation action.

HI-AWARE made valuable contributions within CARIAS, including original research on the implications of +1.5C warming, gender and climate change, migration patterns in South Asia, and adapting to heat stress. The solutions identified have already touched the lives of many people, and hold the potential to reach millions more that suffer from floods, heat, and droughts. HI-AWARE has improved our understanding on how glacier-dependent basins are changing, with vital consequences for the water, food, and energy nexus of the Indus, Ganges and Brahmaputra basins and the millions of people who depend on these rivers.

This report highlights HI-AWARE achievements over more than four years, providing an overview for anyone who wishes to learn more about this experience.

**Murali Kallur and Bruce Currie-Alder**  
International Development Research Centre

## Messages from Steering Committee Members

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**Atiq Rahman (BCAS)**

Our association with HI-AWARE has been a wonderful experience. I often cite the project to my students as an example of high quality interaction and capacity building. Since we have generated a good amount of new knowledge in HI-AWARE, we should go forward from here. We now have a good understanding of climate change adaptation in the HKH and we hope that the partnership that this project has given rise to continues in the time to come.

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**Yusuf Zafar (PARC)**

For PARC, the experience has been great and full of learning. We benefited immensely by working in a multicultural and multi-disciplinary team. There are many MSc students who got a chance to participate in the project and add to their knowledge on water management and climate change. The model for water management developed in HI-AWARE will be replicated in Hunza Valley in an area of 5,000 acres. There are plans to link 50,000 solar pumps with a high efficiency irrigation system in the future. This is crucial since Pakistan is laying great emphasis on water management in the next five year plan.



### Ajay Mathur (TERI)

HI-AWARE has been an excellent initiative and we are proud to have been a part of this process right from its conceptualization. For example, the research carried out on springshed management highlights the importance of public infrastructure and community institutions in poverty alleviation and resilience building. There is scope for the HI-AWARE scientific work to be built upon and for connecting with policymakers to further identify gaps. This work can be used to leverage the SDG framework to work with national policies and align the adaptation approaches with other development issues. Through its multidisciplinary approach, HI-AWARE helped to build national and subnational policies on resilience. TERI has benefited a lot from HI-AWARE and will continue to engage with policymakers to convert messages to action.



### Bram de Vos (WENR)

HI-AWARE has done very good evidence-based research which has been linked with policy change processes. In particular, I liked the 15 key messages that are policy relevant. They are also presented in a storytelling format which is easy to read and understand for policy makers. Our research shows that a 1.5 degrees warming scenario can be catastrophic for the mountains and the industrialized countries should reduce greenhouse gas emissions. WENR has benefitted hugely. The end of project period is always difficult, especially since we need to determine how to go on from here. But we are keen to participate in the future through research programmes, including potential PhD programme.

## Messages from Co-Principal Investigators, HI-AWARE

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### Philippus (Flip) Wester, Principal Investigator

It was great being a part of HI-AWARE as its Principal Investigator. Together with the team, we were able to work on all aspects of the project as planned. I am glad to see that the 15 synthesis messages have come out well and we could contribute towards adaptation research and practice. I am pleased that the initiative ended as the team had expected and was able to touch the lives of communities in all the study areas in the process. Unlike other consortia, HI-AWARE has piloted adaptation options, some of which are already being scaled out. The inclusion of strategic partners in all river basins and inclusion of young researchers were good practices of HI-AWARE.

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### Anjal Prakash, Co-PI, ICIMOD and Coordinator

I am happy to have been part of this project for the entire project period. In my understanding, HI-AWARE has been a successful research project. In particular, I liked the research with impact approach that has contributed to solar powered irrigation in Pakistan, National Adaptation Plan in Nepal, Eco-San Toilet in Bihar, India, and has influenced the State Action Plan in Mizoram and Climate Change Plan in Bangladesh. These are the highlights of the project and I am happy to have been part of this process which has been a great learning for me.

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### Arun Shrestha, Joint-Principal Investigator

HI-AWARE has contributed in adaptation research and practice with more than 50 papers, and 2 special journal issues focusing on urban water and gendered vulnerabilities. I consider this a great achievement for a project span of five years. One of the highlights of the programme is strong stakeholder engagement with more than 100 recorded engagements in the four study basins. This engagement made the research relevant for people on the ground and therefore represents the voice of poor and marginalized in the HKH region. I look forward to a second phase of work where we could take these forward in action.



### **Bashir Ahmad, Co-PI, PARC**

Apart from all the good work done, I liked the capacity building as envisaged in one of HI-AWARE's work packages. This was specially targeted towards young professionals and the internal survey done on importance, personal interest and ability shows that majority of the respondents showed an increased capacity. The HI-AWARE team also agrees that the initiative has been able to fulfill its objectives with flexibility during the project duration.

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### **Hester Biemans, Co-PI, WENR**

Apart from good research, I liked the partnership approach of HI-AWARE which has been a great learning. The north-south divide in research has been bridged through this project with successful partnership between researchers from different areas and backgrounds. The transdisciplinarity needed for climate research has been fully practiced in HI-AWARE. Personally, I have learnt many things from this project and I look forward to working in the second phase of HI-AWARE.

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### **Md. Abu Syed, Co-PI, BCAS**

HI-AWARE was an action research project for BCAS team which led to a lot of work on the ground. In particular, I consider our work on the climate flood resilient habitat in the lower Teesta basin as a success. We see that there is a demand which needs to be channelized and upscaled. The other work that I liked in particular is on transformative adaptation pathways towards resilient ecosystem and livelihoods. The research done by HI-AWARE has also contributed towards the review of BCCSAP (Bangladesh Climate Change Strategy and Action Plan), Delta Plan and Climate Smart Investment Plan for Agriculture (crop, livestock, fisheries) in Bangladesh and we look forward to working on the second phase of the project.

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### **Suruchi Bhadwal, Co-PI, TERI**


I am happy to have been part of this research right since its inception. I'm also glad to report that milestones that were envisaged have been achieved. HI-AWARE's legacy includes capacity building of young researchers, regional network of scientists, knowledge and evidence based research, taking research to practice and contributions of many HI-AWARE researchers to IPCC.



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# Executive Summary

HI-AWARE's overall goal is to enhance the adaptive capacities and climate resilience of the poor and vulnerable women, men, and children in the mountains and plains of the glacier and snowpack-dependent river basins of the Hindu Kush Himalaya (HKH), focusing on the Indus, Ganges, and Brahmaputra river basins, through the development of robust evidence to inform people-centred and gender sensitive climate change adaptation policies and practices for improving livelihoods. This report documents the journey of HI-AWARE from February 2014 to October 2018. This end of project report provides a comprehensive overview of the project, its major outcomes and impact. It is aimed at researchers, policy makers, practitioners and students interested in the issue of climate change adaptation in HKH region as well as project management, research with impact, and capacity building in large scale action research settings. The report is divided into three parts: generating knowledge, research uptake and strengthening expertise.

Under generating knowledge, HI-AWARE's cumulative research output stands at 28 papers in top peer reviewed journals including a paper in *Nature - Climate Change*. This is eight papers more than the total end of project target of 20. Additionally, HI-AWARE produced 21 working papers. Two special issues focusing on Gendered Vulnerability and Urban Water are forthcoming in the journals *Environmental Development* (Elsevier) and *Water Policy* (IWA Publishing) containing 20 papers. An additional 5 papers have been submitted to different journals. These papers focus on high quality and policy and practice relevant research on climate change impacts in HKH region; the drivers and conditions leading to vulnerability; and innovative climate change adaptation approaches and practices.

Our research uptake aimed at promoting evidence-based and tested innovative adaptation approaches and practices with relevant communities and institutions at various levels. The effort was to improve policies and practices that help vulnerable

populations adapt to climate change. Under this component, three pilot initiatives were executed that focused on solar powered irrigation pump, Eco-San toilets and flood resistant housing. The 2017 monsoon floods in Nepal and Bihar (India), caused widespread loss of lives and property, including in HI-AWARE's pilot areas in Gandaki River Basin in Bihar where Eco-San toilets are being implemented. During floods, sanitation becomes a particular problem as people have reduced means of maintaining personal hygiene, especially with regard to defecation. Open defecation only adds to the contamination of ground water, which then affects those who use it for household uses. Eco-San toilets provided respite to people in these flooded areas. Earlier, the government of Bihar recognized and extended financial approval for Eco-San as a sanitation facility for flood affected regions in Bihar. In Pakistan, the aim was to establish solar pumping systems along with a climate smart agriculture package. The project was aimed at sensitizing the farmers and promoting the adoption of this technology. 10 farmers have installed the solar pumping system and related smart agricultural practices at their farms. The pilot in Bangladesh was on flood resilient habitat which has also been adopted by the local communities. The local government is considering this technology to promote flood resistant housing in the area.

The third component of HI-AWARE focuses on strengthening expertise of HI-AWARE research community for conducting high quality research on adaptation issues and communicating and using research results strategically. HI-AWARE had supported six fully sponsored PhD candidates and four partially sponsored candidates. Of the 10 candidates, 5 have defended their thesis, the other five will complete their PhDs in 2019. 24 out of 28 HI-AWARE supported Master's candidates have completed their thesis. The rest are finalizing their research and will graduate in Dec-March 2018-19.

# Who We Are

2



# Introduction



The Himalayan Adaptation, Water and Resilience (HI-AWARE) Research on Glacier and Snowpack Dependent River Basins for Improving Livelihoods began in March 2014 and officially concluded in October 2018. HI-AWARE worked in three river basins of the Hindu Kush Himalaya (HKH) region, namely, Indus, Ganges and Brahmaputra, spanning four countries – Bangladesh, India, Nepal and Pakistan. The overall goal has been to enhance the adaptive capacities and climate resilience of poor and vulnerable women, men, and children in the mountains and plains of the HKH through use of robust evidence to inform and contribute to people-centred and gender sensitive climate change adaptation policies and practices for improving livelihoods.

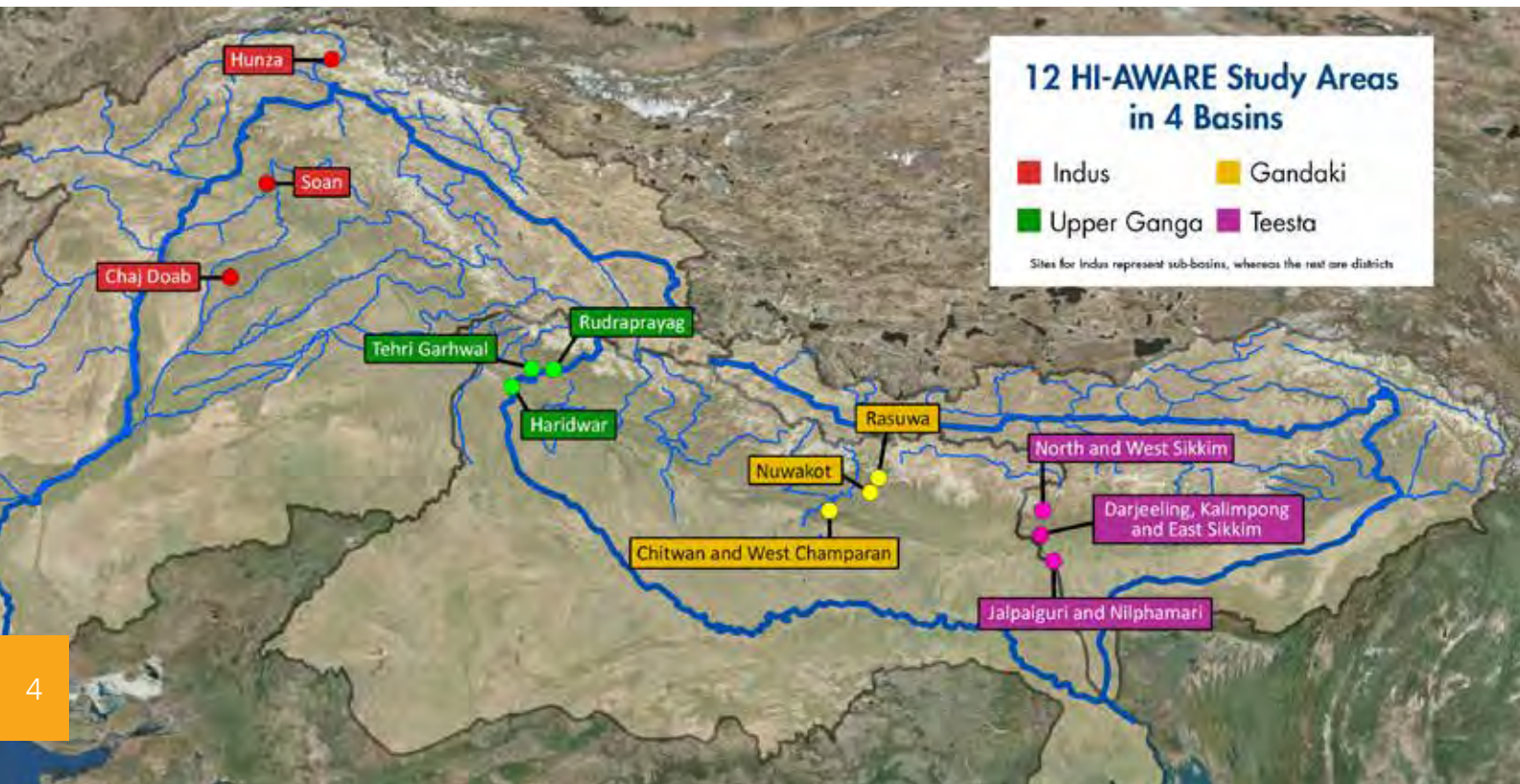
HI-AWARE worked in a consortium format made up of five members: International Centre for Integrated Mountain Development (ICIMOD) in Nepal; The Energy and Resources Instituted (TERI) in India; Bangladesh Centre for Advanced Studies (BCAS) in Bangladesh; Pakistan Agricultural Research Council (PARC) Pakistan; and Wageningen Environmental Research, Wageningen University and Research (WUR) in the Netherlands. The consortium members worked with strategic partners in their respective study basins. These include: FutureWater in the Netherlands; Practical Action in Nepal; Leadership for Environment and Development (LEAD) in Pakistan; and Megh Pyne Abhiyan (MPA), The Mountain Institute (TMI) and Centre for Ecology Development and Research (CEDAR) in India. Some work is further sub-contracted to Implementing Partners. Most of the funding for HI-AWARE came from the Department for International Development (DFID), United Kingdom that was given to the International Development Research Centre (IDRC), Canada to manage. IDRC, additionally, also contributed funding. ICIMOD led the consortium and was accountable for its performance to IDRC, who then further reported to DFID.

The HI-AWARE consortium has been driven from the global South, with four of the five partners being southern organizations. The lead institution, ICIMOD, is a regional intergovernmental organization owned by the eight regional member countries in the region. BCAS, TERI and CAEWRI-PARC are lead organizations in their respective countries dealing in climate change adaptation research and advising governments, while WUR, with a regional office in Bangladesh, has a strong track record in research, capacity building and policy advice in the globalSouth. The HI-AWARE research emphasised climate change adaptation, defined as a high priority area of work by the governments in the region.

# Where We Work

To inform the design of sustainable and evidence-based adaptation pathways, a set of diversified and representative research and pilot intervention sites were essential. The sub-basins for the research and pilot interventions were selected through stakeholder consultations meetings held in Pakistan, Bangladesh, India and Nepal during the proposal formation phase in 2013 and were confirmed during the inception phase in 2014 (See figure below). These sites acted as:

- Research sites for generating knowledge (e.g. on biophysical impacts of climate change, socioeconomic drivers of vulnerability, gender-differentiated coping capacities, etc.) include:
  - Indus - Hunza (Upstream); Soan (Midstream); Chaj Doab (Downstream) – Pakistan
  - Ganges - Rudraprayag (Upstream); Tehri Garhwal (Midstream); Haridwar (Downstream) – India
  - Gandaki - Rasuwa (Upstream); Nuwakot (Midstream); Chitwan (Downstream) - Nepal ; West Champaran (Downstream) - India
  - Teesta - North and West Sikkim, Sikkim (Upstream); Darjeeling and Kalimpong, West Bengal, and East Sikkim, Sikkim (Midstream) Jalpaiguri, West Bengal - India; Nilphamari (Downstream) – Bangladesh
- Pilot intervention sites for experimentation and action research:
  - Indus - Soan – Pakistan
  - Ganges - Rudraprayag, New Delhi – India
  - Gandaki - West Champaran – India
  - Teesta - Rangpur – Bangladesh



## 5 CONSORTIUM MEMBERS

Bangladesh Centre for Advanced Studies (BCAS), Bangladesh ([www.bcas.net](http://www.bcas.net))

International Centre for Integrated Mountain Development (ICIMOD), Nepal ([www.icimod.org](http://www.icimod.org))

Pakistan Agricultural Research Council (PARC), Pakistan ([www.parc.com](http://www.parc.com))

The Energy and Resources Institute (TERI), India ([www.teriin.org](http://www.teriin.org))

Wageningen University and Research Centre (WUR), the Netherlands ([www.wur.nl](http://www.wur.nl))

## 6 STRATEGIC PARTNERS

Centre for Ecology Development and Research (CEDAR), Uttarakhand, India ([www.cedarhimalaya.org](http://www.cedarhimalaya.org))


FutureWater, the Netherlands ([www.futurewater.eu](http://www.futurewater.eu))

LEAD Pakistan, ([www.lead.org.pk](http://www.lead.org.pk))

Practical Action South Asia Office, Nepal ([www.practicalaction.org/nepal](http://www.practicalaction.org/nepal))

Megh Pyne Abhiyan (MPA), Bihar, India ([www.meghpyneabhiyan.wordpress.com](http://www.meghpyneabhiyan.wordpress.com))

The Mountain Institute India (TMI India), Sikkim ([www.tmiindia.org](http://www.tmiindia.org))

A scenic view of a mountain town. In the foreground, a large, light green building with a red roof and white window frames is prominent. The town extends up a hillside with various colorful buildings and houses. In the background, a large, forested mountain rises under a clear blue sky. The text "Our Key Messages" is overlaid on the right side of the image, next to a large yellow arrow pointing right.

# Our Key Messages



Even 1.5 Degrees is Too Much

Too Hot to Bear: Concerted Efforts Needed to Address Urban Heat in South Asia

More Severe Floods in the Indus, Ganges and Brahmaputra Basins Likely in the Future

Floods Need Not Spell Doom if Planning and Management are Inclusive

Mountain Waters Crucial for Downstream Agriculture

Socio-economic Development, not Climate Change, the Main Driver of the Future Water Gap

Rising Demand and Dwindling Water Supply: Urban Himalaya Running Dry

Enduring Vulnerabilities Limit Adaptation: Major Climatic and Socioeconomic Drivers in the HKH Region

Changing Genderscapes in the Hindu Kush Himalaya, but Unchanging Institutions and Policies

Moving to Adapt

Strengthening Decisions for Adaptation through Multi-Stakeholder Engagement

Climate Smart Water Management Vital for Sustainable Agriculture

Communities are Already Experiencing Critical Climate Stress Moments

Adapt Before It's Too Late: Adaptation Pathways in the Hindu Kush Himalaya

Working Towards Effective Adaptation: Contributions from HI-AWARE Pilots to Enhancing Climate Resilience in the HKH Region

# 1

## Even 1.5 Degrees is Too Much

The Indus, Ganges and Brahmaputra river basins are extremely susceptible to temperature increase. Under a 1.5 °C global warming scenario, these river basins would warm up by more than 2 °C on average by the end of this century. At higher altitudes this warming will be even more marked, due to elevation dependent warming. A 2 °C global warming scenario could lead to a warming of around 2.7 °C in these glaciated river basins. Currently, more likely climate change scenarios, specific for these river basins, suggest regional temperature increases between 3.5 and 6 °C by 2100. The majority of the projections also indicate overall wetter conditions in the future and increases in extreme precipitation events.

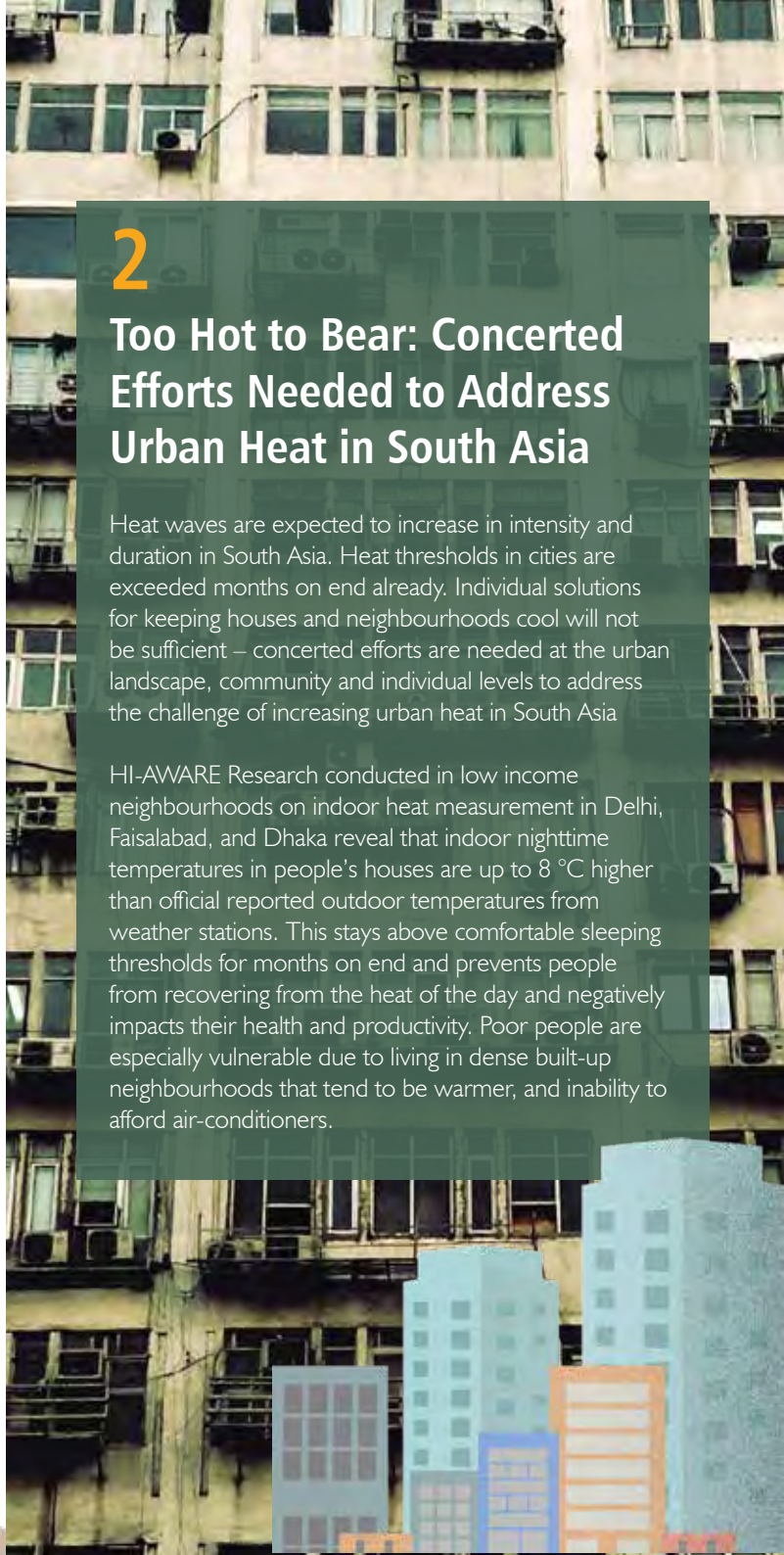
This will lead to significant losses in glacier volume, from 36 to 64%, depending on the warming scenario, and impact timing of water flows and water availability. Under current more likely GHG emission scenarios the regional temperature increases will be between 3.5 and 6 °C by 2100, indicating that the 1.5 and 2 °C scenarios are not suitable for adaptation planning in South Asia.

# 2

## Too Hot to Bear: Concerted Efforts Needed to Address Urban Heat in South Asia

Heat waves are expected to increase in intensity and duration in South Asia. Heat thresholds in cities are exceeded months on end already. Individual solutions for keeping houses and neighbourhoods cool will not be sufficient – concerted efforts are needed at the urban landscape, community and individual levels to address the challenge of increasing urban heat in South Asia

HI-AWARE Research conducted in low income neighbourhoods on indoor heat measurement in Delhi, Faisalabad, and Dhaka reveal that indoor nighttime temperatures in people's houses are up to 8 °C higher than official reported outdoor temperatures from weather stations. This stays above comfortable sleeping thresholds for months on end and prevents people from recovering from the heat of the day and negatively impacts their health and productivity. Poor people are especially vulnerable due to living in dense built-up neighbourhoods that tend to be warmer, and inability to afford air-conditioners.



# 3

## More Severe Floods in the Indus, Ganges and Brahmaputra Basins Likely in the Future

Robust region-specific climate change projections developed by HI-AWARE for the Indus, Ganges and Brahmaputra (IGB) river basins indicate that extreme precipitation events, the main driver for floods in the region, will likely increase in frequency and severity in the coming decades. Peaks in five-day precipitation sums are shown to increase between 15% and 170%. The average river flow is projected to increase in all three upper river basins: roughly 50% in the upper Indus, 30%–40% in the upper Ganga, and 25%–50% in the upper Brahmaputra towards the end of the century. Therefore, floods will become more frequent and severe in the mountainous and downstream areas of the IGB river basins. Flood-resilient housing shows promise as an adaptation option to address this hazard.



# 4

## Floods Need Not Spell Doom if Planning and Management are Inclusive

Farmers in South Asia historically appreciated moderate seasonal floods, as these brought sediments with nutrients, water for irrigation, replenished groundwater and revived water bodies. But, scenarios have changed, and flooding is becoming more destructive.

Floods need not spell doom if river management, including planning and control, take into account people's concerns, experiences and skill sets. This requires an approach that focuses on balanced interaction between the ecology and human systems at basin level in the Hindu Kush Himalayan (HKH) region.

Climate and Flood Resilient (CFR) housing on the floodplains, consisting of raised and protected plinths, provisions for safe drinking water, EcoSan toilets and solar power, can prevent displacement and maintain health conditions during floods. These low-cost innovations can equip communities to become resilient to extreme and frequent riverine and flash floods.



# 5

## Mountain Waters Crucial for Downstream Agriculture

130 million farmers in the downstream plains of the Indus and the north-western part of the Ganges basin depend on water originating from glacier and snow melt from the mountains.

In terms of crop production, 9% of the ~46 million metric tonnes of wheat that is harvested each year in the Indus Basin can be attributed to water from glacier and snow melt. Similarly, 15% of the annual 19 million metric tonnes rice production, 28% of the 4 million metric tonnes cotton and 17% of the 53 million metric tonnes of sugarcane can be attributed to this meltwater. In the Ganges Basin, 3% of cotton production and 7% of sugarcane production can be attributed to meltwater.

Discharge from glacier and snow melt and groundwater provide a reliable supply of irrigation water during parts of the growing season when other water sources are scarce. Any changes in the future availability of meltwater or further groundwater depletion will therefore impact agriculture.

Understanding the links between sources of water demand and sources of water supply is important for developing appropriate adaptation measures. In HI-AWARE we developed a water resources model to help understand risks and to evaluate solutions to manage the water budget.

# 6

## Socio-economic Development, not Climate Change, the Main Driver of the Future Water Gap

Mean annual water availability is likely to increase by 36-42%, 37-46% and 17-46% in the IGB, respectively, due to an increase in precipitation that is projected consistently across climate models for all three river basins.

Water consumption in downstream areas of the IGB basins is projected to increase by 24%, 42% and 107%, respectively, during the 21st century. Water use for industrial and domestic purposes is projected to increase three to seven fold. Although it is currently small compared to the volume of water used in agriculture, it will form a significant portion of total water use in future.

Since, the increase in water availability will be stronger in the upstream parts of the three basins, the dependency of downstream water users on upstream water resources will increase.

We estimate that the current blue water gap, based on unsustainable groundwater withdrawals, is 83 km<sup>3</sup>/year in the Indus and 35 km<sup>3</sup>/year in the Ganges, and will increase by 7% and 11% towards the end of the century. Socio-economic developments leading to increased demand are the main driver of the increasing water gap.

# 7

## Rising Demand and Dwindling Water Supply: Urban Himalaya Running Dry

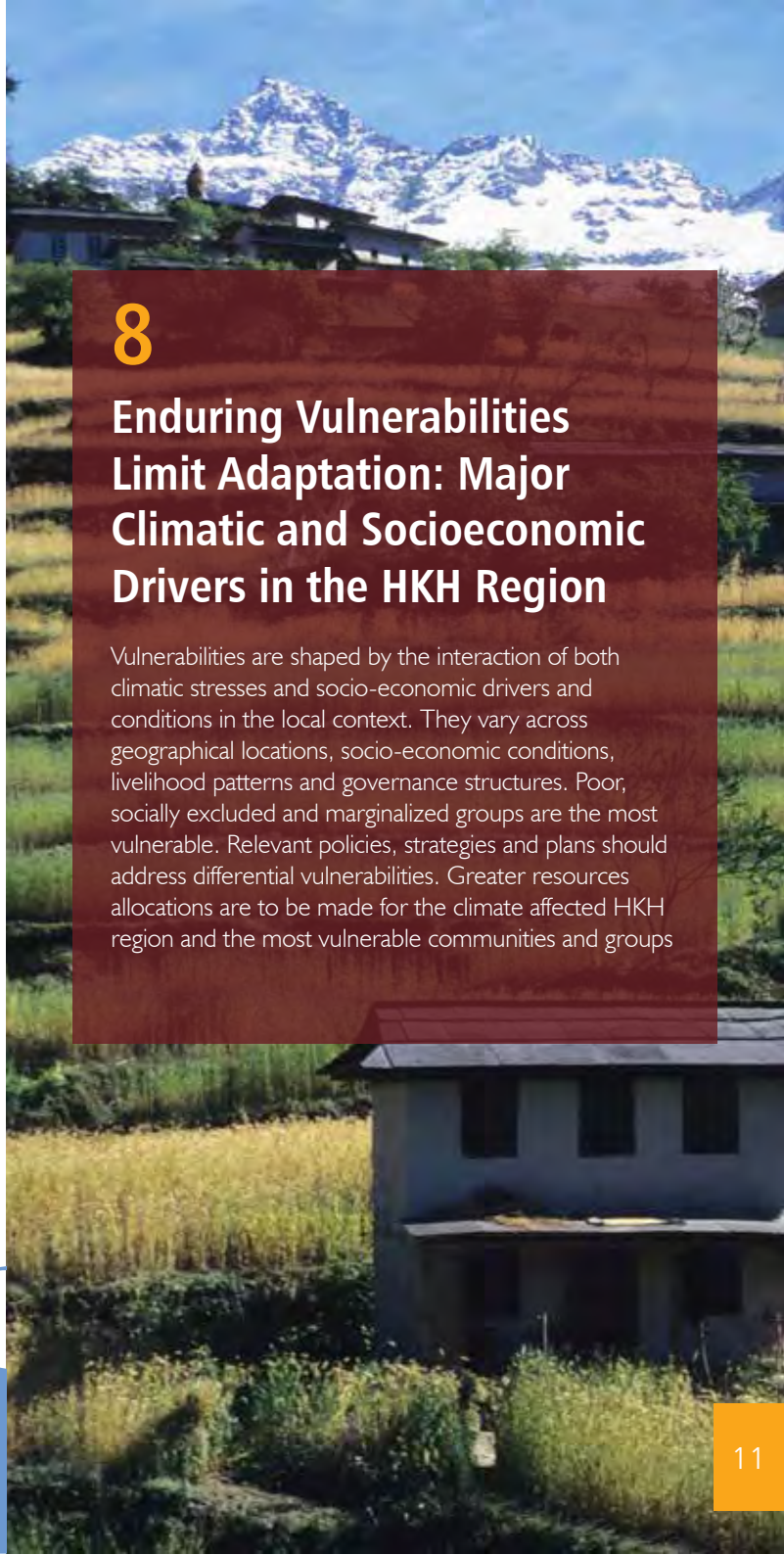
The water demand-supply gap in 8 surveyed towns across the HKH region is 20-70%. There is a high dependence on springs (ranging between 50-100%) for water supply in three-fourths of the urban areas of the Himalaya. The gap between demand and supply may double by 2050 in a business as usual scenario. A holistic approach to manage water that includes springshed management along with planned adaptation is of the utmost importance for securing safe water supply in the urban Himalaya. Along with springshed management, other options could be explored in the wake of rising water demand and use. However, HI-AWARE has demonstrated that springshed rehabilitation is possible and therefore, there is an evidence to take this forward.



# 8

## Enduring Vulnerabilities Limit Adaptation: Major Climatic and Socioeconomic Drivers in the HKH Region

Vulnerabilities are shaped by the interaction of both climatic stresses and socio-economic drivers and conditions in the local context. They vary across geographical locations, socio-economic conditions, livelihood patterns and governance structures. Poor, socially excluded and marginalized groups are the most vulnerable. Relevant policies, strategies and plans should address differential vulnerabilities. Greater resources allocations are to be made for the climate affected HKH region and the most vulnerable communities and groups



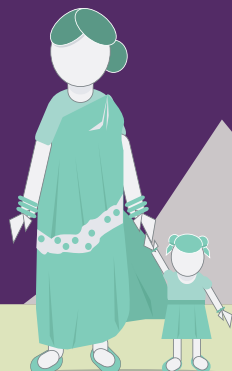
# 9

## Changing Genderscapes in the Hindu Kush Himalaya, but Unchanging Institutions and Policies

Climatic stressors and socio-economic changes are changing traditional genderscapes in farming communities. Changes are taking place demographically, in the roles and responsibilities of women and men, and the domains and spaces they occupy. This is mostly due to the long-term migration of men seeking alternate income sources outside their base locations. To some extent, these changes have enhanced women's capacities. However, they have also increased women's vulnerabilities due to weak implementation of existing measures or lack of sufficient policies to safeguard the increased involvement of women in public spaces.

There is an opportunity to capitalise on the improved skills of women, and their new-found confidence and capabilities through initiatives promote women as leaders.

Urgent actions are needed to bring changes in the institutional and policy domains to ensure women's security and participation by regulating markets and promoting gender friendly technologies that support resilient livelihoods.



# 10

## Moving to Adapt

Labour migration in the Hindu Kush Himalaya boosts household adaptive capacities by spreading risk and diversifying livelihoods. It is incumbent on policy makers to make migration more beneficial for people, and to help build household resilience in the face of environmental change. However, migration is a costly and complicated pathway, which is not available to, or feasible for, all households. Thus, other in-situ adaptation options are equally important.

# 11

## Strengthening Decisions for Adaptation through Multi-Stakeholder Engagement

Actors and contexts drive adaptation choices. HI-AWARE has used multi-stakeholder processes to prioritise context specific adaptation options, allowing for holistic planning around persistent risks in study basins of the Hindu Kush Himalayan (HKH) region. These prioritised options include, among others, water storage, high efficiency irrigation systems (HEIS), mixed cropping, preservation of local seeds (seed banking) and knowledge on local techniques for cardamom cultivation, and early-warning systems, in the Indus, Gandaki, Lower Teesta, Upper Teesta, and Upper Ganga river basins respectively.

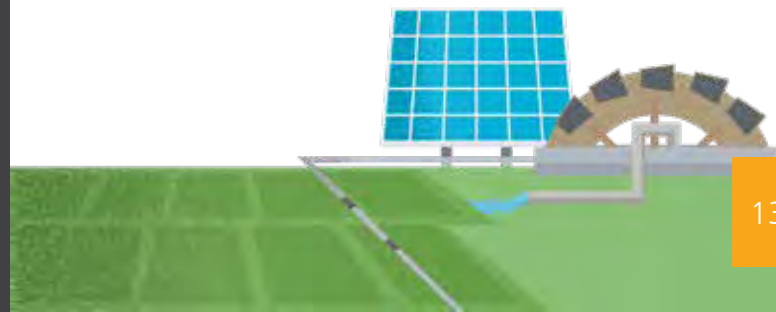


# 12

## Climate Smart Water Management Vital for Sustainable Agriculture

Climate smart water management practices are important to cope with increasing climate variability and improve agricultural sustainability in South Asia.

Novel solutions like solar powered irrigation pumps can accelerate the adoption of improved irrigation methods (e.g. drip or sprinkler) and proven water saving practices (e.g. mulching), and crop diversification. In high- and mid-altitude mountains, re-adoption of traditional crops is vital to cope with water stress induced by rapidly changing patterns of snowfall and glacier melt.



# 13

## Communities are Already Experiencing Critical Climate Stress Moments

Communities in the Hindu Kush Himalayan region are already experiencing critical climate stress moments, which form a growing risk to their livelihoods. These stresses are experienced differently by men and women and are driven by a changing climate and perceptions of more extreme weather events in the past years. Community perceptions of change and climate events in the past ten years reveal increasing temperatures, erratic and untimely rainfall, hailstorms, drought and decrease in snowfall. These variabilities affect agriculture, the major component of their livelihoods, at various stages of the crop cycle depending on the study sites, and communities are adapting to these changes by altering the crop cycle or shifting to climate resilient crops.

# 14

## Adapt Before It's Too Late: Adaptation Pathways in the HKH region

Adaptation requires careful consideration of what to do when in order to sustain development efforts over time.

Assessment of when people are most vulnerable guides adaptation to offer fit-for-purpose solutions to people in different socio-cultural contexts. Critical climate stress moments are already experienced across different sectors in the Hindu Kush Himalaya. People are coping, yet not prepared enough for future changes in climate. For timely adaptation it is crucial to assess when turning points for decision-making are reached.

HI-AWARE started the development of adaptation pathways in the Hindu Kush Himalaya region. Making adaptation pathways helps to assess whether development is sustainable within the context of climate change and when adaptations are needed. In order for development plans to be climate-resilient they need to include choices and actions that reduce climate change impacts to sustain development efforts over time. Participatory development of adaptation pathways helps to prepare for change and facilitate the transformation needed for adaptation.





# 15

## Working Towards Effective Adaptation: Contributions from HI-AWARE Pilots to Enhancing Climate Resilience in the HKH region

The pilots implemented by HI-AWARE present contextually relevant and ecologically friendly technologies in the field of flood resilience, climate smart agriculture, and water and heat stress management. They have shown promising results and responses to existing climate risks at the local level, and in preparation for uncertainties relating to future climate risks.

The co-designing, planning, testing and implementation of various technologies with communities and other stakeholders, and existing technologies, are critical factors for successful pilots in the HKH region.



To read more  
[http://hi-aware.org/publications\\_ category/hi-aware-briefs/](http://hi-aware.org/publications_category/hi-aware-briefs/)

# Research Design

16



# Context

The HKH region, often called the third pole due to having the largest concentration of snow and ice outside the polar regions, is the source of ten of the largest rivers in Asia, providing water and other ecosystem services to more than 240 million people in the mountains and over 1.65 billion inhabitants downstream, of which a large proportion are poor and marginalised. Stretching some 3,500 km through some of the world's wettest and driest environments, and rising eight vertical kilometres through nearly every agro-ecological zone existing on Earth, the HKH region is a very fragile environment that is highly vulnerable to climate change. This is compounded by rapid socio-economic changes seriously threatening the livelihood systems of the poor communities. Over the past years, scientific consensus has been building on the general pattern of change in the HKH region, confirming a gradual increase in temperature and a modest increase in total precipitation in the source areas of the Indus, Ganges and Brahmaputra rivers by the end of this century. Throughout the HKH region, glaciers are receding and the net glacier melt runoff is on the rise. Another topic of debate is the relative contribution of greenhouse gases to climate change in the Himalaya, versus short-lived climate pollutants such as black carbon, which has regional and local sources.

What is also still very uncertain is how the combination of increasing temperatures and changing precipitation patterns will impact the timing of precipitation and runoff and the frequency of extreme weather events like extended periods of extreme heat or high intensity precipitation. Extreme weather events already appear to affect the Ganges basin more frequently and create flooding, though indications of change in the frequency of droughts are ambiguous. Most climate impact studies to date have focused on yearly totals and long term averages. This leaves translation of how more local and seasonal, time-specific shifts will impact people in the mountains and plains during critical moments (e.g. water shortage during sowing time), and how to adapt, still largely unexplored territory. Also very uncertain is the extent to which increasing atmospheric aerosol loading may be contributing to changes in precipitation patterns in the Himalaya region through effects on both cloud microphysics and on atmospheric heating and cooling.

Under this context, the basic rationale for the consortium's research as contained in HI-AWARE's full proposal and Inception Report remains unchanged. The overall goal of HI-AWARE was to enhance the adaptive capacities and climate resilience of the poor and vulnerable women, men, and children in the mountains and plains of the glacier and snowpack-dependent river basins of the Hindu Kush Himalaya (HKH). The project focused on the Indus, Ganges, and Brahmaputra river basins, through the development of robust evidence to inform people-centred and gender sensitive climate change adaptation policies and practices for improving livelihoods.

# Research Question and Objectives

## Main research question

How to develop timely adaptation measures and approaches to respond to rising temperatures, seasonal shifts in glacier and snowmelt induced runoff, and increased frequency of extreme events in the HKH mountains and floodplains in order to improve the resilience of livelihoods of the poorest and most vulnerable women, men and children in the region?

**Overall Objective:** To enhance the adaptive capacities and climate resilience of the poorest and most vulnerable women, men and children in the mountains and plains of the glacier and snowpack dependent river basins of the Hindu Kush Himalayan (HKH) region, focusing on the Indus, Ganges and Brahmaputra river basins, through the development of robust evidence to inform people-centred and gender sensitive climate change adaptation policies and practices for improving livelihoods.

## Specific Objectives (SO):

1. To generate science-based knowledge on the biophysical, socio-economic, gender, and governance conditions and drivers leading to the vulnerability of the livelihood systems of poor women, men and children to climate change.
2. To create robust evidence and improved understanding of the potential of adaptation approaches and practices, with an explicit focus on gender and livelihoods, based on turning point analysis and socioeconomic cost-benefits analysis.
3. To develop stakeholder-driven and gender inclusive adaptation pathways based on the up- and out-scaling of institutional and on-the-ground adaptation innovations that enhance the capacities of the poorest and most vulnerable to adapt to climate change, focusing on barriers and bridges to success as well as possible co-benefits.

4. To promote the uptake of the robust evidence generated at various scales through the development of synergies between science-based knowledge and adaptation practices of communities in order to shape improved policies and practices that help vulnerable populations adapt to climate change.
5. To further strengthen the scientific expertise in climate change adaptation and resilience research and to contribute to improving science-policy-stakeholder networks and problem-solving capacity in the HKH region.



# Research Approach and Methodology

HI-AWARE followed a research framework comprised of three work packages (see Figure 1). Each of the five research components (RC) under Work Package 1 was led by different institutions and individuals from the consortium, each with strong skills in natural sciences, climate sciences, hydrology, social sciences, GIS and policy analysis who have spent considerable time and energy in developing detailed work plans during the inception phase (April-September 2014). Some issues such as gender and vulnerability are cross-cutting and meant to be addressed by each RC as well as in the communication of research outcomes. This work package featured the inclusion of societal actors in the research process, from local communities to policy-makers and other key stakeholders, the dispersed organisation of research teams across four countries and 12 study areas, plus the testing of pilots in relation to adaptation criteria and the development of hybrid knowledge across traditional disciplines.

The development of the HI-AWARE proposal involved consultations with key stakeholders in all four countries as well as a comprehensive review of relevant, but limited, literature to better understand local and regional priorities and identify strategic gaps. Additionally, it built on the expertise of the partners involved, especially the substantial work that ICIMOD has been doing on the bio-physical drivers of vulnerability, the monitoring of glacially-fed river basins and the development of open access data portals (HICAP, HighNoon, MENRIS).

Under Work Package 3 there were a number of inter-connected strategies in place for building capacity and strengthening expertise, including financial support to 28 MSc students of which 57 percent are women, and 10 sandwich PhD candidates. The MSc students were linked to research components in the four study basins and were supervised both by a designated HI-AWARE researcher and a faculty member from the respective university. PhD students were supported through program funds at Wageningen Environmental Research, TERI and ICIMOD and dissertation topics linked to HI-AWARE research objectives and RCs under work package 1 (see Annexure 2).

With support from the Himalayan University Consortium (HUC), based at ICIMOD, the HI-AWARE Academy provided an opportunity for learning from leading academics on climate science, the economics of adaptation and vulnerability and interacting with other researchers beyond those directly supported by the programme. Annual international conferences on Climate Change Adaptation Policy and Science (CCAPS) have also been organised in Kathmandu (Sept. 2014, Sep. 2018), New Delhi (Feb. 2016), and Islamabad (Feb. 2018) bringing together policy-makers, donors, researchers and civil society actors engaged in climate adaptation. Additionally, a range of panels and workshop sessions have been held at other regional and global events including COP 22 (November, 2016) and the World Sustainable Development Summit organised by TERI in Delhi (Oct. 2016, Feb. 2018). These conferences and workshops provided opportunities for peer-learning and networking beyond the organised interactions that the programme entailed.

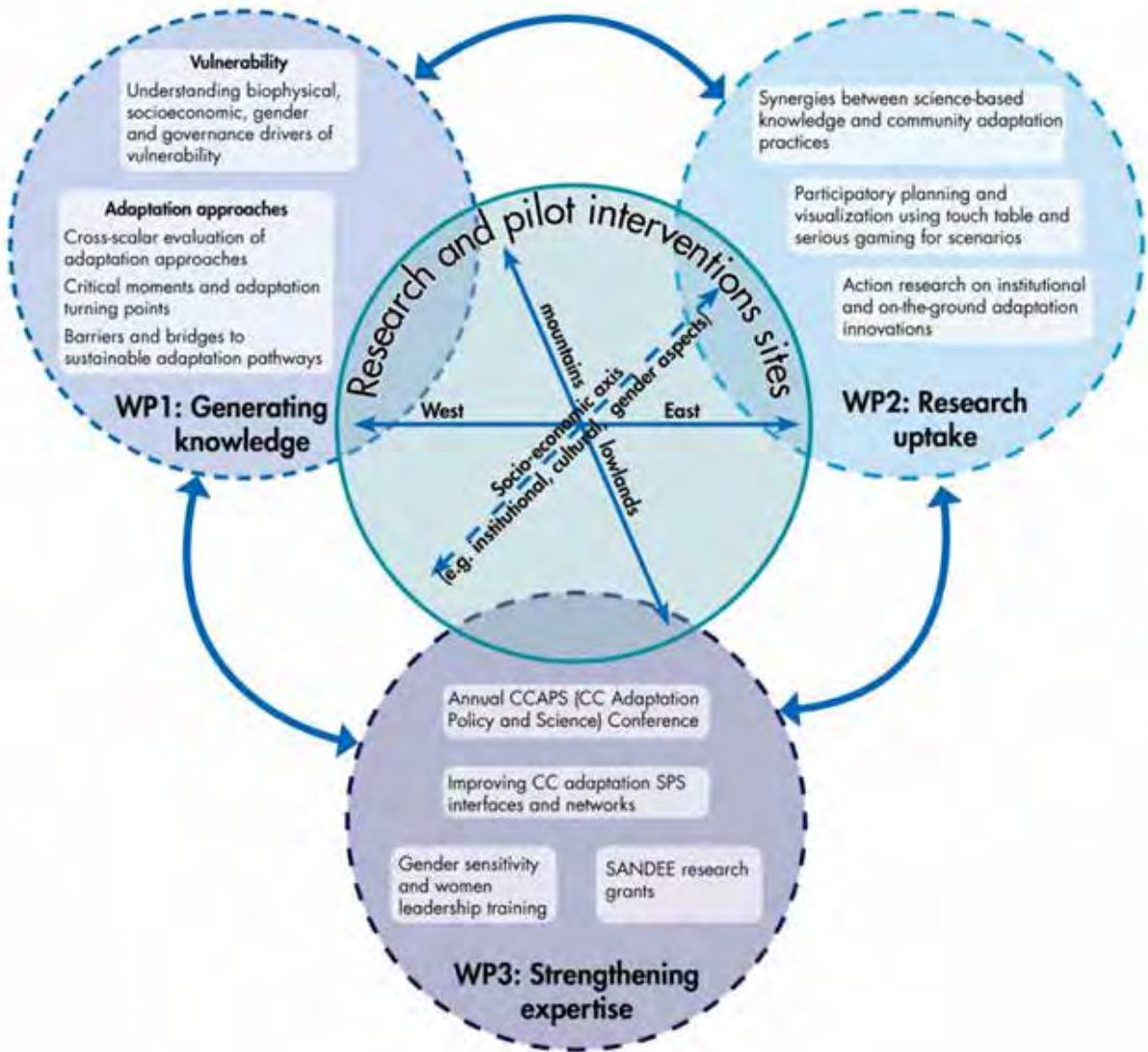


Figure 1: HI-AWARE Research Framework

## Work Package 1: Generating Knowledge

Focused on high quality and policy and practice relevant research on (i) climate change impacts; (ii) the drivers and conditions leading to vulnerability; and (iii) innovative climate change adaptation approaches and practices. All consortium members contributed to implementing the five Research Components in Work Package (WP) 1 and research is now well underway as we head into the final year of HI-AWARE. There are five Research Components (RCs) which constitute WP 1, Generating Knowledge, and these are organically linked to each other as well as to WP 2 (Research Uptake) and WP 3 (Strengthening Expertise).

### **RC 1: Bio-physical drivers and conditions leading to vulnerability and climate change impact:**

The main objective of this research component was to generate scientific knowledge on climate change impacts, vulnerability drivers, and adaptation policies and practices from biophysical perspectives. Accordingly, we studied mountain-specific and basin-scale climate change scenarios, impact of climate change on water availability in the IGB river basins, and climate change impacting extreme temperature and precipitation. We have consolidated the major learnings from each of the three components. In total, these new insights are important for global policy issues such as implications of a 1.5 degree world. At the local and national level, it helps in building future scenarios and policy implications for sectors like agriculture and hazards like floods and landslides in HKH region.

### **RC 2: Socio-economic, governance and gender drivers and conditions leading to vulnerability:**

Vulnerability to climate change is a multi-layered and multi-faceted issue, determined by both biophysical and socio-economic drivers. Socio-economic drivers of change play a role that is equal to if not greater than changing climate in terms of shaping people's vulnerabilities. Further, there are varying gendered differences in vulnerabilities in any context. Not all women or all men are equally vulnerable, nor are they vulnerable in a similar way – vulnerabilities vary in nature and type. However, vulnerabilities to climate change are often studied in isolation and compartmentalization of the various interlinked contextual conditions occurs e.g., social and gender, political, economic and geographical/location, and other socioeconomic drivers of change, such as globalization, urbanization, technological and infrastructure development. This research component looked at three main drivers of vulnerability – socio-economic, governance and gender.

### **RC 3: Monitoring and assessment of climate change adaptation practices:**

RC 3 monitored and assessed the different climate change adaptation practices, in order to promote uptake of robust evidence generated at various scales through the development of synergies between science-based knowledge and adaptation practices of communities and to shape improved policies and practices that help vulnerable populations adapt to climate change.

This component has four tasks.

1. To review existing climate change adaptation practices: In this component, we focused on systematic review of existing climate change adaptation practices relevant for the HKH region particularly focusing on:
  - (a) agricultural water management, climate change and high altitude livelihoods, with a focus on glacier and snow fed irrigation;
  - (b) climate change adaptation in the hills; and
  - (c) the drying up of springs and domestic and drinking water issues in cities located in the hills and mountains.
2. To identify and analyses important adaptation practices: Under this section, ICIMOD-HI-AWARE carried out intensive programme for understanding adaptation needs and options including a wide variety of interventions, reflecting adaptation's multi-faceted nature. Methods included stakeholder driven prioritization, cost-benefit analysis, reviews, monitoring of meteorological data, piloting adaptation options, etc.
3. To develop robust evidence: HI-AWARE has prioritized the relevant adaptation practices and approaches which are important to be piloted for future up-scaling and out-scaling. The table below gives a short description of the three pilots and two demonstrations undertaken by the respective institutions and the status.
4. To develop new approaches to adaptation practices. This component focussed on the cost of adaptation and the (co-)benefits of adaptation and mitigation intervention. The task was to evaluate adaptation options sufficiently for making sound decisions.

### **RC 4: Critical Moments and Adaptation Turning Points:**

This RC aimed to identify and analyse 'critical moments' and 'adaptation turning points' (ATPs) for different sectors and events and understand how climate change will impact the timing and duration of these critical adaptation moments. During the reporting period, the method to identify critical moments were used in the qualitative study across all the 12 study sites. This method has been applied in the field. Further Altera developed a method to identify and analyses adaptation turning points (working paper published), and developed a tool to quantify adaptation turning points visually (in RC 1, but the application to map ATPs in published as deliverable in RC4).



### **RC 5: Designing Sustainable Adaptation Pathways:**

This research component designed sustainable adaptation pathways that enabled the development of policies and practices to help vulnerable populations adapt to climate change. The exploration of adaptation pathways is a novel approach for decision making under uncertainty. Adaptation pathways are defined as sequences of policy actions to achieve targets under changing climate and societal conditions. These pathways are narratives that define different trajectories of growth or future development paths which are sustainable and contribute to building resilience. Adaptation pathways encourage taking short-term actions to address current risks, while at the same time planning longer term adaptation that may be required in the future.

## **Work Package 2: Research Uptake**

Aimed at promoting evidence-based and tested innovative adaptation approaches and practices with relevant communities and institutions at various levels in order to improve policies and practices that help vulnerable populations adapt to climate change. HI-AWARE has pursued an active policy and stakeholder engagement right from the start, and focused on further developing its KMC and Research into Use (RiU) strategies in this reporting period with the active contribution of all consortium members. The RiU strategy was developed using methods such as the interest-influence matrix and the Rapid Outcome Mapping Approach (ROMA).

## **Work Package 3: Strengthening Expertise**

Focused on strengthening the capacity of the HI-AWARE research community for conducting high quality research on adaptation issues and communicating and using research results strategically. A total of 28 Master's students have been supported by HI-AWARE, out of which 24 have submitted their thesis (see Annex 2). HI-AWARE had supported six fully sponsored PhD candidates and four partially sponsored candidates. Of these 10 candidates, 5 have already defended their theses while the other five students will complete their PhD in early 2019.

# Monitoring, Evaluation and Learning

The consortium partners together with ICIMOD's Strategic Planning, Monitoring and Evaluation (SPME) unit used the Participatory Impact Pathways Analysis (PIPA) to build a collectively-owned theory of change (see Figure 2) and a logical framework (logframe) based on it. SPME produced a 30-page monitoring, evaluation and learning report that included the overall programme theory of change, the logframe, risk analysis and outcome logic models specific for each basin. HI-AWARE has periodically revisited this theory of change as part of multiple reviews held over the lifetime of the project. The logframe has become the programme's main management tool. Progress against it is reported on regularly, including during monthly management team meetings. The theory of change was revisited during midterm review in 2016 and was changed to reflect the changed policy and practice scenarios in the region.



## The HI-AWARE Theory of Change and Impact Pathways

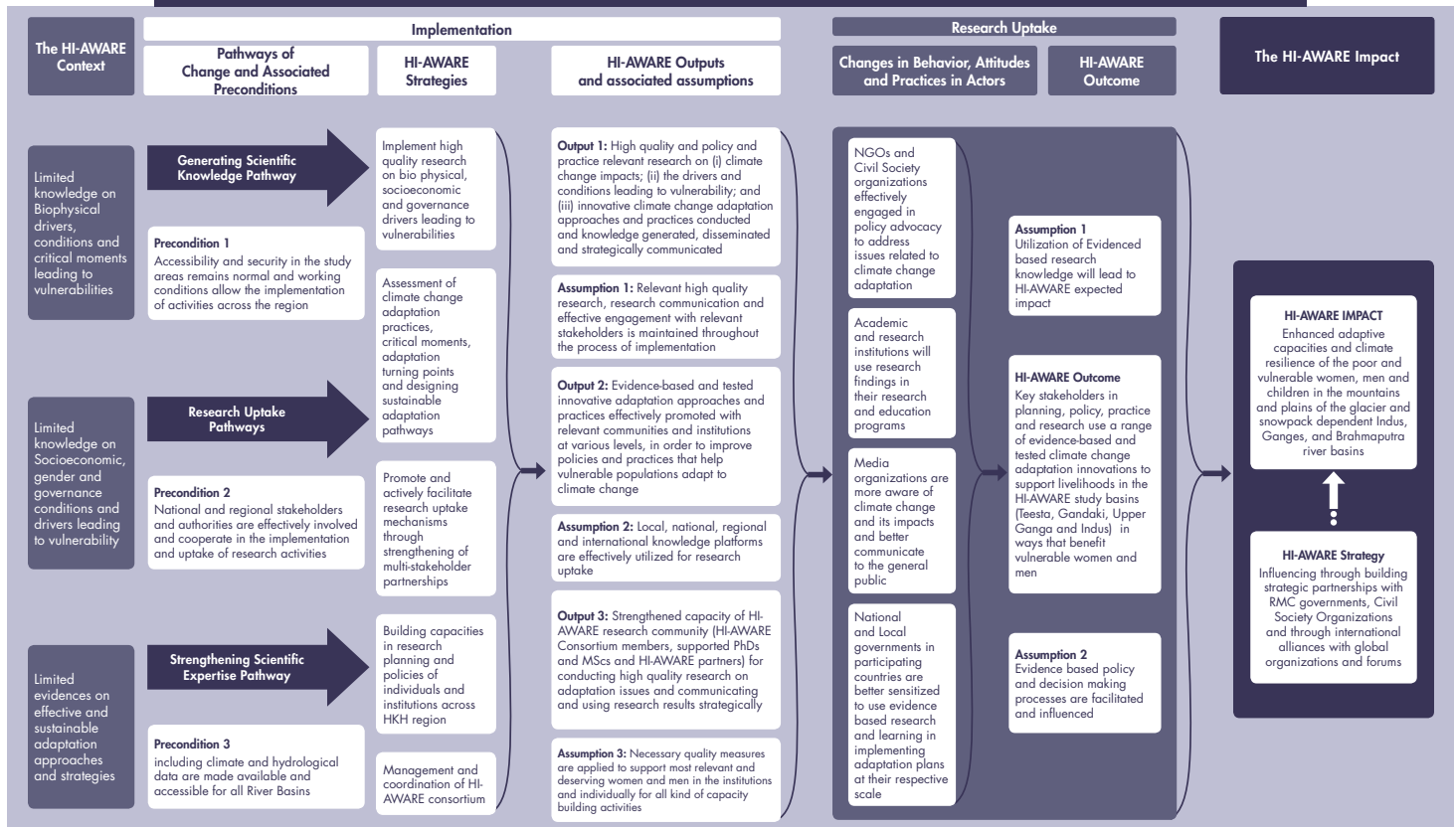
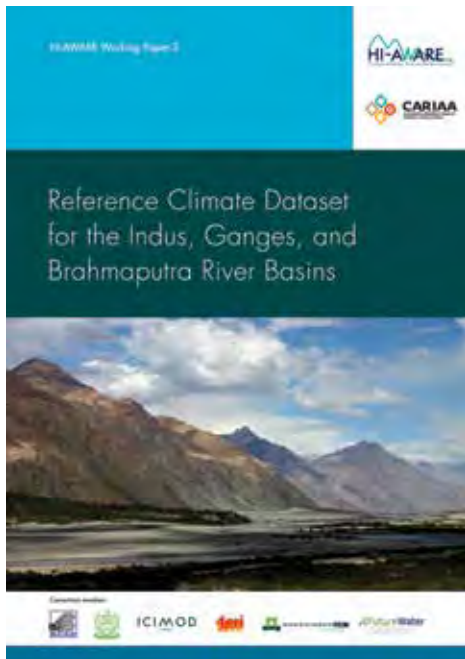


Figure 2: HI-AWARE theory of change and impact pathways

A woman wearing a red knit hat and a red long-sleeved shirt is holding a large bunch of green leafy vegetables. She is standing in a field with banana trees and other green plants in the background. The image has a diagonal split with a light green and white background on the left and a dark green background on the right. There are orange geometric shapes in the bottom left and bottom right corners.

# Contribution to Adaptation Research and Practice

# Data Sets Generated



"...novel high-quality and high-resolution reference climate dataset (Lutz and Immerzeel 2016) covering the IGB river basins with a particular focus on improved representation of high-altitude precipitation...covering a 30 year period from 1 January 1981 to 31 December 2010"

Link to the paper:

<http://lib.icimod.org/record/32311/files/HIAWARE%20WP2.pdf>

HI-AWARE has produced a number of bio-physical and socio-economic datasets over the past 5 years. These will be uploaded on [ICIMOD's Regional Database System \(RDS\)](#) from where they can be download by researchers and the general public.

## Bio-physical datasets

It is known that mountain topography and the variability in climate over short horizontal distances makes development of climate scenarios specific to smaller regions very difficult. However, HI-AWARE led a study that resulted in a novel high-quality and high-resolution reference climate dataset (Lutz and Immerzeel 2016) covering the IGB river basins with a particular focus on improved representation of high-altitude precipitation. Covering a 30 year period from 1 January 1981 to 31 December 2010, this dataset was used for the downscaling of the 8 GCMs (4 GCM each for RCP4.5 and 8.5) to analyze future projections for the period of 2016-2045 (representing 2030s) and 2036-2065 (representing 2050s) for the National Adaptation Plan process of Nepal.

A new future climate dataset was developed by Lutz, et al. (2016) which, for the first time, assessed shifts in seasonal water availability in combination with changes in hydrological extremes at basin scale for the Upper Indus Basin. It concluded that despite large future uncertainties in terms of climate and long-term water availability, basin-wide

patterns and trends of seasonal shifts in water availability are consistent across climate change scenarios (see Figure 3). Analysis of future hydrological extremes reveals that increases in intensity and frequency of extreme discharges are very likely for most of the Upper Indus Basin. It calls for sound basin-wide adaptation strategies to be developed across sectors to account for the growing population in the downstream that is dependent on increasingly uncertain water resources.

TERI has generated scenario information to enhance knowledge and understanding in mountain regions over the HKH region for selected RCPs using the WRF model to assess changes in climate. The dynamic downscaling of climate data is being carried out by TERI for two time periods, one in the past and the other for a future time period, 2000-2009 and 2020-2029 respectively. The research activity contributes to development of mountain and river basin scale climate change projections in order to assess its impacts on water supply in the HI-AWARE study basins. Ten years baseline (1996-2005) of control simulations and 10 years future simulations (2020-2029) of future simulation has been completed using CCSM4. The Community Climate System Model (CCSM) version 4 is a coupled climate model for simulating the earth's climate system with initial and boundary conditions. The initial analysis shows a huge bias in mountain regions in the reanalysis baseline simulation data compared with the modelled data. As suggested by the consortium members,



the model has been re-run for the baseline period 1996-2005 using CCSM4 initial conditions. Currently model simulation has been completed and model post processing is going on to analyze the future changes in rainfall and temperature over four study areas.

A rich database has been generated for the Rathang glacier and is in process of being collected for the Pindar glacier. The deliverable for this component was generation of datasets which is in continuity for the mentioned glaciers where TERI is operating. An automatic weather station (AWS) was installed in Upper Indus Basin at the Mountain Agricultural Research Centre (MARC), Juglot in Gilgit. This weather station is being used to gather weather data and monitor the changes in the weather pattern for assessing the possible impacts on agriculture. The data from these stations will be valuable for assessing the impacts of climate change on the glaciers and meltwater regime.

WENR has developed a hydrology and food production model for the entire Indus, Ganges and Brahmaputra. They also estimated the future water gap in South Asia and improved the understanding of drivers behind it, using the HI-AWARE climate dataset (paper submitted and online).

## Socio-economic datasets

A study examining the patterns of migration, and its role in building adaptive capacities of households in four critical sectors – agriculture, livestock, forests, and water – in the four study basins, surveyed 1,987 households for collection of socio-economic data. A sample size of 402 households was determined using Cochran's sample size formula for each river basin. However, the number of actually surveyed households is higher than the determined sample sizes for all basins. Data was collected through stratified sampling technique for upstream, midstream, and downstream areas. The analysis was carried out using descriptive statistical tools (means, frequencies, percentages, and the unpaired t test), and

supported by field narratives. The study found that the capacity of households in the study sites to adapt to the negative effects of environmental changes and shocks in four crucial livelihood sectors – agriculture, livestock, forests, and water – was poor, with a maximum of 35% households undertaking at least one adaptation option, in the water sector. The linkage between migration and household adaptive capacity was found to be positive, but statistically significant only in the agricultural sector. At present, migration is more a response strategy of households to various changes, including environmental changes, and their effects on local livelihoods.

This study on socioeconomic, gender and governance drivers of vulnerabilities and impact produced qualitative information on socioeconomic, governance and gender drivers and conditions leading to vulnerability to climate change across study sites. Three tiers of field studies were carried out in 2015, 2016 and 2017. First, for understanding the situation, second, for understanding socioeconomic drivers and conditions of vulnerabilities, and third, for understanding multi-dimensional nature of gender vulnerabilities. These have built on rich qualitative data sets to understand complex social relations that shape vulnerabilities and capabilities of the people. For the study on gendered vulnerability, more than 200 FGDs with homogenous groups of women and men of different social strata have been conducted. The data sets are available in form of field reports, FGD notes, and published and unpublished basin level reports. The findings of the study conclude that farm dependent marginal communities do experience climatic stressors and are forced to look for alternative livelihoods when there is crop failure due to water scarcity or other calamities. There is increasing trend of women's involvement in non-farm employment such as enterprise and in the market labour force. There is change in gender roles and responsibilities triggered by male outmigration in search of alternative income. However, due to lack of enough policy instruments that provide security for women and children in public space, women have become more vulnerable with increased incidence of violence.

# Research Conducted

HI-AWARE has been able to create a wealth of knowledge over its duration. This includes peer reviewed papers, working papers, workshop reports, posters, etc., a full list of which can be found in Annexure 3. This is a selection of twelve publications done by the Consortium Research Management Team (CRMT) keeping in mind criteria such as contribution to adaptation research as well as representative regional and thematic spread (such as gender, migration etc.).

**1** Knowledge about future climate change is essential for the formulation of robust adaptation policy. This publication describes a novel method to select climate models for robust projections of a wide range of possible futures in terms of climate change for a specific region, in this case the Indus, Ganges, and Brahmaputra river basins. The climate projections resulting from this method were used by HI-AWARE in various climate impact and adaptation studies, and the method was implemented in Nepal's NAP process.

Lutz, A. F., ter Maat, H. W., Biemans, H., Shrestha, A. B., Wester, P., & Immerzeel, W. W. (2016).

**Selecting representative climate models for climate change impact studies: An advanced envelope-based selection approach.** International Journal of Climatology. <http://doi.org/10.1002/joc.4608>

**2** Water resources in South Asia depend significantly on glacier melt water from the Hindu Kush-Himalaya. Changes in future glacier mass will lead to shifts in water availability and timing of river flows in the future. Knowledge about these shifts is essential for the formulation of robust adaptation policies. This publication provides a basis for estimating these shifts by providing projections of future glacier mass change for all possible climatic futures.

Kraaijenbrink, P.D.A., Bierkens, M.F.P., Lutz, A.F., Immerzeel, W.W. (2017). **Impact of a global temperature rise of 1.5 degrees Celsius on Asia's glaciers.** Nature 549, 257-260. <http://sci-hub.tw/10.1038/nature23878>

**3** While a previous paper focused on understanding temporal patterns of irrigation water demand, and how that related to the cropping patterns in different parts of the IGB, this paper looks at when different sources are used for the supply of irrigation water. An improved understanding of the links between sources of water demand and sources of water supply is needed when designing ways to anticipate changes to this system in the future. This paper tries to understand and elucidate the importance of glacier and snowmelt from High Mountain Asia for downstream agriculture.

Biemans, H., Siderius, C., Lutz, A.F., Nepal, S., Ahmad, B., Hassan, T., von Bloh, W., Shrestha, A., Immerzeel, W. (submitted). **How important is snow and glacier melt from High Mountain Asia for downstream agriculture?**

**4** Presently, it is unclear what approaches are used in the existing policies in South Asia to cope with future climatic changes. There is some mix of 'strategic (spatial) planning', 'scenarios' and 'adaptive governance' approaches being used. Moreover, scoring of key policy characteristics suggests that certain policy characteristics are missing or weak. This research article makes two contributions to adaptation research. First, it identifies the lack of research in adaptation policy domain in South Asia. Findings show that the four South Asian countries (Bangladesh, India, Nepal and Pakistan) contribute to only 8% of the total journal articles on adaptation policy and governance globally, with the least from Pakistan and Nepal. Second, it finds that with the exception of Climate Change Policy of Nepal, none of the other adaptation policies discuss transboundary scale adaptation measures and approaches. The focus is limited to the national or sub-national scale only.

**5** Downstream areas of a river basin have high population density compared to steep mountain areas due to relative comforts and livelihood opportunities due to fertile land. With democratic processes in almost all countries in HKH in post-colonial period, the governments have promoted land redistribution policies through land ceiling acts; yet access to land is an issue in marginalization resulting from climatic stressors, which is a result of feudal practices prevalent in these areas. Increased incidence of flood during rainy season and prolonged drought are the main climatic stressors in downstream areas of the river basins in HKH. Taking the case of downstream areas of Gandaki River basin, located in West Champaran district of Bihar, India, this paper analyses lives of the most vulnerable, i.e., people living in floodplains inside embankments. Using anthropological surveys, gendered vulnerabilities in four villages in West Champaran are explored. Such vulnerability, in the context of a changing climate, combines social, political, and economic dimensions: the patriarchal creation of gender norms and biases; unequal access to water, sanitation, credit, and public distribution services; and limited employment opportunities. These elements influence the livelihood options of women and men differently, determining their capability in responding to risks posed by climatic and socio-economic stressors. The paper informs policy makers and implementers of the needs of people living in the floodplains, among which women and girl children are the majority due to outmigration of men.

**6** The linkages between migration and adaptation in the HKH are poorly known. This study is an effort to fill the existing gap in quantitative empirical research studies investigating migration and adaptation in environmentally vulnerable areas. The adaptive capacities of households in four key sectors – agriculture, livestock, forestry, and water – were analysed. The linkage between migration and household adaptive capacity was found to be positive, but statistically significant only in the agricultural sector. Thus, migration helps households' adaptive capacity by spatially diversifying household income sources, but this potential is limited at present as remittances are small and mostly used for meeting basic requirements.

Vij, S.; Moors, E.; et al. (2017) **Climate adaptation approaches and key policy characteristics: Cases from South Asia.** Environmental Science and Policy 78, 58-65. <http://dx.doi.org/10.1016/j.envsci.2017.09.007>

Udas, Pranita B, Prakash, A. and Goodrich, C.G. (2018) **Gendered Vulnerabilities in Diaras: Struggling with Floods in the Gandak River Basin.** Economic and Political Weekly. Vol. 53, Issue No. 17, 28 Apr, 2018. PP- 46-54. Available online at <http://www.epw.in/journal/2018/17/review-womens-studies/gendered-vulnerabilities-diaras.html>.

Maharjan, A., Hussain, A., Bhadwal, S., Ishaq, S., Ahmed Basharat, S., Sachdeva, I., Ahmad, B., Hassan S.M, T., Tuladhar, S., Ferdous, J. (2018) **Migration in the lives of environmentally vulnerable populations in four river basins of the Hindu Kush Himalayan Region.** HI-AWARE Working Paper 20. Kathmandu: HI-AWARE

**7** Gender is a well-accepted concept and agenda to be addressed in climate change research and programmes for addressing vulnerabilities emerging from climatic stressors. The challenge is how to translate the intersectionality, interlinkages and thus the complexity of “gender” into practice. This paper contributes to this gap by conceptualising gendered vulnerability to climate change, specific to the Hindu Kush Himalaya region. The conceptual framework given in this paper guided HI-AWARE research study on gendered vulnerabilities in four river basins, namely Indus, Upper Ganga, Gandaki and Brahmaputra. Based on review of literature, the paper argues that gender is not only a powerful and pervasive contextual condition, but that it also intersects with other contextual conditions such as social, political, geographical and economic structures and settings, and with socioeconomic drivers of change like globalisation, urbanisation, consumerism and other developments like markets, infrastructure and technology, to shape differentiated vulnerabilities. Manifestations of gendered vulnerability to climate change are the result of these complex and interlinked factors, which cannot be simplified for the sake of efficiency. Simplification of gender leads to the danger of missing important and critical nuances which could underpin effective adaptation policy and practice.

Goodrich, C.G., Udas, P. B. & Larrington-Spencer, H. (Forthcoming) **Conceptualizing gendered vulnerability to climate change in the Hindu Kush Himalaya: Contextual conditions and drivers of change.** Environmental Development – Special issue on Gendered Vulnerability in HKH region

**8** Neglected and underutilized food crops (NUFCs) have high nutritional value, but their role in achieving nutrition security is not adequately understood, and they do not feature in food and nutrition policies and programmes of the countries of the HKH region. Drawing examples from Pakistan and Nepal, this study investigates the importance of NUFCs in achieving nutrition security in the mountains and identifies key underlying reasons for the decline in their cultivation and use. The study identifies the need to mainstream these crops into national programmes and policies and to integrate them into local food systems. This will not only improve the nutrition security of mountain areas, but also biodiversity and local mountain economies.

Adhikari, L.; Hussain, A.; Rasul, G. (2017) **Tapping the Potential of Neglected and Underutilized Food Crops for Sustainable Nutrition Security in the Mountains of Pakistan and Nepal.** Sustainability 2017, 9, 291. <http://dx.doi.org/10.3390/su9020291>

**9** Since natural resources in the HKH are transboundary, there are plenty of upstream downstream linkages. This study considered the case of Teesta River basin and estimates the water demand of upstream and downstream regions as well as entire Teesta river basin shared by India and Bangladesh. While upstream hydropower projects demand substantial water, the water required by the upstream irrigation projects alone goes beyond the water supply capacity of the trans-Himalayan Teesta river during dry and lean season. This may underpin the shortage of water in the lower riparian country, which fuels the zero-sum game in the river basin, where one player is affected by the intervention of another. The result from this analysis with zero-sum game perspective may be useful for reviewing transboundary water policies, basin management and development, sustainable water resource management and water sharing mechanism among countries in the transboundary river basin.

Arfanuzzaman, Md., Abu Syed, Md. (2017) **Water demand and ecosystem nexus in the transboundary river basin: a zero-sum game.** Environment, Development and Sustainability 2017. 1-12. <https://doi.org/10.1007/s10668-017-9915-y>



**10** Unplanned urbanization is causing significant changes in land use and land cover, reducing the recharge areas of springs. Climate induced changes in the physical environment comprise of increase in rainfall variability and heat stress which lead to more landslides and glacier melt respectively. These critical stressors, climatic and non-climatic, are adversely affecting the socio-ecology and hydrological regimes of urban agglomerations in the HKH region. This paper and the special issue on Urban Water covers discussions revolving around these issues in twelve towns from five countries of South Asia. It is based on primary research and attempts to fill the knowledge gap about the status of water resources and water supplies in the Himalayan towns. It identifies areas for future research and action on urban issues in the region.

Prakash, A., Wester, P., Singh, V., Kovacs, E.K., & Molden, D. (2018). **Water management in Himalayan towns: What we know and what is needed?** Special issue – Water in Himalayan Towns: Lessons for Adaptive Water Management, Water Policy, Forthcoming.

**11** In a warming world an increasing number of people are being exposed to heat, making a comfortable thermal environment an important need. This paper explored the potential of using Regional Internet Search Frequencies (RISF) for air conditioning devices as an indicator for thermal discomfort with the aim to quantify the adaptation potential of individuals living across different climate zones and at the high end of the temperature range in India. We related RISF for the years 2011–2015 to daily daytime outdoor temperature in 17 states and determined at which temperature RISF for air conditioning starts to peak, i.e. crosses a 'heat threshold', in each state. Using the spatial variation in heat thresholds, we explored whether people continuously exposed to higher temperatures show a lower response to heat extremes through adaptation (e.g. physiological, behavioural or psychological). The paper's findings contribute to a better understanding of local heat thresholds and people's adaptive capacity, which can support the design of local thermal comfort standards. Follow-up research within HI-AWARE further focussed on measuring indoor thermal comfort of people in low-income housing, and tried to identify low-cost solutions.

Singh, T., Siderius, C., & Van der Velde, Y. (2018). **When do Indians feel hot? Internet searches indicate seasonality suppresses adaptation to heat.** Environmental Research Letters, 13(5), 054009.

**12** Future hydrological extremes, such as floods and droughts, may pose serious threats to livelihoods in the upstream regions of the Indus, Ganges, Brahmaputra. This paper examines the impacts of climate change on future hydrological extremes in these river basins. It uses a fully-distributed cryospheric-hydrological model to simulate current and future hydrological fluxes and force the model with an ensemble of 8 downscaled General Circulation Models (GCMs) that are selected from the RCP4.5 and RCP8.5 scenarios. The outcomes show an increase in the magnitude of climatic means and extremes towards the end of the 21st century where climatic extremes tend to increase stronger than climatic means. Future mean discharge and high flow conditions will very likely increase.

Wjngaard, R.E., Lutz, A.F., Nepal, S., Khanal, S., Pradhananga, S., Shrestha, A. B., Immerzeel, W. W. (2018). **Future changes in hydro-climatic extremes in the Upper Indus, Ganges and Brahmaputra River basins.** PLoS ONE 12(12): e0190224.



# Cross-consortia engagement of HI-AWARE

HI-AWARE was engaged in three cross consortia research projects through the Opportunities and Synergy Fund (OSF). They were – 1.5 degrees, migration and meta-synthesis of gender, social differentiation and inclusion in adaptation. The fact that OSF funds have been granted to HI-AWARE shows its expertise and contribution towards the overall consortia. Below, we report the major outcomes of the engagements in these cross-consortia research work.

The OSF project on migration and climate change issues in South Asia worked towards a synthesis report on 'Migration in climate hot spots in South Asia: diversity in patterns and approaches'.

## 1.5 degrees

The researchers from the CARIAA consortia have prepared peer-reviewed scientific publications on the impacts of 1.5 versus 2.0 degrees global change in their respective hot spots, to provide scientific evidence for the IPCC's Special Report. From HI-AWARE, the journal article "South Asian river basins in a 1.5 °C warmer world" has been submitted to a leading peer reviewed climate change journal. Based on a regional quantitative assessment of the impacts of a 1.5 versus a 2 °C global warming for the Indus, Ganges and Brahmaputra river basins (IGB), the paper analyzed ensemble of General Circulation Models. It showed that a global temperature increase of 1.5 °C implies a temperature increase of 1.4 – 2.6 ( $\mu = 2.1$ ) °C for the IGB. For the 2.0 °C scenario, the increase would be 2.0 – 3.4 ( $\mu = 2.7$ ) °C.

## Migration

The four CARIAA funded consortia- HI-AWARE, ASSAR, DECCMA and PRISE were operational in the South Asian countries (Bangladesh, India, Nepal and Pakistan). Each consortium worked in one of the three climate "hot spots"

identified by CARIAA. The consortia looked into issues related to vulnerability and adaptation of communities to climate change risks in diverse ecosystems and with a variety of approaches and research methods. Migration was a common thread across the consortia and the ecosystems. However, the strategic positioning of this theme varied across the consortia, with DECCMA giving it a priority position in the design itself whereas in ASSAR and HI-AWARE, it was not positioned in the full proposal or consortium work plans but has been identified as extremely important based on the results of the situational analysis, community consultations. Thus, all the four consortia were undertaking research in this theme using diverse approaches and methods. The OSF migration research pooled the data/information from all the four consortia working in South Asia to develop a synthesis paper. The synthesis paper, now under publication as a working paper, helped in better understanding the role of migration in environmentally stressed ecosystems and populations. The research analyzed adaptive capacities of households in four key sectors – agriculture, livestock, forestry, and water. The research showed that the linkage between migration and household adaptive capacity was found to be positive, but statistically significant only in the agricultural sector. Thus, migration helps households' adaptive capacity by spatially diversifying household income sources, but this potential is limited at present as remittances are small and mostly invested in meeting basic requirements. At present, migration is more a response strategy of the households to various changes, including environmental changes and their effects on local livelihoods. The results have been synthesized into a working paper titled - "Migration in the lives of environmentally vulnerable populations in four river basins of the Hindu Kush Himalayan Region".

## Meta-Synthesis of Gender, Social Differentiation and Inclusion in Adaptation Research and Action

This research demonstrated multiple causal combinations of contextual 'conditions' through which women's agency is either strengthened or dampened as 'outcome', thereby pointing to possible entry points for moving towards sustainable and effective adaptation. The research was carried out through a method of meta-analysis called Qualitative Comparative Analysis (QCA). QCA is a method that bridges qualitative and quantitative analysis. Using QCA, the research examined 25 cases across Asia and Africa to understand diversity and heterogeneity with regard to their different causally relevant conditions and contexts by comparing cases as configurations. The work built upon ongoing CARIIA research on vulnerability and adaptation and synthesized emerging findings on gender at a cross-consortia level. The evidence came mainly from 25 qualitative case studies across these hot spots that offered the advantage of generalizing to some extent our findings from the comparison across multiple cases while not ignoring their strong dependence on local context. The analysis showed that lack of focus on women's agency in all its complexity has contributed to the failure of several adaptation interventions. Efforts to strengthen the adaptive capacity of poor women (and men) need to move beyond stereotypes to think creatively about a range of resources and opportunities that can create an enabling environment for women to exercise their agency. It was found across all study contexts which experienced environmental stress, that in the absence of such an enabling environment, women's agency is suppressed. A peer reviewed journal paper has been drafted entitled - "Women's agency and adaptive capacity in climate change hot spots: A qualitative comparative analysis from Asia and Africa which is ready for submission".



# On Ground Adaptation Interventions



# HI-AWARE Pilot Interventions

## Climate Smart Agriculture Practices

Pakistan is one of the most vulnerable countries to climate change owing to its agrarian economy. Farming communities in semi-arid regions of Pakistan, including in the Potohar Plateau, face major hurdles due to lack of irrigation planning, heavy dependence on rain, and difficulty in accessing markets. Agriculture in the Soan river basin of the Potohar region is either rain-fed or dependent on groundwater, and is characterized by mono-cropping. This makes it extremely vulnerable to climate change. The pilot has introduced a package of Climate Smart Agriculture practices and innovations, including Fixed and Portable Solar Pumps in Chakri village, Rawalpindi district. This intervention combines water pumped through fixed and portable solar pumps with innovative farm practices around integrated water resource management (IWRM) using tunnel farming and high-efficiency irrigation systems (HEIS) like sprinkler system, drip irrigation, Composite Energy Powered Irrigation Systems (CEPIS) and agricultural diversification. The adoption of 'Developmental On-Farm Research Pilot (DOFRP)' model entailed converting a 4 acre farm into a learning and training site for other farmers, researchers, students, and professionals in the region. The solar pumps have been designed with careful consideration of technical and environmental factors so that farmers have access to water throughout the year. Interactions through multiple farmer field schools and other workshops led to HI-AWARE support to at least 2 other small farmers for adoption of these practices. Increased crop diversification has enabled small farmer incomes to increase by 3 to 4 times. Adoption of HEIS have enabled water saving and doubling of cropping area by small farmers. In addition, the 'portability' of solar pumps allows large farmers the flexibility to increase irrigated area by 3 to 4 times.

The pilot has been able to influence many government institutions, international and private organizations, as well as individuals. Inputs have been sought by the Punjab Province for schemes on high value agriculture through climate smart technologies including sprinkler irrigation systems. Based on HI-AWARE's extensive work on solar water pumps, the Federal Government launched "Prime Minister's support program for farmers for solar tube wells" and invited two experienced members of the HI-AWARE team to lead policy formulation. The International Fund for Agricultural Development (IFAD) has sought technical support from HI-AWARE for a forthcoming project in Gilgit-Baltistan worth PKR 12 billion, under which 50,000 acres of barren land will be converted to agricultural land. The experience and success of the pilot will be used to reinforce climate smart agriculture in the National Climate Change Policy.



## Eco-San and Flood-Resilient Habitat (FRH)

North Bihar, India is home to eight major tributaries of the Ganga that makes 77% of the region vulnerable to floods. The analysis of HI-AWARE field data revealed the high levels of vulnerability to floods and the extreme inconveniences faced due to inadequate sanitation. Cost-benefit analysis and the construction of adaptation cost curves revealed that substantial health costs and convenience losses can be averted by ensuring access to toilets in the field area. Ecological sanitation (Eco-San) toilets provided the most cost-effective adaptation option in this specific context. The intervention in Naya Tola Bishambharpur, West Champaran is being implemented as part of the concept of flood resilient habitat. Apart from secure and appropriate sanitation, it focuses on ensuring safe drinking water, resilient housing, and learning patterns of co-existence with floods. This framework is crucial to building climate resilience in communities vulnerable to floods.

There are 6 completed structures and 2 more are under construction currently. The foundation of many of these structures withstood an extreme flood event in 2017, which confirmed that the flood levels for the past 20-25 years must be taken into account to determine height/foundation measurements (as was the case in the pilot intervention), and led to further innovations in the toilet design.

The government of Bihar, through its Lohia Swachh Bihar Abhiyan (LSBA) has helped to promote ecological sanitation in flood prone areas by ensuring loans to the beneficiaries from JEEViKA (Bihar Rural Livelihoods Project). This recognition has led to a statewide study on disaster resilient sanitation and ecologically sustainable technologies, to be undertaken by MPA, supported by UNICEF, Bihar.

It is imperative to develop a narrative around disaster resilience and ecologically sustainable sanitation systems within Bihar given its close linkages with safe drinking water, especially in high water table conditions.





## Climate and Flood Resilient House (CFRH)

A set of region-specific robust climate change scenarios for the Indus, Ganges and Brahmaputra river basins indicates that extreme precipitation events in the basins will increase strongly. Depending on the climate change scenario, severity of flood events is expected to more than double towards the end of the century. Bangladesh lies downstream of three major rivers in South Asia – the Ganges, Brahmaputra, and Meghna, and is prone to climate induced disasters due to its complex geographic location and topography and climate phenomena. Future design of infrastructure in flood-prone areas needs to take into account the projected changes in frequency and severity of flooding events. The objective of this action research has been to demonstrate that improved low cost CFR houses can build community resilience against climate extremes and climate induced changes such as floods, soil erosion, heat and cold waves, through household-managed disaster risk mitigation and adaptation approach, and provide more secure and dignified living conditions for the poor and vulnerable groups living on floodplains and sand bars.

Six CFRH structure currently stand completed in Char Dhushmara and Char Haiboth kha in Rangpur district, with more being planned for construction. Communities and local leaders including Parliament Members have responded positively to the innovation. Discussions are on with the Department of Local Government (DLG), Directorate of Housing and Local Government Department, Rural Development Academy, Bogura, and House Building Research Institute (HBRI) of Government of Bangladesh to promote the uptake of the CFRH model in housing schemes for the poor such as the Asrayan Project, and Ekti Bari-Ekti Khamar (one home-one farm) Project.





## Heat Stress Management through Modified Roofs (ModRoofs)

Cities, world over, are seeing rapidly growing rates of urbanization, mostly coinciding with less developed regions. If they continue to grow unplanned, extreme events, attributed to climate change or otherwise, will lead to exacerbated vulnerabilities in these urbanized zones considering the exposure (population) levels. This action research aimed to generate evidence on current indoor heat exposure in growing South Asian cities, and experiment with probable solutions such as the Modified Roofs (ModRoofs) leading to safer and healthier lives. Developed by ReMaterials and promoted by Mahila Housing Sewa Trust (MHT), the ModRoof is a structural modification in the roofing of low income houses which mostly have corrugated cement or metal sheets as roofs. These were installed in five households of Sawda Ghevra, home to the largest resettlement zone on the fringes of Delhi, with ten houses acting as a control for testing the efficacy of the roofs in a real-time setting. Currently, the perceptions of comfort of people owning a ModRoof cannot be reconciled with field measurements. This necessitates further testing.

Potential linkages with the Delhi Urban Shelter Improvement Board, Ministry of Rural Development, and the Ministry of Housing and Urban Development are being explored. MHT, an implementation partner in the pilot, has already piloted micro-finance for greater proliferation of the technology in Ahmedabad, and such schemes could also be outscaled to meet demands in other field sites.





## Sustainable Agricultural Practices in High Elevation Regions

The aim of this intervention in Hudu village in Rudrapyag, India is to ensure that communities are able to adapt to changes in climate while maximizing agricultural outputs from their land. It used an integrated approach focusing on agriculture, horticulture and livestock. As part of this pilot, a range of options including land consolidation, fencing, testing efficient/improved agricultural techniques to enable crop productivity (traditional and new) were implemented. Between 2017 and 2018, different crops were experimented with and communities were trained in land preparation, selection of crop varieties, cutting of the seeds, sowing and harvesting. Considerable decline in snowfall presented opportunities to grow crops such as potato and other horticultural produce. Potato yields doubled from 2017 to 2018.

About 42-45 families were part of the implementation process and several others benefitted from distribution of cardamom. The involvement of a community based organization (CBO) and the introduction of a potato variety that could be potentially used as a tuber for the next sowing season as well, was envisaged so as to ensure sustainability of the intervention. Scaling up this intervention would require considerable capital and mainstreaming through development policies/programmes. There has been considerable interest from the District Administration, which could potentially help in upscaling.



# Stakeholder Engagement and Impact

# Strategy for Stakeholder Engagement

As part of the Participatory Impact Pathway Analysis (PIPA) process, the HI-AWARE consortium identified important actors from an initial actors mapping exercise during the launch of HI-AWARE in 2014. Further, the interest–influence matrix was used to differentiate between stakeholders according to their interest in the project and ability to exert positive or negative influence. The nature and means of engagement with particular stakeholders was determined by which category of the matrix they fell in.

In Figure 4 below, the left panel presents the four categories of stakeholders based on the interest-influence combination. The right panel gives the guidelines for engaging with each stakeholder category.



Figure 4: Influence-Interest Matrix

Source: [http://ec.europa.eu/smart-regulation/guidelines/tool\\_50\\_en.htm](http://ec.europa.eu/smart-regulation/guidelines/tool_50_en.htm)

Over time, HI-AWARE has been involved in many fora where there were opportunities to engage with policy makers, practitioners, government officials, NGOs and community members among different stakeholders. Stakeholder engagement in HI-AWARE is conceptualized as a process that is dynamic, iterative, and evolving. The emphasis is on network building/strengthening that facilitates stakeholder-to-stakeholder engagement during the project period and beyond.

The figure below summarizes the process of stakeholder engagement in HI-AWARE till date. From an initial mapping of 'actors' we moved to detailed stakeholders identification with the help of our 'strategic partners'. It was felt that stakeholder identification is necessary at both basin and sub-basin scales, and would need to be geographically differentiated across upstream, midstream, and downstream parts of the four study basins. Interactions with the initially identified stakeholders contributed to needs-based tailoring of research outputs, further additions to stakeholders list, and also the strategic selection of priority stakeholders. These initial wide-ranging interactions with stakeholders can be said to have laid the foundation

for later collaborative arrangements for research uptake. The loops in Figure 5 below illustrate the iterative nature of the engagement process in its key stages.



Figure 5: Stakeholder Engagement Process

In HI-AWARE, strategic partners to consortium members were expected to play a lead role in stakeholder's identification and engagement. Besides relying on the strategic partners, HI-AWARE used two other methods to ensure that its stakeholder identification is relevant and inclusive.

- The commonly used 'snowball' method in which current stakeholders suggest a new set of stakeholders, the newly included suggest further addition, and so on.
- A more systematic approach for stakeholder identification, especially since the objective is to achieve policy and practice uptake of research, is the Rapid Outcome Mapping Approach (ROMA), which was also used.

HI-AWARE also used participatory methods of engaging with stakeholders that are co-defined and co-designed with stakeholders. Some of the practical methods are as follows:

- Co-designing of stakeholder interactions
- Participatory mapping of issues and stakeholder needs (see Box 1)
- Co-developing research outputs with stakeholders
- Joint monitoring of research outcomes

HI-AWARE has conducted approximately 120 stakeholder engagement events, led by different consortium partners across study basins (Figure 6). Further information can be found in Annexure 4.



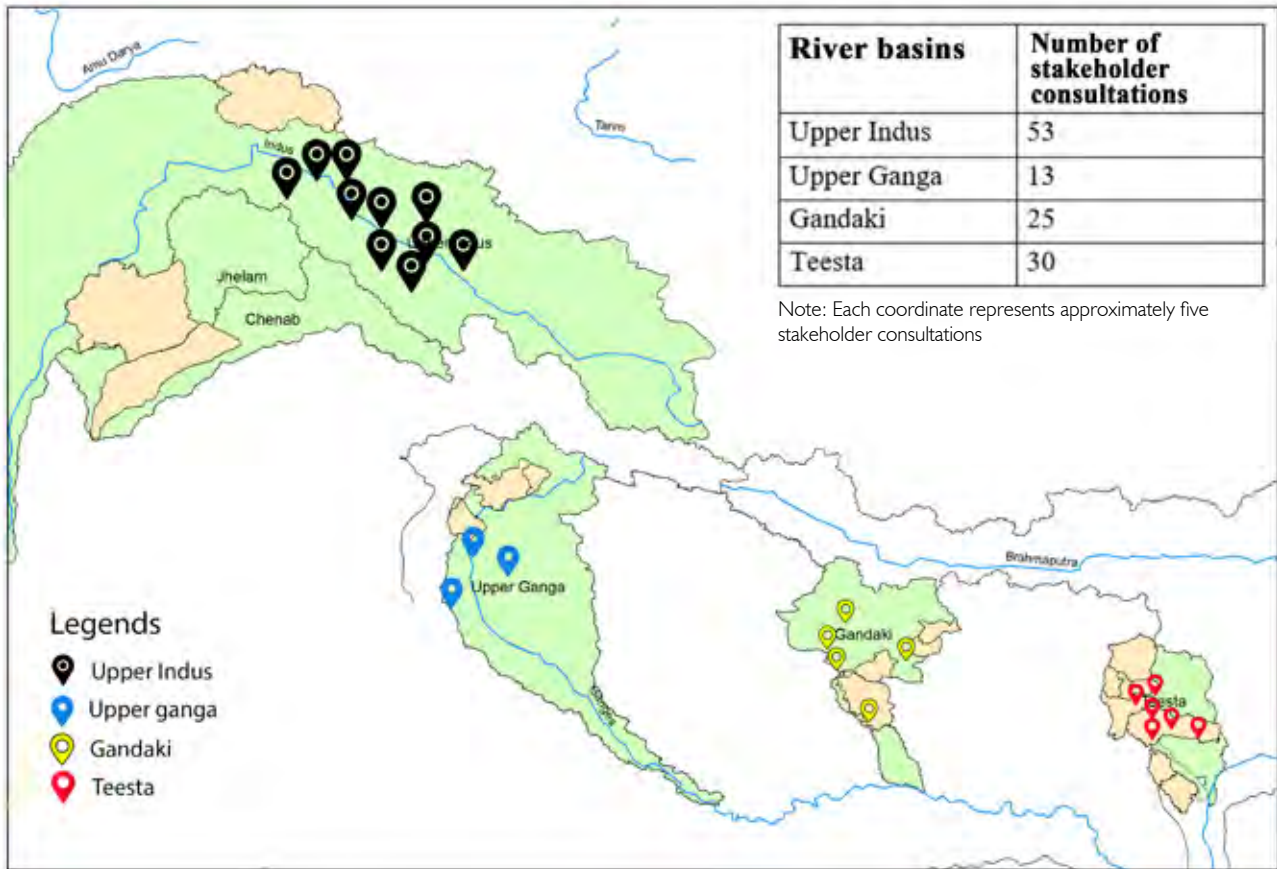


Figure 6: HI-AWARE stakeholder consultations across study basins (Map not to scale)

## Box 1: Use of the Touch Table and Story Maps

Participatory engagement of stakeholders in HI-AWARE has been facilitated using innovative technologies.

### The touch table

The touch table is an interactive digital design table that can display and combine numerous climate and policy maps to support stakeholder engagement, ownership in knowledge co-creation and interactive design of policy options. The touch table can help visualize climate modelling results and stakeholders can interact with the research outputs in a highly participatory process, drawing up their feedback and ideas. This is how the touch table can facilitate group discussions about spatial aspects, like e.g. the identification of focus areas or a prioritization of adaptation measures. With the combination of available data and the knowledge of the participants, new insights and knowledge can be co-produced.

Within RiU, the touch table has been used to discuss research findings with end users in the context of the Nepal National Adaptation Plan (NAP) process. It has not only been used to communicate and discuss spatial research outcomes with stakeholders, but also to capture local knowledge from these stakeholders and put it on the map. Maps for current and future climate have been compared and superimposed with policy maps. Articulated feedback and demands by the users provided useful insights that have been used when taking the HI-AWARE research further.

In this way, the touch table helped in wider outreach of the research activities and create more visibility. Limitations of the platform were also identified; mainly the technical expertise and infrastructure required and difficulties to scale up use due to the device required and the technical expertise. Therefore, in the second half of the project there was a greater emphasis on using online tools (Story Maps) to communicate HI-AWARE results worldwide and gather input from users.

### Story maps

Telling a story might be one the most effective ways of communicating a message. HI-AWARE has many stories to tell and Story Maps is a tool that lets you tell a story with maps. Users are guided through the story step by step using maps, pictures, videos in their browser and can actively participate by bringing in their knowledge. Story maps provides a platform that showcases and highlights research results from different RCs of HI-AWARE. Quick to set up and visually appealing, they provide more visibility to the research outcomes and also reach an audience beyond the scientific community.

The crowdsourcing aspect of story maps enables user to share their views and upload their own content to the platform. This functionality can be used to involve stakeholders of HI-AWARE by asking them to share their views on adaptation or their own adaptation activities on the story map, thus building up a database from the bottom-up.

Story maps played the role of an 'integrator' of knowledge generated in HI-AWARE. An Adaptation Solutions Portal has been developed, where anyone is able to bring in Adaptation Solutions and put them on the map, helping communities throughout the HKH region to learn from each other and exchange successful practices and ideas. By providing a tangible project, the Story Map contributes to the HI-AWARE legacy, remaining available after the project.



Touch Table

# Key Engagements

## 1 From NAPA to NAP : A story of change

The National Adaptation Programmes of Action, set in motion by the Conference of Parties (COP), was set in place to aid developing countries achieve their adaptation goals. The context for Nepal was quite challenging – the country had engaged in the adaptation process at an international level quite a few times. It had launched a formal NAPA plan in 2010, but had also committed to formulating and implementing the National Adaptation Plan in 2015.

HI-AWARE's initial engagement with development experts and government officials in Nepal revealed the need for capacity building. Building on the assessment from IPCC's 2007 iteration, HI-AWARE knew of the lack of science-based evidence and constraints to adaptation planning that existed throughout the Hindu Kush Himalaya (HKH) region. By choosing to engage with a national level planning process, HI-AWARE was also made aware of the clear demand by officials on two levels: firstly, the generation of a historical climate dataset and, secondly, the tailoring of climate change scenarios. This would also fulfill the overall NAP objectives through which medium- and long-term climate adaptation planning was to be achieved.

However, the vision for adaptive capacity would be realized through strategic support and building of expertise for NAP focal points. Banking on institutional partnerships that existed between ICIMOD and the Ministry of Population and Environment (MoPE), HI-AWARE provided assistance in four major areas: technical assistance in producing climate trend and scenarios, vulnerability and risk assessment in four major sectors which includes, water and energy, forest and biodiversity; gender and





social inclusion; and livelihood and governance. This support was made possible through knowledge that was generated through the various research components within the HI-AWARE work plan. Along with support provided by institutional partners such as Practical Action, Nepal, the HI-AWARE ICIMOD team was involved primarily in modelling of future projections on temperature, precipitation and other extreme events. In addition, a vulnerability and risk assessment framework was also developed to better contextualize planning efforts. Multiple rounds of discussions with focal points at MoPE were also carried out to ensure that the knowledge generated would be integrated into Nepal's national planning.

This value addition was further realized in an interaction workshop in January of 2018 with representatives of the NAP process and HI-AWARE-ICIMOD colleagues where the Nepal team acknowledged the inputs of HI-AWARE research as part of a report on observed climate trends and future climate scenarios. HI-AWARE's involvement with the national planning process has prepared the groundwork for addressing important adaptation gaps. The learnings from this stakeholder engagement process will be used for engaging with other member countries in the HKH.

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## 2 Climate Change Certificate Course Programme

The ICIMOD - HI-AWARE research findings and knowledge on climate change and its impacts were packaged in the form of a climate change certificate course programme and delivered to district level local government officials from Chitwan, including private sector and Agriculture and Forestry University (AFU). This was a unique programme with four modules spread across five months designed to meet the needs at the local level. Subsequently, an MoU was signed between HI-AWARE (ICIMOD) and AFU to strengthen its faculty in climate change and serve as be a knowledge hub for dissemination of such climate related knowledge to various stakeholders.

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## 3 The State of Cryosphere Conference in Gangtok, Sikkim

TERI co-organised the State of Cryosphere (with specific focus on Eastern Himalaya and Sikkim) Conference in association with the Integrated Mountain Institute (IMI) and other partners including the Department of Science and Technology, Sikkim, Divecha Centre for Climate Change and Swiss Development Cooperation amongst others. The event held on 19-20 February 2018, helped identify key bottlenecks in furthering glacier research, and chalking out a research roadmap to build knowledge and capacities for the Eastern Himalaya. This close partnership with regional stakeholders had helped forge "partnerships for change" and help sustain key issues of research identified by HI-AWARE beyond its timeframe. The outcomes (and roadmap) of this conference was to carry out further research on understanding the role of black carbon on glacial melt; increased understanding on water usage patterns; and understanding the role of glacial melt on water availability and access with respect to upstream and downstream communities.

## 4 Engagement with Bangladesh Country Strategy

BCAS-HI-AWARE team has engaged with Bangladesh Climate Change Strategy and Action Plan (BCCSAP 2009) review team to incorporate lessons learned from HI-AWARE research into the BCCSAP review document and ultimately into revised BCCSAP. This is the key national policy document which govern national adaptation programme and financing and into the national planning process. HI-AWARE-BCAS and DECCMA-BUET teams jointly organized a national level RiU stakeholder meeting on 17 January, 2018 at Water Resources Planning Organization (WARPO) Dhaka. Director General of Bangladesh Water Development Board and Director General of WARPO jointly opened the meeting. Institutional focal points from different Ministries, Government Agencies and Planning Commission participated in the meeting. Focal point from Ministry of Housing and Public Works; and Director, Department of Local Government has shown keen interest in replicating or incorporating the Climate and Flood Resilient Habitat (CFRH). BCAS-HI-AWARE team is continually engaging with these two important institutions on this.

## 5 EcoSan Technology Uptake by State Government and UNICEF: Flood Resilient Sanitation – EcoSan Toilets in Lower Gandaki, Bihar, India

Bihar is frequently ravaged by floods and is the most flood affected state in India. North Bihar in particular is home to eight major tributaries of the Ganga that makes 77 percent of the region vulnerable to floods. If building climate resilience among communities vulnerable to floods has to be meaningful, then the concept of flood-resistant habitat is inevitable. August 2017 witnessed the worst floods in 25 years. With floods set to become more erratic with climate change impacts, there is a need for solutions that address both developmental and adaptation needs, and improvement in sanitation plays an important role in this. ICIMOD and Megh Pyne Abhiyan (MPA) under HI-AWARE have piloted flood-resilient sanitation in Naya Tola Bishambharpur in Champaran District of Bihar under the larger framework of flood resilient habitat to alleviate the effects of poor sanitation in general, and especially during floods. Eco-San toilet has now been recognized by State Government's JEEViKA Programme and UNICEF's Bihar office is also promoting it as safe sanitation technology in flood affected regions of Bihar.



Chatthi Devi in front of her completed Eco-San toilet in West Champaran, Bihar

# Capacity Built

An integral part of the HI-AWARE research effort has been to contribute to the research community by engaging not just with existing researchers but also encouraging and supporting new talent and potential. This is evident in the number of Masters and PhD students that HI-AWARE supported. To gauge this strengthening of research capacity, HI AWARE conducted a capacity building survey in 2018 across the consortium to assess gains and losses in individual and institutional capacity through the project timeline, based on the perceptions of the researchers involved. The survey was designed on the lines of CARIAA's capacity self-assessment that was conducted in 2015 (baseline) across CARIAA consortia and administered through Google Forms. Different dimensions to both individual and institutional capacity were identified and specific questions framed under them. These questions were considered and then rated on a 5 point scale. For the individual capacity question, these ratings were based on the degree to which the identified capacity is important to collaborative research on adaptation (Perceived Importance), the degree to which the identified capacity is interesting to an individual (Interest), and the degree to which an individual possesses or is able to use the identified capacity (Ability to Execute) (Hammill, Harvey and Cochrane, 2016). Out of a total of 62 respondents, 19 had also attempted the baseline survey conducted by CARIAA in 2015. The following graph represents the change in perceptions of those 19 individuals.

## Capacity building of Individuals

It is evident that there is a clear increase in ratings accorded to certain indicators of individual and institutional capacity. Most importantly, individuals' perception of their own ability across criteria has improved (see Figure 7).

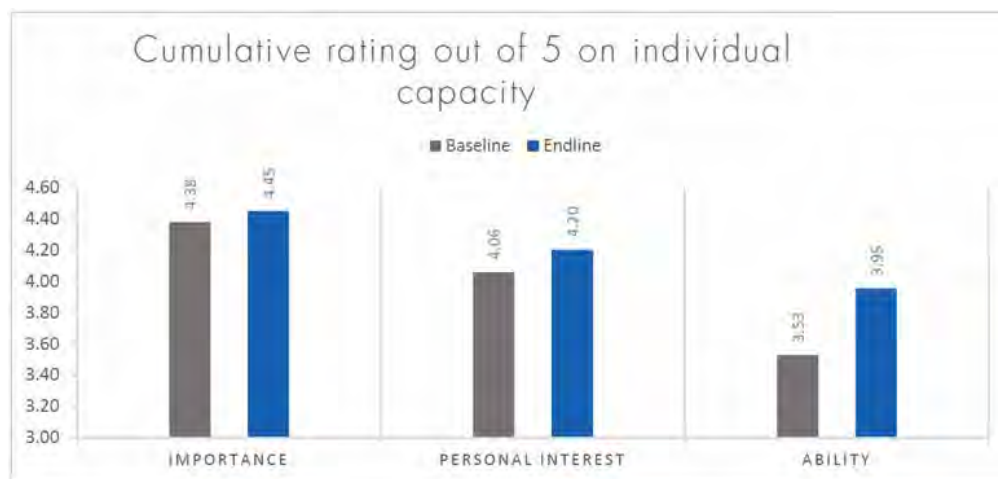


Figure 7: Cumulative Rating for Individual Capacity

Overall, in the endline survey, on an average, perceived importance relating to individual capacity was rated 4.45/5 and personal interest was rated 4.20/5 portraying a high degree of alignment between these. These ratings were also marginally higher than their respective baseline figures. Ability was rated 3.95/5 which demonstrates a jump from its baseline figure 3.53/5. Therefore, an increase in individual capacity is quite evident from the survey implying that HI-AWARE's efforts towards capacity building have worked. Specific examples of individual capacity building include the following:

### Support provided to students for Master's, MPhil and PhD:

- BCAS has been supporting an MPhil and an MSc student from Rajshahi University under HI-AWARE fellowship. Sk. Junnun Al - Hussain (MSc student) finished his study under the title of "Identification of drought and flood induced critical moments and coping strategies in hazard prone lower Teesta river basin" in July 2017. Another MPhil student Abdullah Al Mamun converted his MPhil to PhD recently. Mamun will submit his PhD thesis titled "Climate change adaptation and socio-economic patterns in Teesta basin of Bangladesh" to Rajshahi University.
- Binod Parajuli, M.Sc. grantee with HI-AWARE-ICIMOD was selected to attend the G20: Think 20 Summit in Germany, to present on his thesis flood risk communication. He successfully defended his Master's thesis which was done under the aegis of Tribhuvan University, supported by HI-AWARE.
- HI-AWARE's young researchers Sangita Dandekhya (ICIMOD) and Talha Mehmood (PARC) each received scholarships to pursue higher education. Sangita, grantee of the Erasmus Mundus scholarship, will be pursuing a PhD in hydro informatics and water management from Brandenburg University of Technology Cottbus-Senftenberg. Talha Mehmood, will be pursuing a Ph.D. in hydrology from Universität Würzburg, Germany, under the HEC-DAAD scholarship.
- In 2017-18, TERI team engaged 7 female and 4 male Masters level students in different research components. Two PhD Students selected by TERI School of Advanced Studies, Sudeshna Maya Sen and Divya Sharma are doing their research on integrated farm management under RC3, and determinants for community level decision making regarding livelihood strategies under a water scarcity context, respectively.
- WENR is supervising three PhD students under HI-AWARE (2 from Pakistan, 1 from India). These PhD projects will continue beyond the durations of HI-AWARE, and the candidates plan to defend their theses in autumn 2019. They are also co-supervising two PhD students at Faisalabad University who are working on theses on heat stress and have worked with HI-AWARE on the measurements in Pakistan. They are engaged in regular supervision of BSc and MSc students from Wageningen University. Three PhD students are working hard on their dissertations. Sumit Vij has published his first paper, the others are finalizing theirs.
- Two PhD students were supervised at strategic partner FutureWater, partly supported by HI-AWARE. Arthur Lutz defended his thesis titled "Impact of climate change on the hydrology of High Mountain Asia" and was awarded his PhD degree at Utrecht University in May 2016. René Wijngaard will finalize his PhD thesis titled "Climate Change in Mountainous River Basins: Multiscale Modelling Challenges" at Utrecht University in 2019.
- PARC under HI-AWARE is making efforts to strengthen the expertise of a number of M.Sc. fellowships have been awarded to students of local universities to develop their expertise in the science of climate change and climate change adaptation. Muhammad Saleem Pomee who has been partially supported by PARC component of HI-AWARE for PhD in Germany is about to complete his synopsis.

## Building of Research Capacity

- As a network partner, faculty members from TERI School of Advanced Studies, M V Shiju and Gopal Sarangi are closely engaged in RC2 and RC3 working groups respectively.
- Ganesh Gorti from TERI was selected for a panel presentation at the Integrated Disaster Risk Management Conference held in Iceland in 2017. The presentation focused on the multi criteria analysis tool, and its assessment for prioritizing adaptation options in the study areas.
- A Master's degree student from TERI SAS has contributed to the publication of an article titled "Mass Balance Reconstruction Since 1963 and Mass Balance Model for East Rathong Glacier, Eastern Himalaya, Using Remote Sensing Methods" in *Geografiska Annaler*, (Volume 97, Issue 4, December 2015, Pages 695–707). In this study mass balance, accumulation, ablation, runoff and temperature lapse rate for the East Rathong glacier are estimated for the time period 1963–2011 using remote sensing methods and climate data.

### Box 2: HI-AWARE Researchers in IPCC

HI-AWARE researchers Golam Rasul and Anjal Prakash were selected as Coordinating Lead Authors (CLAs) for the IPCC special report on Oceans and Cryosphere in a Changing Climate. Avash Pandey and Santosh Nepal have been selected as chapter scientists in the report while Mandira Shrestha is contributing author in the report. Suruchi Bhadwal and Soumyadeep Banerjee have been selected as lead author in the IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. In the upcoming 6th Assessment Report, Philippus Wester, Anjal Prakash, Suruchi Bhadwal and Arfan Uzzaman are selected as lead authors. Philippus Wester will also be leading the cross chapter paper on mountains. Altogether, 9 HI-AWARE researchers are working for IPCC reports.



ICIMOD- HI-AWARE  
Researchers in IPCC

## Consortia Partner Institutions

The survey also incorporated the indicators for mapping change in perception on institutional capacity. The cumulative rating given was 4.07/5 which is only marginally lower than the baseline rating (4.09) (see Figure 8). Since the analysis included only those 19 researchers who completed the baseline, only a marginal change in institutional capacity could be reflective of the high expectations they had from institutions in the beginning, which have been sobered down over time, due to experience and awareness. Another reason could also be that the institutions that were chosen to be part of the HI-AWARE consortium, were in many ways, leaders in their respective fields in their respective countries. However, a result of the multiple gender sensitization trainings and workshops that included senior management as well, has been that 'Gender sensitivity and policies' has been rated higher in comparison to baseline, pointing to the increase in support to these aspects in their organization.

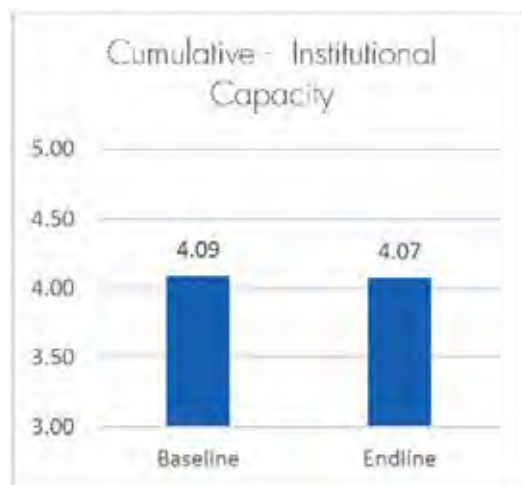


Figure 8: Cumulative Rating for Institutional Capacity

## Stakeholder's Capacity Building

- Climate Change Certificate Programs were conducted in Nepal (see Box 3) and Pakistan.
- LEAD Pakistan conducted a summer school in which participants were taken to the field - capture both formal and informal trainings and workshops.
- PARC has organized almost 50 stakeholder engagement events catering to engineers, government officials, media, policy makers, community members and other professionals.
- BCAS conducted multiple trainings in the pilot sites of community members on kitchen gardening, and carpenters and saw mill workers on building of CFRH.
- An expert mason from Kairi village, Munna Mahato, was christened '*Shauchalay Master*'. He was brought to Naya Tola Bishambharpur so that local masons could be trained in the process of building the EcoSan toilets. As a result, at least three masons of Bishambharpur – Birender Rai, Bali Choudhury, and Lagan Sahni - are now experienced with the design and construction of the toilets.

### Box 3: Certificate Programme on Climate Change in Nepal

The Certificate Programme was part of the Research into Use (RiU) component of one of three work packages of HI-AWARE. The course was designed to enhance the understanding and capacity of government officials of Chitwan district, Nepal on integrating climate change adaptation and mitigation into their respective sector development planning and implementation. In order to understand the capacity needs of the prospective participants, the HI-AWARE conducted consultations with relevant government departments and line agencies in Chitwan district. The course was designed in four modules. Practical Action Nepal, a strategic partner in HI-AWARE research consortium, was a co-organizer of the events. The Certificate Programme on Climate Change was designed, and delivered with the District Coordination Committee (DCC) Chitwan, Nepal, over four-month period with one event in each month. It was implemented along with the stakeholder engagement events in the Gandaki River basin. The certificate course was implemented following a learner-centered approach in which participants attended interactive classroom sessions as well as participated in field work.

Effectiveness of the certificate course has been looked at from various angles and findings are presented in a **Tracer Study** (Shah, Ahmad, Ahmad & Shrestha, 2018)

conducted by the SPME unit at ICIMOD. This study was conducted 14 months after the programme was over. The overall objective of the study was to see how participants are applying the knowledge and skills imparted through this course in the ex-post scenario, and hence to assess the overall effectiveness of the course. It revealed the following:

Course was designed in a way that it has further strengthened theoretical knowledge, skills, and practical understanding of the participants, and participants are able to confidently provide expert opinion in various aspects of climate change;

Participants are able to better apply learnings from the course not only to better perform their duties but also to better advocate for inclusive, gender sensitive, and integrated planning for climate change adaptation;

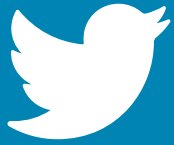
The Certificate Course has a viable trickle-down effect not only in terms of application of learnings for climate change adaptation planning but also in terms of participants further mentoring and training staff and colleagues in their respective institutions;

The Certificate Course has helped participants in promotions and rewards at their respective institutions;

Supervisors/heads of institutions of the participants are satisfied with the performance of their trained staff.



# Social Media Engagement\*



A community of over 1400 followers, development professionals and organisations

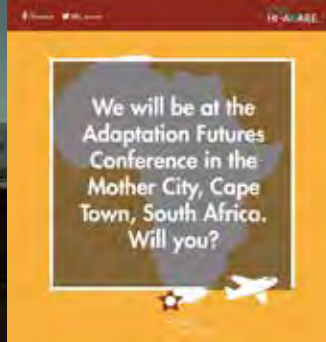
Our events have had an estimated reach of over 70'000 Twitter accounts

\*The social media accounts such as facebook and twitter would be active till September 2019 and would be handled by KMC lead of HI-AWARE. Later on, depending on the funding of second phase of HI-AWARE, a decision would be taken on continuation or merging the accounts with new projects, if any.

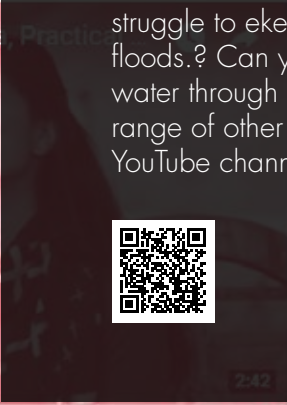
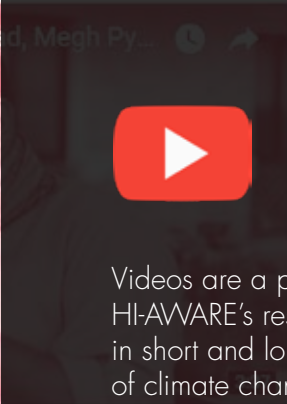


Follow us on our official Twitter handle @hi\_aware





Our Facebook engagement has seen a steady rise since 2016. We have a growing community of over 1400 followers who constantly engage with our content. Our Facebook wall is mainly used to share research updates, upcoming publications, and stakeholder engagements.



Videos are a powerful medium. With this belief, HI-AWARE's research objectives have been captured in short and long documentaries exploring cases of climate change and adaptation in its four study basins. How do communities in the Teesta basin struggle to eke out a living affected by yearly floods.? Can you really test the iron content in water through crushed guava leaves? These and a range of other videos have been uploaded onto our YouTube channel.





# Evaluating Our Work

# Research Quality Plus

In this section, we report on the work done under HI-AWARE using the Research Quality Plus (RQ+) method to show contribution of HI-AWARE towards adaptation research. It integrates the criteria used for evaluating research quality used in the external evaluation of the CARIIA program as well as those used in the mid-term external review of HI-AWARE. The Consortium Research Management Team (CRMT) of HI-AWARE then gave rating along the criteria in a self-assessment. The ratings are summarized in Table 1

## Integrity of the research outputs: Very Good

HI-AWARE has been able to produce a number of peer reviewed articles that show methodological rigour in research. For example, the hydro modelling work by HI-AWARE against different climate scenarios was published in *Nature*, and has been used as input into the 1.5° C report of the Intergovernmental Panel on Climate Change (IPCC). The research results range from future climate scenarios, glacier status, and precipitation distribution to upstream-downstream linkages in the river basins. There is also adequate and sound social science expertise across the team. Research outputs have been published in high impact journals and made available for the policy makers to gain insights and put them into practice. The various RCs have engaged in integration and consolidation across sites to produce best adaptation options. There has been uptake of HI-AWARE adaptation solutions packages and knowledge products by the regional governments of the study sites.

## Legitimacy of the research outputs

### Addressing potential negative consequences and outcomes: Good

HI-AWARE was careful in its approach to study sites so that the community in focus was always well informed about the research conducted and in many areas was part of planning and co-designing interventions.

- *Situational analysis*: The situational analysis was conducted for all four study basins to understand the socio-cultural, political and ecological landscape. This allowed researchers to gain ground level information which could then be taken into account while steering research.
- *Co-designing Pilots*: The implementation of adaptation options across pilot sites saw research teams and partners involved local stakeholders right from the outset. Being involved in planning and design phase of interventions instills a feeling of ownership and allows for dialogue that can address concerns and potential problems.
- *Stakeholder Engagement*: HI-AWARE's engagement with stakeholders at all levels – community, local service providers, local governments, district and provincial administration as well as national level policy makers, ensured that knowledge generated is of value/ worth and is usable
- *Strategic Partners*: Involvement of strategic partners across the study sites helped in understanding the organizational landscape and context much better in specific sites. This enabled the team to customize interactions and research approach with potential stakeholders according to local practices.

## Inclusiveness of vulnerable populations: Very Good

HI-AWARE in all of its research components focused on different kinds of vulnerabilities disaggregated by geography (for example, urban-rural, upstream-midstream-downstream), gender, caste and class (including intersectionality) so as to understand site specific power dynamics better, as well as the specific drivers of these vulnerabilities. The involvement of strategic partners helped in learning about community specific vulnerabilities.

Research methods such as multi-criteria analysis helped in determining most important adaptation interventions from the perspective of local stakeholders.

## Gender responsiveness: Very Good

Gender responsiveness has been a pillar of HI-AWARE since its inception. HI-AWARE also received the 'gender innovation award' at ICIMOD for its exceptional focus in trying to mainstream gender in the adaptation sector.

### *Organizational Level*

- *Gender Transformative Approach:* To overcome the disparities that exist, extra focus was given to inducting women in the project – whether at the consortium level or even at the level of partner organizations. Since the inception phase, the HI AWARE project has laid emphasis on the inclusion of women as researchers in both senior and junior positions ensuring opportunities for women in the research and development sector across the 4 countries involved. This is also evident in the partnership contracts at the strategic and operational level, which clearly state that if a partner organization was to hire a new staff to work on the HI AWARE project, then preference should be given to women.
- In addition to this, our events, *conferences and workshops* have seen a good percentage of female participation in the last two years. Percentage estimates for female participation as panelists in various conferences held so far show that almost 50% of panelists have been women. Participation is encouraged through letters of invitations.

### *Implementation/Research Level*

- *Research Design:* HI-AWARE as a research project is committed to including gender sensitive and specific perspectives and drivers of vulnerabilities to climate change by making it a part of its project design. One of our five research components of Work Package 1 is focused exclusively on gender (Research Component 2) which works closely with the other research components and work packages.
- *Gender sensitive methodologies:* Gender is an integral part of the conceptual framework of HI-AWARE. The component on gender, socioeconomic and governance drivers and condition of vulnerabilities formed the basis for other RCs. The research methodology adopted for this component was inspired by anthropological research tools that value people's experiences and perceptions, especially of women and the most vulnerable communities. Repeated field studies over a period of three years in the same villages from 2015 to 2017 allowed researchers to interpret the findings based on

personal observations, in addition to information from focus group discussions (FGDs) and key informant interviews (KIIs). The complex issue of gender vulnerabilities could thus be interpreted in a better way, since the observations focused on women, girls and some men who were identified as the most vulnerable in the climate hot spot. This research component provided information about ground realities as a building block for other research components through regular writeshops and workshop of researchers. In addition, one workshop of researchers was dedicated to integrating gender in the other RCs. The pilot activities were carefully selected to address gender problems emerging from climatic stressors.

- *Intersectionality*: The concept of intersectionality finds dedicated space in the gender research conducted by HI-AWARE. It delineated the interplay of caste, class, gender to show how different forms of power are produced and how that might drive vulnerability.
- *Field Level*: At the field level, HI-AWARE ensured participation of and interaction with women through FGDs KIIs and as part of the household surveys. When these household surveys are conducted, researchers make a conscious effort to interview the women in the house wherever possible. The pilot intervention in West Champaran, Bihar on flood resilient habitat including ecological sanitation, is exemplary in this regard. The interventions is primarily women-led and being promoted by them as well.
- *HI-AWARE Academy*: The third work package of the project is about strengthening expertise. Under this package, the project aimed to develop the capacity of young students and researchers enrolled in Master's and PhD courses from regional countries. There are a total of 28 Master's students and 10 PhD students. Stress has been laid on ensuring that at least 50% participation in the programme is by female candidates. As a result, 57% (16) of the Master's students are females, ensuring a healthy gender balance.
- HI-AWARE has also supported a revision of Master degree curriculum of Environmental Science at Tribhuvan University to integrate gender, through capacity building of faculty engaged in curriculum development and preparation of resource book on gender. In addition, it has made efforts to influence the content of training and formal courses to integrate gender.

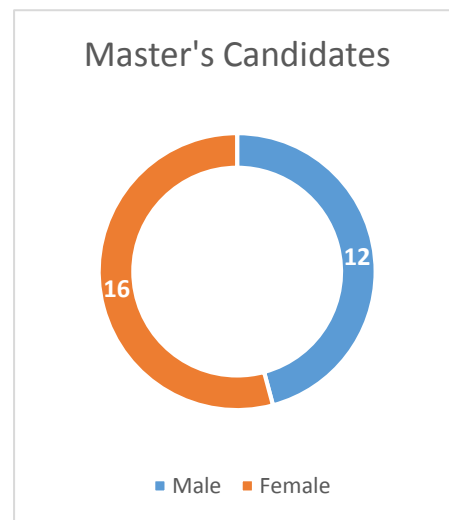


Figure 9: HI-AWARE Masters candidates by gender

### Engagement with local knowledge: Good

Although there is room for improvement, and as mentioned above, the situational analysis, involvement of strategic partners and local stakeholders in the planning and design of research and interventions served to ensure that local knowledge informs HI-AWARE research. In addition, with the aim of promoting integration of local knowledge and scientific research conducted, HI-AWARE facilitated, multiple stakeholder engagements across levels (village, block, district) and exposure visits for local government officials and professionals. For example, local knowledge of flood resilient technologies in Bihar and inclusion of local community members in updating of Local Adaptation Plan of Action (LAPA) in Nepal was undertaken. The Adaptation Portal is an application that encourages crowd sourcing of adaptation actions being undertaken by communities of the HKH.

## Importance of the Research Outputs: Very Good

The research by HI-AWARE has been innovative, necessary and contribute to adaptation goals of the region. Research areas such as Critical Climate Stress Moments are quite innovative and useful for policy makers to identify adaptation turning points and therefore implement suitable adaptation plans. Concept of adaptation pathways has been applied in the research based on the existing knowledge in the scientific arena and will be of help in the further development of the topic in IPCC AR6 cycle. Inputs to policy making by new approaches such as Climate Resilient Development Pathways was undertaken in the study areas.

## Positioned for use/Research in use: Good

The development of the HIAWARE proposal involved consultations with key stakeholders in all four countries as well as a comprehensive review of relevant, but limited, literature to better understand local and regional priorities and identify strategic gaps. The research output of HI-AWARE's bio-physical RC has been used in the National Adaptation Plan (NAP) and Local Adaptation Plan of Action (LAPA) of Nepal to identify the climatic disruptions. The research team organised training for local communities along with the policy makers to prioritize the adaptation options in the LAPA framework, especially after the restructuring of the governance structure in Nepal. Additionally, pilots result from the research have been implemented in Pakistan (solar powered irrigation pumps), Bangladesh (flood resilient houses) and India (Eco-san toilets) as adaptation options. Knowledge products such as briefs, of all the sub-components of RCs have been published to help policy makers identify major gaps in climate change adaptation measures, inclusive of suggestions and recommendations.

Table 1: Four criteria rating research quality of HI-AWARE

| Rating research quality  | Unacceptable | Less than acceptable | Good | Very good |
|--|--------------|----------------------|------|-----------|
| What is the integrity of the research outputs?                 |              |                      |      | ✓         |
| What is the legitimacy of the research outputs?                |              |                      |      |           |
| (i) addressing potential negative consequences and outcomes    |              |                      | ✓    |           |
| (ii) inclusiveness of vulnerable populations                   |              |                      |      | ✓         |
| (iii) gender responsiveness                                    |              |                      |      | ✓         |
| (iv) engagement with local knowledge                           |              |                      | ✓    |           |
| How important is the research output?                          |              |                      |      | ✓         |
| How is the research output positioned for use/Research in use? |              |                      | ✓    |           |

# 21



Working  
Papers

# 28



Peer Reviewed  
Journal Articles

# 28



Masters  
Students'  
Dissertations

# 60



Blogs

A full list of publications and other media outputs can be found in Annexure 3 and 5 respectively  
or visit [www.hi-aware.org](http://www.hi-aware.org)



## Most cited

### 95 Citations

The nexus approach to water–energy–food security: an option for adaptation to climate change

Golam Rasul, Bikash Sharma

### 61 Citations

Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia

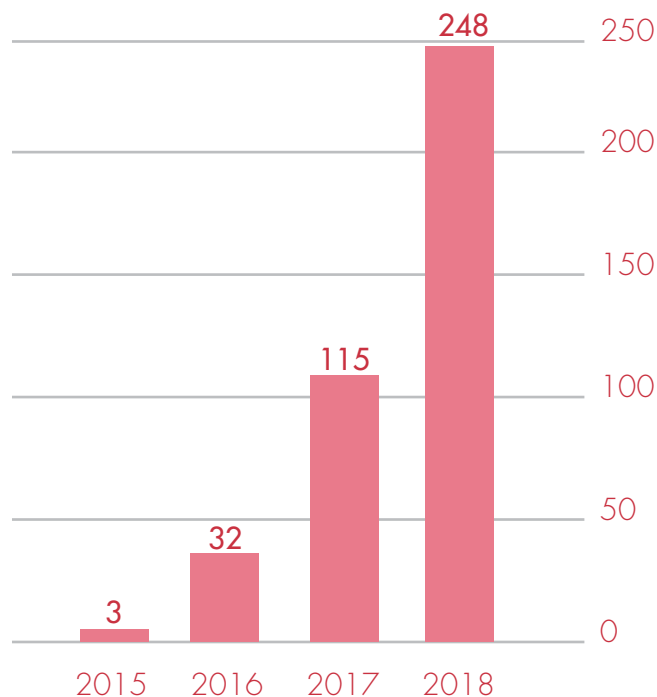
Golam Rasul

### 46 Citations

Selecting representative climate models for climate change impact studies: an advanced envelope-based selection approach

Arthur Lutz et al.

# Citations



Source: Google Scholar HI-AWARE profile

# Comparing Intended and Actual Outcomes

In the partnership meeting that concluded on 17 August, 2018, participants were asked to rate the actual outcomes in relation to intended outcomes on a Google form.

## Reflection on Consortium's Theory of Change

Partners appreciated the Theory of Change (ToC) as an important tool that helped the consortium visualise impact pathways underlying which is HI-AWARE's thinking on how change will occur. The ToC made partners stay focused, align their thinking, and assess the larger impact of smaller outputs. It acted as the “goalpost” and was broad enough to allow for flexibility in activities. It also acted as the base with which the logframe and individual work plans were integrated. “The ToC worked as the coordinator of all activities to achieve the outcomes”, said one partner. Another partner who is a scientist said that it helped her to relate her science with the larger research objectives and impacts.

At the same time, it was felt that HI-AWARE ToC's initial design promised more than what was feasible. As one partner remarked, “The proposal was probably written keeping 7 years in mind, whereas the project was awarded for five years”. Therefore, it was seen as too ambitious leading to the lesson that it is prudent to promise less and do more rather than the other way around. Many partners were using the ToC for the first time for programmatic planning and implementation. This also helped improve the planning and monitoring capacity of partners. A rough rating from 1-5 (5 being the highest/achieved) across partners in the consortium conducted during the last partnership meet showed that more than 80% felt that the ToC worked in its objective of guiding the overall research (see Figure 10).

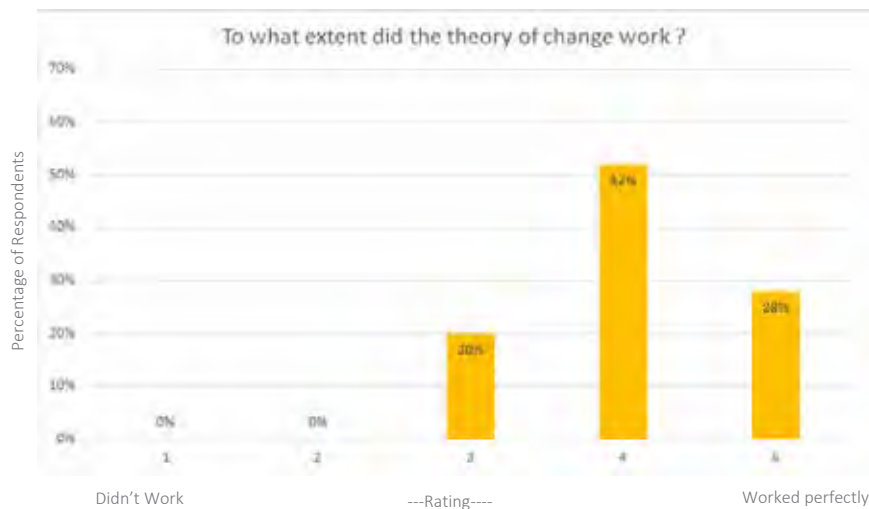


Figure 10: Reflection on theory of change

## Reflection on Project Objective

Similarly more than 80% respondents felt that the project objectives have more or less been fulfilled. Particularly, Specific Objective (SO) 1 is perceived as 80% achieved\* (see Figure 11). SOs 4&5 are seen to be 80-90% achieved. SOs 2 & 3 seem to be lagging with 2 being 40-50% achieved and 3 lagging far behind at 20%. SO 3 focused on adaptation pathways work based on the research in RC 2, 3 and 4. However, these researches took time to come out with the results and so its consolidation in RC 5 could not happen as desired in all the study basins. However, in Nepal, the adaptation pathways work was well integrated with National Adaptation Plan process wherein HI-AWARE had given strong inputs on scenarios and gender issues. The team felt that the project objectives were over-ambitious to begin with. The major constraint of time prevented the creation of 'robust evidence' as far as the pilot interventions go. More time is needed to generate robust evidence, followed by further community and stakeholder consultations for upscaling and outscaling. This will help build resilience informed by the evidence base created, and to pursue policy influence. At the same time, one partner questioned as to how the positive reactions of community and policymakers could be accounted for as evidence. Further, there was a question about what all can be considered and collected as evidence in an ever evolving context of adaptive capacity and resilience building. Perhaps a very important question to ask, as one of the partners mentioned, is to question whether the evidence created is the 'right kind' of evidence. Some felt that there was delay in the production of outputs and the time management could have been better.

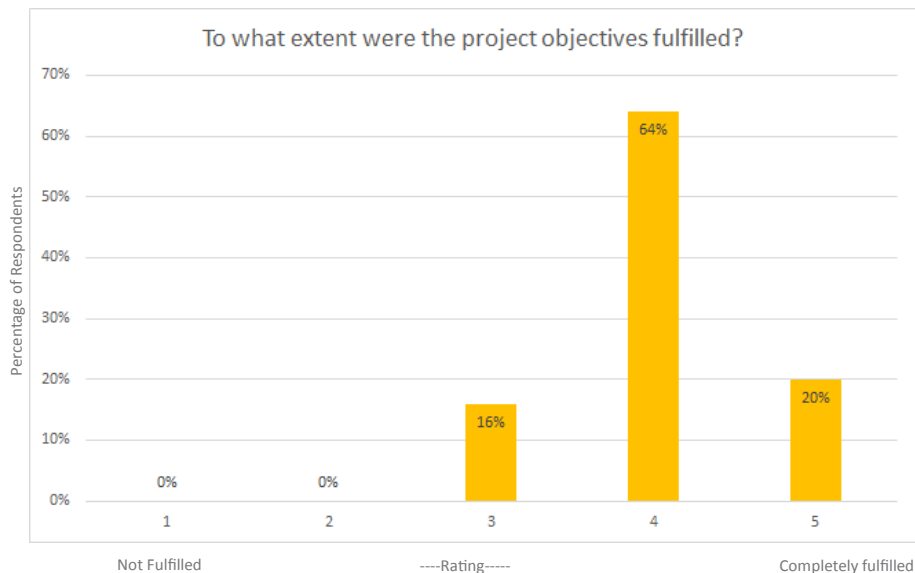
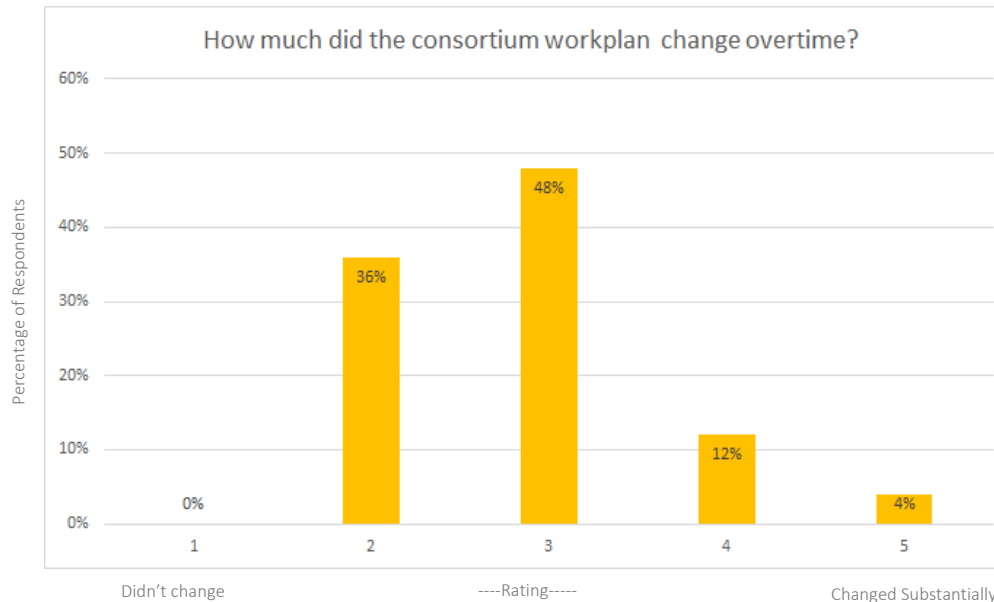


Figure 11: Reflection on project objectives

\*These estimates of percentage of completion were conveyed verbally by respondents in the partnership meeting.

## Reflection on the consortium work plan

According to the rating by partners, majority of the respondents (48%) felt that the workplan only evolved with time but did not change completely. The work plan was first conceptualized in the first six month of the project through a number of meetings and formation of working groups. The work plan was revisited every year to see if there were changes needed to



reflect the changed policy and field contexts. A major change of the work plan was done after the mid-term review in 2017 which identified couple of issues that needed attention. It is to be noted that the major objectives and sub objectives did not change as conceptualized in the project but small adjustments were made in work plan leading to activities of the project. The reflection on the consortium work plan shows this process as perceived by the researchers and the same is represented in Figure 12.

Figure 12: Reflection on consortium work plan

## Reflection on Research-into-Use approach

Work Package 2 of HI-AWARE aimed to put 'Research into Use' through effective promotion of evidence-based and tested innovative adaptation approaches and practices with relevant communities and institutions at various levels, in order to improve policies and practices that help vulnerable populations adapt to climate change. This was to help in the uptake of robust evidence that is generated under Work Package 1.

In the partnership meet, RiU drew mixed reactions from the group (see Figure 13). A third of the respondents gave the RiU approach an average rating of 3. Some offered criticism that there wasn't enough time allocated to demystifying the science that was produced to the communities that are affected by it. However, putting research into use is not just about the communities. The outreach towards policy was also seen to be lagging in comparison to what was foreseen at the start of the project. Some felt that the activities under RiU started too late in the project cycle whereas others pointed out that planning

and execution had been happening since the very start. This is evidenced by the number of stakeholder engagement and trainings conducted across different levels. Members recalled that the Citizen Science Climate Adaptation Ateliers (CISCAAs) which were to encourage citizen science had to be dropped due to a combination of lack of time and inclination amongst the partners. It was also suggested that the customization that was perhaps needed for reaching out to the policy makers was missing. Even if the expertise to put research into use existed, there were many things to follow up and not enough time in which to do so. Another member noted that, identification or mapping of stakeholders, high level engagements with ministries, policy champions and think tanks were being done from Day 1. The 75 stakeholder engagements, 5 Climate Change Adaptation Policy and Science (CCAPS) conferences, and multiple HI-AWARE Academies are evidence of engagements.

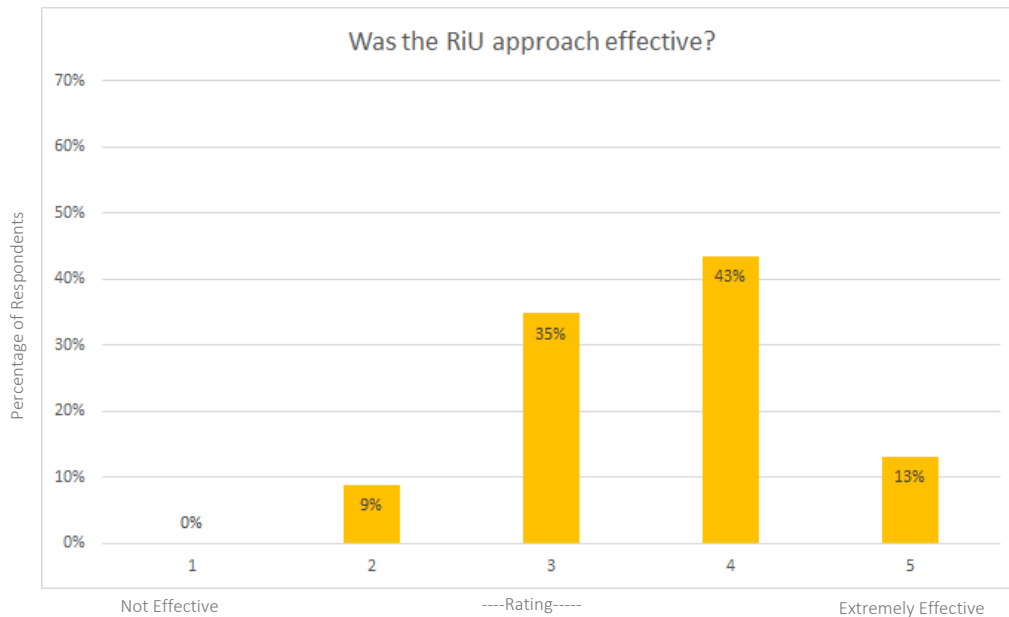


Figure 12: Reflection on RiU

Additionally, however, the research outputs could've been translated into local languages for wider dissemination. A point of consensus was that projects should have the foresight to evaluate which objectives are realistically achievable and which are not. The former should be focussed upon to achieve more impact. More staff time or dedicated RiU experts should be allocated to pursue RiU objectives. Engaging media and journalists, and involving M&E expertise in RiU efforts is important as well.



# Risk Management

# HI-AWARE Risk Register

The HI-AWARE risk register consisted of implementation related risks, research related risks and partnership risks. The review of the risk register were held during partners meets every six months. During the meetings, risk register was reviewed and mitigation strategies were evaluated. The following high likelihood/impact risks and challenges were identified, including treatment strategy and residual risk. One of the risks that was not well anticipated in the initial years was the risk associated with exchange loss. It affected the consortium in a major way later on and was adjusted with some difficulties including changing the work plan and activities to suit the budget.

Table 2: Snippets from Risk Register

## Implementation Risks

| Risk   | Likelihood (L-M-H) | Consequence (L-M-H) | Risk Rating (L-M-H) | Treatment/ Strategy   |
|--|--------------------|---------------------|---------------------|---|
| 11. Lack of coordination among partners to integrate programme results leads to missed opportunities for synergy | M - H              | H                   | H                   | <ul style="list-style-type: none"> <li>- Implemented initiatives identified during Nov. 16 work week</li> <li>- Implemented the planned integrative studies</li> <li>- Clarified the role of the Consortium Coordinator in this regard</li> </ul> |
| 12. Delays in staffing delays implementation   | L                  | H                   | H                   | No longer a risk as staff are now in place  |
| 13. Staff turnover delays implementation   | M                  | H                   | H                   | Developed a tailored strategy of incentives with each consortium partner, e.g. capacity building  |
| 15. Issues with absorption of funds delays implementation  | M-H                | M                   | H                   | <ul style="list-style-type: none"> <li>- An issue for BCAS and PARC</li> <li>- Transfer issue was resolved</li> </ul>   |
| 16. Late submission of reports delays release of funds   | M                  | H                   | H                   | Co-PIs started taking responsibilities more seriously   |
| 17. Delays in release of funds delays implementation   | H                  | H                   | H                   | Became more timely with writing and review of reports   |
| 18. Communication gap among members and partners delays implementation   | L                  | H                   | H                   | More active communication between consortium members and strategic partners began   |
| 19. Under-performing members or subcontractors delays delivery of quality output                                 | L                  | H                   | H                   | Emphasized on follow up   |

## Updated Partnership Risks

|  |    |   |   |   |
|--|----|---|---|---|
| P6. Foreign exchange fluctuations impact negatively on local currency budgets, leading to reduction of available funds | H  | H | H | Led partners to raise options to manage with IDRC, or redistribute amongst consortia<br>Discussed and agreed an approach at CRMT, that was ratified by Steering Committee<br>Captured scale and impact and reported on it.  |
| P7. Inefficient ways of working reduce time available for actual content work and tire people out.                     | H+ | H | H | Streamlined meetings and limited participation;<br>Explored web and face-to-face opportunities for meetings as an alternative;<br>Meeting agendas – followed guidelines developed at 2016 Partnership Review, and also included and made space for fun/ socializing/ side-meetings without cramming them over breakfast and late dinner.<br>Considered a 'team building' component.<br>Decided who needs to know/participate in each type of meeting. |

## Research Risks

|  |   |   |   |  |
|--|---|---|---|--|
| R1. Lack of partner collaboration affects research and outcome pathways                              | M | H | H | Built trust through more substantive conversations at meetings   |
| R2. Lack of trust with stakeholders leads to lack of information (or inappropriate, misleading info) | L | H | H | Substantial trust has been built in local communities and with relevant stakeholders and this will be built upon through networking and collaboration with strategic and operational partners          |
| R5. Lack of sustained interest by stakeholders – research fatigue                                    | M | H | H | Improved planning and strategizing to avoid redundancies.<br>Better integration of proposed field activities – planning board or map of who is doing what, where and when (physical and virtual / web) |





# Lessons Learned

# Lessons Learned

Hindsight is a wonderful gift, and the value of a Reflection Workshop comes from identifying the learning opportunities for what, given the chance to embark on something similar again, would Members and Partners recommend be done differently with respect to the partnership aspects of HI-AWARE.

## Reflections on Consortium Structure and Organization

As mentioned above, HI-AWARE is one of four CARIAA Consortia. Led by ICIMOD, the HI-AWARE Consortium includes BCAS in Bangladesh, TERI in India, CAEWRI-PARC in Pakistan and WUR in the Netherlands, supported by strategic and implementing partners in each country. Following the co-development of a partnering agreement between Consortium Members, and a mid-term learning review of the project in August 2016, HI-AWARE formally drew to a close in 2018. Following are some of the lessons learnt about partnerships and research from a management perspective over this 5-year long journey:

### Team Members

Benefits of HI-AWARE's Capacity Building efforts have cut across participant categories and have been layered and substantial. This includes capacity building of early career researchers, individual professionals involved in HI-AWARE, especially co-principal investigators and senior researchers, and consortium members and strategic partners – particularly with respect to M&E methodologies, research-into-use, knowledge management, gender, partnerships, and trans-disciplinary ways of working. Capacity development can occur in both expected and unexpected ways through partnerships: the informal opportunities to exchange and share knowledge and learning between individuals are as valuable as formally structured approaches. Capacity development has not only occurred around research and knowledge, but also related to approaches that have been used in HI-AWARE, including monitoring and evaluation, and the partnering approach and frameworks.

HI-AWARE's members and partners were also exposed to diversity which is a complex issue in a trans-boundary, trans-disciplinary collaboration – it can relate to culture, gender, age, hierarchy, professional knowledge and expertise, organizational systems and policies, and organizational values. It can also relate to different working styles, and cultures (Consortium operated across five countries and two continents). The regional and cross-border aspects of the programme could be at times political, adding to the challenge. One of the most important features of HI-AWARE was the co-creation of knowledge and exceptionally generous sharing of data, particularly in a region where trans-boundary sharing of data is not a simple task. The focus has been to identify and work with the right individuals (those who have influence, credibility and are committed to generating knowledge), in the right organization to ease this sensitivity in the interests of serving the mission of the project. The development and use of the HI-AWARE information portal, and development of robust M&E systems, through ICIMOD's thought-leadership in these areas, was recognised as a real strength by consortium and strategic partners.

### Management of Consortium

Operating across five countries and two continents, the regional and cross-border aspects of the programme that could be at times political, and the cross-sectoral approach, including NGOs, academia, government and research, that added very rich diversity, was both a highlight and presented genuine challenges in working together. The quality of engagement among partners has improved and built over time. Face-to-face meetings were identified as important to build relationships and

trust among them. Regular “health-check” and reviews allowed for self-reflection for the consortium and to make amendments where needed. The initial Partnership Agreement workshop in particular has been crucial to building deep understanding of each of the partners right from the outset, and for grounding the collaboration in a set of principles to help inform how people would work together, not just focus on what they would do. The Agreement document was reference on a number of occasions throughout the project life-cycle, for reference, review and induction purposes and to help work through occasional misunderstandings. There has existed a shared focus among partners on the mission and objectives which is evident in the high levels of commitment of personal and organizational time, despite challenges such as financial losses due to exchange rate flux. On the other hand, involving Strategic Partners has provided real value for money and also presents an avenue for sustaining knowledge generated under HIAWARE beyond the funding period.

The leadership demonstrated by each of the member and partner representatives was key, many of whom had the responsibility to interpret the new ways of working of HI-AWARE back to their own organization. The CRMT and Steering Committee appear to have been well-functioning and fit-for-purpose governance structures, which allowed appropriate leadership to occur. The CRMT and Co-PIs only meetings worked well and have tackled all issues related to coordination and planning. Monthly meetings were recorded and followed up for necessary action. Minutes of all meetings were kept with the consortium secretariat and posted on the KM platform for combined viewing. In hindsight, the distribution of tasks and responsibilities amongst consortium members could have been done in a more precise way during the planning stage in 2014. Having all institutes involved in almost all tasks makes it more difficult to hold institutes accountable for different tasks and deliverables. Roles weren't described in sufficient detail. This made the consortia management heavy which took away time from research. Though the trans-disciplinary work required pooling together the expertise, in reflection it was felt that we went a bit overboard and were enthusiastic in adding more work without much thought of how much time it would involve. For example, research on spring and urban water was supposed to be only review but we went ahead with full fledged research understanding the need and urgency which took a lot of time than actually planned. The consortium also suffered from a complicated financial structure which is discussed in detail in the next section.

Some lessons learnt include:

- To avoid complications, identification of partners should be subject to rigorous selection and due-diligence processes which consider not just financial due-diligence, but commitment to the agreed purpose, competency, right mind-set of partner, and availability of time and resources commensurate with the level of commitment made.
- It is beneficial to have an intentional approach to collaboration, utilizing agreed frameworks and approaches to help support the delivery of the initiative through building common understanding, building stronger relationships and adhering to agreed ways of working.
- It is important to acknowledge, value and report on in-kind contributions from all members and strategic partners, to ensure an understanding of the ‘real costs and value’ of the programme.
- Leadership matters – having leaders able to push the boundary of ‘business as usual’ practice, and who can lean in when the going gets tough and help lead partners through conflict and challenge is fundamental. Equally important is having internal advocates in partner organizations who can do the same to build understanding and openness to new ways of working in their own organizations, so that change is embedded and not just temporary.

## Delivery of Work

The work under HI-AWARE was divided into different work packages and research components, and the responsibilities to lead these components and subcomponents was divided among partners. Prominently, the fact that the programme was flexible enough to accommodate pilot activities, when this had not been part of the original design, and that these applied research initiatives could be tested across borders, has been very important to the success of HI-AWARE. Academics from Europe have been able to participate in fieldwork as well, which according to them has been a most welcome feature of HI-AWARE. Being able to conduct field trials has been a genuine strength of HI-AWARE, and the role of on-the-ground strategic partners has facilitated this greatly, although involving them in co-design from the very early stages is key to ensure the best sites are selected and access is expedited.

Additionally, one of the main highlights of HI-AWARE remains its people and their quality, commitment and professionalism which was a genuine value-add, as was the amount of goodwill, commitment and the diversity and complementarity of the individuals involved.

- When selecting organisations for potential collaboration, it is important to also consider which individuals will be allocated to the partnership since much of the success of partnering comes down to the interest and ability of people to have a collaborative mindset and to maintain excellent working relationships. This is also a consideration in the event of turnover: the need to consider how their replacements will be selected and inducted into the partnership.
- It can take some time for the network effect of partnering to gain momentum, particularly in a research consortium which is initially slow to generate and execute research questions, collect and distribute data and write and publish papers. More thinking is needed on how to track and assess in terms of its value-add to the initial investment, once funding has ceased. It is worth considering what provisions could be made at the outset in the design of future collaborations to consider mechanisms, measurement and sustainability of knowledge-sharing networks beyond formal funding periods.

## Looking Forward

### Financial Structure of the Consortium

The management and financing structure of HI-AWARE was relatively complex and this has led to challenges in the relationships across the consortium: funding was provided directly to the Consortium Members for the activities falling under their remit (linked to the various Research Packages and including sub-contracts to Strategic Partners). In addition, funding for Consortium Management was provided directly to ICIMOD to administer on behalf of the entire Consortium in its additional capacity as Consortium Manager. While this appears on the surface to be relatively straightforward, a challenge experienced by ICIMOD was being held to account by the donor for the overall performance of the Consortium, while not at the same time being able to exert oversight over associated funds dispersal or management. It is recommended that for future partnerships, it is better to vest both financial and technical control with the lead institution.

A reflection on the dual role for ICIMOD of being both the consortium manager (an administrative and leadership role) and a consortium member (implementing partner). For the most part this worked well, but where the roles of individuals were blurred across the two remits, there is a strong requirement for 'intentional transparency' and to be very clear to the Consortium Members when someone is acting in the role of implementing partner versus consortium manager. In the HI-AWARE structure, the Consortium management role is something which is done on behalf of all the partners, and to that extent the agency fulfilling that role is accountable to the Consortium members for the expenditure of those funds. This is not the case when fulfilling the role of implementing partner, when the accountability lines flow to one's own organizational hierarchies.

*Lessons Learnt include:*

- Consider funding and accountability flows and how this will impact on partner relationships (particularly equity, openness and trust) in the design of any funding mechanisms within a collaboration context. Decentralizing decision making can help build transparency and trust, share responsibility and balance power.
- Where dual roles for consortium management/implementing partner are held, be overtly or intentionally transparent about the separation of duties, ideally ensuring that the consortium coordination role (down to personnel) is separate and distinct from the other. This should help prevent the development of mistrust or suspicion. Being accountable to Consortium members for coordination responsibilities and related decision-making, in a very transparent and open way, will also assist this.

## Capacity Building

Just as capacity building was considered a highlight of HI-AWARE engagement, it is also recommended that capacity-strengthening needs, specific to partners being able to participate fully and equitably in a consortium/ partnership be factored in from the outset. This may include for example, investing in the development of content-specific areas such as monitoring and evaluation, knowledge management and communications expertise, and partnership skills for each partner. The Consortium Members could themselves co-create the Terms of Reference for any consortium-specific roles or training to maximize ownership and to tap into the varied expertise the partners have to offer (to the consortium and each other). Understand that it may take time and an initial investment to ensure all partners in a collaboration are equipped to be able to fully participate and contribute equitably in a partnership/consortium arrangement. In multi-year projects, this may involve reinvestment where key personnel turnover and new staff are brought up to speed. Partnerships do not benefit from an assumption of pre-existing collaborative competence. The collaborative competence is a mix of differential capabilities that the consortia as a whole has and that is needed for a project to be implemented. It is very context specific but criteria could be developed for assessing it for projects similar to HI-AWARE.

## The Role of Strategic Partners

The value-add of the strategic partners in HI-AWARE was widely acknowledged, particularly in the implementation of pilot activities under HI-AWARE, and also for their community connectedness and advocacy skills and agendas. On reflection, it was felt in particular by strategic partners, that engaging them earlier at the co-design stage of the consortium would have maximised their value-add, leading to improved site selection (for pilot research activities) and work planning. Logos of Strategic Partners were not represented in HI-AWARE publications from the outset since they became part of the consortium later. This is however important to be addressed as it recognizes the value of their inputs to HI-AWARE as well as strengthens their position when using these materials for advocacy purposes, providing them with legitimacy when discussing findings with local governments.

*Lessons learnt include:*

- Engage Strategic Partners from the outset in the co-design and work planning processes in order to maximize value-add and appropriateness of any interventions. Understand that it can take time for new partners (not there from the outset) to feel comfortable and confident enough and on top of the issues, in order to be able to contribute fully: this is especially the case when there are perception of other partners as being 'big' and 'powerful' and where the partnership culture essentially causes 'less powerful' partners' to hold back.
- Where partners join a consortium after start-up, work to ensure their drivers and needs are understood and reflected in any agreement (perhaps through an amendment), so they don't feel less valued than founder members. Strategic partners also identified a need for follow-up support to field work, beyond the funding period, in order to ensure that the research is not one way and extractive, but incorporates a feedback loop to disseminate knowledge back into participating communities.
- Build in feedback and follow-on to pilot communities and local governments to close the research loop and maximise knowledge dissemination at the user end.

## Integration of learning across silos

Great efforts were taken by the consortium members to integrate research learnings across the various research packages and ensure these learnings were known and shared. Still, beyond the consortium management team (CRMT) some, especially strategic partners felt that more could be done to ensure learnings are shared and integrated across the consortium and to prevent silos of knowledge developing. For example, the work packages had specific outputs while a shared understanding of different research components could have been brought together better for more integrated understanding. Not that it was not done well but there was a scope for improvement in this component. This is important to ensure that members and strategic partners retain their engagement with the overarching HI-AWARE vision, and not just their own particular areas of remit.

## Role of the Donor

HI-AWARE Members identified the potential value-add that the donor like IDRC brought to HI-AWARE. It played role of a project ambassador or champion and facilitated HI-AWARE engagement across the other CARIAA global consortia. IDRC was involved in the co-design process for the partnership governance structure; this ensured they did not merely replace existing knowledge and expertise and were flexible and willing to adapt to the needs and circumstance of the Consortium. They were prepared not to 'take the power' which might otherwise sit with them, which is a common barrier to genuine engagement.

## Partnership Governance

The Consortium benefited considerably from attention to its governance processes – reviewing the value and efficacy of meeting formats at the mid-term review to ensure these became more efficient and effective over time. One learning however, is to be cautious that agreed governance processes, such as decision-making meetings, do not slip in periods of busyness, when people will often revert to 'business-as-usual' even when not intending to do so: a little bit of light touch attention will help to keep engagement on track. Governance structures must be reviewed regularly to take account of changes in contexts and to maximize efficiency and effectiveness for all partners.

## Understanding different academic traditions and reaching agreement on shared approaches

A notable feature of the HI-AWARE programme is that it crosses boundaries in many ways, including national/geographical/cultural. Researchers and scientists from a range of academic traditions – Dutch, Canadian, Nepali, Indian, Bangladeshi, Pakistani – have been brought together to design, debate, conduct, analyze and write about their research. This has inevitably led to some tension and misunderstanding in the partnership as they apply their different approaches and standards which may be 'business as usual' in their home countries, but are not acceptable in an international context. Rigorous debate and critique for one group from a European Western paradigm is not necessarily perceived the same way as for some from South Asia.

Considerable time and effort was put into surfacing some of these academic traditions at the outset during the partnering agreement, including on the vexatious issue of lead and co-authorship of papers. Guidelines were developed and applied, yet throughout the project and especially towards its conclusion with a flurry of research papers, the issues of co-authorship and leadership remained a sensitive issue, and a strong driver of some non-supportive behaviours. The original HI-AWARE partnering agreement was revisited to check the guidelines for co-authorship were still relevant. Furthermore it was agreed that authors for all final papers will go to the CRMT for consideration and approval (proposed by the relevant Co-PIs). Therefore, as HI-AWARE has demonstrated, investing time at the commencement (or prior) of any international research consortium to carefully exploring the different motivations, traditions and pressures of each partner with respect to academic traditions (including in particular authorship) has long term benefits. Check in with partners on a regular basis as to their interpretation of that, as well as any difficulties they are experiencing with respect to implementing the protocol. Ensure decisions about lead authors are made openly at the CRMT level (or equivalent) and with justification, against the agreed criteria.

## Legacy

Evidently, there is a desire among the consortium partners to collaborate together in some form or other, beyond the HI-AWARE funding period. This is perhaps, the ultimate indicator of success in partnerships (beyond achievement of the goal and objectives of the project). With HI-AWARE coming to a close before the end of 2018, in terms of its funding, some areas that could be treated as HI-AWARE's legacy are as follows:

- Cohort of young MSc and PhD researchers will carry forward their work
- Regional network of scientists
- Knowledge and evidence base expanded
- Research to practice – evidence to inform policy making
- The HI-AWARE Brand
- Many researchers from HI-AWARE have been chosen as IPCC Authors
- Understanding of the values of diversity and across disciplines
- Understanding of the partnership approach
- Strategic Partners to scale up HI-AWARE pilots through their advocacy and work on the ground
- Knowledge and experience of partners for future work
- Capacity development







# Annexures

## Annexure I : HI-AWARE Outputs and Indicators

| Outputs and indicators | Cumulative end of project target  | Progress as on Oct 12, 2018  |
|------------------------|---|--|
| Output 1, indicator 1  | <p>1. Two scientific papers (2) (monitoring of high mountain, upstream-downstream linkages)</p> <p>Cumulative targets:</p> <ul style="list-style-type: none"> <li>- Datasets: 10 + as per demand</li> <li>- Scientific papers: 9</li> <li>- Touch table application: 1</li> <li>- Reports: 2</li> <li>- Data sharing platform: 1</li> <li>- Documented public-domain models: 2</li> <li>- Equipment procured and installed: 4</li> </ul>  | Cumulative – 10 peer reviewed journal articles, 3 working papers; 9 data sets published  |
| Output 1, indicator 2  | <ol style="list-style-type: none"> <li>1. One synthesis journal article on river basin specific differential vulnerabilities.</li> <li>2. One synthesis journal article on interrelations and interplay of socio-economic and bio-physical drivers of vulnerability (linking RC 2 and 1).</li> <li>3. One dialogue process in one of the Study Basins to facilitate regional cooperation.</li> <li>4. One journal article on gender and climate change vulnerabilities.</li> <li>5. Regional workshop on adaptive strategies for gender inclusive climate resilient development organized and report produced.</li> <li>6. Cumulative: 4 peer reviewed journal articles</li> <li>7. Cumulative: 7 working papers</li> </ol> | Cumulative: 9 peer reviewed journal article (forthcoming - (see details in Annex 2 of this report) , 5 book chapters (forthcoming), 1 peer reviewed journal article published in Economic and Political Weekly (EPW), 6 working papers published + 1 working paper on socio-economic drivers |
| Output 1, indicator 3  | <ol style="list-style-type: none"> <li>1. Review of CC policies of 4 partner countries.</li> <li>2. Piloting of three climate adaptation practices successful.</li> <li>3. Four CISCAAs established and up and running.</li> <li>4. Six peer reviewed outputs accepted</li> <li>5. Four policy briefs published.</li> <li>6. Two book chapters published.</li> <li>7. Field monitoring database published (based on CISCAAs and springs research).</li> </ol>   | Working papers (7) no 3, 4, 6, 13, 14, 16, 17<br>Peer reviewed Journal articles - 8<br>(11 peer reviewed journal articles on urban water is forthcoming in Water Policy  |

|                       |   |   |
|-----------------------|---|---|
| Output 1, indicator 4 | <ol style="list-style-type: none"> <li>1. Methodologies for assessment of critical moments developed and tested.</li> <li>2. 12 surveys / workshops conducted to identify critical moments and ATPs.</li> <li>3. Sector specific and spatially explicit quantification tool for ATPs and identification of hot spots in each basin developed.</li> <li>4. Two peer reviewed papers on CMs, ATPs, methods, tools and field realities.</li> <li>5. Mapping of ATPs in the four Study Basins and validation by stakeholders</li> </ol> | <p>Cumulative</p> <p>Five working papers (1 published, 4 in pipeline), three journal articles published</p>   |
| Output 1, indicator 5 | <ol style="list-style-type: none"> <li>1. Synthesis report on stakeholder driven and gender inclusive adaptation pathways.</li> <li>2. Eight stakeholder meetings on APs</li> <li>3. Three reports</li> <li>4. Two journal articles</li> </ol>  | <p>Cumulative</p> <p>Three peer reviewed journal articles published</p> <p>Four peer reviewed journal articles and two working papers in pipeline</p> |

(See Annex 3 for details on publications)

## Annexure 2: Master's Theses Details

| S. No | Student Name            | Thesis/ Dissertation Details   | Institute                                     | Year       |
|-------|-------------------------|--|---|------------|
| 1     | Maria Javed             | Hydrological Response to Climate Change on Soan River Catchment  | National University of Science and Technology | 2018       |
| 2     | Kripa Shrestha          | Landslide Risk Assessment of Chepe River Corridor, Gandaki River Basin, Nepal  | Tribhuvan University                          | 2018       |
| 3     | Sk. Junnun Al - Hussain | Identification of Drought and Flood Induced Critical Moments and Coping Strategies in Hazard Prone Lower Teesta River Basin                                | Rajshahi University                           | 2017       |
| 4     | Trinayana Kaushik       | Identification and Study of Impacts of Drying Springs in Devprayag, Uttarakhand: A Perception Analysis   | TERI University                               | 2017       |
| 5     | Subina Shrestha         | An Assessment of Potential Synergies and Conflicts in Climate Mitigation and Adaptation Policies of Nepal  | AIT Thailand                                  | 2017       |
| 6     | Prajwal Bhandari        | Gendered vulnerability in Irrigated Agriculture in the Context of Climate Change: A case study of Labdu Dikure Shera Irrigation system in Nuwakot District | Pokhara University                            | 2017       |
| 7     | Nithish Kanetkar        | Understanding the Governance of Micro and Mini Hydro Projects in Uttarakhand   | TERI University                               | 2017       |
| 8     | Krity Shrestha          | Irrigation System Governanace and Climate Change: Study of Panchakanya Irrigation System to Understand its Adaptive Capacity and Challenges                | Pokhara University                            | 2017       |
| 9     | Abha Nirula             | Assessment of Early Warning System for Floods in Uttarakhand: A Case Study Approach  | TERI University                               | 2017       |
| 10    | Yamini Yogya            | Understanding Livelihood Impacts of Climate Change in the Upper Ganga Basin: A Case Study Approach   | TERI University                               | 2017       |
| 11    | Shreya Trivedi          | Assessment of Socio-Economic and Livelihood Vulnerabilities and the Disaster Risks: A Study of Landslide Affected Areas of North and West Sikkim           | TERI University                               | 2017       |
| 12    | Vishaka Gulati,         | Understanding the Vulnerability of Rural Livelihoods of East and South Sikkim Across the Different Seasons   | TERI University                               | 2017       |
| 13    | Navin Rai               | Hydropower and Climate Variability: Issues of Adaptation in Upper Teesta Catchment   | Sikkim University                             | 2017 MPhil |
| 14    | Rashmita Sarkar         | Women and Water: Adaptation Practices to Climate Variability in the Sikkim Himalaya  | Sikkim University                             | 2017 MPhil |
| 15    | Ashmita Paudel          | Water Availability Under Climate Stress in a Hilly Settlement of Nepal: A Case Study from Tansen, Palpa  | Tribhuvan University                          | 2017       |

|    |                        |  |   |      |
|----|------------------------|--|---|------|
| 16 | Regan Sapkota          | Understanding Climate Change and Role of Community Forestry Governance in Climate Change Adaptation: Cases from Udipur, Lamjung  | Tribhuvan University                          | 2017 |
| 17 | Sijal Pokharel         | Linking Environmental Stress with Human Displacement: A Case of Belaspur Village, Nuwakot, Nepal   | Tribhuvan University                          | 2017 |
| 18 | Binod Prasad Parajuli  | Analysing Information Flow in Flood Risk Communication: A Case of Gandaki River Basin  | Tribhuvan University                          | 2017 |
| 19 | Sunam Pradhan          | Physical and Socio-economic Aspects of Farming in Irrigated Scenario in the Context of Climate Variability: A Case of Khageri Irrigation System in Chitwan, Lower-Gandaki Basin, Nepal | Tribhuvan University                          | 2017 |
| 20 | Zubair Hafeez          | Hydrological Response and Reservoir Operation Strategy under Climate Change – A Case Study of Simly Dam  | National University of Science and Technology | 2017 |
| 21 | Kashif Jamal           | Hydrological Response Under Climate Change of Hunza River Catchment- A Comparative Hydrological Modeling   | National University of Science and Technology | 2016 |
| 22 | Hammayun Zulfiqar Rana | Impact Assessment of Climate Change on Hydrological Response and Urban Flooding for Adaptation Strategies (Case of Lain Nullah, Pakistan)  | National University of Science and Technology | 2016 |
| 23 | Ganesh Gorti           | Understanding Differential Vulnerability to Climate Change: A Case Study Approach  | TERI University                               | 2015 |
| 24 | Sanjita Tamang         | Opportunities and Challenges for Livelihood Enhancement Through Aquaculture at Kulekhani Reservoir- Gender and Socio-Technical Perspectives  | Tribhuvan University                          | 2018 |

### Theses Under Review

|    |                       |  |                                    |               |
|----|-----------------------|--|------------------------------------|---------------|
| 25 | Bashudev Neupane      | Impacts of Land Use-Land Cover Change on basin hydrology and water availability in Marsyandgi River Basin          | Tribhuvan University               | 2018          |
| 26 | Razia Begum           | Quality comparison of drinking water sources in three mightiest mountain cities of Gilgit-Baltistan, Pakistan      | Karakoram International University | 2015          |
| 27 | Md. Abdullah-Al-Mamun | The Changing Pattern of Socio-Economic Condition and Climate Change Adaptation of Teesta River Basin of Bangladesh | Rajshahi University                | 2018<br>MPhil |
| 28 | Kribina Pathak        | Springs Water Status Study of Tansen Palpa   | Rajshahi University                | 2018          |

## Annexure 3: List of HI-AWARE Publications

### Peer reviewed Journal Articles

Rasul, G. (2015). Water for growth and development in the Ganges, Brahmaputra, and Meghna basins: an economic perspective. *International Journal of River Basin Management*, 5124 (March), 1–14. <http://doi.org/10.1080/15715124.2015.1012518>

Collier, E., & Immerzeel, W. W. (2015). High-resolution modeling of atmospheric dynamics in the Nepalese Himalayas. *Journal of Geophysical Research: Atmospheres*, 120(19), 9882–9896. <http://doi.org/10.1002/2015JD023266>.

Rasul, G., & Sharma, B. (2015). The nexus approach to water–energy–food security: an option for adaptation to climate change. *Climate Policy*, 16(6), 682–702. <http://doi.org/10.1080/14693062.2015.1029865>

Rasul, G., Hussain, A., Mahapatra, B., & Dangol, N. (2017). Food and Nutrition Security in the Hindu Kush Himalayan Region. *Journal of the Science of Food and Agriculture*.

Collier, E., Maussion, F., Nicholson, L. I., Mölg, T., Immerzeel, W. W., & Bush, A. B. G. (2015). Impact of debris cover on glacier ablation and atmosphere–glacier feedbacks in the Karakoram. *Cryosphere*, 9(4), 1617–1632. <http://doi.org/10.5194/tc-9-1617-2015>

Rasul, G. (2016). Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia. *Environmental Development*, 18, 14–25. <http://doi.org/10.1016/j.envdev.2015.12.001>

Dahri, Z. H., Ludwig, F., Moors, E., Ahmad, B., Khan, A., & Kabat, P. (2016). An appraisal of precipitation distribution in the high-altitude catchments of the Indus basin. *Science of the Total Environment*, 548-549, 289–306. <http://doi.org/10.1016/j.scitotenv.2016.01.001>

Bettini, G., Nash, S. L., & Gioli, G. (2016). One step forward, two steps back? The fading contours of (in) justice in competing discourses on climate migration. *The Geographical Journal*. <http://doi.org/10.1111/geoj.12192>

Biemans, H., Siderius, C., Mishra, A., & Ahmad, B. (2016). Crop-specific seasonal estimates of irrigation-water demand in South Asia. *Hydrology and Earth System Sciences*, 20(5), 1971–1982. <http://doi.org/10.5194/hess-20-1971-2016>

Lutz, A. F., ter Maat, H. W., Biemans, H., Shrestha, A. B., Wester, P., & Immerzeel, W. W. (2016). Selecting representative climate models for climate change impact studies: An advanced envelope-based selection approach. *International Journal of Climatology*. <http://doi.org/10.1002/joc.4608>

Thapa, B., Scott, C., Wester, P., & Varady, R. (2016). Towards characterizing the adaptive capacity of farmer-managed irrigation systems: learnings from Nepal. *Current Opinion in Environmental Sustainability*, 21(October), 37–44. <http://doi.org/10.1016/j.cosust.2016.10.005>

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## Annexure 4: List of Stakeholder Engagement Events

|            |  |  |
|------------|--|--|
| 4/30/2014  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Asia Launch of CARIAA  |
| 6/29/2014  | The Energy and Resources Institute (TERI)                                | Discussion for collaboration with Watershed Management Directorate of Uttarakhand state government   |
| 6/29/2014  | The Energy and Resources Institute (TERI)                                | FGD with communities and consultations with government officials in Uttarakhand have been conducted in Inception phase                                     |
| 7/5/2014   | The Energy and Resources Institute (TERI)                                | HI-AWARE field trip to Upper Ganga Basin - to understand one-the-ground realities and to interact with stakeholder and communities                         |
| 7/13/2014  | Bangladesh Centre for Advanced Studies (BCAS)                            | HI-AWARE field trip to Lower Teesta Basin  |
| 7/16/2014  | Bangladesh Centre for Advanced Studies (BCAS)                            | HI-AWARE Impact Pathways Workshop in Nilphamari, Bangladesh  |
| 7/17/2014  | Bangladesh Centre for Advanced Studies (BCAS)                            | Meeting with High Commission of Canada   |
| 7/18/2014  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | HI-AWARE Field Trip to Lower Teesta Region - To understand on-the-ground realities and to interact with stakeholders and communities                       |
| 7/29/2014  | The Energy and Resources Institute (TERI)                                | HI -AWARE Field Trip to Upper Teesta Region - to understand one-the-ground realities and to interact with stakeholder and communities                      |
| 8/28/2014  | The Energy and Resources Institute (TERI)                                | Workshop in Sikkim conducted in inception phase  |
| 9/4/2014   | Other  | HI-AWARE Science-Policy Dialogue - Outcomes of the HI-AWARE Inception Phase were presented to Nepali stakeholders, the Steering Committee and ICIMOD staff |
| 10/9/2014  | The Energy and Resources Institute (TERI)                                | International Consultation on Climate Change Adaptation in India and Africa  |
| 11/9/2014  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | International Conference on Mountain People adapting to Change   |
| 11/12/2014 | Innovation, Environnement, Développement Afrique (IED)                   | Methodology development for research components  |
| 11/22/2014 | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Cryosphere Monitoring  |
| 11/27/2014 | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | ICIMOD-Pakistan day  |

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| 12/17/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Meeting with Rajshahi University on HI-AWARE Master's Fellowship   |
| 12/22/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Consultation meeting with Bangladesh Water Development Board at Dimla, Nilphamari  |
| 12/22/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Consultation meeting with Bangladesh Water Development Board at Dimla, Nilphamari  |
| 12/22/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Community level consultation at Dimla, Nilphamari  |
| 12/23/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Community level consultation at Patgram, Lalmonirhat   |
| 12/24/2014 | Bangladesh Centre for Advanced Studies (BCAS)                            | Consultation meeting with Bangladesh Water Development Board at Rangpur  |
| 1/6/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Field Visit to Lower Indus, Chaj Doab, Pakistan  |
| 1/18/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with NGOs for Collaboration in Upper Ganga   |
| 2/2/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Field Visit to West Champaran District, Bihar, India (Lower Gandaki)   |
| 2/3/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Field Visit to the Teesta Region, Sikkim, Siliguri, Jalpaiguri (India)   |
| 2/9/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with HI-AWARE partners ICIMOD, TERI and local partners   |
| 2/10/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with Jalpaiguri Science and Nature Club  |
| 2/10/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with Ms Sumita Ghatak, In-charge of the Wildlife Division and Gorumara Wildlife Division, District Forest Office, Jalpaiguri |
| 2/10/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with Dr. P T Bhutia, Chief Conservator of Forests (CCF), West Bengal Forest Department                                       |
| 2/10/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Meeting with Dr. Subir Sarkar, Department of Geography at North Bengal University  |
| 3/9/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Second Field visits to Nuwakot for Situational Analysis  |
| 3/11/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead) | Field Visit to Chitwan (Flood Plain Area of Gandaki Basin) Nepal   |

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| 3/13/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | Meeting with Communication Officer, District Development Committee, Chitwan, Nepal   |
| 3/29/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | RC1 meeting on monitoring and climate scenario down-scaling  |
| 5/11/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | International Conference on HI-AWARE   |
| 5/25/2015  | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | The special session on 'Water and Mountains' convened by ICIMOD and the HI-AWARE consortium at the 15th World Water Congress held in Edinburgh, Scotland |
| 7/3/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | RC2 and RC4 Training   |
| 7/24/2015  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on "Installation of heat monitoring system including data loggers" by WUR, Netherland and PARC  |
| 8/11/2015  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on Project Monitoring and Evaluation: ICIMOD and PARC   |
| 9/3/2015   | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | Round Table on "The Agony of Rivers: Floods in Bihar"  |
| 9/7/2015   | Bangladesh Centre for Advanced Studies (BCAS)   | DECCMA HI-AWARE Joint Stakeholder Workshop   |
| 11/26/2015 | The Energy and Resources Institute (TERI)   member institution  | Workshop on 'Water Availability and Access in Mountain Areas of the Teesta Basin'  |
| 12/6/2015  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on solar- powered AC pumping system for deep tube wells   |
| 1/6/2016   | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | HI-AWARE Stakeholders Consultation Workshop in the Teesta Floodplain   |
| 1/7/2016   | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Community Consultation on the findings of Participatory Research   |
| 2/15/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | HI-AWARE stakeholders consultation workshop for the Gandaki Basin  |
| 2/23/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | HI-AWARE Annual meet and CCAPS 2016  |
| 2/27/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | HI-AWARE Academy   |

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| 3/2/2016   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Heat Management in the wave of Climate Change   |
| 3/4/2016   | The Energy and Resources Institute (TERI)   member institution  | State-level Consultations on "Adaptation to Climate Change in the Upper Ganga Basin" in Dehradun, India   |
| 3/11/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | "Farmer Managed Irrigation Systems (FMIS) at the Crossroads: Mapping Climate and Socio-Ecological Challenges"                                     |
| 3/29/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | Stakeholder Workshop on "Developing Criteria for Classifying and Assessing Climate Change Adaptation Options in the Gandaki River Basin"          |
| 4/6/2016   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Stakeholder Consultation Workshop of "Efficient Participatory Irrigation Institutions to Support Productive and Sustainable Agriculture"          |
| 4/27/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | Research into Use (RiU) Workshop in Dhunche, Rasuwa   |
| 5/30/2016  | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Seminar on "Monitoring of Urban Heat Coping Practices in Dhaka City" under HI-AWARE   |
| 5/31/2016  | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Community Consultation Workshops in Tepamodhupur Union of Kaunia, Rangpur   |
| 6/1/2016   | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Community Consultation Workshops in Balapara Union of Kaunia, Rangpur   |
| 6/2/2016   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | National Stakeholder Consultation Workshop for Prioritization on Adaptation and Mitigation  |
| 8/10/2016  | International Centre for Integrated Mountain Development (ICIMOD)   member institution                        | Adaptation to Climate Change Impacts in Gandaki River Basin of Nepal: Putting Research into Use   |
| 8/31/2016  | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Sharing the Findings of Situational Analysis of the Lower Teesta River Floodplains  |
| 11/9/2016  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Community Consultation Workshop on Climate Change Adaptation in Water, Agriculture and Energy Sector  |
| 11/10/2016 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Stakeholder Consultation Workshop on Climate Adaptations and their prioritizations in Water, Agriculture and Energy Sectors to Improve livelihood |
| 2/8/2017   | Bangladesh Centre for Advanced Studies (BCAS)   member institution  | Stakeholder Workshop on Flood and Climate Resilient Housing   |

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| 3/9/2017   | The Energy and Resources Institute (TERI)   member institution  | Challenges and opportunities for sustainability in agro-ecosystems in Sikkim"- Stakeholder consultation workshop   |
| 4/15/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training/workshop on olive and fruit plants cultivation  |
| 4/25/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on domestication and commercialization of medicinal plants for income generation  |
| 4/25/2017  | The Energy and Resources Institute (TERI)   member institution  | Heat Stress Management in Urban Areas (Case study of Delhi)  |
| 5/17/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training Workshop on Springshed Management in Indus Basin" By ICIMOD and PARC  |
| 6/14/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Solar Electrification of Buildings   |
| 8/23/2017  | The Energy and Resources Institute (TERI)   member institution  | Challenges on the Path towards a Lower Carbon Construction Industry  |
| 9/14/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Exposure Visit of participants of trainees of "Climate Change-Implications and Adaptations for Rural Areas" Organized by National Commission for Rural Development |
| 9/14/2017  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | National training on "Climate Change-Implications and Adaptations for Rural Areas" Organized jointly by NARC and National Commission for Rural Development (NCRD)  |
| 11/25/2017 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Farmers Field Day on Climate Smart Agriculture   |
| 1/31/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Farmers Field Day on Climate Smart Agriculture   |
| 2/15/2018  | The Energy and Resources Institute (TERI)   member institution  | The Third Pole- A melting pot of climate change threats and actions  |
| 2/25/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Media Briefing on "4th Climate Change Adaptation Policy and Science (CCAPS)  |
| 2/26/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | 4th Climate Change Adaptation Policy and Science (CCAPS) Conference  |



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| 2/28/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | HI-AWARE team interaction with Parliamentarian on climate change in HKH, Region  |
| 3/1/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | 4th Climate Change Adaptation Policy and Science (CCAPS)" participants visit to Pilot site   |
| 3/1/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | "4th Climate Change Adaptation Policy and Science (CCAPS)" participants visit to Chakri  |
| 4/3/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Media Exposure Visit of Climate Smart Agricultural Practices   |
| 4/3/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Media Exposure Visit of Climate Smart Agricultural Practices with High Efficient Irrigation System coupled with Renewable Energy                               |
| 4/17/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training of Gilgit Baltistan (GB) Government staff of International Fund for Agricultural Development (IFAD) project on establishing pilot sites in GB.        |
| 4/30/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Professional training on Climate Change and Disaster Risk Reduction By ICIMOD and PARC   |
| 5/4/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of CC & DRR training participants to Chakri  |
| 5/4/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of CC & DRR training participants to Chakri  |
| 5/16/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training of AJK district officers on solar water pumping, drip/sprinkler and greenhouse tunnels.   |
| 6/19/2018 | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | ICIMOD at Adaptation Futures 2018 Dialogues for Solution   |
| 8/8/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of China Science and technology and Lanzhou University delegates to HI-AWARE pilot site for future technical collaboration and pilot upscaling           |
| 8/26/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of Gansu Natural Energy Research Institute (UNIDO International Solar Energy Center for Technology Promotion and Transfer, China) to HI-AWARE pilot site |
| 8/27/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit by trainees of LEAD Pakistan   |

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| 8/27/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Summer School on Climate Change and Sustainable Water Management by LEAD and PARC  |
| 9/13/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | National training on climate change impacts on agriculture and its adaptations   |
| 9/21/2018 | International Centre for Integrated Mountain Development (ICIMOD) (Lead)                                      | 5th Climate Change Adaptation Policy and Science Conference  |
| 9/25/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Exposure visit of a Chinese delegate   |
| 9/25/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training workshop on Kitchen gardening   |
| 9/25/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Exposure visit of a Chinese delegate   |
| 9/25/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Exposure visit of a Chinese delegate for   |
| 9/26/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training workshop on Kitchen gardening   |
| 9/26/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of On Farm Water Management to Pilot site for its up-scaling in ha area  |
| 9/27/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training workshop on Kitchen gardening   |
| 9/27/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Consultative Workshop on Resilient Adaptations and Livelihood Improvement Interventions for Expansion of Quality Honey Production in the Country |
| 9/28/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training workshop on Kitchen gardening   |
| 10/2/2018 | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | 6th Climate Change Adaptation Policy and Science (CCAPS) Conference-Lessons, Achievements and Way Forward of HI-AWARE Project                    |

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| 10/3/2018   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | CCAPS Conference-Lessons, Achievements and Way Forward of HI-AWARE Project- Visit to HI-AWARE pilot sites in Chakri                                |
| 10/3/2018   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit of CCAPS Conference participants to HI-AWARE pilot sites in Chakri   |
| 10/4/2018   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on Climate Smart Agriculture for ICT/Rawalpindi farmers in collaboration with National Rural Support Program (NRSP)                       |
| 10/8/2018   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on Climate Smart Agriculture for farmers belonging to Chakwal district in collaboration with National Rural Support Program (NRSP)        |
| 10/9/2018   | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on Climate Smart Agriculture for farmers belonging to Attock district in collaboration with National Rural Support Program (NRSP)         |
| 10/10/2018  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Training on Climate Smart Agriculture for farmers belonging to Jhelum/ Pind Dadan Khan in collaboration with National Rural Support Program (NRSP) |
| 04/29/2016  | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Community Consultation and Engagement Workshop   |
| 05/27/2016. | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Farmers Field Day  |
| 2/4/2015    |   | Field visits to Nuwakot for Situational Analysis   |
| n.d.        | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | Visit by German Bank Officials at pilot sites  |
| n.d.        | Pakistan Agricultural Research Council (PARC), Climate Change, Alternate Energy and Water Resources Institute | KfW Senior Project Manager and team visited the Chakri pilot site.   |

## Annexure 5: List of Media Outputs

### Blogs

Hussain, A. (2015, February 12). Climate Change in Downstream Areas of the Indus River Basin [Blog post]. Retrieved from <http://hi-aware.org/climate-change-in-downstream-areas-of-the-indus-river-basin/>

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