HI-AWARE Internal Report

Citizen-driven Science Climate Adaptation Ateliers - CISCAAs

Consortium members

About HI-AWARE Research Report

This work of the Himalayan Adaptation, Water and Resilience (HI-AWARE) consortium under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) with financial support from the UK Government's Department for International Development and the International Development Research Centre, Ottawa, Canada. CARIAA aims to build the resilience of vulnerable populations and their livelihoods in three climate change hot spots in Africa and Asia. The programme supports collaborative research to inform adaptation policy and practice.

HI-AWARE aims to enhance the adaptive capacities and climate resilience of the poor and vulnerable women, men, and children living in the mountains and flood plains of the Indus, Ganges, and Brahmaputra river basins. It seeks to do this through the development of robust evidence to inform people-centred and gender-inclusive climate change adaptation policies and practices for improving livelihoods.

The HI-AWARE consortium is led by the International Centre for Integrated Mountain Development (ICIMOD). The other consortium members are the Bangladesh Centre for Advanced Studies (BCAS), The Energy and Resources Institute (TERI), the Climate Change, Alternative Energy, and Water Resources Institute of the Pakistan Agricultural Research Council (CAEWRI-PARC) and Wageningen Environmental Research (Alterra). For more details see www.hi-aware.org.

Titles in this series are intended to share initial findings and lessons from research studies commissioned by HI-AWARE. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the HI-AWARE consortium, they have only undergone an internal review process.

Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication.

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Acknowledgements

This work was carried out by the Himalayan Adaptation, Water and Resilience (HI-AWARE) consortium under the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) with financial support from the UK Government's Department for International Development and the International Development Research Centre, Ottawa, Canada.

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

Kathmandu, Nepal, October 2018

Published by

HI-AWARE Consortium Secretariat
Himalayan Adaptation, Water and Resilience (HI-AWARE) Research
c/o ICIMOD
GPO Box 3226, Kathmandu, Nepal

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Citation: Siderius, C., Uddin, N., Singh, P., Virk, Z., Syed, A., Bhadwal, S., Ahmad, B., Groot, A. (2018) Citizen-driven Science Climate Adaptation Ateliers - CISCAAs. Kathmandu: HI-AWARE

Contents

Summary

This note describes the aims, background and set-up of Citizens-driven Science on Climate Adaptation (CISCAAs). A CISCAAs is a site, mostly village/urban neighbourhood, where adaptation practices and approaches are observed in a real life situations, involving the local community.

Nine CISCAAs were installed in three countries; Pakistan, India and Bangladesh. The main mode of data collection was done through automatic weather stations. Of these nine sites, three were situated in an urban setting, supporting work on better understanding heat stress in cities, while six were situated in rural areas, with data used in a farming context.

In the HI-AWARE project, a modest level of interaction with citizens (urban and rural based) was achieved, mainly through discussion of weather patterns and related actions. Further levels of interaction could be facilitated – as mentioned by involved citizens - by linking weather observations with soil moisture measurements, or with improved multi-day weather forecasts. Within the lifetime of HI-AWARE this was not achievable, but the data collection continuous.

1. Creating robust evidence on the effectiveness and applicability of adaptation practices

HI-AWARE's goal was to create robust evidence on the effectiveness and applicability of adaptation practices. The establishment of ateliers for Citizens-driven Science on Climate Adaptation (CISCAAs) contributes to this goal. A CISCAAs is a site, mostly village/urban neighbourhood, where adaptation practices and approaches are observed in a real life situations, involving the local community. CISCAAs will help monitor site-specific coping and adaptation practices, adding detail to stakeholder consultations or literature study. Such monitoring can address a variety of practices like climate-smart agriculture, resilient housing, improving drinking water quality and smart local energy grids.

In the CISCAAs, a process of participatory data collection and processing with regard to adaptation practices is linked with science driven testing (the pilots) and modelling. Work by the World Resources Institute (Spearman and McGray, 2011) describes lessons on the use of M&E for adaptation including a) defining adaptation success requires consideration of the context in which adaptation activities occur; b) a diversity of inputs - including information and participants - contributes to successful adaptation M&E systems , and c) tracking assumptions is an important component of M&E systems for adaptation, in order to contend with the uncertainties associated with climate change. More interaction and exchange among data collectors, model developers, and end-users/decision makers may lead to a rich two-way learning process, which may yield to quicker model development, adaptation and resilience. People-centred 'climate ateliers' (often also called 'observatory labs') align well with recent insights in monitoring for adaptation and monitoring of adaptation.

Aims of the CISCAA approach:

- To help create robust evidence (i.e. better understand local coping practices, add detail and context to existing knowledge); by gaining insight into effectiveness and feasibility of piloted adaptation measures (e.g. linking performance /effects of adaptation measures to weather data and fore/nowcasting)
- To involve the local community (and get their commitment. Not only take, but also give information[1]);
- To contribute, if only in a limited way, to increased resilience.

Through a CISCAA we aimed to monitor the effectiveness of adaptation measures and the environmental context in which measures are applied.

HI-AWARE has established 9 CISCAAs in the study areas where during the lifetime of the project evidence is collect on the different practices and strategies of local stakeholders. There is no fixed, one-style approach for setting up a CISCAA. CISCAAs fit in the trend of moving research from laboratories and controlled test sites into the real-life situations, e.g. farmer's fields. In the next paragraph several examples from different projects are briefly described. What these have in common is the concept of participatory monitoring, in real life situations, resulting in a form of knowledge co-creation (see also figure 1). A partnership between local community and researchers is established and a (semi) continuous presence of researchers and medium to long-term involvement required.

Participatory monitoring and knowledge co-creation can address a variety of societal issues, environmental problems and measures. Next to climate or weather related impacts, other environmental issues like pollution due to sanitation, groundwater quality or soil fertility, have often high priority. Within the context of a research project, bounded by time and money, there is often need to focus. Ideally, such a focus should be derived through an open stakeholder process. In practice, the focus is partly determined by project goals. Since HI-AWARE targets adaptation to climate change, the participatory monitoring is mainly related to those environmental issue and those measures having a direct link to climate and weather, or an indirect link, to ecosystem services, e.g. water availability.

CISCAAs and Pilots

In HI-AWARE both Pilots[1] and CISCAAs are being initiated. While they share characteristics, they are also different in their conceptual approach to doing research. Pilots can be considered as a science-driven approach, aimed at testing a specific technology or measure, or combination of technologies, in a real life situation. A pilot is designed primarily by researchers, with a contribution from local stakeholders through. CISCAAs is a bottom up approach, strongly involving the local community in the design and monitoring of environmental problems and measures that can help cope with these problems. Researchers provide input, but work together with the local community. This type of monitoring could be considered to be a more bottom-up approach to knowledge creation. CISCAAs and pilots, however, are not exclusive. In HI-AWARE, CISCAAs and pilots are established alongside each other. Interaction with the local community is important for both. Basic equipment like the automatic weather stations can be shared.

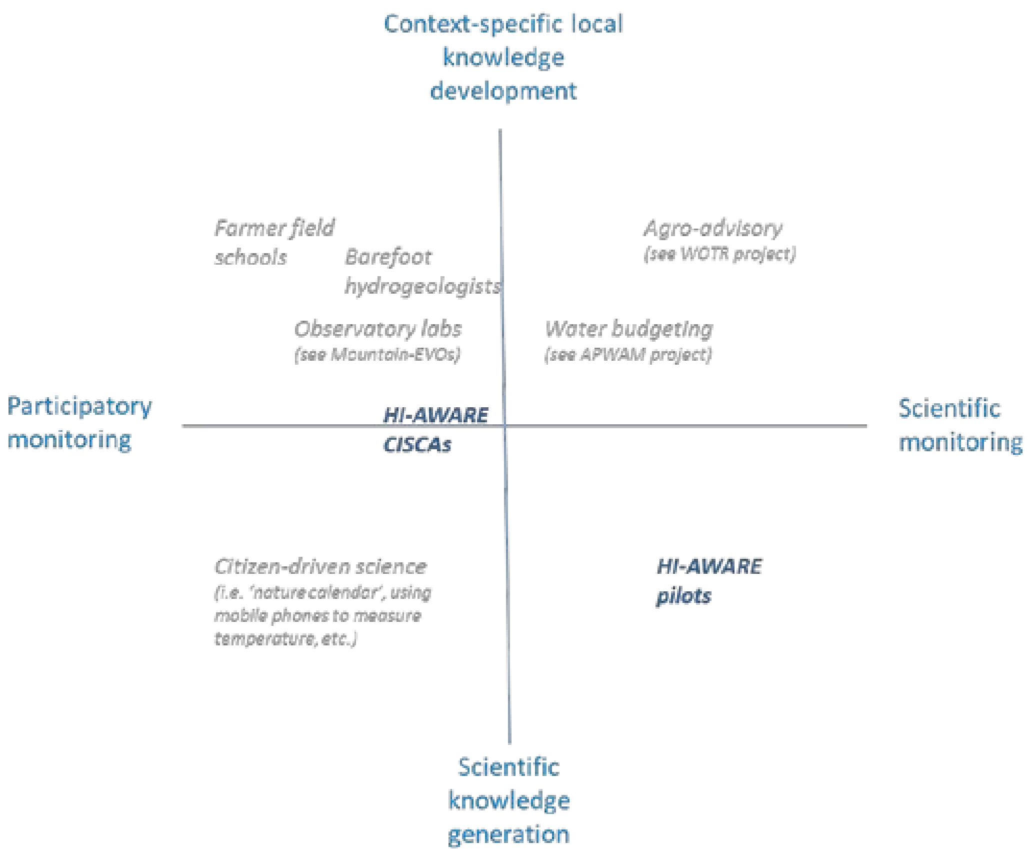

Figure 1: Dimensions of field research and the position of HI-AWARE's CISCAAs and Pilots (note: illustrative and open for discussion. Many more projects can be added. No single quadrant is better than the other)

[1] Three pilots have been defined, on climate smart agricultural practices (a.o. solar powered irrigation) on, flood-proof housing and on small hydropower. Not officially a pilot according to the tasks and deliverables, but an activity that can be considered as a pilot as well is the heat stress and adaptation campaign.

Citizen-driven, participatory and/or action research

Citizen science can be simply classified as the involvement of volunteers in research. "A citizen scientist is a volunteer who collects and/or processes data as part of a scientific enquiry." (Dickinson et al., 2010; Silvertown, 2009). This could be seen as a participatory approach, though participatory research is often associated with research that involves those who have a direct stake in the research and could shape the research, e.g. being farmers that might benefit from a certain new technology or management regime and/or could help improve the research itself. In the case of citizen science 'volunteers', such a stake in the output is likely to be much more indirect; e.g. citizens observing rainfall or, say, birds. The benefit is in e.g. the joy of observing or in contributing to protect something felt important.

In recent years the concept has increasingly been linked to large-scale data collection, made possible because of i. the existence of easily available technical tools (internet, smartphones) for disseminating information about projects and gathering data from the public, ii. the increasing realisation among professional scientists that the public represent a free source of labour, skills, computational power and even finance and iii. of the condition to undertake project-related science outreach (Silvertown, 2009).

Bonney et al. (2009) add a further dimension to a citizen science project: "Most citizen science projects also strive to help participants learn about the organisms they are observing and to experience the process by which scientific investigations are conducted." Bäckstrand (2003) gives a further reasons for such approaches; "Civic science is used interchangeably with participatory, citizen, stakeholder and democratic science, which are all catch words that signify various attempts to increase public participation in the production and use of scientific knowledge. Three rationales for civic science are identified: restoring public trust in science, re-orienting science towards coping with the complexity of environmental problems and installing democratic governance of science."

In HI-AWARE we lean towards the participatory side of citizen-driven science[4], with people having a direct stake rather than using random volunteers and without explicitly planning to use internet or smartphones to collect massive amounts of data from or via citizens.

[4] Other related terminology: PRA (participatory Rural Appraisal) Chambers, R., 1994. The origins and practice of participatory rural appraisal. World development, 22(7): 953-969.; Collaborative action research (e.g Termeer et al); PAR (Participatory Action Research).

2. Examples

The concept of participatory monitoring, or knowledge co-creation, is not a new concept and has been explored in various research projects in the past years. Here, three examples from the region, in the agriculture, climate and water domain, are briefly discussed.

Mountain-EVO – Environmental Virtual Observatories

The mountain-EVO project adopts the concept of Environmental Virtual Observatories (EVOs) (Buytaert et al., 2014; Karpouzoglou et al., 2016). The potential of EVOs is to be decentralised and open technology platforms for knowledge generation and exchange that enable participation of marginalised and vulnerable communities bypassed by the traditional mechanisms. In this project it will analysed how EVOs can be used to generate knowledge and to alleviate poverty in 4 remote and poor mountain regions: the Ethiopian highlands around Lake Tana, the Central Tien Shan Mountains of Kyrgyzstan, the Kaligandaki watershed in Northern Nepal, and the Andes of central Peru.

In each location, evidence will be collected on the local decision-making processes on ecosystem services and their local socio-economic context. At the same time, a technology toolset to enable EVO development for each case is being developed. Subsequently, the results of both processes are brought together to implement tailored EVOs to support citizen science and local knowledge generation.

The project aims to create novel ways to interact with EVOs focussing on leaflets in the national language, community radios, and mobile phone applications. It will evaluate how the improved access to local observations fosters cross-scale linkages between the poor and external actors, as well as linkages between communities and marginal groups. Lastly, it will investigate how this can lead to better community awareness of environmental change and identification of pathways for poverty alleviation.

Reference: Buytaert et al. (2014). Citizen science in hydrology and water resources: opportunities for knowledge generation, ecosystem service management, and sustainable development. Frontiers in Earth Science 2:26

WoTR – community Agro-advisories

WOTR is an Indian NGO specialised in watershed development. As part of Climate Change Adaptation project WOTR has installed 69 Automated Weather Stations (AWS) in project villages. The Indian Meteorological Department (IMD provides WOTR with 3-day weather forecasts for the project area, received online, on a daily basis. Unusual likely weather events such as unseasonal rain, frost or temperature spikes are conveyed directly to the villages either through word-of-mouth, SMSs or a phone call to key informants in the project villages. Besides this, the weather information obtained from the village based AWSs is displayed daily on black boards at accessible places in the village, by village youth who have been trained to read the weather data. This helps inform farmers to actual local weather conditions and alerts them to likely problems that may arise for their farms and livestock.

Based on these short-term local weather forecasts, agricultural experts from WOTR prepare agro-advisories with inputs from CRIDA and the state agricultural university, the MPKV, with whom WOTR has a knowledge sharing collaboration. These advisories, that are crop and locale-specific, include integrated nutrient-water-pest-and diseases management recommendations that stress organic and environmentally sustainable interventions. These advisories are issued in the local language at least twice a week in the summer months and more frequently during the agricultural season, as required, thus alerting farmers and giving them enough time to implement suggested measures. These advisories are disseminated through SMSs to mobile phones, Wallpapers that are put up at prominent places in the project villages and by word-of-mouth.

At regular intervals, meetings are organized with farmers to discuss these advisories and get their feedback. In addition to developing and disseminating "regular" crop advisories, crop-weather-related Contingency Plans for specific crops are prepared which will be operationalised before and during the Kharif and Rabi seasons. This helps farmers better respond to unexpected weather event (like delayed onset of rains, dry spells, pest attack, etc), mitigate risks and reduce losses. www.wotr.org

APWAM – local performance monitoring

To evaluate conjunctive use in a tank irrigation site Alterra developed an approach to match water demand with supply using low-cost and low-maintenance performance monitoring techniques. Using such techniques, farmers and WUA members could themselves do the monitoring, requiring only limited guidance from external agricultural extension workers or irrigation experts.

The performance monitoring was primarily based on a crop-specific water budgeting method: for each cropping season, the actual volume of water supplied was compared with crop water requirements. Based on this comparison, land and water use strategies could be adapted in the subsequent cropping season. The cycle was repeated for several consecutive years, which improved farmers' insight into their resource use and generated an overall insight into the effectiveness of the various improvements in the tank irrigation system.

This integration of performance monitoring of land and water use to support conjunctive use, combined with a range of technical innovations in a participatory setting, is called 'improved conjunctive use'. Actual water supplied was monitored from three sources: effective rainfall, tank water and groundwater. Effective rain within the command area, i.e. the amount of rain actually benefitting crop growth, i.e. not contributing to runoff or seepage, was calculated from total monthly rainfall.

Improved tank rehabilitation requires little additional investment compared to traditional tank rehabilitation with its exclusive focus on technical interventions. One prerequisite is the availability of a local organization that can share required knowledge on crop-specific irrigation water requirements and water supply monitoring with WUAs. In the APWAM project the regional office of a State university fulfilled this role.

Reference

C, Siderius., et al. 2015. 'Climate-smart tank irrigation; a multi-year analysis of conjunctive water use under high rainfall variability'. Agricultural Water Management.

3. HI-AWARE Approach

The HI-AWARE project builds on ongoing research by individual project partners, using previous experiences and insights from others. CISCAAs are part of the broader stakeholder process within the project. Within the CISCAAs the effectiveness, usefulness, acceptability etc. of different measures is monitored.

Through installation of standard automatic weather stations (AWS), variability and extremes in weather can be monitored. Meteorological data, like rainfall, humidity and wind speed are instantly available for the local community; the stations have consoles that can be placed within the village. In addition, simple agro-advisory indicators can be provided, of interest to stakeholders or of use for evaluating any measures. Next, AWS data could be supplemented with forecasts from the meteorological department. Based on stakeholder's needs and suggestions further monitoring could be designed: flow from mountain streams, radiation and the efficiency of solar or hydropower. Concluding, one could distinguish several levels of interaction linked to different 'ambition levels' in developing the CISCAAs:

1. MODEST: AWS are installed and local weather data provides context to stakeholder discussions, observed local adaptive practices and any pilots, e.g. providing insight in the local effectiveness of solar powered irrigation by observations of radiation (efficiency) and rainfall patterns and related water needs (effectiveness). Findings are discussed with stakeholders. (CISCAA = AWS + process)

2. ENTHOUSIASTIC: interaction on weather and its variability leads to further discussions on various coping strategies and critical moments. Interaction will have a frequency of at least twice a year (after every cropping season). During these meetings local coping strategies to deal with weather variability and availability of water resources are discussed. In several locations, interaction might lead to the development and exchange of other indicators based on weather observations, including forecasts and indicators like cumulative rainfall over the cropping season, soil water stress, expected extreme rainfall). Insights from CISCAAs help to better understand the local context of adaptation, i.e. will provide context to stakeholder discussions, observed local adaptive practices and any pilots. (CISCAA = process + AWS)

3. AMBITIOUS: weather monitoring is a catalyst for further monitoring, which will be designed together with local stakeholders. Possible examples are a more detailed soil moisture monitoring using low costs materials, linked to the forecasting, or the observation of availability and quality of drinking water from springs and wells using basic equipment to understand during which periods there is a lack of proper drinking water. In the urban heat stress sites, different coping strategies as suggested by the local community, like covering the roofs with cloths or sleeping on the roof, could be monitored e.g. with the handheld device. Interaction is frequent and demand based rather than planned. See also ANNEXI (CISCAA = process with a flexible design)

The choice for the ambition level depends on several factors:

1. Stakeholder interest (are main issues related to the focus areas of the project, and does monitoring address their direct needs?);
2. Partner interest and capacity (have we or our local partners staff who is interested in various types of monitoring, are there activities in the sites which can be linked, is the equipment which can easily be deployed);
3. Available budget (and, related, staff and travel time);
4. Links with other project activities such as PhD research projects;
5. Project duration – it is very interesting to monitor responses to varying conditions over the year, but we will have to report within the lifetime of the project.

In HI-AWARE, we have aimed for the 'modest' level, while setting up the CISCAs, keeping open opportunities to be more ambitious in follow-up projects. The CISCAAs were meant to be an integral part of the HI-AWARE project, not a separate activity. The capacity building and periodic forums can be integrated in the existing stakeholder process. A better understanding of local weather conditions (through time series of various meteorological parameters like precipitation, radiation, temperature, wind speed, humidity) will help in assessing the robustness of different local coping strategies or adaptation practices (ANNEX I).

Figure 2: CISCAA cycle: determine current practices and critical moments - observe and measure - verify against longer term climate data and scenarios - improve decision making.

4. Location & Equipment

Locations

- Indus (Pakistan): 2 rural, 1 urban
- Upper Ganga (India): 3 rural, 1 urban
- Teesta (Bangladesh: 1 rural, 1 urban

In this document we will mainly describe the rural CISCAAs. The use of the urban AWS is described in several publications (e.g. Singh et al., forthcoming and Jacobs et al., forthcoming)

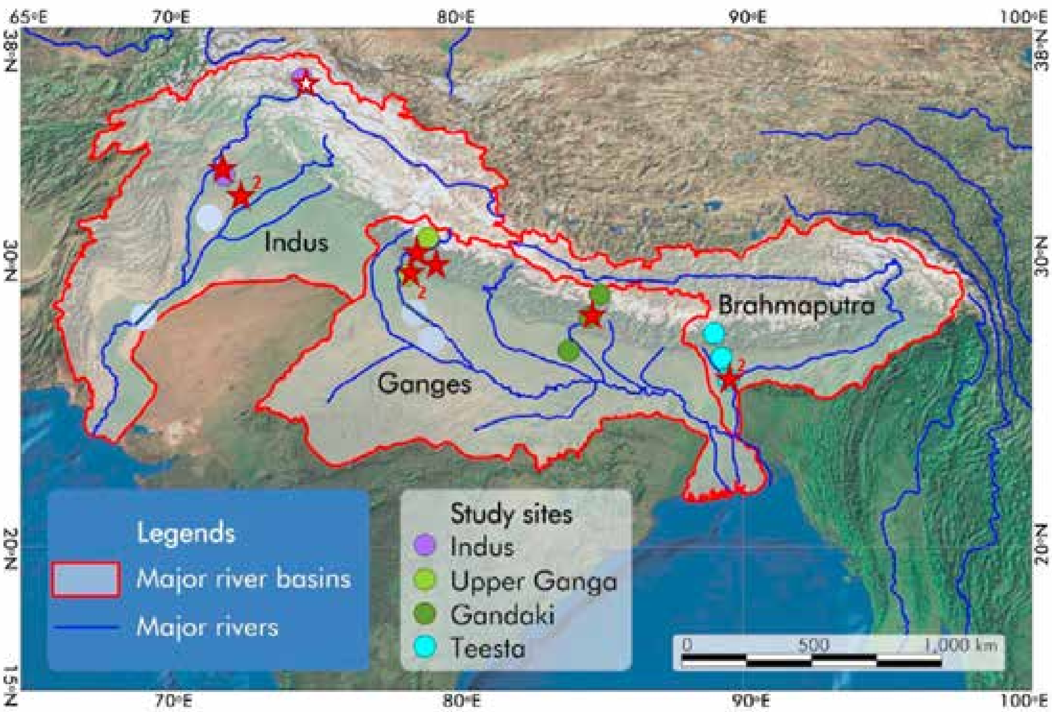

Figure 3: CISCAA locations within the HI-AWARE case study sites and target basins

Automatic Weather station (Davis Pro[5])

- Wireless Vantage Pro2™ ISS with Pyranometer & Daytime Fan-Aspirated Radiation Shield $ 650
- Vantage Connect® for Wireless Systems
- Service plan 60 minutes interval
- Mounting pole for Vantage Connect
- Vantage Pro2™ Console/Receiver

Measures wind speed, rain, temperature, humidity and solar irradiance (and 4 x soil moisture, 4 x soil temperature)

Figure 4: Davis automatic weather station with receiver

5. Implementation

Pakistan - CISCAA 1

Location

The first weather station under CISCAA was installed at HI-AWARE Pilot site at Sandhu Farm, Soroba Chakree. The name of the station is "HI-AWARE Pilot Site (Chakree) AWS". The station is located at Latitude: 33.31242 and Longitude: 72.82725.

Local Owner

The local owner of the weather station is Mr. Aman Sandhu, owner of the Sandhu Farm – HI-AWARE Pilot site. Mr. Sandhu has been trained by the PARC team to read and interpret weather information from the console available at pilot site.

Details of AWS

The AWS was installed on 28th October 2016 and collected the data for the entire year for the period of its subscription i.e. 28th October 2017. After the end of subscription the weather station was relocated at secure, fenced location on the pilot site. The station is collecting data about parameters like, rainfall, temperature, humidity, solar radiation, solar incidence, wind speed and direction, and evapotranspiration, in real time and this information is being relayed to the console. The official name of the station on the weather link network is "HI-AWARE Pilot Site (Chakree) AWS".

Location Aim

The station was installed at HI-AWARE Pilot site in Chakree, keeping in view the following aims and objectives;

- The HI-AWARE pilot site in Chakree is the main piloting site under HI-AWARE Pakistan. It serves as training and learning site for local farmers, students, professional and practitioners etc. The site has implemented nearly all the climate smart interventions relevant for the Food-Energy-Water Nexus approach and climate change adaptation in the area. These interventions rely on specific information regarding weather and climate parameters at the site. For example for installation of the fixed solar pumping systems or the design of the portable solar pumping system, the angle of solar incidence, total sunshine hours and total solar power (watt/sqm) etc. were important parameters which can only be accessed through data received from the automatic weather station.

- The Sandhu Farm is located at the confluence of three villages in the Chakree area and villagers from all three villages (Gang, Gahi Syedan, Soroba) can easily access weather forecasts from the farm for timings of their cultivation and harvest.
- The station serves many research activities at the pilot site where researchers use data from the station to include climate information in their research trials.

- Weather information and forecasts from the AWS have proved useful to strengthen the network of AWS in the Rawalpindi District

AWS Uses

The AWS has served following purposes so far;

- Weather Forecasting information for local farmers in the adjacent villages of the Pilot site.
- Climate Data for experimental trials of mungbean, peanuts, wheat and maize crops being administered by MARC research team.
- Humidity and evapotranspiration data for cucumber, bitter gourd cultivation in tunnels.
- Station functioning and parameters explained in trainings and exposure visits to students, practitioners, and professionals.
- Solar Energy data used in design of Poratble Solar Water Pumping System, and Installation of Fixed Solar Pumping Systems at the Pilot Site.

Problems Encountered

Following problems were encountered while installing/operating the AWS;

- The site remained under development for at least 2 years since its inception, the weather station had to be relocated to a secure location.
- Periodic maintenance is required for the weather station due to the busy nature of the learning site.

Future Options

A plan to include the Chakree AWS in the national grid is under process. Pakistan Meteorological Department has shown interest to include this station in the national grid.

Pakistan - CISCAA 2

Location

The second weather station was installed at Mountain Agriculture Research Centre (MARC) located at Juglote/ Gilgit, Gilgit Baltistan, Pakistan. The name of the station is "MARC Juglote Station". The station is located at Latitude: 35.68246 and Longitude: 74.62953.

Local Owner

The weather station is located within the premises of MARC and is owned by MARC which is subsidiary research centre of PARC. The resource person for the station is Mr. Arshad Afridi who is a Scientific Officer at MARC and has been trained in handling the AWS.

Details of AWS

The AWS was installed and made operational on 20th August 2017. It was properly installed in fenced enclosure and has been functioning normally since installation. The station is monitoring weather and climate parameters such as temperature, rainfall, pressure, relative humidity, solar radiation, solar incidence, wind speed and direction and evapotranspiration. The official name of the station is MARC Juglote Station

Location Aim

The station was installed at MARC site keeping in view the following aims and objectives;

- The network of weather stations in northern mountainous areas of the Indus Basin is scanty and reliable local information and forecast is of utmost importance for framers and orchard owners. Since MARC is holds significant authority for issuing agricultural information to the farmers regarding sowing or harvesting times, and information regarding pest attacks it made sense to bolster the advisory services of MARC with weather and climate information.
- MARC is located a central location near KKH and can give representative weather/climate information in the area.
- The station serves many research activities at MARC where researchers use data from the station to include climate information in their research trials.
- Weather information and forecasts from the AWS could be relayed to the provincial meteorological department.
- The data collected form the station would prove useful for filling the gap in the climate datasets of Upper Indus Basin

AWS Uses

The AWS has served following purposes so far;

- Weather Forecasting information for local farmers in the adjacent villages of MARC
- Climate Data for experimental trials of potato and pulses crops being administered by MARC research team
- Forecasting information for harvest of wheat at MARC
- Station functioning and parameters explained in Trainings and exposure visits to students of Karakoram International University
- Climate Data for 6 months used in HI-AWARE supported research on "Conservation of Indigenous Medicinal Plants (Aconitum Heterophyllum (Patris or Blue Lavender) in Northern Areas of Pakistan

Problems Encountered

Following problems were encountered while installing/operating the AWS;

- The console provided with the weather station was a wired model instead of wireless model, therefore the resource person had to manually collect for immediate uses.
- The cellular connection in the area is generally weak, so data is usually being collected in catch up mode.

Future Options

The AWS at MARC can act as the first step towards improved data collection from the Upper Indus Basin. More AWS systems will be installed in Astore and Gilgit valley to augment the data collection and strengthen the weather observation network in the upper Indus basin

India – CISCAA 1 to 4

AWS details

Location	Station Name	Device ID	Installation Date	Latitude	Longitude
TERI School of Advanced Studies, New Delhi, India	hiawaredelhi	001D0AF1123B	April 1, 2016	28.5447	77.1474
Hee Bermiok, West Sikkim, India	hiawaresikkim	001D0AF1122B	March 29, 2017	27.2531	88.2208
Hudu, Rudraparayag, Uttarakhand, India	hiawareuk	001D0AF1124E	May 2, 2017	30.5035	79.1501
Singtham, Gangtok, Sikkim, India	hiawaregangtok	001D0AF1124F	July 15, 2017	27.2867	88.6199

TERI School of Advanced Studies, New Delhi, India

Hee Bermiok, West Sikkim, India

Hudu, Rudraparayag, Uttarakhand, India

Singtum, Gangtok, Sikkim, India

Objective

- Gathering local weather information at the Pilot and the study sites
- Provide weather information to the farmers and local communities
- Awareness though demonstrating the use of weather information for agricultural planning and related weather services
- Use of weather information data into ongoing adaptation research activitie

Use of AWS

- Weather forecast and current weather condition is used by the communities for their daily activities but it is only limited to temperature information to make decisions on whether they send their children to school or not in Sikkim site. They also see AWS as a value addition in their tourism hospitality business.
- At Huddu, Uttarakhand the AWS is installed at the pilot intervention site and data is being collected to correlate with crops grown etc.
- AWS based at TERI – SAS, New Delhi is used largely by students for their project work and is purely for scientific analysis of climate data

Challenges

- AWS doesn't provide the information related to soil moisture which is an important parameter for agricultural planning. Therefore, the use of AWS is very limited in its application
- The in-built 24 hour forecast does not provide enough time for planning
- Farmers need weather forecast with a week lag time which at present is not possible through single station and limits the wider acceptance by the community
- Periodic maintenance is a major challenge as the stations are in remote areas where the accessibility is an issue.

Exit Strategy

- It is planned to transfer the AWS to the local research institutes in all the sites
- AWS installed in New Delhi will be transferred to TERI-SAS and the formalities have been completed.

Bangladesh - CISCAA 1

Location

The first weather station of HI-AWARE project was installed at Bangladesh Meterilogical Department premise at Dhaka. The name of the station is "HI-AWARE Pilot Site (BMD) AWS". The station is located at Latitude: 23.766667 and Longitude: 90.383333.

Local Owner

The local owner of the weather station is forecast division of BMD. Mr. Mizanur Rahman has been trained by the BMD and BCAS team to read and interpret weather information from the console available at pilot site.

Details of AWS

The AWS was installed on 28th October 2016 and collected the data for the entire year for the period of its inception. The station is collecting data about parameters like, rainfall, temperature, humidity, solar radiation, solar incidence, wind speed and direction, and evapotranspiration, in real time. The official name of the station is "HI-AWARE Pilot Site (BMD) AWS".

Location Aim

The station was installed at HI-AWARE Pilot site in Dhaka, keeping in view the following aims and objectives;

- The HI-AWARE pilot site in Dhaka is the main piloting site under HI-AWARE Bangladesh to monitor the outdoor heat exposure. It serves as training and learning site for local farmers, students, professional and practitioners etc.
- The station serves many research activities at the pilot site where researchers use data from the station to include climate information in their research works.
- Weather information and forecasts from the AWS have proved useful to strengthen the network of AWS in the Dhaka.
- The weather information of HI-AWARE AWS will be cheeked with other observatories like JICA and BMD also.

AWS Uses

The AWS has served following purposes so far;

- Outdoor heat index monitoring in Dhaka and forecast weather information for local people.
- Climate Data for experimental trials of crops being administered by BMD research team.
- Station functioning and parameters explained in trainings and exposure visits to students, practitioners, and professionals.

Future Options

A plan to include the HI-AWARE AWS in the national grid is under process. Bangladesh Meteorological Department has shown interest to include this station in their main data stream soon. In the view of data transfer and use, BCAS has an AMU with BMD in this regards.

Bangladesh - CISCAA 2

Location

The HI-AWARE project contributed to the GeoPotato project (http://geopotato.com/) in accordance with the project support policies of Bangladesh Centre for Advanced Studies (BCAS). The second weather station of HI-AWARE project was installed at Gajaria sub district of Munshiganj district as GeoPotato study site in Bangladesh. The station name is GeopotatoAWS5. The latitude, longitude and elevation of the stations are 23.453, 90.469 and 6m respectively.

Local Owner

The weather station is located in the potato field of Munshiganj and is locally supported by the depertment of Agricultural Extension (DAE), Govt of Bangaldesh. The research team of BCAS and Bangladesh Agricultural

Information Services (AIS) mainly maintains the station. The resource person for the station is Mr. Toufiq who is an Agricultural officer of DAE, GoB and has been trained in handling and monitoring the AWS.

Details of AWS

The AWS was installed and made operational on April 17, 2018. It was properly installed in fenced enclosure and has been functioning normally since installation. The station is monitoring weather and climate parameters such as temperature, rainfall, pressure, relative humidity, solar radiation, solar incidence, wind speed and direction and evapotranspiration. The official name of the station is GeoPotatoAWS5

Location Aim

The station was installed at potato field site keeping in view the following aims and objectives;

- The network of weather stations in Megna river areas of Munshiganj is capturing the micro climate and forecast is of utmost importance for potato framers and owners.
- The station is located a central location massive potato growing area and can give representative weather/climate information in the area.
- The station serves many research activities and data will be transferred soon to Bangladesh Meteorological Department (BMD) data stream.
- Generate the early warning on potato late blight from weather information could be the better production of potato yield in Munshiganj.
- BMD have no meteorological observatories in Munshiganj so the station would prove useful for filling the gap in the climate datasets of this subdistrict of Bangladesh.

AWS Uses

The AWS has served following purposes so far;

- Weather Forecasting information for local potato farmers in Munshiganj
- Late blight early warning in potato for optimal spree in field at study area
- Station functioning and parameters explained in Trainings and exposure visits to agricultural officer/stuff of Government of Bangladesh.

Problems Encountered

Following problems were encountered while installing/operating the AWS;

- The console provided with the weather station was a wired model instead of wireless model, therefore the resource person had to manually collect for immediate uses.
- The cellular connection in the area is generally weak, so data is usually being collected in catch up mode.

Future Options

The Munshiganj district occupying 6 subdistrct but we have only two AWS for providing weather early warning. More AWS systems can be installed in other sub district to augment the data collection and strengthen the weather observation network in the highest potato growing area in Bangladesh.

6. Conclusions

HI-AWARE's goal was to create robust evidence on the effectiveness and applicability of adaptation practices. In total, 9 CISCAAs were initiated under HI-AWARE. A CISCAAs is a site, mostly village/urban neighbourhood, where adaptation practices and approaches are observed in a real life situations, involving the local community. In HI-AWARE, a project focussed on climate (and change), the CISCAAs were organised around the automatic weather stations that were installed under the project.

Interaction with the (farming) community and other stakeholders varied from site to site, with extensive interactions taking place in the field sites in Pakistan, and more modest use of data and information in India. In Bangladesh the automatic weather station contributed to data collection and discussions from another project on potato growing.

More time is needed for the CISCAAs initiated under HI-AWARE to become fully functioning and useful. A project of 5 years, with an effective implementation period of three years - if one leaves out the start-up phase and final reporting period - is too short for CISCAAs to fully develop. The installation of equipment took time, and procedures for exchange of information had to be established. Most of the CISCAAs will be maintained in one form or the other, through different projects or core funding. A main lesson is to start the CISCAA process earlier in the project, to make most use of the information it generates and exchange it facilitates.

Finally, inclusion of soil moisture measurements, to translate weather parameters to crop water availability, and of multi-day forecasting, i.e. the link to national meteorological institutes, is essential to make the information the automatic weather station generates more useful.

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Annex 1

HI-AWARE Initial brainstorm (Dhulikhel, 2015) about potential parameters that could be observed, could be observed and those local communities would like to see observed. The sectors of Agriculture and Water, Health, Energy and Housing/Floods were addressed.

GROUP: AGRICULTURE AND WATER

<table>
<tr><td>What are we observing? How?</td><td>Observations (Measurable)
Soil moisture,
Soil types
Soil temperature
Air temperature
Rainfall
Humidity
Irrigation (metering)
Crop types and crop stages (how long it takes for each stage)
Monitor weather forecasts with observed data
Depth of water table (underground water used for irrigation)
Calculated
"Water stress"
Pest attacks</td></tr>
<tr><td>What would local communities want us to observe?</td><td>Soil fertility
Water stress
Rainfall (forecasts)
Advance information on pests and diseases
Weather and climate services – including forecasts/warnings
Market information (when to sell and where to maximize profits)
Crop scheduling (agriculture calendar)</td></tr>
<tr><td>Common methodology (learn from partners)</td><td>Potential experiments
Water for irrigation (solar pump, rainwater harvesting, etc)
Link up with local NGOs who are already doing pilots
Soil management
Pest management</td></tr>
</table>

GROUP: HEALTH

What are we observing? How?	• Heat stress >> measuring temperature gradients between cities and rural area, outside and inside households. Composition of the house hold is important to look at (age, gender, jobs etc.) Come up with 'climate proof' qualities of houses. Air pollution is linked to heat in cities. If heat rises, air pollution also increases. • Focus on three study areas (measurements), one in B'desh, one India, one Pakistan, in the low planes from rural to urban. • To measure with equipment: temperature, humidity, wind, radiation. Daily logs. Indoor and outdoor. • To measure with questionnaires: experiences of stake holders (how did they sleep etc.). • Water quality issues >> measure water quality but how to link this to adaptation measures. Nobody is aware of adaptation measures are already taken. Solutions: household water treatment. Difficult to link to CC because of many variables • Water quantities >> women are often responsible for gathering water resources
What would local communities want us to observe?	• Adaptation: come up with 'climate proof' measures for houses >> where is the house coolest. Paint (cooling down), windows, green roofs. Unknown how farmers adapt to cc at the moment >> first observe, then measure. • Not only look at human heat stress but also livestock. Outside cases in countryside might be interesting for farmers.
Common methodology (learn from partners)	• Focus on narrow scope and do that good; heat stress. • No control group; but periods when no heat stress is present can be some sort of control. • No definition on heat stress linked to health: differences in experience depending on where people live: Mountain people are possibly more sensitive for high temperatures because they are not accustomed. • Need for health information to link to heat stress parameters. Sources: hospitals (respiratory or other issues), WHO (Delhi office) and perhaps health insurance companies. • Cities to research: India Dehli, Sidepur, Gorukpur, Rhotak, Gurapur, might be cities to research. B'Desh: Dhaka, Gulna. Pakistan: Islamabad. All case studies still need to be decided.

GROUP: FLOOD

<table>
<tr><td>What are we observing? How?</td><td>

Types of Flood	What is being observed	Countries
Flash floods	Warning is done at a short span	Nepal, India and Pakistan
Glacial Lake Outburst Flood	Warning is difficult (UNDP\NDMA is doing some project)	Nepal, India and Pakistan
Riverine flood	Proper monitoring is done, EWS is ok	Bangladesh, India, Nepal, Pakistan

- Pakistan – Glof and Flash flood - Goal of measurement is to be used in modelling for regional climate model
- Nepal - Monitoring upstream will provide information downstream – innovation could come from the linkage between upstream and downstream – communication between people so that lives are saved in time of flood
- Bangladesh – Riverine flood in teesta due to barrage is opened – need a dialogue between WB and BD.

</td></tr>
<tr><td>What would local communities want us to observe?</td><td>

- BD- floods have effect on many sectors – agriculture, health, migration, river bank erosion etc – how to get rid of these problems, communities wants to know the early warning to take precautionary measures – flood forecasting-
- ICIMOD's model for early warning system
- How long the flood is going to remain (duration, extent, depth) – extent of damage and relief

</td></tr>
<tr><td>Common methodology (learn from partners)</td><td>

- Bcas – experimented methods on early warning
- Governance structure within the village of how the information is going to be translated – capacity for responding, resources and awareness to adopt
- Kosi \HYCOS project of ICIMOD – flood information system – to be set up at community level
- Site selection for flooding is an issue – literature or stakeholders consultation – flood atlas,
- (upper ganga, kosi, Teesta)

What we want to observe – adaptation option taken by people – How do people cope with floods – what are the adaptation options – flood risk management options are in place, disaster management programs are functioning, observation is what people are doing? What people are doing and how is this effective? It is important to observe those options –

Ramesh – riverine flood – more structure measure is needed, early warning systems do not protect the farm – farm is barren for 4-5 years, structural measures are required for floods – watershed management helps a lot but it is difficult to communicate. Integrated flood management is something to be piloted.

</td></tr>
</table>

GROUP: ENERGY

What are we observing? How?	**Energy measures to observe could be:**
	• Energy for improved individual / household level energy access for lighting
	• Energy for improved community resilience e.g. micro hydro
	• Energy for clean drinking water – pumping? Filtering? (improved quality of life, gender, health)
	• Energy for cooking for improved indoor air quality, time saving and gender equity (e.g. rice cooker example from Vietnam)
	• Energy for enhanced agricultural livelihoods – solar and wind for irrigation pumpsets
	• Energy for diversified livelihoods – e.g. micro hydro for agro processing
	  • Focus on renewables (solar, wind, small hydropower, biomass)
	• Energy sources which pollute less
	• To meet the gap of conventional energy – esp. in hills
	  • Not biomass burning?
	  • Not large hydropower?
	RE pumpsets example
	• Incident solar radiation
	• Efficiency of solar cell
	• Tracking the sun through the day
	• Angle of solar panels
	• Efficiency of pump
	• Discharge of irrigation pumpset
	• Income of farmer in different seasons / "critical moments"
	Participatory management example
	• Institutional arrangements (e.g. ownership type)
	• Financial arrangements (e.g. subsidy)
	Micro hydro example
	• Stream flow
	• Hydraulic head
	Additional comments:
	We have to find an existing example of energy adaptation (e.g. PARC wind pumpsets, participatory governance/management of energy resources)

What would local communities want us to observe?	• Outcomes and effectiveness of intervention (e.g. increased agricultural production, drinking water available) • Benefits, experiences from other places • Livelihood impact (income) • How much influence / control they have on their energy security (e.g. can they change angle of panels?, costs) • Reliability • Corruption
Common methodology (learn from partners)	Question from the group: Going from observatory lab to pilot testing / intervention

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