

Workshop Proceedings

# Training Workshop on Springshed Management in HKH Region

17-19 May 2017, NARC, Islamabad



Consortium members



ICIMOD



## About HI-AWARE

The Himalayan Adaptation, Water and Resilience (HI-AWARE) Research Consortium conducts research and pilot interventions, capacity building and policy engagement to enhance the climate resilience and adaptive capacity of poor and vulnerable people living in the mountains, hills and flood plains of the Indus, Upper Ganga, Gandaki and Teesta river basins in Pakistan, India, Nepal and Bangladesh.

HI-AWARE aims to influence policy and practice to aid the climate resilience and adaptation of poor and vulnerable populations in the region by generating evidence based knowledge on geophysical, socioeconomic, gender and governance drivers and conditions leading to climate vulnerability, as well as monitoring and assessing adaptation measures. It focuses on identifying 'critical moments' when communities are most vulnerable to climate risks, 'adaptation turning points' when existing adaptation strategies no longer work, and "adaptation pathways", sequences of policy actions that address both short-term responses to climate change and longer term planning. It looks at strengthening the expertise of researchers, students and science-practice-policy networks to conduct as well as use research on climate/ social vulnerabilities, resilience, and adaptation.

HI-AWARE comprises of five consortium members: The International Centre for Integrated Mountain Development (ICIMOD), the Bangladesh Centre for Advanced Studies (BCAS), Pakistan Agricultural Research Council (PARC), The Energy and Resources Institute (TERI)-India, and Alterra-Wageningen University and Research Centre (Alterra-WUR).

## Acknowledgement

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17-19 May 2017, NARC, Islamabad

**Organized by:**

Himalayan Adaptation, Water and Resilience Research (HI-AWARE), Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), and Climate Change, Alternate Energy & Water Resources Institute (CAEWRI), National Agriculture Research Centre (NARC). Islamabad

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# Acknowledgements

We are indebted to HI-AWARE team in ICIMOD, Yousaf Zafar (Chairman of PARC), Munir Ahmad (Member Natural Resource Division), and Omer Farooq (Member Social Sciences Division) for gracing this workshop with their valuable insight and comments.

## Executive Summary

The Climate Change, Alternate Energy and Water Resources Institute (CAEWRI) of the Pakistan Agriculture Research Council (PARC) in collaboration with the International Centre for Integrated Mountain Development (ICIMOD) conducted a training workshop on spring water resources of Pakistan at Islamabad from 17-19 May 2017. The three-day workshop aimed to bring more visibility to research on springs in Pakistan, share ICIMOD's methodology and approaches for springshed management, enhance institutional capacity in implementing a common methodology for springshed management, and understanding springs in relation to hydrogeology and groundwater. Researchers from national institutions such as the Global Change Impact Studies Centre (GCISC), LEAD Pakistan, and the Pakistan Council of Research in Water Resources (PCRWR) participated in this event and shared their experiences through discussion and dialogue.

The workshop was inaugurated by the Director-General, National Agriculture Research Centre (NARC), Mohammad Azeem Khan, and was followed by presentations from Bashir Ahmad, Nawraj Pradhan, and Salar Saeed on the springshed management initiative by HI-AWARE in Pakistan.

The second day of the workshop was a technical session in which Nawraj Pradhan from ICIMOD familiarized the workshop participants with an eight-step methodology for springshed management developed by ICIMOD and its partners. He elaborated the significance of each step through plenaries and group work.

The last day of the training workshop was dedicated to a field visit to the village of Pir Sohawa in the Margalla Hills, where information on springshed management was shared with the participants, who included researchers, practitioners, from various fields and organizations. (See Annex 3 for the List of Participants)

# 1. Introduction

The Hindu Kush Himalayas (HKH) are the source of countless perennial rivers, which originate from glaciers, but it is the springs that sustain the lives of millions of people inhabiting the hills and mountains there. Water scarcity is expected to be a major challenge for most of the region due to increased water demand and lack of good management.

There are several studies and reviews of the present status of knowledge of water resources in the Himalayas, these studies have indicated that there are a number of studies covering the Himalayan Rivers and glaciers, but springs and streams are relatively under-studied. Springs and their significance for water security in the Himalayas remain poorly understood, as do the livelihood implications of changes in these springs. Moreover, springs are generally overlooked in matters of administration and conservation. In recent times, the concept of 'springshed' management is gaining significance and could add value and an important dimension to conventional 'watershed' management approaches.

Springs are a part of groundwater systems, and the science of hydrogeology that governs the occurrence and movement of groundwater and aquifers is not well developed understood. This often results in misconceptions about springs, which exacerbates the problem. Springs are also part of complex socio-technical and informal governance systems and have a strong linkage with gender and equity as well as the availability of water.

In the Himalayan region, natural springs and their sustainable development are not given due importance at both policy and practice levels, even though they play a critical role in water security. To develop innovative solutions towards sustainable management of these traditional water sources, there are large gaps in data and understanding that must be filled first. There is also a need to raise awareness among relevant policy and decision makers, and to develop skills and share knowledge on this critical topic with field practitioners and community members.

ICIMOD, together with partners in the region, is engaged in the promotion of awareness and capacity building to protect and develop springshed across the Himalayas. In collaboration with the HI-AVARE team of the Pakistan Agricultural Research Council (PARC), ICIMOD organized a three-day awareness building and training workshop on Springshed Management in the HKH Region in Islamabad, Pakistan, on 17-19 May 2017.

## Objectives of the workshop:

PARC brought together key stakeholders (from the Ministry of Environment, NGOs, Civil Societies, etc.) from all over Pakistan linked to water resources and springshed management for this training.

### These were the key objectives of the workshop:

1. Bring more visibility and outreach to research on Himalayan springs, and their management.
2. Share ICIMOD's 'Eight-Step Methodology' and its experiences in implementing this approach.
3. Enhance institutional capacity in implementing a common methodology of springshed development and management in the HKH region.
4. Characterize springs on the basis of nature, type and discharge, and expound on its links to hydrogeology and groundwater of the locality.



### Outcomes of the training:

1. The workshop enhanced earlier understanding of springs and contributed to capacity building among partners.
2. A common methodology and approaches for springshed management were finalized.
3. Action plans and a way forward for springs management were given a final shape.

# Highlights of the Opening Session

## Plenaries and Presentations

Scientists, researchers, and experts in the field of water resources, natural sciences, and social sciences gathered at the Social Sciences Research Institute of the National Agriculture Research Centre (NARC) to shed light on spring water resources in Pakistan and various management issues in this domain. The session started with the recitation of verses from the Holy Quran by Qari Hafiz Javed.

**The Director-General of NARC, Muhammad Azeem Khan,** gave a warm welcome to all the participants. He stated that springshed management is a new concept that calls for attention, because springs should be considered an important water resource in Pakistan. Due to frequent earthquakes since 2005 many springs have changed their course and are showing some dynamics in the availability of water too. Therefore, developing an inventory of springs and assessing the availability of water there throughout the year will be an important contribution to the area of water development and management.



**Munir Ahmad, Director of the Climate Change, Alternate Energy, and Water Resources Institute (CAEWRI),** gave an overview of the institute and its experiences in water management in the country. He talked about the overall water availability situation in Pakistan as also about food security and the challenges people are facing in these areas. He observed that, for Pakistan, water availability is a major concern and inadequate utilization of water resources results in problems like shrinking command area, lack of development of mini-dams, and less efficient irrigation systems.

Due to climate change, temperature rises of 0.6-1 °C and a decrease of 10-15% in rainfall have been observed. At present, the main challenge is to enhance food production with limited water availability. There is a dire need to develop strategies for sustainable agriculture in the various agro-ecological zones of Pakistan.



**Bashir Ahmad, Principal Investigator HI-AWARE**, gave a brief about the initiative. It is a regional project that comprises five implementing partners: the International Centre for Integrated Mountain Development (ICIMOD), the Bangladesh Centre for Advanced Studies (BCAS), the Pakistan Agricultural Research Council (PARC), The Energy and Resources Institute (TERI) in India, and the Alterra-Wageningen University and Research Centre (Alterra-WUR) in The Netherlands.

He further spoke of changing climate scenarios and HI-AWARE's strategies to address this situation in three study areas of Pakistan. He outlined the progress of the project so far with respect to various technical studies and piloting activities in different study areas across the Indus Basin.

Then he explained HI-AWARE's climate smart technology package, which includes technologies and interventions in various sectors such as agriculture, energy, and water as also informed decision making. Some of the climate-smart interventions he talked about, were the introduction of fixed and portable solar pumping systems in the Soan basin (a study area in the Indus Basin), crop diversification, use of high efficiency irrigation systems, and installation of temperature and weather monitoring systems in the Soan basin and Chaj Doab study areas.



**Nawraj Pradhan** highlighted the significance of springs and springshed management in the HKH. He mentioned ICIMOD's experiences in other springshed initiatives across the Himalayas. He pointed out there is sufficient research on Himalayan glaciers, rivers, and snow, but when it comes to lakes, springs, and streams, there is hardly any data or research - apart from anecdotal knowledge.

The science of springs is not yet well developed, particularly in relation with precipitation and discharge patterns. Also, when spring sources dry up, water supply systems become dysfunctional. So, revival of springs is an important concern, and interventions need to be planned keeping in view hydrogeology status, land use changes, and climate elements.

**Omer Farooq, Member Social Sciences Division (SSD) of PARC,**

appreciated that an important issue had been taken on board. He said it is the responsibility of social scientists to evaluate critically the cost associated with shifting conventional means of food production to modern ways. Food security has a direct relation with water availability. According to the previous Census, 20 million acres are available for cultivation. This implies that half an acre per person is available to ensure food availability. He added that harnessing non-conventional water resources to ensure food security would be an important step in adapting to global developments such as the increase in population and climate change.



**Munir Ahmad, Member Natural Resources Division (NRD) of**

**PARC,** gave his views about the presentations delivered earlier in the session. He commented that the potential of renewable energy for Pakistan is vast and that water availability is one of the main factors governing agricultural productivity. He appreciated that Bashir Ahmad and his team had pointed out that studies on springshed management have not yet been conducted in Pakistan and need to be focused on more in future. He also applauded the initiative taken by Nawraj Pradhan to impart knowledge about ICIMOD's approach to springshed management in the HKH region.

**Vote of Thanks**

Munir Ahmad, Director CAEWRI, thanked all guests, particularly Abdul Wahid, Jasra Country Director ICIMOD, Mohammad Azeem Khan, DG NARC, Munir Ahmad, Member NRD, and Omer Farooq, Member SSD. He also gave special thanks to the Media Teams of NARC and PARC, all engineers, social scientists, researchers, and the HI-AWARE team.



# Highlights of the Technical Session

## Significance of springs in Pakistan (Salar Saeed)

- **Salar Saeed, GIS/RS Analyst at HI-AWARE and study lead for springshed management in Pakistan**, gave a presentation on the significance of springs in the HKH region of the country.
- Key points from the presentation are:
  - The HKH region, although a source of countless perennial rivers and streams, harbours a substantial number of mountain communities which are largely dependent on spring water for their sustenance.
  - Springs play an important role in the daily lives of these communities.
  - They serve as main sources of drinking water for people and livestock, and are used for irrigation as well, especially during the dry months from December to February.
  - The current study is aiming to:
    - Develop a better understanding of the hydrogeology prevalent in the mid-hills of Pakistan
    - Evaluate the impact of climate change on water quantity and quality
    - Comprehend the relationship between precipitation, groundwater recharge, and spring discharge.
  - Essential steps required for spring management are mapping, setting up monitoring systems, understanding social and governance aspects, and learning about the study sites.
  - Tehsil Murree in district Rawalpindi and tehsil Gojal in district Hunza have been selected for the springshed management study.
  - Water samples will be collected from these springs and the water quality will be assessed.
  - The water samples are to be collected during and after the monsoon to understand discharge during peak and dry seasons.



**Nawraj Pradhan** introduced the eight-step methodology for springshed management.

Key points from his presentation are:

- Groundwater policies have been inadequate so far in the hill regions of South-Asia (in Pakistan, India, Nepal, Bangladesh);
- There is an urgent need to understand trends in precipitation, infiltration of water, geology and groundwater movement and aquifers systems;
- The basic purpose of installing a data-monitoring system is to monitor springs' discharge, aquifer systems, and also to take awareness to the local people;
- Different types of springs exist across the HKH region. These may include but are not limited to contact springs, karst springs, depression springs, and fracture springs.



**Eight-Step Methodology for Springshed Management** (Source: ICIMOD 2016)

## Key Discussions points:

- Questions were raised on the social and governance aspects of springshed management. ICIMOD and its partners have developed a series of social surveys and focus group discussion formats to that effect;
- Unplanned development and land use changes without understanding aquifer systems have added to the severity of problem;
- Attention to linkages with the trends in rainfall patterns changing from long monsoon spells to erratic downpours, and how this impacts aquifers or groundwater recharge.

## Reviving springs; An Eight-Step Methodology (Nawraj Pradhan)

Key steps of the methodology is given below:

- The first step is to collect background information of the identified area. This is done through a reconnaissance survey that includes identifying issues, delineating springshed boundaries, comprehensive mapping of springs and springsheds, and community involvement for resource mapping. The expected outputs are data about types of springs and rock structure as also the creation of a base map;
- The second step is setting up a data monitoring system, which includes data collection, storage, and analysis, and its dissemination to the community. It is also important to analyse the present institutions and governance system. Tools are a questionnaire survey, focused group discussions, key informant interviews, and dialogues with community members and policy makers;
- This is followed by hydrogeological mapping and creating a conceptual layout of springsheds;
- Further steps consist of classifying spring types, developing spring management protocols, and measuring the impact of spring revival.

A springshed approach differs from a watershed approach in that it takes into account not just a 'ridge to valley' but rather a 'valley to valley' approach. Information on the types of springs (perennial or seasonal), dependency and the usage of these springs, and also the underlying geology is crucial for reviving springs.

ICIMOD as a regional platform is facilitating in applying a common methodology across the HKH, enabling data collection and sharing, building capacity through training of various stakeholders (local and national), connecting spring managers and practitioners across the HKH in a network, and designing a toolkit for the implementation of strategies for springshed management.

## Key Discussions and Group work

The following key points were derived from the interactive session after the eight-step presentation:

- Characterization of the type of springs that exist at a certain location helps to understand the aquifer systems in that landscape;
- The storage and transmission functions of an aquifer significantly depend on the underlying geology and rock types;
- Springs may also vary in their appearance, which is regulated by the type of discharge it displays - for example, a high-discharge spring could be linked to limestone geology;
- The current study on springs in Murree is focusing on springs identified through topographical sheets. Now, ground reconnaissance surveys are being conducted to verify their actual existence;



- It is recommended to extend the water quality analysis by including water pollution measurement, because spring water can be a source of many toxic chemicals;
- Identification of springs via the Global Positioning System (GPS) was discussed. Also a mechanism was talked over to develop an inventory of springs by assigning alphanumeric codes for each spring at target locations.

Later, participants were divided into two groups to have a discussion about the research sites, i.e. Murree and Hunza. The key points that came up, are:

- What instruments will be required for monitoring and how will springs be selected for regular monitoring;
- A data collector will be identified and appointed who will be trained to get rainfall and discharge measurements;
- Measuring discharge data bimonthly and rainfall data daily is required, for it can give a near to exact situation of the selected springs;
- For the water tower selection two tools were proposed: focus group discussions with partners and data-based criteria development;
- Springs with a high dependency of population should be selected for monitoring;
- The drinking water quality of a spring should not be ignored;
- It should be remembered that perceptions of water may be totally different among women, men, and children.



**Group work:**

Discussion about the research sites and selection criteria for springs





# Highlights from the Field Trip

## Field Trip to Pir Sohawa, Islamabad (19 May 2017)

The field trip to Pir Sohawa was facilitated by CAEWRI, NARC. Pir Sohawa is a small village located in the Margalla Hills on the outskirts of Islamabad. The village houses a population of nearly 40 households and approximately 200 people.

The aim of the field visit was to provide the workshop participants a general idea of springshed management on the ground.

The following specific objectives were achieved during the field visit:

- Involve the community in a dialogue on the importance of springs and their management;
- Gain knowledge about rocks and topographical features of an area;
- Understand hydrogeology and recharge areas of springs;
- Get familiar with instruments used in monitoring discharge data, rainfall, and climatic conditions and processes involved in inventorying these data sets;



Spring Source in Pir-Sohawa



Discharge outlet for community use

## Key Observations

- The village faces constant water scarcity issues, since the discharge from their spring is limited, barely meeting their requirements;
- Interestingly, locals report that the water from the spring, though limited, had never stopped, thus characterizing it as a perennial spring;
- Locals believe that the appearance of the spring was the result of the prayers of a famous saint, 'Bari-Imam', who used to reside and meditate in these hills;

- The spring appeared to hold high religious and spiritual importance to the villagers, who believe that water from the spring has healing qualities for skin and gastric problems;
- There were many grievances and complaints from community members regarding the nonchalant attitude of the local administration to water issues. Villagers were particularly aggrieved by the fact that a restaurant just uphill from their village had installed a tube well pump on their property, which had significantly reduced the discharge of the spring;
- A key strategy to address their water issues, identified by villagers, was the construction of a permanent storage tank at the outlet of the spring (which happened to be the base of an old tree);
- A good amount of willingness was observed among the local people to co-operate with the workshop participants and PARC's research team. Community leaders were ready to implement the springshed management methodology in their village in collaboration with PARC.



Conducting key - informant interview for trainees in progress at the spring study area

Focus Group Discussion by the PARC Springshed Team



# Closing Session

Closing Remarks by Chairman PARC

**Yousaf Zafar T.I, Chairman of the Pakistan Agricultural Research Council,** expressed his delight at being a part of this important workshop on springshed management. These are his key remarks:

- Water is a primary life-giving resource, and its availability is an essential component in socio-economic development and poverty reduction, but unfortunately we take this resource for granted.
- One of the biggest off-shoots of climate change is how to ensure water security. The water crisis is one of the most critical issues for Pakistan, as the country stands 17th in the list of water-stressed countries.
- Per capita water availability in Pakistan is decreasing each year and there future predictions anticipate water shortage. This would pose a serious threat to future water scenario of the country.
- The dependence of Pakistan on a single river basin, i.e. the Indus, leaves it in a weak position in contrast to most surrounding countries, which enjoy a multiplicity of river basins and diversity of water resources. In such alarming conditions, harnessing of non-conventional water sources such as spring water can play a vital role in sustaining livelihoods of vulnerable communities settled in the hilly and mountainous areas of the country.
- This workshop has laid an important foundation for strengthening individual capacities in the field of water management, especially springshed management. Rapid uptake of this fruitful information is expected.
- This excellent start and collaboration should continue, if we are to meet the needs of water security in Pakistan as well as the Sustainable Development Goals.



# Conclusion

The session concluded with the distribution of certificates to the participants. Nawraj Pradhan summarized the learning from the workshop in these key points:

- Springs are an important resource in the HKH region. Its significance should not be undermined, as mountain communities are dependent on this resource.
- Collaborative efforts are required to mainstream springshed management in government policies and priorities.
- Stakeholders should work together for the conservation of these resources and take up community-based management strategies for this purpose.
- ICIMOD's eight-step methodology can be a useful tool to implement springshed management in the HKH region of Pakistan.

# Annex 1: Stakeholder Engagement Report

## Purpose of the event:

The purpose of the workshop was to share a methodology for springshed development and management that has been developed by ICIMOD in collaboration with its partner institutions, and to enhance institutional capacity in implementing this common methodology in the HKH region.

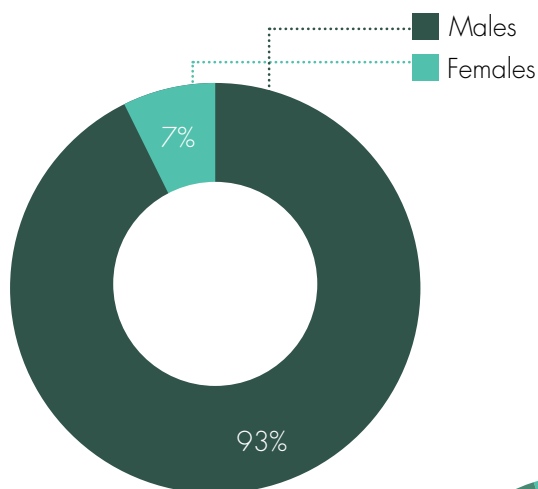
Contribution to HI-AWARE results:

The workshop was in the context of HI-AWARE research component RC3 and it highlighted the importance of springs as significant water resources. It gave a detailed insight about the various steps required in springshed management and how the process can be initiated at community level.

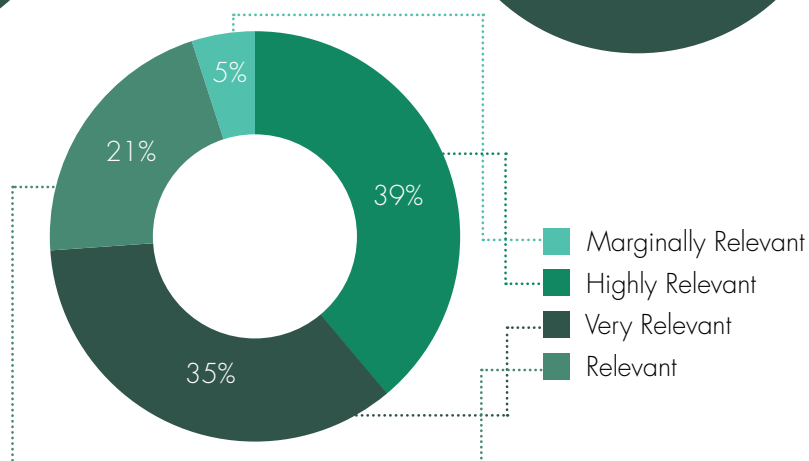
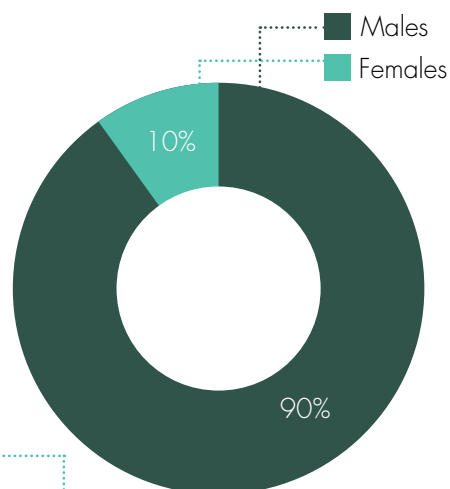
## Event Statistics

Participants										
Disaggregated by gender			Participation for 1 <sup>st</sup> time			Relevance of the event to your work				
Men	Women	Total	Men	Women	Total	01	02	03	04	05
40	03	43	19	02	21	-	02	09	15	17

Participant Segregation by Gender



First time Preparation



Segregation by Relevance

## Annex 2: Programme Schedule

Day 1: 17 May 2017	
12:00 – 12:30	Significance of Springs in Pakistan context and Role of HI-AWARE Project Bashir Ahmad, Salar Saeed, CAEWRI, NARC, Islamabad.
12:30 – 01:00	Significance of Springs in the HKH context and Role of HI-AWARE Project Nawraj Pradhan
01:00 – 02:00	Lunch Break
02:00 – 03:00	Introduction to ICIMOD's & partners' methodology and approaches for springshed management  Step 1-8 (Springshed Management)  Nawraj Pradhan
03:00 – 03:30	Group Discussions
Day 2: 18 May 2017	
09:00 – 10:30	Step 1: Comprehensive mapping of springs and springshed  Reconnaissance survey, spring mapping, data gathering, and delineation of springshed – with examples from the field  Step 2: Setting up a data monitoring system  Data collection, storage, retrieval, and analysis – simplified examples from rainfall and spring discharge data sets  Nawraj Pradhan, Salar Saeed, Aizaz Ahmad
	Tea Break

10:30 – 12:30	<p>Step 3: Understanding social and governance aspects of springs</p> <p>Introduction to socio-economic PRA tools: FGD, KII and questionnaire survey</p> <p>Step 4: Hydrogeological mapping</p> <p>Geology – basic mapping at local scales – understanding dip and strike of water bearing openings + integrating geological mapping with hydrogeological concepts</p> <p>Building local awareness &amp; training local communities and para hydro-geologists?</p> <p>Using community manuals and approaches</p> <p>Nawraj Pradhan, Aizaz Ahmad</p>
12:30 – 01:30	Lunch Break
01:30 – 02:30	<p>Springshed Management Research into Use</p> <p>Nawraj Pradhan</p>
02:30 – 03:30	<p>Finalization of Plans (Data collection and methodologies)</p> <p>Nawraj Pradhan, Bashir Ahmad, Naveed Mustafa</p>
Day 3: 19 May 2017	
08:00 – 09:00	Departure for field (Pir Sohawa)
09:00 – 10:30	Field Work/FGD
10:30 – 11:00	Working Tea
11:00 – 01:00	Field Work/FGD
01:00 – 02:00	Lunch
02:00 – 03:00	Field Work
03:00 – 04:00	Return to Islamabad



## Annex 3: List of Participants

S.No	Name	Designation	Department/Organization
1	Rashid Mehmood	Director	Honey Bee Research Institute (HBRI), PARC
2	Irum Raza	Scientific Officer	Social Sciences Research Institute
3	M. Khubab	Assistant Professor	Bahria University
4	Shamimul Subtain	Director	Farm Operations and Services (FO&S), PARC
5	Bashir Ahmed	PI (HI-AWARE)	Climate Change Alternate Energy and Water Resources Institute (CAEWRI), PARC
6	Pervez Khalid	Principal Scientific Officer	Planning and Research Management Committee (PRMC), PARC
7	Ghulam Shabir Mirza	Principal Scientific Officer	PARC
8	Bilal Khalid	Programme Leader	LEAD Pakistan
9	Khalid Farooq	Director	Agriculture Poly-Technic? Institute (API)
10	Rana Naveed Mustafa	Senior Scientific Officer	CAEWRI, PARC
11	Adnan Shafiq Rana	(Meteorologist)	Pakistan Meteorological Department
12	Ali Kamran	Scientific Officer	CAEWRI, PARC
13	Nelufar Raza	Scientific Officer	CAEWRI, PARC
14	Ahmed Zeeshan Bhatti	Deputy Director	Pakistan Council for Research in Water Resources, (PCRWR)
15	Qaisar Khan	Senior Scientific Officer	Social Sciences Research Institute (SSRI) PARC
16	Salar Saeed	Scientific Officer	CAEWRI, PARC
17	Amir Fahim	Senior Scientific Officer	CAEWRI, PARC
18	Bilal Iqbal	Senior Scientific Officer	CAEWRI, PARC
19	Dr Yousaf Riaz	Principal Scientific Officer	National Institute of Bio-technology
20	Abdul Wahab	Senior Scientific Officer	CAEWRI, PARC
21	Imtiaz Ahmed	Director	Rangeland Research Institute, (RRI) PARC
22	Sher Mhammad	Chief Scientific Officer	PARC
23	Muhammad Ilyas	Principal Scientific Officer	Nature Resource Division (NRD), PARC
24	Engr. Muhammad Asif	Scientific Officer	CAEWRI, PARC
25	Zafar Iqbal Khan	Director F&A	PARC
26	Qurban Husain	Director W&R	PARC
27	Khawaja Asim Tasmeem	Director	Administration, NARC
28	A.W. Jasra	Country Representative	ICIMOD
29	Muhammad Zubair Anwar	Principal Scientific Officer	SSRI, PARC
30	Mansoor Ali	Research Assistant	CAEWRI, PARC
31	Sultan Ishaq	Senior Scientific Officer	CAEWRI, PARC
32	Masooma Hassan	Research Assistant	CAEWRI, PARC
33	Abdul Hyee Qureshi	Director	SSRI, PARC
34	Asghar Ali	Principal Scientific Officer	SSRI, PARC

35	Ifitikhar Ahmed	Principal Scientific Officer	CSI PSP
36	Amir Mumtaz	Senior Scientific Officer	Global Change Impact Study Centre (GCISC)
37	Ghulam Akbar	Senior Scientific Officer	GCISC
38	Tariq Mustafa	Technical Officer	CAEWRI,PARC
39	Muhammad Arshad	Principal Scientific Officer	Oil Seed, PARC
40	Abdul Ghafoor	Principal Scientific Officer	CAEWRI, PARC
41	Zeeshan Virk	Scientific Officer	CAEWRI,PARC
42	Arshad Ashraf	Principal Scientific Officer	CAEWRI,PARC
43	Muneeb Ahmed Khan	Scientific Officer	CAEWRI,PARC



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