Ladakh 2016

SUSTAINABLE MOUNTAIN DEVELOPMENT SUMMIT-V

Water Security & Skills for Development in the Mountains

20 to 22 September 2016

LAHDC LEH
LADAKH AUTONOMOUS HILL DEVELOPMENT COUNCIL, LEH

Ladakh Snow Leopard Foundation

INTEGRATED MOUNTAIN INITIATIVE

SUSTAINABLE MOUNTAIN DEVELOPMENT SUMMIT V

Water Security & Skills for development in the mountains

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Preface

Dr R.S. Tolia
President, Integrated Mountain Initiative

«I consider this getting together, exchanging of experiences, and learning gained from failures and successes as the most important achievement of IMI.»

The Integrated Mountain Initiative (IMI) has been organising Sustainable Mountain Development Summits (SMDS) and other events between summits. Between 2011 and 2016, five summits have been held for the states in the Indian Himalayan region. In my opinion, organising five such summits in this period is a remarkable achievement. I consider this getting together, exchanging of experiences, and learning gained from failures and successes as the most important achievement of IMI. This has only been possible due to indefatigable efforts of past summit convenors, namely Mr P.D. Rai and his able team led by Mr R.P. Gurung at ECOSS, Mr Alemtemshi Jamir and his able second-in-command, Mr Amba Jamir at the newly established Sustainable Development Forum of Nagaland, and finally Fantry Mein Jaswal and her team at Sustainable Development Forum, Arunachal Pradesh. We must not forget the efforts of our capable and indefatigable secretary, Mr Sushil Ramola who has been instrumental in providing us with a solid foundation on which each of these summits have been organised. We must applaud and appreciate the efforts put in by these individuals, their respective organisations and hordes of volunteers

At each summit, discussions have been shaped by an agenda, which IMI and individual participants have collectively raised to new orbits of excellence through exchanges and mutual learning. These learning takes place formally and informally during each summit and at events between summits. I consider this continuity and focus as the second achievement of IMI and its chapter states.

From the start, we have deliberately allowed IMI, as a pan-Indian mountain states civil society movement, to develop spontaneously and not confine itself to a particular format. Indeed, this mindset of working according to a formal framework has been the cause of non-development of our mountain regions. This is well documented in the reports and studies that have been published by IMI. I would regard these tireless efforts to study and document different processes in the mountain states as our third achievement, which facilitates learning and shapes efforts to develop the mountain states of India.

Today, the Indian Himalayan Region accounts for 11 full-fledged states along with the district of Darjeeling out of 30 states in India. Barring a few, the mountain states are not only bereft of technical institutions, but also of basic infrastructure and facilities. Over the last few years, IMI has endeavoured to document these challenges and the evolution of the mountain states through the policy-makers dialogue. These documents serve as a repository of the collective knowledge generated by IMI in collaboration with regional, national and international bodies, including the then erstwhile body for policy development, Planning Commission of India. Our mission, vision and the values under which we work reflects these experiences and learning, which have been included in our Memorandum of Association. This document is available and accessible for anyone interested in it.

IMI and its member states are happy to learn that the National Institution for Transforming India

(NITI) has established a working group to understand and address the issues that affect mountain states. It is a good beginning for NITI, which is now the apex body for policy development in India and is now setting the tone for future approach, or rather approaches, for development in India, including the mountain states. We have big hopes from NITI and its initiatives, and will follow its work very closely.

«We all need to work together to ensure that Ladakh, and other mountain regions in India, are able to achieve the same level of development as the rest of the country...»

At the same time, I must also draw attention to the key recommendations that resulted from several rounds of intense deliberations, in which many of our members participated. One of the recommendations was to provide two percent of the gross military support to mountain states, but this has still not been implemented. We need to take account of such gaps and work to address them.

I visited Ladakh as Chief Secretary of the new state of Uttarakhand in 2005 to participate in a workshop on seabuckthorn by the Field Research Laboratory (now Defence Institute for High Altitude Research), which is a unit of Defence Research and Development Organisation (DRDO). Based on my visit, I would make two recommendations in addition to the others that have emerged from the summit.

First, Ladakh (now divided into Kargil and Leh districts) is one of the largest districts in India and located in the trans-Himalayan cold desert ecosystem. Other people in the country do not understand the conditions under which local institutions and people work. It is therefore important that the recently-upgraded G.B. Pant Institute of National Himalayan Environment and Sustainable Development establish its sixth unit in Ladakh. This will help us include and address the specific requirements of our cold deserts. I come from a similar cold desert region and I am familiar with the conditions under which snow-bound regions in the Himalayas survive. It is very difficult to visualise the challenges from Delhi or peninsular India. It's therefore pertinent that an apex institution of the Ministry of Environment, Forest and Climate Change is located in Ladakh and I hope the ministry to takes note of this recommendation.

Second, I echo a suggestion made by the former IMI councillor from Ladakh, Rigzin Spalbar who served as Chief Executive Councillor of LAHDC, Leh. He had approached IMI for support to establish a full-fledged university in Ladakh. When I heard this, I was struck by the fact that Dehradun alone has more than 300 students from Ladakh. It is not difficult to imagine the additional financial burden this places on the family of the students, who have no other alternative as there are no centres for higher learning in Ladakh. I am sure these two recommendations will go a long way in addressing and partially mitigating the impact of the harsh climatic conditions of Ladakh.

As a keen student of history, I salute Ladakh as a great repository of learning and its experiments and experiences with development. Other mountain states must try to emulate the excellence that has been achieved in this region. We all need to work together to ensure that Ladakh, and other mountain regions in India, are able to achieve the same level of development as the rest of the country, even as we cope with a harsher and challenging environment in the mountains.

The late Dr R.S. Tolia served as President of IMI from its inception till 21 September, 2016. He passed away on 6 December, 2016.

Convenor's note

The Sustainable Mountain Development Summit-V (SMDS-V) in Ladakh was shaped by the collective vision shared by the mountain states and regions of India—to learn from each other and to work together to achieve sustainable development in the Indian Himalayan Region. At the start of the planning process, a decision was taken to orient discussions at the summit around the crucial themes of Water Security and Skills for Development in the Mountains. Water Security was then divided into three sub-themes: Receding Glaciers and Snow Cover Areas, Water for Mountain Agriculture, and Water Conservation Techniques – Traditional and New. The theme of Skills for Development in the Mountains was also divided into three sub-themes: Skills Required in the Mountains, Integration of Institutional and Individual Capability Building for Enhancing Sustainable Agriculture in Mountain States, and Entrepreneurship and Success Stories.

The presentations and discussions around these themes and sub-themes were lively, informative and useful. Each technical session reflected the rich regional diversity of the mountain regions of India and their varied experiences of development. The Legislators and Policy-makers Meet was held as a special parallel session on 21 September and well-attended by office-bearers and officials from different governmental and non-governmental agencies.

One of the key objectives of a Sustainable Mountain Develop Summit is to provide policy recommendations for implementation across the mountain states. This objective was well-served with representation from Government of India, various state governments, researchers, activists and scholars. Furthermore, the proceedings of the summit document the discussions and help identify areas for further research, share important developmental lessons from different parts of the Indian Himalayan Region and provide relevant policy recommendations.

The summit was inaugurated by the Hon'ble Deputy Chief Minister of Jammu and Kashmir, Dr Nirmal Singh. He emphasised the need for such conferences and the need to discuss issues such as water security and skills needed for development in the mountain regions of India.

A day each was dedicated to each theme, with the Legislators and Policy-Makers Meet as the only parallel session at the summit. This special session was co-chaired by the Chairman/ Chief Executive Councillor of the Ladakh Autonomous Hill Development Council, Leh, Dr Sonam Dawa Lonpo and Member of Parliament, Sikkim, Shri P.D. Rai. The participants included Councillors from Ladakh Autonomous Hill Development Council, Leh and three Members of Parliament: Shri Thupstan Tsewang (Ladakh), Shri P.D. Rai (Sikkim) and Shri Conrad Sangma (Meghalaya). A summary of the specific discussions that took place during the conference are documented in this publication, along with relevant policy recommendations.

The valedictory session of the summit was chaired by the Hon'ble Minister for Tribal Affairs, Government of India, Jual Oram. He ap-

Hon'ble Union Minister for Tribal Affairs, Sh. Jual Oram speaking during the valedictory session on SMDS-V on 22 September, 2016.

«SMDS-V was marked by several interesting discussions, sharing of experiences and dialogues between different perspectives on issues related to development at large...»

preciated the efforts taken to organise the summit and emphasised its importance to shape development policies and practices for achieving sustainable development in the mountains. In this session, the SMDS baton was formally handed over to Dr Lalbiak Ngente, Councillor, IMI who represented Mizoram, which will host SMDS-VI.

SMDS-V was marked by several interesting discussions, sharing of experiences and dialogues between different perspectives on issues related to development at large, with specific reference to Water Security and Skills for Development in the Mountains. This is one of the central objectives of each mountain summit and in my opinion it was achieved during the summit and this publication will help these discussion reach a wider audience. The proceedings of the summit also provide key inputs for policy development for the mountains. This is envisioned as a key reference document for further research and policy discussions related to Water Security and Skills for Development in the Mountains, especially in the context of the Indian Himalayan Region.

In keeping with the tradition followed by previous summits, local Ladakhi skills and products were prioritised and integrated into the organisation of SMDS-V. We partnered with several civil society groups and individuals to achieve this objective and showcase the diversity of talent, skill and traditions that exist in Ladakh. We also tried to ensure that each session of the summit reflected the diversity of the Indian Himalayan Region.

The organisation of such as event was a mammoth task in the context of the limited infrastructure and various connectivity challenges in Ladakh. On behalf of Ladakh Snow Leopard Foundation and Ladakh Autonomous Hill Development Council, Leh, I acknowledge the untiring support of the District Administration, Leh and various civil society organisations. Without their support and help, this summit would not have been possible. I also acknowledge the support from Integrated Mountain Initiative for entrusting us with this responsibility and their help in organising the event. Lastly, I acknowledge the guidance of the executive committee and the footwork by the core-team to bring ideas and plans to fruition in the form of SMDS-V.

Jigmet Takpa, IFS

Chief Conservator of Forests (Wildlife), Ladakh Region
Project Director, Ladakh Renewable Energy Development Agency
Chief Executive Officer, Ladakh Snow Leopard Foundation

SMDS-V Partners

Programme Schedule

Tuesday, 20th September 2016		
Inaugural Session		
16:00 – 17:00	Arrival and Registration of Participants	
17:00 – 17:10	Welcome address from Convenor SMDS-V: Shri Jigmet Takpa, IFS	
17:10 – 17:20	Address by President of IMI: Dr. RS Tolia/Shri Alemtemshi Jamir, CS (Retd) Nagaland	
17:20 – 17:30	Remarks from Co-Patron, SMDS-V: Dr. Sonam Dawa Lonpo, Chairman/CEC-LAHDC, Leh	
17:30 – 17:50	Address by Chief Patron, SMDS-V: Dr Nirmal Singh, Deputy Chief Minister, Jammu & Kashmir	
17:50 – 18:00	Inaugural address: Shri Prasanna Ramaswamy G., IAS, Deputy Commissioner, Leh	
18:00 – 18:10	Lighting of Lamp and opening the event	
18:10 – 18:30	Appreciation of Ladakh and its culture – Video Presentation	
18:30 - 19:00	Inauguration of Photography Exhibition & Photo-shoot	
19:30 - 21:30	Dinner & Networking	
Day 1: Wednesday, 21st September 2016		
Theme: Water Security in the Mountains		
9:00 – 9:20	Contextualization of the theme: Shri. Amba Jamir, Executive Secretary, SDFN & Councillor, IMI	
9:20 – 9:40	Keynote address 1: Dr. Amita Prasad, Joint Secretary, MoEF &CC	
9:40 – 10:00	Keynote address 2: Prof. Philippe Cullet, Senior Visiting Fellow, Centre for Policy Research, New Delhi	
10:00 – 10:15	Tea Break	
Technical Session 1: Receding Glaciers and Snow Cover Areas		
10:15 – 10:25	Moderator: Dr. Shrestha Tayal, Area Convenor, Centre for Himalayan Ecology, TERI University	
10:25 – 10:45	The role and trends of glaciers snow and permafrost: A technical perspective	Dr. Dorothea Stumm, Senior Glaciologist, ICIMOD
10:45 – 11:05	Lifestyle choices, innovative policies with focus on glaciers and snow cover in Sikkim	Dr. Smriti Basnett, Sikkim University
11:05 – 11:25	Brief Review of Snow cover and Glaciers in Ladakh	Thupstan Angchuk, JNU
11:25 – 11:45	Impact of glacier retreat and melting permafrost, with special reference to Ladakh	Dr. Joseph Tshetan Gergan, Scientist F (Retired), Wadia Institute of Himalayan Geology, Ladakh
11:45 – 12:30	Open house discussion	
12:30 – 13:30	Lunch Break and networking	
Technical Session 2: Management of Water in the Mountain States		
13:30 – 13:40	Moderator: Dr. Rajan Kotru, ICIMOD	
13:40 – 14:00	Irrigation systems of Ladakh's farming communities: survivability of traditional irrigation practices in the modern era	Dr. Joseph Hill, Assistant Professor XISS

14:00 – 14:20	Water security in the Darjeeling Hills, unravelling the seen and unseen forces	Shri. Roshan P Rai, Darjeeling Himalayan Initiative
14:20 – 14:40	Policy perspectives on ground water extraction issues in mountain regions	Shri. Siddharth Patil, ACWADAM
14:40 – 15:10	Open house discussion	
15:10 – 15:30	Tea Break	
Technical Session 3: Water Conservation Techniques – Traditional and New		
15:30 – 15:40	Moderator: Dr. J.C Kuniyal, Scientist, GB Pant Institute of Himalayan Ecology and Sustainable Development	
15:40 – 16:00	Water conservation techniques: Issues, challenges and solutions	Smt. Minakshi Arora, India Water Portal, New Delhi
16:00 – 16:40	Artificial glaciers: A high altitude water conservation and harvesting technique	Shri. Tsewang Norphel, Engineer (Retd), Leh-Ladakh
		Shri Sonam Wangchuk, SECMOL/The Ice Stupa Project
16:40 – 17:00	Dhara Vikas Programme: Conservation and preservation of rain-fed streams and springs	Shri Pem Norbu Sherpa, Coordinator, Dhaara Vikas Programme, Sikkim
17:00 – 17:20	Successful traditional practices and the need to converge such practices to policy	Shri. Vengota Nakro, Councillor, SDFN
17:20 – 17:40	Open house discussion	
17:40 – 18:00	Presentation of Outcomes of the day moderated by Shri. RP Gurung, CEO, Ecotourism & Conservation Society of Sikkim (ECOSS) & Councillor, IMI, Smt. Priyadarshinee Shrestha, Team Leader, WWF, Sikkim and Smt Bhawana Luthra, LEAD India	
20:00 onwards	Dinner and Cultural Performances	
Day 2: Thursday, 22st September 2016		
Theme: Skills for Development in the Mountains		
9:00 – 9:20	Contextualization of the theme: Shri. Alemtemshi Jamir, CS (Retd) Nagaland & Vice President and Councillor, IMI	
9:20 – 9:40	Keynote address 1: Smt. Jyotsna Sitling, Joint Secretary, Ministry of Skill Development and Entrepreneurship	
9:40 – 10:00	Keynote address 2: Shri. Sushil Ramola, Chairman, B-ABLE & Councillor, IMI	
10:00 – 10:15	Tea Break	
Technical Session 4: Skills Required in the Mountains		
10:15 – 10:25	Moderator: Smt. Jyotsna Sitling, Joint Secretary, Ministry of Skill Development and Entrepreneurship	
10:25 – 10:45	Issues in skill development and entrepreneurship in mountains	Dr. Sapna Poti, Head - Jammu, Kashmir and North East Region, NSDC
10:45 – 11:05	Mountain state skilling for employability: case study of Sikkim	Smt. Mrinalini Shrivastava, IPS, Sikkim
11:05 – 11:25	The experience of sustaining traditional skills in Ladakh	Dr. Sonam Wangchok, President, IALS & Secretary, Himalayan Cultural Heritage Foundation
11:25 – 11:45	Entrepreneurship in Sikkim	Shri Karma Bhutia, Founder and CEO, iShippo, Sikkim
11:45 – 12:05	Enterprising Ladakh: Prosperity, Youth, Enterprise and Cultural Values	Shri Moses Kunzang, Addl Deputy Commissioner
12:05 – 12:25	Promoting Entrepreneurship in Ladakh	Dorjay Wangchuk, JKEDI
12:25 – 12:45	Open house discussion	
12:45 – 13:30	Lunch Break and networking	

Technical Session 5: Integration of Institutional and Individual Capability building for enhancing Sustainable Agriculture in Mountain States (FAO-TC)		
13:30 – 13:40	Contextualization of the session: Hon. Shri. PD Rai, MP Sikkim & Councillor, IMI	
13:40 – 14:00	Strengthening institutional capacities in agriculture for sustainable mountain development	Shri. John Paulraj, Programme Coordinator, IMI
14:00 – 14:20	IMI's role in integrating agriculture/allied sectors in mountain development	Shri Amba Jamir, SDFN
14:20 – 14:40	Sharing experiences of FAO-TCP	Shri Sunder Subramanian, Development Consultant and Policy Advisor
14:40 – 14: 55	Integration of institutional and individual capability for enhancing sustainability agriculture for mountains	Smt. Binita Shah, Founder of SARG, Uttarakhand
14:55 – 15: 15	Open house discussion	
15:50 – 15:30	Tea Break	
Technical Session 6: Entrepreneurship & Success Stories		
15:30 – 15:40	Moderator: Shri. Sushil Ramola, Chairman, B-ABLE & Councillor, IMI	
15:40 – 16:00	Living sustainably in the Himalayas	Smt. Rashmi Bharti, Co-Founder, Avani, Uttarakhand
16:00 – 16:20	Ecotourism: A new livelihood alternative and conservation opportunity in Hemis National Park	Shri. Jigmet Takpa, IFS, CCF (Wildlife), Ladakh
16:20 – 16:40	Weaving stories of change: The weavers of Chizami	Smt. Seno Tsuhah, Project Team Leader, Northeast Network (NEN), Nagaland
16:40 – 17:00	Seabuckthorn for sustainable mountain development	Dr. Tsering Stobdan, DIHAR, Leh
17:00 – 17:15	Open house discussion	
17:15 – 17:50	Presentation of Outcomes of the day moderated by Smt. Mrinalini Shrivastava, IPS, Sikkim	
18:00	Valedictory Session	
18:00 – 18:20	Concluding Remarks: Hon. Shri PD Rai, MP Sikkim & Councillor, IMI	
18:10 – 18: 20	Address of Chief Guest: Shri. Jual Oram, Union Minister for Tribal Affairs	
18:20 – 18:40	Address by Patron, SMDS-V: Dr. Sonam Dawa Lonpo, CEC/Chairman-LAHDC, Leh	
18:40 – 18:50	Hnding over of SMDS batonfrom Dr. Sonam Dawa Lonpo to Dr Lalbiak Ngente, Councillor, IMI from Mizoram, which will host SMDS-VI	
18:40 – 18:50	Vote of Thanks: Shri. Reuben Gergan, Secretary, SMDS-V	
20:00 onwards	Dinner and Cultural Performances	

Joint Secretary, Ministry of Environment, Forests and Climate Change, Government of India, Dr. Amita Prasad delivering her keynote address.

Participants during a technical session.

Summit deliberations and recommendations

Theme 1

WATER SECURITY IN THE MOUNTAINS

The first keynote address for the theme of water security in the mountains was delivered by Dr. Amita Prasad, Additional Secretary, Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India. The focus was on the peculiarity of problems in mountain and hill states and the need to address issues for these areas in a more localised manner with active involvement of various stakeholders.

The issue highlighted is critical, as six percent of India's population depends on the Himalayan ecosystem for vital services such as water. There is a need to explore and map the resources available in the mountain states. For instance, springs are an important source of water in mountain ecosystems, but face threats due to urbanisation.

There is also a wide gap between policymakers in the government and policy inputs from the grassroots—this is an important link that can be beneficial for all stakeholders. In the past, studies undertaken by the Government of India on water security in the mountains have failed to give results during the implementation of projects as it lacked participation from different stakeholders, which includes collaborations between non-governmental organisations (NGOs) and government agencies.

Another shortcoming seen with these projects has been their lack of focus on sustainability and data sharing. There is no dearth of planning and research but the 'politics of planning' remains the main challenge for sustainable development in the mountains. It's important to explore innovative solutions for addressing the problems of water security in mountain states. At the same time, participatory approaches that involve civil society are essential for the long-term viability of any project.

The second keynote address was delivered by Prof. Phillips Cullet, Professor of International and Environmental Law at School of Oriental and African Studies, University of London and Senior Visiting Fellow at Centre for Policy Research, New Delhi. Water security means different things to different people, but it's important to focus on local points of view. One of the central challenges with regard to water security remains on the issue of accessibility, followed by availability of water. At present, policymaking processes primarily focus on availability rather than accessibility. The issue of access to water can also be interpreted in different ways but the question pertaining to the 'needs' require due importance in understanding the question of 'access'. There is also an urgent need to secure water-dependent livelihoods for mountain communities and understand the links between water security and scarcity. In this regard, each mountain state must develop frameworks for water security that are relevant to their specific needs.

SESSION 1: RECEDING GLACIERS AND SNOW COVER AREAS

Moderator: Dr. Shrestha Tayal. TERI University

Summary

Important points discussed in this session:

- The importance of monitoring the health of glaciers, snow fields and permafrost.
- The need to understand and map mountain permafrost, which has been neglected.
- The involvement of local communities in monitoring and mitigation activities.

The first session under the theme 'Water Security in the Mountains' focused on climate change and its impacts in mountain regions, especially glaciers, snow fields and permafrost. As a glacier-dependent region, this session had a special significance for Ladakh.

The discussion highlighted the importance of recognising receding glaciers as an impact of human-induced climate change. One of the most important points emphasised during the session was the need to fill knowledge gaps in existing knowledge pertaining to water sources in the mountains. For instance, most studies focussed on visible sources such as glaciers and snow fields, while neglecting the important role played by mountain permafrost. As structures of these water sources change, they have an impact on local ecological processes and communities dependent on them. For mountain communities faced with threat from glacial lake out bursts, the risks need to be mapped, understood and addressed.

Dr. Dorothea Stumm, ICIMOD, Kathmandu

THE ROLE AND TRENDS OF GLACIERS SNOW AND PERMAFROST: A TECHNICAL PERSPECTIVE

Permafrost, which is described as rock or ground-material below the surface that remains frozen for at least two consecutive years, remains neglected in current studies on water security in the mountains and climate change. The layer of the permafrost near the surface usually thaws in the warm season and is called the 'active layer'. However, this layer cannot be observed from the surface. There is thus a large knowledge gap in the information about permafrost, even though modelling studies predict that the distribution of permafrost is 14 times greater than glacier cover areas. However, it is difficult to measure permafrost directly and one has to rely on indirect methods or proxies such as Ground Surface Temperature (GST) measurements. Such methods have been used to measure permafrost in Langtang, Nepal since 2013, Ladakh since August 2016 and Kunjerab Pass area in Pakistan since October 2016. There have are numerous additional indicators of the possible presence of permafrost in different parts of Ladakh. The area around Ganglass Catchment in upper Leh town is a good example. Such research activities are far more effective when they involve local communities in mountains areas to build scientific capacity and encourage youth to study science. This will expand current knowledge on glaciers, snow cover areas and permafrost and provide scientific data and inputs to policymakers.

Dr. Smriti Basnett, Sikkim University, Gangtok

LIFESTYLE CHOICES, INNOVATIVE POLICIES WITH FOCUS ON GLACIERS AND SNOW COVER IN SIKKIM

Melting of glaciers leads to the formation of supra-glacial lakes, which expand to form larger lakes. The study of glaciers in Sikkim using area scaling method indicates that snow cover thickness has reduced by an average of six feet. The rapid melting of snow and glacier in the upper reaches of Sikkim has had a negative impact on the yak herders that use these areas. As a direct result of these changes, the next generation of yak herders have started migrating to cities as their traditional livelihood strategies are under threat. The centuries-old practice of yak herding is now dying out in Sikkim due to the impacts of climate change. Another issue that needs attention is the smoke from traditional chulas (hearths) that cause a deposition of black carbon on snow. This needs to be addressed through outreach programmes and the replacement of traditional chulas with smokeless chulas to reduce carbon deposition.

Thupstan Angchuk: Jawaharlal Nehru University, New Delhi

BRIEF REVIEW OF SNOW COVER AND GLACIERS IN LADAKH

Field-based measurements of glaciers in Lahaul, Himachal Pradesh and Stok Kangri in Ladakh, provide evidence of an increase in temperature. There is, however, an urgent need to understand Himalayan glaciers as they are diverse in nature. Such an understanding of the diversity of glaciers will provide critical inputs to develop more sustainable solutions to mitigate the impacts of climate change.

Dr. Joseph Thsetan Gergan, retired glaciologist

IMPACT OF GLACIER RETREAT AND MELTING PERMAFROST, WITH SPECIAL REFERENCE TO LADAKH

The problem of receding of glaciers has overshadowed related issues such as permafrost. Water shortage crises are already emerging in Ladakh. For instance, Leh town depends on a single glacier for its water supply, but this remains insufficient to meet the needs of the growing town. In contrast, the area around Phyang village located 15kms west of Leh town, has eight glaciers and water resources remain under-utilised. Interestingly, there are no glaciers in the neighbouring village of Taru, whose residents depend on seasonal melt from permafrost for water. Thus, the main sources for water in a region like Ladakh include melt-water from snow fields, permafrost and glaciers. The main challenge remains to quantify the extent of permafrost in the region. Due to the difficulties in measuring permafrost, it has been neglected with most studies that primarily focus on glaciers. This has resulted in a narrative of intense water scarcity as a major source has not been included in these studies.

There is also an urgent need to gather and document information about climatic changes over the last few decades from older generations. This will fill a major gap in current knowledge of recent history of extreme climatic events and changes in these areas. There is a big divide between policymakers and different stakeholders, especially people at the grassroots. This divide can be bridged if data along with scientific evidence and interpretations are taken to local communities and they are involved in discussions and interactions to explore collective solutions. These steps need to be taken urgently as large scale migration are already taking place in Ladakh with communities moving lower down from mountains sides to valley floors, due to the effects of climate change. There is also a need to explore if lakes formed by melting of glaciers in the upper reaches of these valleys can be converted into harvesting zones to prevent such migrations.

Policy recommendations from the session:

- Long-term monitoring of glaciers is critical to generate accurate and reliable data on changes and potential risks of water scarcity and disasters.

- There is an urgent need to build scientific capacity amongst mountain communities, as they are one of the main stakeholders in achieving water security, to help monitor the health of snow fields, glaciers and permafrost.
- Develop glacial research centres across the Himalayas, which will work with local communities and the larger scientific community around the world to share data, findings and relevant knowledge and skills.
- Ensure that artificial glaciers are built closer to natural glaciers to augment their cover.
- Develop simple strategies such as snow fences using stone walls to increase the extent and period of snow cover.
- Increase the area of recharge in the head water regions of streams and rivers. This can be done by using natural recessional features of the mountain.
- There is an urgent need to map and study mountain permafrost across the Himalayas. As of now, very little is known about the nature and extent of mountain permafrost, especially in regions such as Ladakh.
- Develop market for locally-made products made from materials such as yak wool. This will help diversify livelihood strategies for mountain communities that depend on pastures in high altitude regions near glaciers and snow fields.

SESSION 2: WATER FOR MOUNTAIN AGRICULTURE

Moderator: Dr. Rajan Kotru, ICIMOD

Summary

Important points discussed in this session:

- The importance of documenting traditional rights over water resources.
- The need to recognise springs as a source of water in mountain regions.
- The importance of involving communities in studying and managing water resources.

There is a growing uncertainty about water supply around the world due to human-induced climate change. This uncertainty is more acute in the mountain regions. Growing population, changing value systems, pollution, toxic emissions from vehicular use and unregulated tourism have caused glaciers to recede at an alarming rate. Glacial melt and spring waters are the lifeline of communities that live in the mountains and special efforts need to be taken to address this uncertainty of water supply in the Himalayas.

The uncertainty, especially water scarcity, can lead to conflicts as evident in the Cauvery river dispute between Karnataka and Tamil Nadu. There have also been international conflicts over water as observed in the disagreements between India and Pakistan over interpretations of the Indus Water Treaty. Around 64 million people in the 11 Himalayan states of India depend on glacier melt and spring water. These states also share these water resources with each other, as well as communities across international borders. Thus, these water resources need to be managed proactively and collectively before they lead to conflicts in the future.

Such water managements systems must include upstream and downstream links as well as local, state and national governmental agencies and non-governmental ones. Institutions, both governmental and non-governmental ones, must take up key issues and required action to ensure that these management systems function as intended.

Dr Joseph Hill, Xavier Institute of Social Service, Ranchi

IRRIGATION SYSTEMS OF LADAKH'S FARMING COMMUNITIES: SURVIVABILITY OF TRADITIONAL IRRIGATION PRACTICES IN THE MODERN ERA

Rapid social changes are taking place in Kargil-Ladakh, which have impacted traditional Farmer-Managed Irrigation Systems (FMIS). These systems have been an important strategy for water security and now face challenges in terms of policies, sustainability, food security and governance.

Policy or legal processes include land revenue settlement that is underway in Kargil district after a gap of 100 years. The settlement process poses a challenge to FMIS in terms of documenting irrigation rights and customs. For instance, JM Baker, who conducted research in Kangra valley in Himachal Pradesh, published a paper in 2003 (Himalayan Research Bulletin) in which he concluded that 'codification of social customs, practices and law during land settlement remains full of contradictions and lack transparency'. In addition to these issues, the old records are partially illegible due to their poor condition and the use of a language and script that is not understood anymore. In many cases, the records are also not up-to-date and often not accessible by villagers, who are not aware of the content of these records. There have been many cases in other parts of the Himalayas where villagers have used such records to defend water rights claims.

The land revenue settlement process in Karchay Khar and Gyaling villages, which have around 20 FMIS were studied between 2013 and 2015. At the time of research, the government had finished the survey of Gyaling and recorded water rights and customs in the new land settlement. The rights and customs in Karchay Khar, especially Dambisthang and Bro Lungma yurba (channel), had not been recorded yet. The Dambisthang and Bro Lungma yurba are productive lands and relieve pressure for the whole village.

There are also questions over the sustainability of Irrigation Department projects. External agencies have started to intervene in FMIS with a dramatic growth in the number of governmental and non-governmental agencies contributing to the maintenance and construction of irrigation channels. For instance, villagers requested help from government agencies to concretise damaged sections of Dambisthang yurba. The project, which was earlier done by community members, was awarded to a contractor who hired non-local labourers to perform the task.

These issues also impact human needs, especially food security. In the past, people in Kargil district were largely self-sufficient as they grew their own food but have now become dependent on resources from outside the region. The elders blamed the younger generation for losing interest and lacking skills for farming. According to scholars like Osmaston, who studied Ladakhi agriculture in 1994, these traditional systems produced yields comparable to Europe's intensive farming systems. There is an urgent need to integrate food security and human needs, when analysing farming and irrigation systems. Lastly, there are issues related to governance and party politics that negatively affect relationships within village communities, as well as the working of governance institutions such as village Panchayats and the Ladakh Autonomous Hill Development Councils that are often out-of-sync with each other.

Roshan P. Rai, Darjeeling Himalayan Initiative

WATER SECURITY IN THE DARJEELING HILLS, UNRAVELLING SEEN AND UNSEEN FORCES

Darjeeling is facing acute water shortage, despite being a water-rich district that is fed by monsoon rains and snowmelt. Like many mountain regions, springs remain one of the main sources of water in Darjeeling. The water crisis has worsened with the decrease in spring discharge. However, the issue of high water deficit is rather complex.

The Upper Lanku area in rural Darjeeling depends on three springs for water supply. The water discharge in these springs has declined over the past decade and the recharge zone is administered by the Forest Department, who have not granted permission for recharge interventions. Urban Darjeeling has a centralised water management system, which does not acknowledge springs as a source of water for residents. Since the springs are ignored, there is no policy for their conservation in the face of challenges such as rapid urbanisation, commercialisation, concretisation, contamination and reducing discharges.

Siddharth Patil, Advanced Centre for Water Resources Development and Management (ACWADAM), Pune

POLICY PERSPECTIVES ON GROUND WATER EXTRACTION ISSUES IN MOUNTAIN REGIONS

There is need to understand the dynamics of groundwater. In the Indian Himalayan regions, groundwater is mainly about springs that support about 64 million people. These springs are the lifeline of these regions and are used for various activities, including drinking and irrigation, in addition to their ecological functions.

It is paradoxical that despite being a storehouse of springs, there is very little data on groundwater in the Himalayas. The current data sets for the region focus on hand-pumps and bore-wells, with little or nothing on springs. This lack of data means that springs are not safe. While depletion of spring discharge due to climate change is an obvious challenge, there are several others that are not even known. There is thus a need to study and understand spring water and methods to preserve and quantify them.

Another important issue is that of aquifers, which serve as sources for springs. Over-extraction from these aquifers can harm the population that depends on them for water. Springs provide water at a specific discharge rate based on the rate at which aquifers discharge water. In the Himalayan region, aquifers may extend from one valley to another, depending on the rock structure. This calls for a need to change the current ridge-to-valley approach for studying aquifers to a valley-to-valley approach. At the same time, sanitation and drinking water programmes must be planned in the context of geological and aquifer features of a landscape to improve their efficiency.

Unregulated drilling for underground water in aquifers has affected the equilibrium between springs and aquifers in the Indian Himalayan region. This has resulted in acute shortage and erratic distribution of drinking water. Since demand for water will continue to increase, there is a urgent need to initiate spring rejuvenation programmes.

Policy recommendations from the session:

- Integrate processes for equitable distribution, sustainability and transparency in projects carried out by different agencies and should include active participation by local communities.
- The need to refine and rationalise policies and regulations for water extraction of groundwater through deep boring in mountainous regions.
- Document and acknowledge urban springs to initiate measures to conserve them and delineate critical zones of recharge for environmental management.

- Involve communities in collection of data, planning and management of water resources.
- Change design of various national and state-driven programmes on watershed development, drinking water and sanitation to make them community-driven and ensure that they are in tune with the geological reality of the area in which they are being implemented.
- The rights and responsibilities of irrigation systems should be documented in new government records. The affected communities must be a part of this process to ensure that they understand the records of their FMIS.
- Traditional farming skills and practices need to be rationalised with pastoral and agricultural skills added to school curricula in mountain regions.
- Government departments and agencies must integrate traditional farming practices in their programmes and provide support for its sustenance. Such practices have been time-tested and require support with regard to market-linkages to sell local produce.
- Government and non-governmental agencies must spread awareness about rain-water harvesting technique to allow people to benefit from them and recharge groundwater.

SESSION 3: WATER CONSERVATION TECHNIQUES – TRADITIONAL AND NEW

Moderator: J.C. Kuniyal, GB Pant Institute of Himalayan Environment & Development

Summary
Important points discussed in this session:

- The importance of conserving water resources through community participation.
- The need to use local resources and communities to conserve water.
- The urgent need to integrate successful conservation practices in policy frameworks.

Glaciers are the main source of water in the Indian Himalayan region. This is supplemented by streams, rivers, lakes, ponds and groundwater. In recent times, this region has faced problems of water scarcity, which not only affects the basic right of access to drinking water; but also threatens the livelihoods of millions of people, especially farmers. A number of factors are responsible for the steady decline in water resources.

One of the most important factors is climate change, which impacts hydrological cycle. Extreme fluctuations in precipitation rates may translate in increase in the amount of rainfall but decrease in the number of days of rain. This causes water to drain away rather than seep into the ground and contributes to a fall in water table levels and deterioration of water quality. Others factors include pollution and changing land use patterns. Atmospheric pollution, especially emission of greenhouse gases such as carbon, contributes to temperature rise with variable effects on climatic systems. Changing land use is driven by the demands of a rapidly industrialising and urbanising society, which contribute to depletion and pollution of groundwater.

Around 80% of India's water resources are used for irrigation and sourced from canals and groundwater. Over the last three decades, the contribution of canal irrigation has declined steadily, while groundwater extraction through tube wells has grown rapidly. However, water supply from this sources has also started to decline and there is an urgent need to develop innovative techniques to conserve and augment scarce fresh water sources.

However, the use of modern tools and techniques of water management are also leading to new challenges. For instance, concrete is being used to build irrigation canals and bore wells are reaching deeper into underground aquifers. While this ensures that water reaches the point of use, there is no seepage to help replenish groundwater.

Minakshi Arora, Arghyam, Bengaluru

WATER CONSERVATION AND PRESERVATION TECHNIQUES: ISSUES, CHALLENGES AND SOLUTIONS

The Uffrainkhal region in Uttarakhand state is spread across three districts; Pauri, Chamoli and Almora. Villages in this district not only suffered from a scarcity of drinking water, but also from problems such as ecological degradation, deforestation and frequent forest fires.

Local community members decided to find and implement a workable and sustainable solution to the issue of forest fires, deforestation and greening of barren lands—all of which were linked to a falling groundwater table in the area.

The first step they took was to pool local seed varieties to rejuvenate the forests. However, they lacked resources (seeds and nursery for local plants), governance/ownership, and awareness about the problems and solutions. These challenges were addressed with the support of local school children, who collected resources to develop a nursery and spread awareness in the community. The governance issue was resolved by involving representatives of the local community through the Khankar Danda or the Gram Sabha.

The community countered the risk of forest fires through water conservation work such as the Chaal-khal—recharge pits to collect rain water. The pits were dug between rows of trees to decrease soil erosion. Around 30,000 to 40,000 Chaal-khals of

different sizes were built across 136 villages. The villagers then started greening barren lands and planted around four million trees. The women folk then started spreading awareness and developed a symbol to designate the household responsible for protecting the forest on any given night.

As a result of these efforts, the barren hills have become green, as four to five million trees have been planted over an area of 506 sq. km. This has increased humidity levels and prevented forest fires. Fourteen springs have been revived and five of them have been marked for integration with the government water supply plan. A total of 136 villages with 30,000 individuals have directly benefited from these activities.

Tsering Norphel, Leh Nutrition Project, Leh-Ladakh
Sonam Wangchuk, SECMOL and Ice Stupa Project, Leh

ARTIFICIAL GLACIERS: A HIGH ALTITUDE WATER CONSERVATION AND HARVESTING TECHNIQUE

Artificial glaciers are a low-cost water-harvesting technique suited for high altitude cold desert regions to ensure supply of water at the beginning of summer. At the start of winter, glacial melt water at different altitudes are diverted through distribution channels to a shaded area, preferably on the north face of the mountain. These channels are designed to ensure a regular supply of water to shallow pools lined with stone embankments. The water then freezes to ice during the three to four months of winter to form an artificial glacier. These artificial glaciers are located as close as possible to the village, so that when temperatures rise, the water reaches the fields when required.

The concept of artificial glaciers is a successful and efficient water conservation technique at high altitudes as a response to climate change-induced water scarcity. Around 80% of Ladakh's farmers are dependent on snow and glacial-melt water for irrigation and domestic use. In General, glacial-melt water drains into the river in the winter, while insufficient water is available during the crucial sowing season in summer. Artificial glaciers ensure supply of water during this crucial period.

In addition, to the economic benefits this provides to farmers and pastoral communities, artificial glaciers also help recharge groundwater reserves, rejuvenate springs and reduce social conflicts over resource use.

Though the project has been successful and benefitted communities that live in the mountains, the technique faces many difficulties and constraints. This includes scarcity of labourers during the winter months to monitor and maintain the water distribution channels, the lack of access roads that increases the cost of material and labour.

The artificial glacier idea has been developed further into the concept of building ice stupas. An ice stupa is a conical structure formed by spraying water from pipes at high pressure generated by using the natural slope of a mountain. These structures can be formed anywhere, where water can be routed through pipes. An experiment was recently conducted to siphon water from a glacial lake in Sikkim. There is a need to explore if water from such glacial lakes can be used to build ice stupas.

Pem Norbu Sherpa, Government of Sikkim

DHARA VIKAS PROGRAMME: CONSERVATION AND PRESERVATION OF RAIN-FED STREAMS AND SPRINGS

Glaciers, snow-melt, lakes, streams and springs are the main sources of water in the Himalayan region. Thus, in a place like Sikkim, the water supply system becomes defunct when springs dry up. This is a major cause for water scarcity in rural Sikkim, which is forcing people to switch to piped water. There have been efforts to dig trenches to revive dry areas to resolve the issue of water scarcity.

Climatic changes and increased usage of water have intensified the problem of water scarcity. The maximum temperature in the capital city of Gangtok has been rising steadily at an average rate of 0.2 degrees Celsius per decade and annual rainfall has been increasing at the rate of nearly 50mm per decade. Despite the increase in rainfall, the number of days with rain has been declining steadily. The trend over the last few years shows an acceleration of these patterns, with winters becoming warmer and drier. This erratic rainfall and dry winters have forced people to collect rain in trenches to recharge aquifers.

The Government of Sikkim's Department of Rural Management and Development and Department of Science and Technology, started the Dhara Vikas Programme in September-October 2008 to conserve spring water. A conceptual framework for the programme was developed through the participation of different stakeholders and scientific agencies. As part of the programme, various initiatives were carried out, including exposure visits, meetings with water user groups, Gram Sabha meetings and district-level orientation programmes for awareness, and implementation of Dhara Vikas Programme. Job card-holders and local village Panchayats were taken on board and para-hydrogeologists were also consulted to recharge aquifers in south Sikkim.

Around 100 ha were taken up in recharge areas. Surveys were carried out of water resources, interactions were held with water users, geological assessments were carried out and a final survey of the recharge area were done by a technical team, Panchayat members and water users. Recharge ponds and trenches were constructed at strategic places to collect rain water to revive springs. The monthly water discharge rates were monitored at each collection point from February to March, 2013-14. The 2009-2016 data collected with the

help of WWF indicated that water discharge by springs has increased, which implies that aquifers have been recharged.

Such a project cannot move without people's participation. In this regard, awareness and sensitisation programmes play a very important role. A website was also developed (www.sikkimsprings.org) to collect and disseminate information in the form of a spring database, a spring atlas, weather data, springs, lakes and streams that have been conserved. In 2012, Sikkim was declared as a resource state after this successful initiative.

In the next stage, the programme will try to identify if aquifers are linked in a network or isolated. For such an exercise, it's important to understand the different types of aquifers in the Himalayan region. At the same time, it's important to use local knowledge to understand needs in the context of the unique geology and hydrology of a landscape.

Mr. Vengota Nakro, Sustainable Development Forum Nagaland, Kohima

SUCCESSFUL TRADITIONAL PRACTICES AND THE NEED TO CONVERGE SUCH PRACTICES TO POLICY

There are several successful traditional water conservation practices that need to be integrated with policy. Climate change has had an impact in Nagaland with an increase in annual precipitation and a decrease in rainy days. Extreme rainfall events over a few days have emerged as a big concern, along with the gradual warming of average temperatures.

One example of successful traditional water conservation practice is the zabo system developed in Kikruma district of Nagaland to harvest rainwater. This included afforestation in catchment areas and development of feeder channels in forested areas, siltation tanks, water harvesting ponds, and open irrigation channels leading to paddy fields. Generally, villagers are able to harvest water from these ponds three to four times each year.

This system provides water, when rainfall is scarce and allows villagers to grow several crops, including rice paddy. This has provided water security and helped improve agricultural productivity and financial returns. It has also helped recharge aquifers and springs. This system is now being adopted by villages in other regions too. There is an urgent need for convergence of conservation practices in policy to achieve water security.

Policy recommendations from the session:

- There is an urgent need to explore overlaps between science, technology and traditional ecological knowledge and practices to mitigate the impacts of climate change.
- The planning and execution of projects related to water management and climate change adaptation must include active participation from local communities.
- There is an urgent need to learn lessons from successful practices in different mountain regions. These lessons must be included in policy frameworks to manage vital resources such as water.

PARALLEL SESSION: LEGISLATORS & POLICYMAKERS MEET

Theme-based discussions

Moderators:
Shri. P. D. Rai, Member of Parliament, Sikkim
Dr. Sonam Dawa Lonpo, Chief Executive Councillor, LAHDC, Leh.

Important points discussed in this session:

- The importance of understanding and addressing the problems of water security and skills in the mountains.
- The need for the 11 mountain states to work together to ensure that policies and schemes are geared towards the challenges of mountain regions.
- Meaningful dialogues between policy and traditional practices of resource management.

This session was attended by legislators and policymakers, including elected representatives such as Members of Parliament, Members of Legislative Assemblies, Members of Legislative Councils, and Councillors from Ladakh Autonomous Hill Development Council as well as government officials representing Government of India and state governments, and representatives of non-governmental organisations. The discussions in this session were structured around the main themes of Sustainable Mountain Development Summit-V: Water Security and Skills for Development in the Mountains, and specific concerns related to development in the mountains.

The first half of the session focussed on discussions about causes, challenges and solutions to water-related issues in mountain regions. The important issues that were brought up were related to receding glaciers, water scarcity, depleting groundwater, the rapid increase in population and the resulting rise in demand for water and the lack of specific policies to address these problems in mountain regions. A lot of emphasis was laid on the need to curb unsustainable and exploitative use of groundwater, the need to revitalise drying springs and pasture lands and integration of water security issues in policies for the mountain states. Another issue that was discussed was the draft National Water Framework Bill, 2016 and the proposal of the Parliamentary

Standing Committee to bring water on the Concurrent List—whereby Government of India and state governments will have to work together to legislate and act—and similar initiatives being explored by the government to bring unity to water-related laws. There were suggestions that water should be made a fundamental right on the lines of right to education, the need to align water-related laws with Supreme Court of India's directives, the need to develop a framework to resolve inter-state water conflicts, and the need to check deforestation in the Indian Himalayan region.

In addition, some of the discussions focussed on proactive measures to achieve water security, such as water harvesting strategies to augment the current supply of water. Similarly, there is a need to develop and revive community-based water management systems such as the churpon system in Ladakh to ensure a fair distribution of water resources. Once this system fell into disuse, villages across Ladakh have started experiencing water scarcity, uneven distribution and conflicts over access to water. There is thus a need to align such practices with formal policy frameworks for effective resource management.

There is also a need to explore the use river water, such as the Indus in Ladakh, to meet the needs of local communities. A sewage treatment plant is being developed in Leh to recycle waste water from Leh town for use in agriculture. However, there is a need to also engage with security forces stationed in the mountain regions to check their sanitation practices. Open defecation facilities in army camps not only cause problems for villages in the vicinity, but also have a negative impact on the environment.

In this regard, four Government of India institutions are relevant to mountain regions. These are National Institute of Himalayan Studies, National Mission of Himalayan Studies, National Institute for Hydel Projects, and Global Planning Plant. The institutions have the expertise to carry out technical studies and pilot projects with regard to water-related issues.

The second half of this session focussed on discussions about Skills for Development in the Mountains. The mountain regions have a rich heritage of traditional skills and a culture that encourages hospitality and work hard. However, the regions face several challenges too. This includes access to knowledge and data, infrastructure development in terms of roads and digital connectivity, industries and transportation. These challenges prevent mountain communities from optimising the use of available skills and resources. One of the solutions for this challenge can be to focus on making better use of traditional skills, while also developing new skill sets, creating institutions that nurture skills etc. It is also important to tap sustainable forms of technology for implementation in mountain regions and institute skill development centres in mountain regions. These are important to ensure that these processes do not stop after the initial funds are exhausted. Entrepreneurship is another area that needs to be encouraged, especially to develop business models suited for mountain regions.

This session ended with consensus amongst the participants to bring together stakeholders from all 11 mountain states in India to create a task force. This is an important first step towards building consensus on developing and redesigning government schemes for mountain regions.

TOPIC-SPECIFIC DISCUSSIONS

Moderator: Mr Conrad Sangma, Member of Parliament, Meghalaya

The second session focussed on two topic-specific discussions; links between livelihoods and conservation in the Himalayas and the challenge of feral dogs in mountain regions.

UNITED NATIONS DEVELOPMENT PROGRAMME

Secure the Himalayas: Securing Livelihoods, Conservation, Sustainable use and Restoration of High Range Himalayan Ecosystems

This presentation highlighted the importance of Himalayan ecosystems and the vital services such as water, food security, mineral resources and medicinal products, which sustain nearly one-third of the world's human population. The Global Environmental Fund Trust has committed funds of $12 million to restore damaged ecosystems and fragmented habitats. This project is called Secure Himalayas and focuses on reducing threats to Himalayan ecosystems and securing sustainable livelihoods to build resilient communities and protect threatened and endangered species. The project will be implemented in Himachal Pradesh, Uttarakhand, Sikkim, and Ladakh in Jammu and Kashmir.

The main objective of the project is secure the Himalayas as a source for fresh water, hydropower, unique livestock breeds, mineral resources, and medicinal plants, while conserving it's rich diversity of cultural and ecological knowledge. The Himalayas face many threats, especially in terms of climatic change and anthropogenic pressures, which are undermining the integrity of its ecological processes. The project aims to address these challenges by strengthening institutions and management practices and develop livelihood strategies to promote socio-ecological resilience amongst mountain communities. As these communities benefit from conserving their natural resources, they can be transformed into guardians of their biodiversity.

World Wildlife Fund for Nature

MANAGEMENT OF FREE-RANGING DOGS IN THE HIMALAYAN CONTEXT

The World Health Organisation estimates that India is home to 25-30 million domestic dogs. From this, feral dogs are emerging as the biggest threats to wildlife across the Himalayas. Their populations are increasing rapidly in many wilderness areas, especially around army camps, where compete with natural predators and pose a significant threat to other biodiversity.

In addition, feral dogs also kill livestock, wild ungulates and the young of birds that breed in the Himalayan regions. Feral dogs, thus, pose a significant threat to human livelihoods as well as biodiversity. There is an urgent need to consider the scale of this problem and its impact on Himalayan communities and biodiversity. This will also require dialogues with the security forces to proactively reduce the number of feral dogs around their camps.

Policy recommendations from the session:

- Explore ways to bridge the gap between knowledge and data, while also improving access to information for all stakeholders.
- The need for the 11 mountains states to work together to ensure that mountain-specific policies and schemes are adopted by Government of India for the Himalayan region.
- The need to regulate and sensitise hotels, guest houses and other users about the sustainable use of water
- The need to enhance skills amongst local communities and provide opportunities to use these skills meaningfully.
- The need to rationalise policies and schemes with localised needs and knowledge in the mountain regions.

Theme 2

SKILLS FOR DEVELOPMENT IN THE MOUNTAINS

The twelfth Five-Year Plan (2012-17) is nearing completion and the target of 8% GDP growth remains elusive. The plan document also outlined the need for policy development by Government of India and the states to provide employment to educated youth, especially through growth in the agricultural, manufacturing and infrastructural sectors. The planning document envisioned that the growth should be fast as well as inclusive and sustainable. The inclusivity includes factors such as gender, class, caste, ethnicity, religion, and geography.

The report submitted by a task force constituted by the Planning Commission in 2008 titled, Problems of Hill States and Hill areas and ways to ensure that they do not suffer in any way because of their peculiarities, recognised the slow pace of development in the Indian Himalayan Region as compared to other parts of the country. The report also highlighted the ecological fragility and the multiple challenges in implementing conventional development initiatives in these regions. The launch of The National Mission for Sustaining the Himalayan Ecosystem, the only location-specific mission, along with seven other thematic missions under the National Action Plan for Climate Change, is a clear indication of the importance of the Himalayan region.

Among other recommendations, the task force emphasised the need to re-shape policies to fit the unique challenges of the mountain regions in national planning, especially in terms of good governance and harnessing of social capital at the grassroots. Other recommendations included increasing focus on agro-horticulture forestry, technology development, connectivity, market linkages and skill development. In addition, it emphasised the potential of cottage industries in the context of tourism, as this added value to locally available raw materials and generated employment.

The National Policy on Skill Development was first formulated in 2009. It was revised in 2015 and renamed as the National Policy on Skill Development and Entrepreneurship. This policy provides a framework for skill development activities in the country and also sets targets for skilling and up-skilling 500 million people by 2022 across India. Other initiatives include the National Skill Development Mission, Pradhan Mantri Kaushal Vikas Yojna and Skill Loan Scheme. Apart from increasing employment and growth, the mission also aims to harness the potential of working individuals in the age group of 15-59 years, which is expected to increase

steadily.

The focus on skilling has become a necessity in the context of uneven patterns of employment and productivity across the country. Nearly 93% of the working population is in the informal sector, which is plagued by sub-scale enterprises and low productivity. Around 58% of this working population is in the agricultural sector, which accounts for 15% of India's GDP. According to data released in 2012 by Government of India's National Statistical Service, only 4.69% of the total workforce in India has undergone formal skill training as compared to 68% in the U.K, 75% in Germany, 52% in the U.S.A and 96% in South Korea. In the context of emerging economies like India, Nobel Laureate Peter Diamond's work on search costs in labour markets is very important. It helps explain the mismatch between demand and supply of labour. He argues that just as measured unemployment does not fully reflect the actual availability of workers, so also the measured vacancies do not fully reflect the actual availability of jobs, due to the lack of education, training and skills.

The challenges in achieving the objective of the policy include limited skilling capacity (3.1 million) and the lack of convergence between school education, skill development programmes and institutional mechanism for research development. Also, in keeping with the policy's emphasis on inclusivity and equity, special attention needs to be given to youth in the North-Eastern states, J&K and the other mountain states.

The first keynote address was delivered by Jyotsna Sitling, Joint Secretary, Ministry of Skill Development and Entrepreneurship. Economic systems in mountain regions are significantly different from the plains. While mountain regions generally have adequate social capital, natural capital and financial capital (in terms of vulnerability), they lack physical capital. Thus, skilling must be viewed from a livelihood perspective in the context of vulnerabilities to natural disasters and seasonal fluctuations. Though Government of India and state governments advocate policies but there is a need to focus on participation in the process of policy development and implementation. At the same time, there is a need to standardise skills and streamline market conditions to absorb skilled youth.

Mr Sushil Ramola, Chairman of B-ABLE delivered the second keynote address. Mountain regions are rich in natural and human resources but are constrained by the lack of development. As a result, youth are driven to other areas in search of employment and livelihood. In this regard, skill development can help bridge the gap between aspirations and opportunities. There has been a significant shift in skill development over the last decade, which is an opportunity for mountain regions. Different areas must focus on specific skill sets in sectors where it enjoys an advantage (such as hospitality or disaster risk management). In this regard, a task force is necessary to understand and adapt schemes for mountain regions.

SESSION 4: SKILLS REQUIRED IN THE MOUNTAINS

Moderator: Ms. Jyotsna Sitling, Joint Secretary, Ministry of Skill Development and Entrepreneurship

Summary

Important points discussed in this session:

- The need to align skill development policies with the context in which they are being implemented.
- The importance of involving different stakeholders in any scheme for skill development.
- The need to study market needs and youth preference as well as traditional and modern skill sets to ensure a more sustainable form of development.

Dr Sapna Poti,
National Skill Development Corporation, New Delhi

ISSUES IN SKILL DEVELOPMENT AND ENTREPRENEURSHIP IN MOUNTAINS

The National Skill Development Corporation was established in 2009 and marked a major shift from the national scale to a more regional focus. Skilling in the mountains has to be contextual as the social and environmental conditions are significantly different from the plains. Often, people in the mountains are reluctant to relocate to other areas. Skilling should thus focus on traditional sectors such as agriculture, handicrafts and handlooms as well as sectors such as adventure sports, soccer, archery, culinary arts, logistics, performing arts, media, culture and tourism to encourage self-employment.

The major challenges for skilling in mountain regions include issues of connectivity (roads and digital), lack of infrastructure development for skill training due to low population densities, and lack of skill training providers. Other challenges are similar to the plains, such as the lack of seed funding, need for strong market links, infrastructural support for packaging and logistics and incubators for entrepreneurial endeavours.

Training in skill and entrepreneurship can be effective only if it focuses on sectors relevant to the area, grooms local training providers, uses unutilised infrastructure such as polytechnic colleges etc, and focuses on arts and crafts unique to the region In addition, skill and entrepreneurship policies and schemes must convergence with other schemes such as MGNREGS, Swachh Bharat Mission, Smart Cities Mission etc and develop links between entrepreneurs and funding institutions and incubators.

Ms. Mrinalini Shrivastava,
State Institute of Capacity Building, Gangtok

MOUNTAIN STATE SKILLING FOR EMPLOYABILITY: CASE STUDY OF SIKKIM

Mountain states in India face a range of different problems, including ethnic violence, lack of jobs, poor infrastructure and environmental risks. These regions are characterised by industrial backwardness; the lack of employment opportunities and low skill base. This can be addressed by concentrating on livelihood-linked skilling, placement-linked skill training and self employment-based skill training. For instance, a combination of these approaches have been used in Sikkim since 2004 to develop links with sectors such as hospitality, tourism, airlines, information technology, retail, healthcare, education, beauty and wellness. The entrepreneurship-based livelihood training targeted sectors such as tourism, agriculture, organic farming, apiculture, horticulture, food-processing, construction and tailoring.

Government of Sikkim has developed a resource centre in the form of the State Institute of Capacity Building (SICB). SICB has carried out numerous projects in collaboration with partners such as Indo-Swiss Social Enterprise, B-ABLE and Tomorrow's Foundation to create a pan-east and north-east partnership in more than 10 sectors and several trades. SICB has also implemented donor projects and achieved 98.3% placements and consolidated Sikkim as a regional resource centre for skill development. SICB follows a model that ensures that policy, processes and institutions work in tandem to achieve the desired objectives.

For placement-linked skill training, SICB initiated community-level awareness, mobilisation and beneficiary identification, followed by counselling, screening and training of beneficiaries and finally job placements with all statutory compliances. For self employment-based skill training, it followed a similar process, except that it ended with entrepreneurial training. In addition, other support was also extended to entrepreneurs, such as entity formation, brand building and marketing, accounting, and compliance and certification. In addition, support for credit linkage and documentation support, production and supply chain support, storage and transportation facilities and shared/ mobile production units, retail support was also provided.

The main strength of the project was its focus on people from remote areas and communities from disturbed areas. The training and placement helped participants gain confidence, increase their knowledge, develop a positive outlook, and earn a higher salary. This in turn had an impact on development of the community, especially in terms of perception of women and marginalised sections, increase in employment and a higher average household income.

Some important aspects of the exercise carried out in Sikkim:

- Commitment of the state to create a youth-friendly environment
- Tapping NGOs and development of Public-Private Partnership models by forming consortiums
- Provision for counselling, mobilisation and outreach
- Development of effective hand holding mechanism
- Promotion of vocational training in secondary schools to inculcate skills necessary to overcome economic challenges
- Need to create a task force to look into future prospects
- Development of model career counselling centres
- Pool funds for research and implementation of a three-year action plan
- Representation on the basis of context vis-à-vis uniformity of government schemes
- Facilitate youth leadership in different spheres and decision-making
- Action research for new technologies to generate employment and removal of obstructions in revenue business
- Develop lead and ancillary skill pools

Dr. Sonam Wangchok,
IALS/Himalayan Cultural Heritage Foundation, Leh

THE EXPERIENCE OF SUSTAINING TRADITIONAL SKILLS IN LADAKH

Several traditional skills in Ladakh have been on the verge of extinction due to lack of application or due to completion from new products. This includes skills such as traditional art, basket-weaving and restoration of religious monuments such as Buddhist chorten (stupa)

A systematic approach is necessary to revive traditions skills. This starts with a revival of interest and appreciation of the skills amongst crafts-men/women, followed by exploration of new innovations and techniques to make the skill more versatile. It is also important to encourage a wider appreciation of traditional skills as a means to earn a livelihood, especially in the context of tourism. In this regard, workshops are an important strategy to impart knowledge and skills to youth and for experimentation with development of new products as souvenirs for tourists. The revival of traditional skills to make handmade paper has not been very successful as most efforts have so far focussed on monks, rather than youth. Similarly, stone carving is another major skill in Ladakh that

requires urgent intervention before it is forgotten entirely.

These experiences and lessons needs to be institutionalised through the formation of a skill- centre to propagate, exchange and show case local skills and organise skill fairs. All such efforts must include local stakeholders if it is to be sustained in the long-term.

Mr Karma Bhutia, iShippo, Bengaluru

ENTREPRENEURSHIP IN SIKKIM

In stark contrast with the general trend of limited digital connectivity in mountain regions, 100% of Sikkim's population have access to internet. This is a unique opportunity to explore various internet based options, such as e-commerce.

An entrepreneur must focus on economy, ecology and ethics, while also incorporating traits of S.H.E.R.P.A.—Sensible, Helpful, Empathetic, Reliable, Passionate and Accessible. The first task for a successful entrepreneur is to identify the market, arrange for appropriate infrastructure and funding and to work passionately. One must also avoid the EMI trap for repaying loans and the tendency to hire individuals with sub-optimal skills.

A business idea must be tested before it is scaled. Feedback from the test is an important way to improve the plan of action and the product. It always helps to have a good mentor to discuss and clarify doubts. An entrepreneur must also ensure that account books are balanced and clean, which is crucial when approaching potential investors and funders. Entrepreneurship is a challenging task with phases of dejection and loneliness, which makes it important to remember the main motive for starting the initiative. It's smarter to focus on solving problems rather than on profits or revenue.

A practical approach to entrepreneurship is critical, especially in the mountain states. While Sikkim is the only state with universal internet access, the possibilities of digital connectivity must not be ignored. If development of digital connectivity is prioritised, skill enhancement and capacity-building must be carried out simultaneously.

Mr Moses Kunzang, LAHDC, Leh

ENTERPRISING LADAKH: PROSPERITY, YOUTH ENTERPRISE AND CULTURAL VALUES

Ladakh Autonomous Hill Development Council, Leh (LAHDC, Leh) developed the Youth Enterprise Policy in 2004 with funds from the European Union. The research was carried out by LAHDC, Leh, Druk Padma Karpo Educational Society, Shey and SP Jain Institute of Management, Mumbai.

The Youth Enterprise Policy raised important questions about the manner in which Ladakhi youth should be educated to encourage economically-productive activities. It also highlighted the need for a conceptual framework to determine existing opportunities, required skills and the changes required in the education system. The policy also emphasises the need for self-reliance, environmental conservation and reduction of skill gaps in the tourism industry. It identified inadequate infrastructure, remoteness from the market and the lack of role models as the main challenges.

The policy recommends the establishment of a Ladakh Youth Enterprise Support Agency dedicated to discuss and address issues related to youth. The policy specifies 11 economic zones—such as agri-business and horticulture—derived from the Vision 2025 document of LAHDC, Leh, to develop products and provide employment. The policy recommends the formation of student groups and the need for awareness camps and sensitisation programmes, with a long-term strategy to initiate skilling at a young age. Unfortunately, the Youth Enterprise Policy was never adopted and implemented in Leh district.

Dorjay Wangchuk, Jammu and Kashmir Entrepreneurship Development Institute, Leh

PROMOTING ENTREPRENEURSHIP IN LADAKH

Jammu and Kashmir Entrepreneurship Development Institute (JKEDI) promotes entrepreneurship across J&K, including Ladakh. JKEDI started a seed capital fund scheme in 2010/11 and adopted a single-window in 2012. The institute has been funding first generation entrepreneurs in the district to generate self-employment and empower local communities.

Under the scheme, 65% of the seed capital is provided by Jammu & Kashmir Bank at an interest rate of 10% per annum and the remaining amount is funded by the state government. JKEDI has also implemented a scheme with different eligibility criteria to enable start-ups with loans upto 8 lakhs at an interest rate of 6% per annum.

JKEDI has also been involved in spreading awareness about various schemes, selection of candidates, counselling of selected candidates, training and post-sanction surveys to monitor how the funds are used. Between 2012 and 2016, a total of 116 people have benefitted from these schemes and a total 16 crores have been disbursed, with a success rate of 95%.

Policy recommendations from the session:

- There is an urgent need for context-specific policies for skill development.
- It is important to focus on the aspirations of youth and address job placements and self-employment separately.
- Increase skills in traditional and non-traditional sectors to

diversify skill sets, preserve local culture and provide dispersed employment opportunities.

- Focus on improving skills across sectors, such as agriculture, services and manufacturing, to build human capital and capacity in the economy.
- Ensure convergence across departments at all levels of the state and central government to provide maximum impact with minimum expenses.
- Address limitations, especially in terms of infrastructure, connectivity and service delivery.
- Explore the use of technology for skill enhancement to foster new ideas, bring innovation to products, and widen the network of interaction and potential markets.
- Explore collaborations between government agencies, NGOs, research institutions and individuals to form consortiums to enhance knowledge exchange and increase the number of stakeholders.
- Replicate success stories in other regions after careful examination and context-specific adaptations. This can be initiated as a pilot model before being scaled up.
- Undertake detailed documentation of traditional practices and skills to conserve local culture and prevent the loss of traditional knowledge in an increasingly standardised global world.

SESSION 5: INTEGRATION OF INSTITUTIONAL AND INDIVIDUAL CAPABILITY BUILDING FOR ENHANCING SUSTAINABLE AGRICULTURE IN MOUNTAIN STATES

Moderator: Mr. P.D. Rai, Hon'ble Member of Parliament, Sikkim

Summary

Important points discussed in this session:

- The need to critically study current agricultural practices in the mountains.
- Integrate traditional practices to make agriculture more sustainable.
- Build linkages with different institutions and stakeholders in planning and execution of agricultural reforms in the mountains. .

The session started with a tribute to the late Dr. Pushkin Phatriyal and the late Dr. T.S. Papola, who have both played a key role in highlighting the developmental imbalances in India\s economic growth and shaped IMI as an institution. The rest of the session was dedicated to discussions around the agreement between the Food and Agriculture Organisation (FAO) and IMI to explore strategies to increase the sustainability of agriculture and allied fields in mountain regions.

Mr John Paulraj, Integrated Mountain Initiative, New Delhi

STRENGTHENING INSTITUTIONAL CAPACITIES IN AGRICULTURE FOR SUSTAINABLE MOUNTAIN DEVELOPMENT

IMI will be implementing the Food and Agriculture Organisation's Technical Cooperation Programme (FAO-TCP) in all mountain states of the Indian Himalayan Region (IHR). The Indian Himalayan Region is ecologically and culturally diverse with complex processes related to agriculture, natural resource management and development. The geographical diversity of the region acts as a constraint on the one hand, and enabled high productivity on the other. Constraints include weather conditions; dispersed population; small and underdeveloped markets; poor transport, communication and infrastructure, which have an impact on food security in this region. The major problems of the IHR include low population density, dependence on natural resources, dependence on rain and glacial melt for agriculture, poor understanding of food production and high livestock numbers in relation to pastures. In the context of climatic changes and the increasing demand on food production, there is an urgent need to address the issue of future food security in India.

In this context, FAO and IMI are developing an action plan and building partnerships with stakeholders in all Indian Himalayan states. FAO's strategic objective is to increase and improve provision of goods and services from agriculture forestry and fisheries in a sustainable manner.

- Organisational Outcome 201: Producers and natural resource managers adopt practices that increase and improve the provision of goods and services.
- Organisational Outcome 204: Stakeholders make evidence-based decisions in the planning and management of the agricultural sectors and natural resources to support the transition to sustainable agricultural sector production systems

The two-year project will focus on strengthening the institutional capacities of mountain communities in agriculture and allied sectors. The TCP will be a one-of-its-kind project that will help build networks and capacity of institutions across the mountain states of the Indian Himalayas. The FAO project will enhance IMI's outreach capability and institutional base across the IHR through workshops with different stakeholders to build partnerships, disseminate information

and strengthen existing networks.

Mr Amba Jamir,
Sustainable Development Forum Nagaland, Kohima

IMI'S ROLE IN INTEGRATING AGRICULTURE/ALLIED SECTORS IN MOUNTAIN DEVELOPMENT

There is an urgent need to document traditional agricultural practices and conduct field research to inform policy. For instance, the practice of shifting cultivation in Northeast India combines knowledge and skills related to forestry and agriculture. Traditional cultural systems and small-scale farm units include adaptive measures. Farmers in mountainous regions use diverse farming options to negotiate various challenges. There is, thus, an urgent need to look at culture with regard to food and food-systems. This not only includes production levels and food security, but also covers issues such as food sobriety with regard to policy and cultural rights.

There is a need to integrate agriculture, agro-forestry systems, horticulture, animal husbandry and dairy farming with forestry and natural resource management in terms of institutional practices and policies. Other related issues include markets, livelihoods, land tenure, access regimes and reforms, value addition, gender inclusion, involvement of youth and use of local seed varieties and traditional knowledge systems.

However, such integration faces a major challenge with regard to poor understanding of mountain regions and their traditional farming systems. These systems have been poorly documented, are linked with other services, remain largely unorganised, and suffer from poor infrastructure development. There is also the issue of policy neglect in these regions, which the states are not always able to address. There is also the added challenge of integrating new technologies in these practices and the unpredictable impacts of climate change.

Despite these challenges, there are several opportunities in these agricultural practices. This includes a well developed body of traditional knowledge, rich agro-biodiversity and diversified livelihood strategies. These practices produce niche products, which require low-inputs to create high value products, and remain open to adaptations.

Mr Sunder Subramaniam,
Development Consultant and Policy Advisor

SHARING EXPERIENCES OF FAO –TCP'

According to a study carried out between 2000 and 2005, around 300 million people are vulnerable to mountain food insecurity. Along with the increase in food insecurity in mountainous regions, there has been a 16% increase in the number of programmes to address the issue. Since 2015 or so, there has been a surge in multi-sector programmes across several states focussed on biodiversity conservation and agriculture. While this has been an important development, there is a need to expand these programmes to other states. In this context, IMI provides several advantages with its expertise and network across the IHR to study agricultural systems. On the other hand, FAO provides a global context to discussions on agriculture and food security. These advantages form the basis for the technical cooperation between FAO and IMI.

Ms Binita Shah,
Supi Agriculture Research Group, Uttarakhand

INTEGRATION OF INSTITUTIONAL AND INDIVIDUAL CAPABILITY FOR ENHANCING SUSTAINABILITY AGRICULTURE FOR MOUNTAINS

Discussions on agriculture in the mountains must focus on processes such as optimum productivity, high value and low volume products, forward linkages, technology and action research, climate change, policy development and natural resource management. There is a need to integrate different stakeholders with each other. The three main stakeholders in agriculture are public sector institutions (those that come up with ideas, generate resources etc); non-governmental organisations and the individual. Agriculture is a complex process that needs intervention from other agencies, depending on the socio-economic context.

In Uttarakhand, one of the main challenges is conflict between humans and wildlife, followed by the lack of implementation of forest policies and increasing outmigration by youth. There is need to create market opportunities and consumer awareness in the context of increased expenditure on dietary and functional foods, where mountain regions enjoy a unique advantage

One such example is that of millets, which is often described as the grain of the future. However, value addition for millets is poorly developed, knowledge integration remains slow, confidence amongst farmer is low and there is limited policy support from the government. However, the farmers that do persevere through these challenges do reap benefits by growing millets. For any interventions in agriculture to be successful, it is important to be clear about the project idea, foster expertise amongst NGOs, plan to extend support for a gestation period, and develop hubs of sub-sectors.

Policy recommendations from the session:

- The documentation and study of traditional agricultural practices is critical.

- There is a need to critically study the strengths of current practices, such as adaptability and traditional ecological knowledge systems. Such an understanding will help improve the sustainability of agricultural practices in the mountains.

SESSION 6: ENTREPRENEURSHIP AND SUCCESS STORIES

Moderator: Mr. Sushil Ramola, B-ABLE

Summary

Important points discussed in this session:

- The need to integrate traditional skills, designs and local materials with a market orientation.
- The importance of working with local communities to develop programmes to improve livelihoods and conserve biodiversity.
- The need to develop mountain-specific entrepreneurship models and schemes.

There are several challenges to living in a mountainous region. Despite these constraints, there are several success stories from mountain areas that have served as a beacon for others to emulate. The spirit of entrepreneurship is now taking root in different parts of the Himalayas. These initiatives often emerge from a mix of inherited skills, culture and the modern aspiration to conserve this heritage while generating value.

Ms Rashmi Bharti, Avani, Uttarakhand

LIVING SUSTAINABLY IN THE HIMALAYAS

There is a need to re-establish and strengthen the bond between humans and the planet. In this context, the idea of skilling is based on the recognition of what one has and its application to different situations. The work at Avani has focused on community action and participation. It works in 160 villages spread across two districts, which are mostly inaccessible by road, in the state of Uttarakhand. It focuses on working with local villagers to make products using material available in and around the village.

Kumaon Earthcraft, a self-reliant cooperative, was established to revive hand-weaving and hand spinning. The cooperative comprises of women, who are primarily farmers and artisans, and has helped them earn a sustainable source of livelihood. Around 1, 400 families in 64 villages have collectively generated around ₹2 crores in little more than a decade.

Natural dye products have also been successful. Though artificial colorants are very harmful, they are present in everything that is consumed and worn. In contrast, natural colours prepared by villagers are non-toxic and environmentally friendly. Avani has helped revived the old art of making natural dyes. The success of such products provides an incentive to villagers to plant, nurture and harvest the produce from trees. This helps conserve local biodiversity and remove invasive plant species.

Avani products are exported to fashion brands and marketed with the tagline, 'farm to fashion'. The project values local knowledge, resources and skills and gives villagers a sense of dignity. It also encourages people to remain at home in the mountains instead of migrating elsewhere. A project is more sustainable if it strengthens traditional skills, rather than try to introduce new ones. As part of the project, village women are managing solar programmes to earn decent financial returns without leaving the village. Many villagers have used these resources to construct homes and send their children to school. In addition to preparing natural dyes, some villages are also harvesting Avani Himalayan Indigo, which can be grown even on wastelands. Avani provides a template of creating rural livelihood opportunities through the preservation of traditional crafts, using appropriate technology, and farm-based activities.

The project faces many challenges, which includes the loss of traditional livelihood strategies that are not valued by locals. Also, the wages paid by the government for artistic work remain very low, while policies for industrial and commercial use of such skills remain ambiguous. One of the main challenges, however, remains the lack of accessibility to markets. In addition, the lack of community centres is another challenge in the efforts to preserve skilled labour in villages. At the same time, water and energy also need to be conserved as they play a vital role in the survival of crafts.

The project also enjoys many advantages. For instance, there is a big market for organic products but this cannot be tapped without a certain level of organisation. This presents an opportunity for mountain states, which can be encouraged through better access to capital and the use of clean technologies.

Mr Jigmet Takpa, Department of Wildlife Protection, Ladakh Region

ECOTOURISM: A NEW LIVELIHOOD ALTERNATIVE AND CONSERVATION OPPORTUNITY IN HEMIS NATIONAL PARK

Home stays in Ladakh has been a major success. The idea for such an initiative is based on the need for villagers to have alternative sources of income in addition to agriculture. This was realised through micro-level planning surveys conducted across Leh—which also provided inputs to develop the Vision Document 2025. The home stay project has been functional

in Ladakh for more than a decade and is an important part of the eco-tourism initiative being implemented in the district.

Ladakh's rich biodiversity, cultural heritage, natural beauty, raw materials for local handicrafts and access to renewable sources of energy, means that it is well-suited for eco-tourism. As home stays became popular with tourists, several women self-help group were established to manage various aspects of the eco-tourism initiative. The process is initiated through village-level training programmes to manage home-stays and eco-tourism initiatives. These initiatives have helped villagers increase their generate income; provide better education to their children, improve personal hygiene, and increase personal nutrition level. The villagers were also trained to make souvenirs and handicrafts for sale to tourists. The Department of Wildlife Protection also collaborates with villagers to hold regular cleanliness drives.

Before these initiatives, there was intense pressure on natural resources in rural areas. This resulted in intense episodes of human-wildlife conflict, even as unregulated tourism exerted further pressure on local resources. The department responded by carrying out micro-level planning and developing systems to regulate tourism, especially in biodiversity-rich areas. As part of these exercises, the department started collaborating with villagers to develop home stays and other ecotourism facilities using renewable energy technologies. This has now been institutionalised with the establishment of the Ladakh Snow Leopard Foundation, which is a society of LAHDC, Leh. It is now responsible for managing ecotourism and landscape-level conservation along with village communities.

Ms Seno Tsuhah, North East Network, Nagaland

WEAVING STORIES OF CHANGE: THE WEAVERS OF CHIZAMI

In the 2000s, an initiative was started to encourage women in Chizami, Nagaland to weave. While weaving was earlier done only for domestic use, this initiative was meant to make weaving a source of income in the context of the demand hand woven products. The initiative was meant to create alternative livelihoods for women, preserve traditional skills and design motifs through the use of a decentralised production model that allowed women to perform other tasks too.

Many women started to incorporated new designs and blend traditional icons with contemporary motifs in products meant for the market, while many introduced their own designs. In addition to generating income, this initiative has helped women participate in decision-making and explore leadership roles. As a result of this, two women were elected to the village council for the first time in the history of the village.

The Chizami initiative started with seven weavers and now has more than 400 participants from different socio-economic backgrounds. The process has enabled an interesting blending of traditional products and modern ideas, including traditional Naga sarongs and cushion covers.

The process has been documented on film, which has resulted in nine documentaries on the initiative. In addition to economic empowerment, the initiative has also improved the social status of women in Naga society, helped support local weaving traditions and conservation natural resources. The initiative still faces many challenges, such as frequent power cuts, the lack of managerial skills, shortage of funds, lack of access to appropriate technology and tools, an absence of functional networks to sustain the initiative and a shortage of skilled labour as weaving is time-consuming.

Dr. Tsering Stobdan, Defence Institute of High Altitude Research, Leh

SEABUCKTHORN FOR SUSTAINABLE MOUNTAIN DEVELOPMENT

Seabuckthorn has emerged as one of Ladakh's prized products. Despite its scope and potential, the supply of seabuckthorn remains low. This delicate fruit had no commercial value till 2001 and its potential was realised with the production of Leh Berry juice. The fruit is a rich source of Vitamin C and all parts of the plant have medicinal value. The plant has been used in the Amchi system of medicine for several centuries to cure various ailments. According to research carried out by DIHAR, seabuckthorn is only grown on 29 sq kms or 0.064 hectares of land in Leh district. DIHAR estimates that 2,400 hectares of land or 0.99 percent of land is required to grow seabuckthorn to meet the current demand. Currently, 305 crores is being generated by collecting plant material like pulp and leaf. The current demand for seabuckthorn is estimated to be around 300 metric tons (MT), while the supply is 50MT. There is a vast untapped potential demand for seabuckthorn. For instance, Indian Army uses this plant as a special ration in high altitude.

Seabuckthorn is a rich source of omega 3 fatty acid and has several medicinal benefits. In addition, the plant is also used as firewood, while its roots control erosion and fix nitrogen to increase soil fertility. An estimated 67.4% of the people who work in seabuckthorn plantation are women.

There is an urgent need to tap the potential of this plant, not only for its health benefits but also for its potential to generate a sustainable source of income in the mountain regions. One of the first steps in this regard is to conduct research on seabuckthorn to develop various products and appropriate technologies.

Policy recommendations from the session:

- There is a need to improve the quality of seabuckthorn

by using specific varieties and new methods of cultivation.

- There is a need to develop community centres to facilitate participation by villagers in various initiatives to enhance livelihoods strategies.
- There is a need to identify and grow plants that are not eaten by wild herbivores, which will reduce conflicts between humans and wildlife.
- Emphasise projects that use local materials, work at a small scale and are decentralised, as these enjoy greater success in mountain regions.
- Ensure that initiatives and projects being implemented in mountain regions respect and integrate traditional skills.
- It is critical to enhance economic and social security measures to promote ecosystem regeneration.
- There is a need for local, inter-district, inter-state, regional and international cooperation for entrepreneurship initiatives.
- Develop mountain-specific policies for skill development with convergences between different schemes, such as Skill India, Digital India, and Start-Up India.
- Create conducive platforms for consumer education, facilitate interface between craft producers and consumers.
- The cultural right of hill communities needs to be upheld. Policies need to be developed that encourage pride and economic viability of traditional skills.
- Support community institutional building, provide incentives to farmers who grow their own raw material, explore convergence of local livelihoods with schemes like MNREGS.
- Gender transformation and gender-inclusive policy interventions are needed to address needs, gaps and rights of people in mountainous regions.

Hon'ble Deputy Chief Minister of Jammu and Kashmir, Dr Nirmal Singh lighting the ceremonial lamp during the inaugural session of SMDS-V on 20 September, 2016.

The registration team with Deputy Commissioner, Leh, Sh. Prasanna Ramaswamy G., IAS (centre left) and SMDS-V Convenor, Sh. Jigmet Takpa, IFS.

Visiting fellow, Centre for Policy Research, New Delhi and London University, Prof. Philippe Cullet delivering his keynote address.

Musical performances by Ladakhi artistes during a summit dinner.

Selection of papers

Water Security in the Mountains

PHILIPPE CULLET. Senior Visiting Fellow, Centre for Policy Research, Delhi. Professor of Environmental Law, SOAS - University of London

WATER SECURITY – A CENTRAL LAW AND POLICY CONCERN

The question of water security has become a central issue over the past two decades. It is the focus of national and state-level policy. This is reflected in:

> National Water Policy, 2012: 1.2(i) 'Large parts of India have already become water stressed. Rapid growth in demand for water due to population growth, urbanisation and changing lifestyle pose serious challenges to water security.'
>
> Draft Nagaland Water Policy, 2016: 6.2 Six-pronged strategy: 'In order to address the concerns, challenges and ensure water security, future welfare and rights of future generations (...)'.

At the same time, while the literature and some policy documents refer directly to water security, various policies and laws make no reference to water security.

The first question that arises is the meaning of water security. For such a common term, it is surprising to see that different actors understand it in quite different ways. Water security may thus include some or all of the following:

- Water security as enough drinking water for each person
- Water security as the ability to grow crops in keeping with physical availability of water
- Water security as availability of water for all water uses, which can be sourced elsewhere and its availability at the local level can be influenced by external factors

Water security is often discussed at the local level but requires consideration of issues at different levels: state, national, international, global.

There is a need for cooperation to achieve water security. This is true at all levels:

- At local levels, water security for all requires frameworks for inter-sector allocation (between different sectors), which is insufficiently regulated today.
- At regional levels, water security for all requires cooperation, for instance, between Himalayan states and states downstream that benefit from the water and suffer from the consequences in case of flooding. This is true domestically (inter-state) and internationally (for instance, Nepal-India).
- At the international level, water security in mountain states requires, for instance, effective cooperation on action to address climate change, which cannot be addressed otherwise.

WATER SCARCITY AND WATER SECURITY

Water scarcity is often seen as the main factor threatening water security. Physical water scarcity is indeed a major issue

in many places, including Ladakh.

At the same time, the dominant discourse on water scarcity hides other very important issues, such as seasonal floods, areas benefitting from regular rainfall etc.

Water security is about much more than availability of water and a large part of the problems that exist are in terms of access to available water. Some of the main constraints on access include economic (e.g. price) and social (e.g. caste) factors.

WATER SECURITY: LAW AND POLICY DIMENSIONS

Water security has been addressed in law and policy terms largely in a top-down manner, despite the recognition that water is a local resource.

The law and policy framework is divided into different sectors, such as different laws for different water bodies (e.g. surface/groundwater) and for different water uses (e.g. irrigation, drinking water)

There is a lack of overall water security perspective in legal frameworks at present. Yet, there is recognition that a broader view needs to be taken, as confirmed by the Jammu and Kashmir Water Resources (Regulation and Management) Act, 2010 that takes an important step to bring different sectoral issues under one roof (though not providing an overall framework legislation). As part of the next step, states like Meghalaya and Rajasthan have started drafting framework for water legislation.

LIMITATIONS OF CURRENT LAWS TO REALISE WATER SECURITY

The current framework for realising water security is lacking in various dimensions:

- Water security is still often equated in water laws with state control over resources (eminent domain)
- Innovations that may contribute to water security are not fully implemented, as in the case of the right to water that 'exists' but is not reflected in any water law
- The strong link between land and water rights gives undue prominence to individual landowners in managing a common resource.

RECENT UNION-LEVEL INITIATIVES: NOVEL AND CONTROVERSIAL PROPOSALS

The lack of a set of common principles for all water and all water bodies has been acknowledged as being problematic. This has led to different initiatives by Government of India.

- Proposed framework legislation has been mooted to ensure that water conservation and use is governed by a single set of principles and is informed by a coordinated framework. This is in effect a reaction of the central government to the lack of state-level initiatives from where such framework legislation should have emerged a long time back and where it should in principle be adopted as water is a state subject.
- A new groundwater model legislation to replace the model legislation on groundwater drafted in 1970 (and amended up to 2005) whose limited scope has shown its limitations in a fast evolving groundwater scenario across the country. This model legislation is meant to be adapted and adopted by states, in consonance with the mandate that states have over (ground) water regulation.
- A renewed proposal to bring water on the concurrent list. The December 2015 report of the Parliamentary Standing Committee on water resources re-stated an earlier proposal to bring water to the concurrent list, a move that would divest states of some of their control over water.

Existing initiatives by the central government level pull in different directions. This requires evaluation of necessity at different levels of the water sector.

DRAFT NATIONAL WATER FRAMEWORK BILL, 2016

The Draft National Water Framework Bill, 2016 constitutes an attempt to bring some degree of coherence to water laws, starting with a set of common principles, which does not exist so far as groundwater and surface water are still governed by different legal regimes.

The Draft National Water Framework Bill, 2016 also seeks to bring water law in line with Supreme Court directives. This includes the recognition of the fundamental right to water that the Supreme Court recognised more than 20 years ago but is not yet reflected in water legislation. This includes the Supreme Court's stricture that water must be seen as a 'public trust', which implies that a state cannot claim full ownership of water but must act as a 'trustee' on behalf of everyone.

The Draft National Water Framework Bill, 2016 also seeks to provide a general framework for fostering water security, in particular by emphasising that conservation is as important as use. It proposes to do this through the introduction of water security plans.

Finally, the Bill also addresses some inter-state issues, which have partly been addressed by the central government level (e.g. Inter-State Water Disputes Act, 1956) and seeks to build on this by, for instance, providing a set of principles for inter-state water conflict resolution.

SUSTAINABLE GROUNDWATER MODEL ACT, 2016

The Sustainable Groundwater Model Act, 2016 takes steps to modernise the old legal regime, including the Groundwater Model Bill 1970/2005 itself modelled on the old legal regime.

The Sustainable Groundwater Model Act, 2016 takes the form of a model legislation that is for states to adapt to their circumstances and adopt as state legislation.

The rethinking was made necessary by:

- The rapid increase in the use of groundwater
- The dramatic depletion of groundwater
- The introduction of new legal principles that require updating of legal frameworks related to groundwater.

Some of the key elements of the Sustainable Groundwater Model Act, 2016 are:

- The recognition of groundwater as a public trust. This constitutes a complete break with the past where groundwater was essentially deemed to be under the control of individual landowners.
- The new legal regime is centred on groundwater security plans that bring to the fore the need to build regulation around conservation and use, rather than only around regulation of uses as has been the case until now.
- The new legal regime is linked to an institutional framework based on the principle of subsidiarity, which is in line with the recognition of groundwater as the most local source of water. The first mandate over groundwater is thus at the Panchayat/municipality level, with mandates moving to higher levels of governance when aquifers span more than one panchayat/municipality and say be at the block or district level.

LESSONS FOR MOUNTAIN STATES

Water security is being integrated in policy thinking at the national level and needs to be given content at the local level. This is imperative in a context where the main regulatory mandate over water is given to states.

Some of the new initiatives taken, in particular the Sustainable Groundwater Model Act, 2016 are positive to the extent that it provides an updated regulatory model in line with needs and current times.

At the same time, Sustainable Groundwater Model Act, 2016 is a positive step only if each state adapts the framework to their needs and circumstances. This was not done in the past (specifically in the context of groundwater) and the result has legislated that are unsuited to the task and so often not implemented.

Mountain states should remember that to emphasise the need to keep water as a state subject, necessary initiatives and actions need to be taken, including development of legislation to ensure that there are no major gaps in the legal framework that may justify the need for centralisation.

States must thus not only apply themselves to the task of developing modern and updated groundwater legislation, but also make sure that they recognise that the state is located between the local (panchayat/municipality) and central government. Constitutional prerogative of a state should not distract it from ensuring appropriate decentralisation of regulatory control over water.

Brief Review of Snow and Glacier Studies and Climate Fluctuations in the North-Western Himalaya (NWH): An Appeal for Holistic Approach for Water Resource Management

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ABSTRACT

With the ongoing debate and discussion around the world, snow and glaciers studies are increasingly becoming one of the important aspects of climate change studies and water resource management. Glaciers and snow in the Himalaya are sensitive to the variations in climate forcing. The high-altitude regions of Himalayan Mountains have the highest concentration of glaciers outside the Polar Regions. Glaciers in the North-Western Himalayas (NWH) are one of the most fragile and least studied. Various glacier studies across the NWH from the past few decades has revealed glacier mass loss in-terms of area and volume but it also shows the non uniformity and diverse behaviour of glaciers within and outside the region. However, glaciers monitored in the Karakoram region show different results, heterogeneous trends has been observed some are losing mass and some either advancing or in equilibrium stage. These diverse results are due to unique behaviours and dynamics of glaciers in Himalayan regions, which differ widely from east to west and from north to south. Long term meteorological data particularly the temperature and precipitation has been studied from the existing weather stations of NWH. The study shows that NWH region has warmed significantly during the study period i.e from 1901 to 2002 and at a higher rate than the global average. Further it shows no trend in winter precipitation but decreasing trend in summer precipitation for almost same study period. We could infer the positive correlations between the glacier mass loss and the meteorological data but to draw a conclusion based on limited studies will be premature and problematic. Under the warming climate scenario management of water resources has become a challenging task. We have to implement various harvesting techniques to fulfil our needs. Holistic approaches from various fields need to be taken to mitigate and minimise the challenges. To find robust solutions, one needs to incorporate both the traditional knowledge as well as scientific expertise. Government should support various projects to monitor the snow and glaciers of the NHW to minimise the uncertainties from this data sparse region and as well as to project and manage the future availability of water.

INTRODUCTION

The Himalayas, which are also known as the 'Water Tower of Asia' (Immerzeel et al. 2010), has become a major attraction for researchers. Geomorphologically, it is the highest and largest mountain region on the planet. With a unique and fragile ecosystem, it is home for millions of people and provides resources for billions of people in areas downstream. These mountains are one of the essential store houses of snow and glaciers and are often known as the Third Pole. The melt of ice from the glaciers, the perennial snow and permafrost from these frozen reservoirs add to various drainage basins in the Himalayas, ultimately give birth to some of the largest rivers of Asia e.g the Indus, the Ganges and the Brahmaputra. These rivers are the lifelines of millions of people in the downstream region. The water of these rivers is used extensively for domestic needs, irrigation and hydropower generation and thus has a direct impact on the environment and also on the socio economic structures of the country.

The Spatial and temporal knowledge and information about snow and ice are valuable not only as water resources but also as important indicators of climate change. Snow and glaciers are very sensitive to meteorological parameters especially to temperature and

precipitation. Any small changes in either of the parameters, will significantly affect the snow and glacier behaviour and health. Snow and ice have significant impacts on ecosystems and also has an influence on climatic systems. Currently mountain glaciers around the world are experiencing a period of recession. The rate of recession in the past few decades has accelerated as reported from the different parts of the globe. However, the scenario of Himalayan glaciers is quite different from rest of world. Heterogeneous trends have been observed across the Himalayan belt. Some of the glaciers in the Karakorum region are advancing, while glaciers of central and eastern Himalayas are retreating and also some glaciers are in equilibrium state. Though, we have a board perspective of the changes taking place in the Himalayan Region but so much has to be done and understood regarding the dynamics and behaviour of snow and glacier across the Himalaya. The precipitation characteristic is not uniform along the whole stretch; the Western Himalayas receive precipitation during the winter due to the Westerlies and the Eastern Himalayas gets the precipitation mainly during the Indian Summer Monsoonal months. This complex topography, climate and high altitude area makes it the best place for the formation of mountain (valley) glaciers. There are 9,575 glaciers in the Indian Himalaya covering an area of 37,466 km2 (Raina et al, 2008; Sangewar et al, 2009). Only few glaciers in the Indian Himalaya have been studied by various organisations, institutions and universities. Glaciers of the Himalayan region are not well documented because of multiple reasons such as inaccessibility of the area and lack of manpower and resource person. Thus, there is an urgent need to develop a platform where manpower can be trained and motivated to take up monitoring and scientific research on multidisciplinary aspects of Cryosphere.

REVIEW OF PUBLISHED PAPERS AND DISCUSSION

Schmidt et al (2010) measured the glacier area change between the years 1969 to 2010 in the in the Trans-Himalayan Kang Yatze Massif, Ladakh, with the help of multi-temporal remote sensing approach. During the study period glacier has lost mass about 14% (0.3% yr-1) from 96.4 to 82.6 km2 and the average ice front retreat amounts to 125 m (3 m yr-1). Within the study period it shows a high decadal variability in the ice loss with the maximum mass loss between 1991 and 2002 (0.6% yr-1), followed by a low rate since then (0.2% yr--1). One of the important findings of the study was, due to high variability in the glacier results and even a lack of variation during the study period of some glaciers. The findings of this study must not be extrapolated for the region, without knowing the properties and behaviour of a glacier, e.g glacier type and size. Further it has raised the urgent need of glacier studies especially in the Trans-Himalayan region of Ladakh, where data is sparse and people are dependent on the snow and melt water of glaciers also to minimise the uncertainties of the Himalayan glaciers.

Kamp et al (2007) studied the glacier fluctuations in the Greater Himalaya range of Zangskar region from 1975 to 2008 with the help of remote sensing data. During the period, various glaciers have been analysed and they found that glaciers are receding from the 1970s but the trend s not uniform. Different periods show different fluctuations and they also encountered certain anomalies where glaciers show either no change or small advance but they were limited to glaciers with high levels relief and which covered large areas and altitudinal ranges. Similar results have been observed by other researchers too. See for instance, Pandey et al. (2011).

Ganjoo et al (2014) investigated the glaciers of Nubra valley, Karakoram (Ladakh) for different time periods from 1969 to 2001. Out of 114 glaciers they monitored, 39 glaciers (34%) showed a gain in the area, 43 glaciers (38%) lost mass, whereas 32 glaciers (28%) show no change in area. Maximum area of 56 km2 has been lost between 1969 and 1989 and only 4 km2 between 1989 and 2001 suggesting the slowing down of glacier retreat in Nubra valley. Ganjoo et al (2014) mentioned the complexity and heterogeneous results of the glaciers studies in the valley and concluded that it is premature to draw any conclusion based on limited understanding. The complexity and variedness has been related to various factors such as topography, micro-climate and glacier type etc.

Bhambri et al (2013) studied the Karakoram glaciers focused on upper Shayok valley for different periods of the year 1973 to 2011 based on available satellite data. They investigated the area change of different glaciers including surging type glaciers and found no significant changes during the study periods. However, further analysis shows that glaciers have decreased slightly until 1989 followed by a slight increase till 2002 and 2011. Overall there were no significant changes in the glacier area, though they observed advances in glacier tongues since 1989. Other studies such as Copland et al. (2011) reported an increase of glacier surge activities after 1990 in the western and central Karakoram region. Few glaciers have been identified as surging types, including Rimo, Chong Kumdan, Kichik Kumdan and Aktash glaciers in the eastern Karakoram (Raina and Srivastva, 2008). Several periodic advancement and blockage of river by Chong Kumdan glacier have been reported and subsequent damage downstream areas after sudden breakage of moraine dam lake (Raina and Srivastava,2008; Hewitt and Liu, 2010).

Viste et al (2015) studied the snowfall in the Himalayas with the help of different models and reanalysis data. By applying strongest anthropogenic

forcing scenario (RCP8.5), the models project reduction in annual snowfall by 30-50% in the Indus Basin, 50–60% in the Ganges Basin and 50–70% in the Brahmaputra Basin by 2071–2100. The reduction of snow have been linked to increasing temperatures, as the mean of the models show constant or increasing precipitation throughout the year in most of the region. Likewise Shekhar et al. (2010) has compared the snowfall of Karakoram with three other mountain ranges in the western Himalayas during 1984–2008, and found that snowfall had been reduced in all the ranges, though less in the innermost Karakoram as compared to the outer ranges.

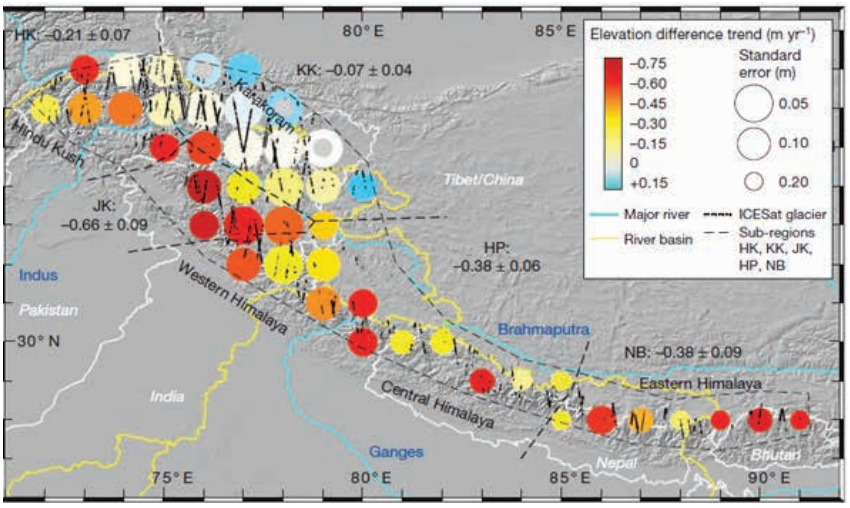

Figure 1: Study region and trends of elevation differences between ICESat and SRTM over 2003–08.

Bhutiyani et al (2010) investigated climate change and precipitation variations from 1866-2006 in north-western Himalayas (Jammu and Kashmir and Himachal Pradesh). The study shows no trend in winter precipitation but decreasing trend in the summer precipitation. Similarly in another study conducted by Bhutiyani et al (2007) on temperature trends across the north-western Himalaya in the 20th century based on automatic weather stations from Leh, Shimla, Srinagar and others parts of the regions, reveal that NWH has warmed significantly during the study period (Srinagar and Shimla (1901–2002) and Leh (1901–1989)) and at a rate higher than the global average. The study further states that unlike other mountain regions, the increasing trend of mean temperature in the NWH is due to the rapid increase in the maximum temperature rather than minimum.

Kääb et al (2012) investigated the glacier mass changes across the Himalayas for the period 2003-08 by combining two elevation data sets, the sparse laser measurements from the Ice, Cloud and land Elevation Satellite (ICESat) and the Digital Elevation Model (DEM) from the Shuttle Radar Topography Mission (SRTM). Maximal regional thinning rates were 0.66 + 09 metres per year in the Jammu– Kashmir region. Conversely in the Karakoram region, glaciers thinning were just a few centimetres per year. Figure 1: Shows the glacier mass changes across the whole Himalayan belt.

Various glacier studies across the NWH from the past few decades has revealed glacier mass loss in-terms of both area and volume but it also shows the non uniformity and diverse behaviour of glaciers within the region as well as outside the region. However glaciers monitored in Karakoram Range show different results, heterogeneous trends have been observed with some losing mass and some either advancing or being in equilibrium. These diverse results are due to unique behaviours and dynamics of glaciers of Himalayan region which differ widely from east to west and from north to south. Long term meteorological data, particularly temperature and precipitation has been studied from the existing weather stations in the NWH region. The study shows that NWH region has warmed significantly during the study period i.e from 1901 to 2002, that also at the rate higher than the global average further it shows no trend in winter precipitation but decreasing trend in the summer precipitation for almost same study period. We could infer the positive correlations between the glacier mass loss and the meteorological data but to draw a conclusion based on limited studies is premature.

Recently, the authors as part of the Glacier Research Group in JNU carried out a review of several published papers by compiling and comparing the datasets (different methods) related to glacier change with climate over the past few decades (See Mandal e al, 2016). We chose two well studied glaciers Chhota Shigri and Hamta glaciers in Pir Panjal range in the Western Himalayas. Significant mass loss during the study period was observed. Even for the same year, different methods show different results; however, all results depict negative mass loss on both the glaciers. Data from the Indian Meteorological Department (IMD) shows a significant increase in average temperature for the entire country and huge variability in precipitation particularly in the state of Himachal Pradesh. Temperature and precipitation plays important role in governing the mass balance of glacier. Thus, it can be said that the glaciers of Lahaul and Spiti region are losing mass due to changing weather conditions, especially the increasing air temperature. However, long-term MB and climate data will provide a better insight to understand and predict the future scenario of glacier health in this region

(Mandal et al 2016).

With neither uniform nor clear picture of climate change and global warming around the world particularly in the Himalayan region, it has become necessary, to understand the micro climate of the region and to estimate the contribution of snow and ice melt runoff to various rivers across the region. It is important to ask questions such as what is the present status of glaciers and snow on the Himalayan region? How snow cover changes and glacier mass loss will affect water resources and the environment ? What are their degrees of environmental impacts? Several outbursts of glacier lakes have been reported from various studies hence it is necessary to monitor the glaciers frequently to understand the physical properties, behaviour as well as to mitigate such hazardous events.

SUMMARY AND FUTURE OUTLOOK

Heterogeneous spatial and temporal glacier results have reported from the NWH especially from the Karakorum region, hence also shows the sensitivity and complexity of the Himalayan glaciers. These diverse results are due to unique behaviour and dynamics of different glaciers which differ widely from east to west from north to south. The complex topography, climate and environment are the driving force of these significant differences of the Himalayan glaciers. Even glaciers from the same region differ significantly due to its interaction between various components example atmospheric circulations, topography and geology etc. Therefore, we need to understand the entire stretch of Himalayan glaciers rather than focus only on various micro physical properties, components and its role towards the glaciers. Glaciers in the NWH are small and fragile due to its topography, environmental condition and climate. It receives scantly of precipitation and also it is a dry arid region so even a small change will have large impacts on glacier behaviour and health. Though glacier studies in these remote and hash environment is challenging but remains critical to understand the impacts of climate change in the region, to assess glacial contribution to the regional water resources. Declaring the state and fate of the Himalayan glaciers based on limited studies may lead to incorrect and misleading conclusions.

We are currently experiencing global warming and climate change, even as our basic necessities have increased exponentially. Thus, we are facing several challenges and need to come up with indigenous alternatives and adaptive measures. Various harvesting techniques like artificial glacier and ice stupas should be critically evaluated and if found to be useful, implement in other areas. There is thus a need for a holistic inter-disciplinary approach that includes participation from scientists, policy makers, decision makers and end users to tackle the various issues whether it is scientific related or social or economic ultimately it will have large impacts on our environment as well to the society.

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Impact of glacier retreat and melting permafrost with Special reference to Ladakh range

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The Indian-Eurasia continental collision is one of the most amazing aspects in the tectonic history of Earth. Tectonic evolution of Himalaya had a strong impact on the climate beyond that of the Indian subcontinent. North West trending Ladakh Batholith has significant position in the tectonic history of Himalayas as it form part of the Trans Himalayan Batholith system that defines the southern boundary of the Tibetan Plateau and Ladakh the Northern boundary of India, which extends East of Bhutan. Ladakh Batholith lies between Karakoram Range on the northeast and Zanskar Range to the southwest in Ladakh. Shayok River originating from the snout of Rimo Glacier flows between Karakoram and the northeastern flank of Ladakh range, and along the Shayok suture; Indus River flows westwards from its source at Mount Kailash in southwestern Tibet, along the Indus suture on the South west, between the Ladakh and Zanskar ranges.

Glaciers in Ladakh range are retreating as are a majority of the glaciers in the Himalayan and Karakoram ranges. Unlike the Karakoram glaciers, which exhibit widespread surge-type behaviour, glaciers in the Ladakh Range mark the southern boundary of Karakoram Anomaly as glaciers of Ladakh range show no evidence of surging. They are primarily influenced by the monsoon climate regime, there by an intermediate zone bordering the Karakoram Anomaly to the north and the western receding Himalaya to the south (Chudely et.al. 2016).

The Ladakh Batholith represents the northern buttress against which the Himalayas have been deformed (England and Searle 1986). Sedimentary successions of Indus Molasse are deformed

as they have been thrust northwards towards the Ladakh Batholith from early Miocene till recently (Sinclair and Jaffey 2001). Digital elevation models analysis of Ladakh Batholith reveal a high degree of variance in the morphometric character of the transverse catchments that drain south-westwards into the Indus valley versus those that drain north-eastward into the Shayok valley. The 16 catchments that drain into the Indus valley are significantly shorter and thinner, and also have a lower mean elevation and lower proportion of their area at high elevation than the six equivalent catchments that drain into the Shayok valley (Jamieson et.al. 2003).

The glaciers on the northern slopes of the Ladakh Range are larger as compared to glaciers on the southern slope. This has lead to the development of larger glacial lakes in the catchments of tributaries of Shayok River flowing from Ladakh range. As a result the sizes of recessional glacial lakes are much larger as compared to the glacial lakes on the southern slopes of Ladakh range. Glaciers on the southern slopes are smaller and hence form smaller recessional lakes. These glaciers have receded to such an extent that their response to current rise in global temperature is more by surface melting of the glacier, rather than recession along the length of glacier; this is evident by the low rate of recession of these glaciers. Surface melting of glacier is also evident by the number of supra glacial channels over height of 5,500m asl on the surface of the glacier

The climate of Ladakh is cold arid with desert conditions. Precipitation occurs during the summer months, when monsoons are forced northwards. Tectonic uplift of Greater Himalayan range to south of Ladakh has reduced the northward penetration of the Indian Summer monsoon into Ladakh; being the likely cause of the reduction in moisture flux that reduce glacier accumulation (Owen et.al. 2006). Moist monsoonal air mass moving northwards is forced to ascend by the Himalayan orographic barrier; this enhances condensation and cloud formation, which ultimately controls the triggering duration high intensity of precipitation events (Bookhagen et.al. 2005). In winters temperatures can go as low as – 250 C. The loss of most of the water through rapid snowmelt in spring means that vegetation cover is minimal and discontinuous in Ladakh (Fort 1983). In recent years, the impact of the Indian summer monsoon across the great Himalayan orographic barrier has increased. Cloud burst of August 2010 over the Ladakh range caused massive damage to life and property, a case of intensified monsoonal precipitation on leeward side of the orographic barrier. Possibly such events have a repeat cycle of about 100 to 60 years.

Climate changes associated with the retreat of glaciers since the end of the last ice age played an important role for the migration of early inhabitants of Ladakh to settle in the deglaciated valleys and on the alluvial fans of the tributaries of the Indus and Shayok rivers. Inhabitants of Ladakh owe a great debt unconsciously to Quaternary Ice Age. Current global warming has accelerated the rate of glacial retreat to such an extent that the inhabitants of Ladakh are forced to adapt to fast depleting glacial melt water, which has been supplying water for irrigation and domestic needs for several centuries. Chhewang Norphel, glacier man of Ladakh, has made an effort to overcome the shortage of water in Ladakh by creating artificial glaciers. Precipitation snow/rains and glacial melt water recharge ground water. Traditionally, ground water was not pumped for irrigation or daily use by the people of Ladakh. The perennial springs and seasonal springs were used for domestic purposes. Over the years, people of Ladakh have perfected a system to utilise and optimise the limited glacial melt water supply.

As glaciers retreat, lakes are usually formed behind the newly exposed terminal moraines. Many of these glacial lakes provided much needed water to the inhabitants of Ladakh. These sources of life-sustaining water have caused many Glacial Lake Outburst Floods (GLOFs) with devastating impacts. This is evident from the large number of boulder strewn across the alluvial fans on the slopes of Ladakh and Karakoram mountains. Remains of drained out glacial lakes in the head waters of tributaries of Indus and Shayok rivers are mute witnesses to numerous instances of GLOFs in geological and historical time, which is clearly seen in Google Earth images of the region. GLOFs, or any other kind of flood, wreak havoc with unrecoverable destruction to settlements, farmlands and loss of life; which disturbs the livelihood of inhabitants for long periods of time. Many a time, they are forced to shift to safer locations. Flash floods in the last century in Ladakh have been recorded in the state government's land revenue records. However, they have not been well recorded in scientific literature. Ladakh witnessed several GLOFs during the 1930s, of which Chong Kumdan Glacier Lake Outburst remains the best documented and monitored GLOF of Ladakh (Hewitt 1982) till date. The flash flood on 26th July 1934, which nearly destroyed Hundar village in Nubra valley (personal communication, Zamul Abedin) was caused when one of the three recessional lakes in the head waters of Hundar Tokpo burst its banks. The remnants of these three drained out glacial lakes are clearly visible in the Google Earth imagery of the region.

GLOF in Karakoram Range are by and large caused with the blocking of river by surging glaciers. Chong Kumdan glacier surged and blocked Shayok river, forming a 16-km long lake with an average width of 1.6km in 1929 (Hewitt 1982). On the other hand, GLOFs in the Ladakh ranges are caused by the bursting of recessional glacial lakes. In recent years, GLOFs have been triggered by prolonged low intensity rains followed by localised intense rains for

short periods of time in the head waters of tributaries of Indus River. These GLOFs have caused considerable damage to life and property but the magnitude of these GLOFs were not large enough to receive due attention from the scientific community and administration. They were usually passed off and recorded as floods in land revenue records.

Rapid melting of permafrost has further accelerated the bursting of glacial lakes. Subsurface ice contained in terminal moraine and melting of permafrost is similarly affected by climate change, causing persistent impact on natural and human systems. The problem of melting of permafrost is not observable spatially and therefore its presence and possible changes are frequently overlooked. This problem has not received its due attention in the country. As a matter of fact, the melting of mountain permafrost and its recession to higher elevations is not well documented in comparison to the recession of glaciers, as mountain permafrost is more difficult to investigate. Unlike glaciers or snow, permafrost is usually concealed beneath the active layer and therefore excluded from effective observation with e.g. satellite-based remote sensing. Permafrost can be identified locally with direct measurements in boreholes, excavated pits, or with geophysical methods (Gruber et.al.2016). Ladakh being in the lee ward side of the Great Himalayan range with a cold arid climate, it is ideal for conducting a detailed study of permafrost, especially mountain permafrost. Melting of mountain permafrost makes considerable contribution to melt water discharge from the glaciated catchments in Ladakh. Seasonal freezing of ground is also responsible for holding of water in winters and releasing it slowly in spring. The impact of melting permafrost has direct bearing on the catchment hydrology as slopes are major contributors to stream flow.

Phutase glacier lake outburst floods in the headwaters of the stream flowing through Leh town, and Phyang Tokpo glacial Lake Outburst floods in August 2006 were triggered by bursting of recessional lakes by prolonged low intensity rains, followed by short spells of localised intense rains in head waters of these two streams. In the preliminary field investigations of Phutase Glacial Lake in the summer of 2007 and 2009, it was observed that the moraine dam collapsed with melting of permafrost and ice core in the terminal moraine with increase of atmospheric temperature, bursting of glacial lake was triggered by the short spell of intense rains. Increase in temperatures has increased the surface melting of glacier above the elevation of 5,500 masl. This is evident by the number of supra glacial channels on the surface of Phutase glacier. Melt water from these supra glacial streams played a major role in the increase of melt water flow into the glacial lake. However, glacial melt water was not enough to fill these lakes rapidly; this was compensated by the long spell of rainfall and by rapid melting of permafrost. This is evident by the number of streams trickling into the lake from valley slopes. Phutase glacial valley has well developed periglacial and mountain permafrost morphological features.

Flash floods in Nimo-Basgo in the intervening night of 4th and 5th August 2010 and in Leh between 01:30 and 02:00 AM the following day claimed many lives with massive destruction to infrastructure. These floods were caused by localised events of extreme intensity of rainfall in a short spell of time. Occurrence of such events in the geological past and over the last few hundred years are exemplified by a number of geomorphological features on the slopes of the Ladakh range of mountains. These types of events seem to have a return period of 60 to 100 years (based on discussion with elderly people in Ladakh, which needs to be authenticated). It is necessary to make a distinction between Cloudburst and GLOFs trigged by intense rains. As the proper distinction is not made, GLOFs do not receive their due attention. .

There is an urgent need for formulation of strategies to effectively mitigate risk of GLOFs. Nearly 60% of inhabitants of Ladakh are settled on the southern slopes of the Ladakh mountain range. Indus River is of little use to local populace of Ladakh as it flows deep down the valley, except for few settlements along the banks of the river. Considering the importance of glacial lake on southern slopes of Ladakh range for people of Ladakh, it is suggested that these glacial lakes be monitored regularly, and develop and implement appropriate engineering interventions to decrease the risk of GLOFs. Efforts have to be made to exploit the maximum amount of water for use by people living downstream by minimum appropriate engineering interventions. At present a small percentage of water flowing from some of the glaciers of Ladakh is utilised. The melt water from small glaciers like Phutase glacier, which flows through Leh town is not enough to meet the growing need of the town. Sudden release of water by GLOFs causes damage to infrastructure and disrupts agriculture activities and large amounts of water go unutilised. With planning and proper investigations, melt water of these recessional glacial lakes can be utilized to its optimum. Many of the recessional features can be utilised to conserve and control flow of melt water downstream. Phutase glacier in the head waters stream flowing through Leh town would be ideal for initiating such an intervention. The controlling of water flow from glacier and higher reaches of valley during summers would go a long way in enhancing the depleting ground water reserves of Ladakh. This would to some extent reduce the rapid reduction of permafrost. This would also increase the area of seasonal ground freezing of near surface ground water to some extent. In turn, this would considerably enhance stream flow during summer months.

In recent times, flash floods related to rains have definitely increased. Detailed geomorphological investigations and mapping is required to prepare hazard maps of the region. There are a number of potentially dangerous glacial lakes in the Eastern Karakoram and Ladakh ranges. Glacial lake formed by the surging of two tributary glaciers, which has blocked the melt water flowing from Kunzang Glacier; forming a lake that is approximately 1,100m long with a width of approximately 600m, in head waters of Kunzang Lungpa, a tributary of Shayok River in the Eastern Karakorams. This lake needs urgent monitoring and detailed investigations to reduce the possibility of bursting of this glacial lake. There are number of potentially dangerous glacial lakes in the head waters of Hundar and Kharu Tokpo tributaries of Shayok River flowing from the slopes of Ladakh range. These glacial lakes need urgent monitoring considering the number of remnants of drained out lakes in the catchment of tributaries of Shayok. The \GLOFs that occurred on 26th of July 1934 in Hundar Tokpo and Kharu Tokpo in August 1982 indicates the vulnerability of glacial lakes bursting in catchment of tributaries of Shayok river. An interesting case of blockage of Kharu Tokpo by a rock glacier is observed in Google Earth imagery of the region. At present, Kharu Tokpo seems to be flowing below a rock glacier, which needs to be confirmed through field investigations.

Glacier lakes in Ladakh need to be studied in detail and inventory of these glaciers needs to be prepared, identifying potentially dangerous glacial lakes in the region and plan for the optimum utilisation of water from these lakes. An early warning system for GLOFs needs to be established for potentially dangerous glacial lakes. Many lives were saved during the floods in Phyang Tokpo August 2006, by the quick thinking of villagers in the higher reaches of the village, who warned the people in lower reaches of the valley through mobile phones of the flash floods. The impact of melting of permafrost on the occurrences of GLOFs needs to be investigated in detail urgently.

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The irrigation systems of Ladakh's farming communities: Survivability of traditional practices in the modern era

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ABSTRACT

Kargil district in trans-Himalayan Ladakh is undergoing rapid change in the early 21st century. Due to a deficit of rainfall in valley bottoms, irrigation is necessary to grow cereals, vegetables and herbs, trees, bushes, shrubs, and fodder. Roughly a half of Kargil district's land is under barley, one-quarter under fodder, the remainder under wheat, pulses, vegetables and oil seed. The majority of the gross area sown is irrigated by Farmer Managed Irrigation Systems (FMIS). Despite its importance for the water security of the bulk of the district's population, these FMIS are facing several threats. This paper makes four broad recommendations. First, the current survey and settlement procedures underway in the district should include documentation of the rights and responsibilities attached to FMIS, especially those constructed in the past hundred years for which no rights have been recorded. Second, it is important that Irrigation Department projects to renovate FMIS involve locals, both in planning and construction activities. Third, traditional farming skills and practices need to be preserved and utilised, for which a multi-pronged strategy is required, i.e. by including agriculture in the school curriculum, by supplying local grain types through the Public Distribution System (PDS), and by preserving and utilising elders' farming knowledge. Finally, division of communities along party political and other lines is damaging village-level institutions and development schemes. Water security implies good governance (Cook & Bakker, 2012), so care must be taken to check factionalism at the grassroots and to ensure proper coordination between various stakeholders in the development process, including villagers, Nambardars, Sarpanches, Councillors, Junior Engineers and other bureaucrats, elected officials, political parties and religious leaders.

INTRODUCTION

Kargil is Ladakh's less known half. It has undergone rapid change in the past few decades. After Indian independence, the villages in the district were mostly self-sufficient. However, population growth and resulting land subdivisions along with political economic developments, these villages have became dependent on outside resources. In 2013-14, a total of 11,454 ha of land was cultivated in Kargil, of which 47% was under grim (barley), 24% fodder, 18% wheat, 8% pulses, and 3% vegetables and oil seed (GoJK, 2014). Data from the 1991-1992 Agricultural Census shows that 81% of households had marginal landholdings (less than 1 ha), a further 11% had small landholdings (1-2 ha), and 6% had small-medium landholdings (2-4 ha) (GoJK, 2011: 25). Several major irrigation projects are underway in the district, such as the ₹36 crores Parchichik project that was started in 2008 and aims to irrigate 10,000 ha[1]. In 2014, the Naib Tehsildar for Sankoo shared his view that land is no longer the prime source of revenue for villagers. Survey data for Karchay Khar village[2] shows that 85% of households have members who have migrated to work as labourers in the recent past, while the remainder have at least one person working outside the village. Migratory work is seasonal and an important source of earnings; however village-based livelihoods remain paramount to the well-being, food security and lives of a majority of the households.

In Kargil district, due to a deficit of rainfall in valley bottoms[3], cultivation of grains, vegetables and herbs, trees, bushes and shrubs, and fodder is only possible by the channelling of snowmelt and spring water to farmland via Farmer-Managed Irrigation Systems (FMIS). Karchay Khar Gram Panchayat, where research was conducted in 2013-15, has at least 20 such FMIS (Hill, 2014). The management of each and every FMIS is guided by a set of rules and rights that exist to ensure the channel's proper maintenance and equitable distribution of water to farmland (Labbal, 2000; Wacker, 2007). This paper argues that FMIS, vital for the water security of these village communities, are under threat for a multitude of reasons, e.g. increase in cash economy, non-farm employment, government programmes, education system, and factionalism.

[1] Sadiq Ali, personal communication, June 28, 2013.

[2] 27 households were randomly selected from a total of 59 households in Karchay Khar mohalla.

[3] Hartmann (1983: 136), quoted in Gutschow (1998: 445), compiled statistics over 30 years (1931-1960) and determined an annual precipitation for Kargil of 306 mm/annum.

This paper's theoretical perspective draws on the water security literature. Cook and Bakker (2012) critically examine the use of the concept of water security in academic and policy debates based on a review of 418 articles and reports. They find that the concept has multiple definitions, and is increasingly being used across disciplines; since the 1990s the concept can even be considered an "emerging paradigm". Four broad themes are identified, pertaining to water availability, human vulnerability to hazards, human needs, and sustainability (with surprisingly little emphasis given to military security). The authors argue in favour of a 'broad and integrative conceptualisation of water security' (ibid: 94). This paper takes such an approach. It looks at water security from four angles, namely legal (land revenue settlements), sustainability (Irrigation Department projects), human needs (food security), and governance (party politics at the grassroots)

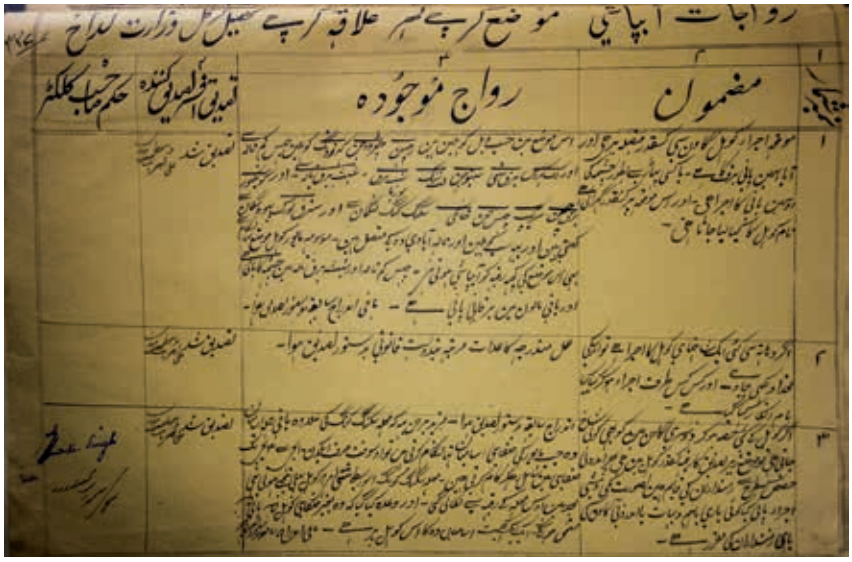

Figure 1: Page one of Karchay Khar's Riwaj-i-Abpashi

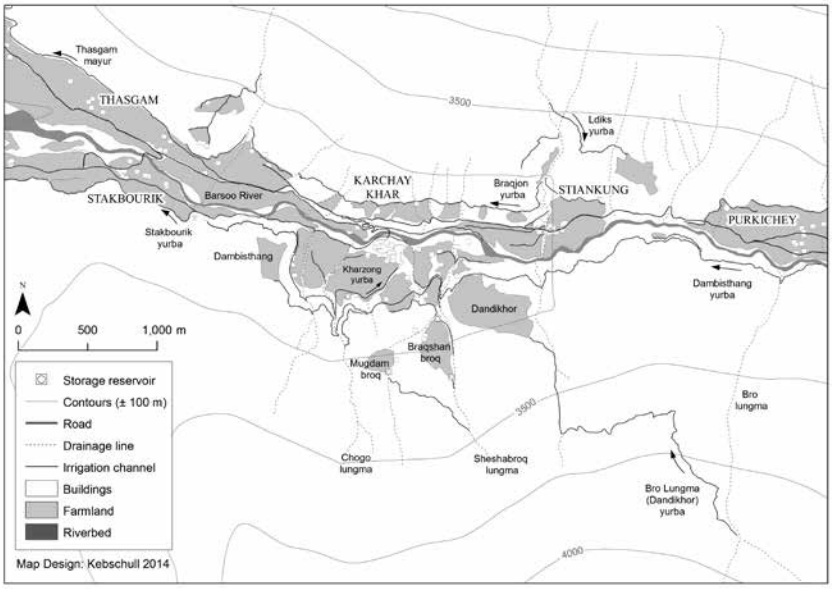

Figure 2: Karchay Khar village and its irrigation systems in 2014

LEGAL ANGLE: LAND REVENUE SETTLEMENTS

After a gap of 100 years, a land revenue settlement is underway in Kargil district. By 2013, settlement operations for five of the smallest of Sankoo Tehsil's 36 villages were completed. The Tehsildar estimated that 31 years will be needed to complete the settlement for Sankoo's remaining villages. The settlement process and its documentation of irrigation rights and customs affect FMIS in several ways. Baker (2003) shows how the colonial codification of social customs, practices, and law during the land settlement was fraught with challenges and contradictions. For example, the extraction and classification of local irrigation knowledge and rights shifted power relations among local groups, undermined the basis of authority of 'water-masters' ('Hrkongpa' and 'Helbie' in Kargil), shifted the terms and contexts of water disputes from local, oral and civil to general, written and state-centred, and expanded the presence and influence of the state at the local level (ibid.). Coward (1990) suggests that the irrigation rights documented during the land revenue settlements of the 19th and early 20th centuries continued to provide much of the social glue required by water users to operate and sustain their irrigation systems. Both Baker (2003) and Coward (1990) show how irrigators used the record of irrigation customs to successfully defend their water rights' claims against competing interests (e.g. creation of new channels or infringement of water entitlements by state or other groups).

In recognition of the importance of the recording of irrigation rights and customs in the current settlement, field research in 2013 and 2014 sought to find out if the land revenue settlement and re-assessments of the early 20th century, which recorded each village's irrigation rights and customs in the Riwaj-i-Abpashi are still relevant today, and if irrigation rights and customs are being recorded in the new settlement. To answer these questions, the irrigation systems of two revenue vil-

lages, Karchay Khar and Gyaling, were investigated. Gyaling was taken as a case study to examine how water rights and customs are being recorded in the new land revenue settlement, because its survey has been completed. Besides talking with farmers, interviews were conducted with government officials such as the Tehsildar and Patwaris at Sankoo Tehsil and the Archives Officer at Kargil's Muhafiz Khana (Record's Room).

Comparison of Karchay Khar's 1910 Riwaj-i-Abpashi (Figure 1) and contemporary irrigation practices reveal that the same rules are followed with minor adjustments to account for demographic changes and land sales (Hill, 2014). Several major FMIS have been constructed since Indian independence, namely Dambisthang *yurba* (in 1950-60) and Bro Lungma *yurba* (*yurba* is the local word for an irrigation channel) in the1980s, the rights and customs of which have hitherto not been recorded by the government (Figure 2). The villagers themselves have sophisticated institutions to manage these channels and to resolve any disputes that arise (inter- and intra-community). For example, Dambisthang *yurba* has a system of water rights based on the original 36 right-holders (one being the village mosque, another being a household that gifted its land for the construction of the channel). Its 12-day system of turns dedicates four days and nights of water to three groups of 12 households respectively. The channel also has a dedicated "Helbie" and an annually selected "Hrkongpa", both of whom are remunerated for their services.

Gyaling's 1910 Riwaj-i-Abpashi mentions only three irrigation channels, however 20 years ago a fourth channel, Shagaran *Kuhl*, was built to supply water to the land of 33 households. Shagaran *Kuhl* has not been recorded in the current settlement, and moreover, the details from the Riwaj-i-Abpashi section of the 1910 settlement are not transcribed into the new settlement, which does not have a Riwaj-i-Abpashi section. Gyaling's Nambardar and other villagers told us that the new settlement was completed in 2006 over a two month period. During the process nobody asked for details about their irrigation systems, and so these were not recorded. Sankoo's new Naib Tehsildar, Mohd Abass, said that under the new settlement, if there's no new irrigation system in a village, then there's no need to record water rights. He was of the view that for the villages where the settlement has been completed, there has been no need to record any water rights. Yet this research showed otherwise—that in Gyaling such rights had not been recorded (Hill, 2015).

SUSTAINABILITY OF IRRIGATION DEPARTMENT PROJECTS

Only in recent decades have outside agencies, such as government and NGOs contributed to the maintenance and sometimes construction of village infrastructure, including FMIS. Yet, there are few if any studies that critically examine how such interventions interact with communities of water users and their management of irrigation channels. The need for external agencies to intervene in FMIS in Asia's high mountain valleys arose due to changes partly external to the region, e.g. geo-political and economic developments, and partly internal, e.g. changing livelihood options and aspirations. Combined with its engineering roots, contemporary irrigation policy is largely guided by an instrumental rationality, resulting in the promotion of standardised solutions that are assumed to have general applicability, hence transferability (Boelens, 1998; Vincent, 1995: 124). However, the normative and organisational arrangements that sustain FMIS reflect the underlying property grid formed during initial construction, because the rights and obligations developed during construction are reproduced through the use, maintenance and repair of irrigation systems (Coward 1986). Thus, standardised approaches that fail to honour existing water rights and build upon existing social arrangements are unlikely to yield positive results (Coward, 1990).

Karchay Khar's oldest FMIS serve the village's most productive land while other smaller channels were developed to serve areas of land on which grass and alfalfa are grown. The village's two longest irrigation channels were constructed after Indian independence without government support. The seven-km long Dambisthang yurba sources its water from Bro Lungma and Barsoo River. Starting in 1951, its construction took 18 years to complete. Local government provided only a little dynamite to help villagers. Developed by 34 households, who were each allotted land at Dambisthang, its water is distributed according to the contribution of labour made during construction. Village elders (especially Sheikhs and Akhoons[4]) make and enforce certain rules pertaining to such FMIS (see Hill 2014: 17). The five-km long Bro Lungma yurba serves a large area of land where 55 households grow alfalfa, much of it for sale to Indian Army and the government's Sheep Husbandry Department. This 30-years-old irrigation channel sources its water from snowmelt at its headwork located at an altitude of 3,800m above msl. Each year at least three working days are spent repairing Dandikhor *yurba*, while up to two weeks of repair work is required for Dambisthang *yurba*. For this reason, villagers seek support from government agencies to concretise sections of the channel that are deemed weak.

Irrigation development projects are largely executed by the Public Works Department (PWD) in Ladakh. In 2011, ₹2 crores, to be spent over a period of 10 years, were earmarked by the Ladakh

[4] Akhuns are clergy who have not travelled abroad for their studies.

Photo 1: Villagers repair collapsed section of a FMIS in 2013

Photo 2: Concretised section of FMIS in 2016 (same section shown in Photo 1)

Autonomous Hill Development Council, Kargil (LAHDC, K), for the improvement of Dambisthang *yurba*. According to the PWD's Junior Engineer, in charge of this project, in the first year ₹25 lakhs was spent on concrete lining and support treatment at the headwork, and in 2012, ₹5.5 lakhs was spent on support work in three places between the headwork and village. The Junior Engineer explained that if set correctly, concrete lining can have a lifespan of 50 to 75 years. The Junior Engineer prepares a tender for whichever sub-project is to be implemented each year, and several contractors apply, having to front 'insurance' money as they do so. The selected contractor will complete the job, striking a balance between quality and cost, for what remains of the project funds is his payment. Some villagers stated their unease with this non-transparent process because it encourages corruption. Yet, this way of working in engineering projects, the norm across India, has been introduced to Ladakh.

In 2013 and 2014, the villagers were happy with the project. They mentioned that due to the 2011 work on Dambisthang *yurba*'s headwork, they now only spend 3 to 5 days at the start of the year repairing the channel as compared to 15 to 20 days in the past. The villagers have retained their ability to repair irrigation channels themselves using local materials. In June 2013, a section of Dambisthang *yurba* collapsed. Within a couple of days the villagers had repaired the collapsed channel section with remarkable skill and cooperation (Photo 1). This section was still functional two years later, in 2015.

In July 2015, unusually heavy rainfall caused rivers across Kargil to swell, washing away the head works of irrigation channels across the district. In each of the three villages visited in 2015—Gyaling, Stakbourik, and Karchay Khar—irrigation channels' head works were destroyed by the torrential flows. Dambisthang yurba's concretised headwork, completed in the first year of the above-mentioned PWD project, was ruined. Later that year, however, as revealed during a visit in September 2016, the section was rebuilt at a cost of ₹1.5 lakhs. In this regard, the villagers of Karchay Khar were lucky because many of Kargil's villages are yet to receive support to repair and strengthen the head works of their FMIS (Dolkar, 2016).

Also in 2015, the Irrigation Department's Junior Engineer had awarded a tender for the renovation of a section of Dambisthang *yurba* close to its head work, to a contractor living in another of Barsoo valley's villages, who in turn had hired a gang of Nepalese labourers to undertake the work. Karchay Khar's Sarpanch explained that his villagers had insufficient money to bid for the contract, and that this sub-project's contractor is allowed to hire whoever he pleases to undertake the work. Besides alleged sub-standard work and corruption, the ten-year long Irrigation Department project to renovate Dambisthang *yurba* may negatively affect the management of the FMIS, because water users are themselves not undertaking all the renovation works. One farmer even said that the work was too tough for him and his villagers.

In the autumn of 2015 and spring and summer of 2016, ₹45 lakhs were spent concretising over 200m of Dambisthang *yurba* (Photo 2). Positively, users of the FMIS were involved: the work was undertaken by 12 Nepalese and five local men from Karchay Khar, and was overseen by Abdullah, who is the long-term and hard-working "Helbie" for this FMIS.

HUMAN NEEDS ANGLE: FOOD SECURITY

The Nambardar of Karchay Khar revenue village recalled how in his father's time, villagers sold their wheat and barley to purchase whatever outside goods they needed, such as clothes and other food items. In 2014, the (now late) Haji Hassan, recalled how they used to exchange their barley for kerosene and oil in Kargil town. His father used to go to Skardu, Srinagar, Leh and Changthang to trade sheep's wool, salt, apricot, rice, dal (pulses) and tea. The Nambardar, Mohd Issa, said that his village used to supply about 20-40 quintal of wheat to Kargil each year, yet nowadays about 120-180 quintal of rice and wheat flour are supplied to the village each year through the Public Distribution System (PDS). The Nambardar thinks that the Agricultural Department should work with village elders to teach the younger generation how to farm properly. He and other village elders' believe that the younger generation have lost interest and never learnt skills required for farming.

> *Today's youngsters give too much water on the first irrigation, whereas actually only a little is needed. The same with fertiliser; too much of which spoils the land. Youngsters don't know about seed, farming, fertiliser...In the old days, if we sowed wheat for two years, on the third year we'd grow peas, but nowadays not so many people understand this* (Mohd Issa, April 2014).

Based on his work in the Zangskar region of Kargil district, Osmaston (1994, as cited in Mankelow, 1999) suggests that traditional Ladakhi farming practices can produce yields comparable to those of Europe's intensive farming systems. Mankelow (1999) shows that growing taller crops using chemical fertilisers helps to offset fodder shortages, yet questions the role agricultural inputs play in exacerbating divisions within communities along wealth and status lines. At the Agricultural Department's office in Baroo (Kargil town), a document titled 'Annual working/action plan for 2013-14' provides data showing that though 46.8% of the net sown area is under barley/grim, no modern varieties have been introduced[5]. Two high yielding varieties (HYVs) of wheat, 'HD 1553' and 'Sonalika' have been introduced, and there is a fodder development programme and a pulses programme too. In Karchay Khar, I conducted a PRA exercise with farmers to understand the pros and cons of different wheat varieties. The farmers listed six varieties, of which one was an introduced HYV called 'Mexican'. Though Mexican gives a yield higher than that of local varieties (ranging from 14% to 320% higher), it needs chemical fertilisers which harden the land, is difficult to harvest, and does not satisfy hunger and nutrient requirements. In 2016, the Nambardar of Karchay Khar said that his villagers only sow traditional varieties of barley, and that Sonalika and Mexican varieties of wheat had been introduced and are grown only on certain fields. Food security and human needs ought to be properly conceptualised to ensure farming systems and irrigation systems continue to function.

Elders are worried that the schooling system discourages youngsters from engaging in farming and other traditional livelihoods. In 2016, I visited a middle school in Kargil district to see what information was being provided to children through their school textbooks. The teachers complained that the textbooks, prepared by the Jammu and Kashmir State Board of School Education, are in part inappropriate for Ladakhi children, and also contain some factual mistakes. In the class VIII Geography textbook, Chapter 4 is titled "Agriculture". On its first page the students are informed that chemicals are an input to agriculture and that subsistence farming has a low output. Are such statements factually correct? Can agriculture, livestock management and so on be given more attention in the curriculum? Another way that traditional farming systems are being undermined is through the PDS, which provides rice and wheat to households. As suggested by Rigzin (2016), barley and wheat should be procured locally and supplied to households through the PDS system.

GOVERNANCE ANGLE: PARTY POLITICS AT THE GRASSROOTS

Governance matters to water security, because good governance is an imperative for the successful management of multiple stressors on the water environment (Cook & Bakker, 2012). In Ladakh, two democratic systems of governance overlap with one another: Panchayati Raj and LAHDC, Kargil. Indeed, LAHDC, Kargil overrides the third tier of Panchayati Raj, namely the Zilla Parishad. These two systems are also out of sync with one another. In the Barsoo valley, which branches off the Suru valley at Sankoo, the two political parties, the National Congress (NC) and the Indian National Congress (INC), are allied with the Islamia School, Kargil (ISK) and Imam Khomeini Memorial Trust (IKMT) respectively[6]. Two of the 26 elected Councillors to the LAHDC, Kargil are elected from the Barsoo valley. In 2003, the Councillor elected by the Thasgam-Thuina constituency stood with the NC, independent of ISK and IKMT. Later in 2008, he stood again with the support of the ISK, and won with a large margin. In the third election to form LAHDC, Kargil in 2013, he lost to his rival

[5] Though according to GoJK (2011: 28) 'improved seed' of grim was distributed from 1996 to 2000, and 2006 to 2010, along with seed of wheat and vegetables.

[6] Even Sheikhs and Akhuns of the same household can be divided in their loyalties to either ISK or IKMT.

(an INC candidate), despite having the backing of ISK.

In the 2011 Gram Panchayat election, at a time when the Councillor was from NC, an NC candidate won the post of Sarpanch in Karchay Khar. Yet in 2013, two years into the Sarpanch's five year stint, an INC candidate was elected Councillor to Thasgam-Thuina constituency. This means that the Sarpanch and his Gram Panchayat might be side-lined by the Councillor for the three years that remained of their term. The Sarpanch was of the view that party politics does not affect intra-community relationships, "*Hum miljulke baithe hain*" (We have lived together). However another villager pointed out that not all the supporters of the respective political parties and Islamic schools talk to one another, and attend one another's functions, ceremonies and rituals. These political divisions have implications on the unity of communities and the allocation of development resources to and within LAHDC, Kargil's constituencies and Gram Panchayats. For example, it's probably not a coincidence that Karchay Khar was awarded ₹10 crores for Dambisthang *yurba*'s renovation when its Councillor and Sarpanch were from the same party, which also controlled LAHDC, Kargil at that time. Roughly ₹76 lakh of the ₹2 crores allocated to Dambisthang *yurba* has been spent, but it's not clear if the remainder will be made available now that the opposition party controls LAHDC, Kargil.

Katpa (2016) recommends the streamlining of convergences between the Jammu and Kashmir Panchayati Raj Act and the LAHDC Act, to avoid ambiguity and conflict of interest. Hardassi (2016), commenting on the political crisis facing LAHDC, Kargil in 2016, opines that the stalemate will have a negative impact on governance and development planning in the district.

CONCLUSION AND RECOMMENDATIONS

Water security, which has different meanings to different stakeholders, allows us to see the value of irrigation water not only as an input to agriculture but also as contributing to food security and human well-being. This paper focused on FMIS, which provide water to the majority of Ladakh's villages, making them inhabitable. These irrigation systems are intertwined with other traditional livelihood systems, like those of agriculture, livestock rearing and silvi-culture, meaning that changes to one will affect the others. Developed over centuries, FMIS function by a complex system of traditional practices that are now under threat, ironically by some of the very structures and programmes that are designed to support villagers. All government structures and programmes have two sides, a positive one, which makes life easier in the short-term, and a negative one, which erodes traditional knowledge and customs.

- This paper's first recommendation relates to one "legal" dimension of water security, the ongoing land revenue settlement in Kargil district. The rights and responsibilities attached to irrigation systems, especially those constructed in the past century, i.e. since the last settlement, ought to be documented in the new government records. This is necessary so that communities can maintain ownership and control over their productive resources. This study shows that in Gyaling village, a recently constructed irrigation system's details were not recorded in the new settlement. Also, it was found that the previous settlement's Riwaj-i-Abpashi had not been transcribed into the new settlement. The old Riwaj-i-Abpashi, it can be noted, is in such a poor condition that it cannot be read by the current Patwari. An awareness campaign is needed to ensure that communities understand and make efforts to record the details of the rights and customs associated with each of their FMIS during the ongoing settlement. Though it will be fraught with challenges (Baker, 2003) such an exercise will be worthwhile.

- The second recommendation relates to the 'sustainability' angle of water security. Can the Irrigation Department develop a system that will allow FMIS renovation projects to be given to the users of that particular FMIS? Currently tenders are given, allowing powerful contractors to monopolise the work. Maybe this is necessary. Regardless, it is important that arrangements are made so that locals themselves undertake and complete these works, with the support of engineers and the use of non-local skilled labourers as necessary. There is a danger that channels will be over-concretised, which will lead to dependence of villagers on outside funds and materials for the maintenance of their FMIS. In the medium to long term, experience shows, many FMIS may fall into disrepair and become defunct, in part due to the loss of traditional knowledge, and in part due to changes in community and societal relationships. Nevertheless, locals are appreciative of support from government departments. To develop a system appropriate for the mountains, sensitisation of relevant government officials may be required.

- As farming practices are intrinsically connected to the water of FMIS, this paper's third recommendation relates to the "human needs" dimension of water security. Traditional seed varieties and farming skills and practices need to be preserved, which requires a multi-pronged strategy. A debate is needed regarding the promotion of "modern" farming practices (HYVs, chemical inputs) by the Agricultural Department—is this the right approach for farming in high mountain valleys? Agriculture, livestock management and other traditional livelihood practices need to included in the school curriculum, which will help the younger generation to not only maintain their interest in agriculture but also to take

pride in their culture and way of life. Local grain types (e.g. barley and wheat) rather than imported rice and wheat should be provided through the PDS. Elders' farming knowledge needs to be preserved and utilised, which can be achieved if relevant government line departments respect and strengthen traditional farming. Only if traditional agriculture and a holistic food security are respected can FMIS maintain their relevance and survive in the coming decades.

• The fourth recommendation relates to the 'governance' dimension of water security, by raising concern about the divisiveness of party politics and of other political institutions. While democracy is a good thing, division of communities along party politics and other lines is damaging to village-level institutions and can undermine the success of village-level development schemes. The government should take steps to reduce factionalism, to minimise the siphoning of funds, and to bring together all the stakeholders, because 'an integrative approach to water security brings issues of governance to the fore, and thus holds promise as a new approach to water management' (Cook & Bakker, 2012: 94).

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Water Security in the Darjeeling Hills, unravelling seen and unseen forces

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ABSTRACT

Water crises are spreading across South Asia at an alarming rate, and the water stressed areas include unexpected locations such as Darjeeling, West Bengal, India, where rainfall is plentiful. Darjeeling Himalaya receives a high amount of rainfall, primarily during the monsoon months and range from an annual average of 4,000mm to 5,000 mm in the southern slopes to 2,000mm to 2,500mm on the leeward side. This rainfall pattern and the high forest that covers 38.23% of the district area (State of Forest report 2010-11) makes water stress in this landscape an ironical phenomenon. The daily water deficit in urban areas is 1,332,500 gallons in Darjeeling, 502,750 gallons in Kurseong and 300,000 gallons in Kalimpong (Municipality Reports).

This paper attempts to unravel the complexity of the issue to understand the cause of water stress. Upper Lanku in rural Darjeeling depends on three main springs for water. According to anecdotal reports, all three springs have shown a decline in discharge over the past 10 to 15 years. WWF-India conducted a study in 2013-14 and found that the major recharge zone lies under the jurisdiction of the Forest Department, which is yet to grant permission for recharge interventions.

In 1850, Darjeeling Municipality developed a centralised water management infrastructure between1910 and1930. The system originates in Senchel Wildlife Sanctuary, with two lakes located 15kms upstream from Darjeeling and a storage capacity of 33m gallons of water that is recharged by 26 springs. This centralised system does not acknowledge the 90 odd natural springs in the town that are also used by people. These urban springs have diverse community-based management systems that have evolved over time and are now facing challenges due to rapid urbanisation, market forces, upstream concretisation and contamination and reducing discharge.

Kalimpong Municipality in 2016 woke up to drilling of groundwater, which divided the town sharply between groups that supported and opposed the work. The drilling brought to the surface a host of issues related to policy gaps, downstream and inter-generational inequity, ownership and access as well as questions about sustainable water management in an urban mountain-scape.

This case study will help identify gaps in National Water Policy 2012, Wetland Conservation Rules 2010, Groundwater extraction rules in the context of a mountain region and propose relevant recommendations.

Key Words: water crisis, Darjeeling Himalaya, springs, aquifers, recharge, water security, governance, equity

DARJEELING AND ITS 'WATER CRISIS'

The National Water Policy 2012 points to "Large parts of India have already become water stressed where issues related to water governance have not been addressed adequately. There is wide temporal and spatial variation in availability of water'. Darjeeling Himalaya illustrates this scenario of water stress and availability with all its complexity.

Darjeeling Himalaya, West Bengal, India receives plenty of water through rains in the monsoon and snow-fed rivers. Despite being a water-rich region, Darjeeling, Kalimpong and Kurseong are experiencing water crises. This situation extends to large sections of rural communities in the region too, but goes under-reported. In the context of growing water insecurity in South Asia, it is critical explore the irony of this water crisis in the water-rich region of the Darjeeling Himalaya.

The first issue to explore in this regard is whether the water crisis is a natural or a human-induced phenomenon. The flows of water are complex and in many instances, issues of water security are a result of power relationships and location in the landscape. It is also a reflection of management visions and ideologies that bring about key questions of equity, access and inclusion. In a rapidly urbanising region such as Darjeeling Himalaya, the rural-urban divide with regard to water and the issue of marketisation are key debates with regard to inter- and intra-generation water equity and water as a right. Increasingly, water discourse is not just about water that can be seen above ground, but also about the 'unseen' water in the aquifers below the ground. The fluidity of water, especially below the ground, shifts ideas of ownership, governance and management beyond traditional departmental silos. In the Indian context, the Himalayas are constantly portrayed as water towers. Yet, water policies are rarely contextualised or adapted for the needs of the communities that live in these mountains.

The paper explores three narratives documented through the involvement of members of the Darjeeling Himalayan Initiative, namely DLR Prerna, WWF-India and Save the Hills to highlight the seen and unseen forces of water within two urban and one rural context. This will help put a human face to complex water flows, analyse the 'crisis' locally and ask critical questions with regard to policies and practices for sustainable water use in the Himalayas.

LOCATING DARJEELING

Darjeeling District is spread over an area of 3,263 sq km, between an elevation of 92 m to 3,539m above msl and accounts for 3.68 % of the total area of West Bengal (Pradhan and Bhujel 2000). It is the only hill district in the state with three sub-divisions; Darjeeling, Kurseong and Kalimpong, with Siliguri in the foothills and plains. Darjeeling is part of a trans-boundary landscape with Nepal in the west, Bhutan in the east and Sikkim in the north. Darjeeling's topography includes the terai, lowland foothills, and mountains. Darjeeling belongs to the lower or outer Himalayas with long ranges generally running north to south and consists of a mass of mountainous spurs and ridges.

TRANS-BOUNDARY BIODIVERSITY LANDSCAPE

Darjeeling is part of the Eastern Himalayas, which has been recognised as one of the world's biodiversity hotspots (Myers et al. 2000). It is also of geo-political importance due to its proximity to Nepal and Bhutan. The Himalayas are geologically young (Xu 1993) and is rich in biodiversity due to its location at the juncture of two continental plates and has representative species from both ecological biozones. There is considerable climatic variability along the topography of these mountains. The moisture-laden monsoon winds bring a deluge of rains along the eastern end of these ranges, which has a richer biodiversity (WWF and ICIMOD 2001). The southern slopes of these ranges get much higher precipitation (4,000 to 5,000 mm) than the leeward sides (2,000 to 2,500 mm).

GORKHALAND AND THE DEMAND FOR STATEHOOD

It is important to highlight the long-standing demand for Gorkhaland, as a separate state from West Bengal, by the people of Darjeeling. The demand comes from a regionally marginalised mountain community that is socially and ecologically different from the rest of the state and whose identity is not acknowledged at the national level. In 1988, the region was given a degree of autonomy in governance in the form of Darjeeling Gorkha Hill Council (DGHC) and Gorkhaland Territorial Administration (GTA) in 2011. This political and historical narrative is important as various elements of the Integrated Mountain Initiative's vision is playing out in the microcosm of the Darjeeling Himalayas. There are issues of regional marginalisation, politics of identity, exclusion and implementation gaps, flow of goods and services downhill without re-investment flowing uphill and a lack of understanding or an attempt to understand the socio-ecology of Darjeeling. This scenario is played out in the case of water, which has several different roles: basis of life, element of power relationships, ownership, equity, conflicts, disasters, religious beliefs and policy gaps.

WATER IN THE DARJEELING HIMALAYAS

The most visible water systems in the Darjeeling Himalayas are the innumerable streams and rivers that flow through the landscape, most of which are perennial and originate in glaciers, snowmelt and groundwater recharged by rainfall. Of them Teesta river is the largest; originating in the Teesta Khangshe glacier in north Sikkim, and joined by numerous tributaries streams that drain Sikkim and the Darjeeling Himalayas. Rangit river, which originates in west Sikkim from the Rathong glacier and is fed by smaller rivers such as Rammam and Little Rangit, originating from the Singhalila range in Darjeeling hills, is one of the larger tributaries of Teesta. In the sub Himalayan regions of Darjeeling, the Teesta is joined by tributaries such as Leesh, Geesh, Chel, Neora and several others that add to its volume. The river finally empties in the Brahmaputra in Bangladesh after travelling 315 kms from its source. The trans-boundary basin of the Teesta river encompasses 12,159 sq kms, of which 10,155 sq km are in India and 2,004 sq km are in Bangladesh.

Innumerable smaller rivulets and streams, locally known as ***kholas*** shape the waterscape of Darjeeling. These ***kholas*** are celebrated in religious beliefs, folk tales and find place in songs of all communities that reside in this area. They are one of the main sources of water for drinking and agriculture.

At the micro-level, people have strong connections with water on a daily basis through the many springs that drain the mountain landscape. Springs or *dhara*(s) are the points where groundwater comes to the surface. Springs are discharge points of groundwater and a crucial water resource, supplying the immediate need of drinking water in mountains and a key element of human life and well-being. Groundwater in the form of mountain springs provides water security to a significant proportion of Darjeeling's rural and urban population. Various geo-hydrological factors determine if a spring is perennial or seasonal. 'Irrigation practices in the higher altitude are also mostly banking on springs or initial order streams, fed by the springs' (Central Ground Water Board report, 2014). These springs are fed by groundwater and are largely recharged by rainwater infiltration. The Himalayan region is blessed with adequate rainfall, but an overwhelmingly high proportion of this precipitation is restricted to the monsoon season and adequate groundwater recharge is hampered by high levels of surface runoff (Tambe et al, 2013). The springs also have a strong cultural connection in the form of *choko pani*: sacred, clean and pure water, which includes traditional conservation practices (Lama and Rai forthcoming)

Much of the debate and discussion about water in this mountain region has primarily revolved around what

is seen above the surface, with little attempt to understand what lies beneath. IN addition to surface water, there are groundwater aquifers that are underground and mostly ignored. The groundwater situation has not been studied in-depth, and in the context of Darjeeling, yet to be brought into the foreground of water-related discussions. It is critical that these unseen aquifers are brought into discourses about water for multiple reasons, including sustainable use and climate-proofing. 'In the present situation of growing population and also due to climatic aberration, availability of groundwater in springs and streams in mountainous terrains is becoming scarce day by day. This has warranted the necessity of deciphering groundwater from further deeper sources as also to make the spring and lower order stream sources adequate and perennial by adopting various scientific measures so that sustainable water supply may be continued' (Central Ground Water Board 2014).

The Darjeeling Himalayas are defined by the monsoons and is water-rich. The water crisis needs to be deconstructed at various levels to get a better understanding of the current situation. This deconstruction is attempted through three case studies that will provide insights to the complexity of the issue to delineate possible solutions.

DARJEELING MUNICIPALITY: CENTRALISED AND DECENTRALISED

Darjeeling Municipality was established in 1850 and is regarded as one of the oldest municipalities in India. In 2011, the municipality had a population of 120,000 and covered 13.81 sq km. Darjeeling is located at an average elevation of 6,982 ft (2,128 m) above msl. The annual total rainfall in Darjeeling town fluctuates between 1,870mm and 3,690 mm.

The water supply system of Darjeeling town consists of 26 springs from Senchal Wildlife Sanctuary located about 15 km away from the main town. The water from the springs are collected and fed to the two Senchal lakes, inaugurated by the Hon'ble Lady Jackson in 28 February 1932. The combined capacity of the two lakes is 33 million gallons (north: 20 million gallons, south: 13 million gallons). This water is distributed through a combination of pipes and tanks across the town. The existing water supply installations were meant for a population of about 15,000 in 1910-1915. A number of water supply installations, like Khangkhola Station, Rambi water line, Sindhap lake (capacity 15 million gallons), Bokshi Jhora and Bangla Khola were added to augment the water supply. However, this could not cope with the rapid rise in population of the town and a 'water crisis' in the dry period (December to May) has become a constant feature over the last two decades or so. The crisis during the last few years or so has worsened due to the drastic reduction in the volume of water discharged in natural springs. The water deficit in Darjeeling can be as high as 1,332,500 gallons per day. This crisis is further compounded by the massive influx of tourists, students and migrant workers to the town. Part of the reason for the 'water crisis' is that almost 95% of the system of about 35 km of transmission main and 83 km of distribution main (excluding service lines and public hydrants) pipelines and valves were laid when the water supply system was established in Darjeeling town with patchwork repairs (Darjeeling Water Works Department report 2012).

'According to a water engineer at the Waterworks Department interviewed in early 2014, the loss of water in transmission from Senchel lakes to the township is around 30–35% of the water supplied. The employee commented that about as much again could be lost within the distribution main. This means that another 30–35 per cent of the water supply could be lost after a mere 65–70 per cent of the town's water capacity reaches the distribution centre'(Drew and Rai 2016). The crisis has led to the development of a lucrative private water trade with over 120 tankers, hand-pushed carts, water carriers and private pipe lines from different water sources.

The water crisis has become synonymous with Darjeeling town and the dysfunctional Senchel system dominates conversations around water in Darjeeling. Suggested interventions revolve around augmenting, repairing, adding a new lake or augmentation through the Balason River Project. When examined closely, the debate over Senchel is usually from the perspective of water-haves and the water-privileged.

The stories of a large segment of the community, who depend on myriad springs around the town, are never discussed or entertained. Access to municipal water as a right is never discussed, as many of these communities are totally dependent on springs for water and have no municipal lines. Thirty two such springs have been identified (Boer 2011), which are accessed and managed by communities. A more in depth study of the springs of Darjeeling Town has expanded this number to over 90 springs (personal communications Lakpa Tamang, 2016). The access and management systems of these springs are diverse, ranging from oral, well documented, restricted to members, open access and individually-managed. These springs can be seen in the heart of Darjeeling Town, such as Lal Dhiki and Giri Dhara, and also on the outskirts, such as Bhotay Dhara and Mull Dara Dhara. They are mostly managed by Gaon Samaj or village community-based organisations. These Gaon Samaj are based on geographical membership and provide welfare services during births, deaths and marriages and help resolve conflicts onvolving its members. Within the geographies of the Gaon Samaj that have springs, they have included its management within its ambit. These Gaon Samaj provide critical services to the community and

in many cases manage and distribute water in areas not supplied by municipal water. This is an everyday example of decentralised and efficient management systems. However, their impact is limited as their interventions are limited to their Gaon Samaj boundaries.

In the Darjeeling Municipality context, it is evident that large sections of the population are not connected to the municipality water grid and depend on local springs, partially or completely for water. It is interesting that an old localised self-governance institution such as Darjeeling Municipality does not include these urban springs in its water discourse and policy. Responses to the water 'crisis' is always a centralised extractive solution of bringing water from outside the town limits to augment its network of tanks and pipes. This seems to be a colonial hangover of a centralised management outlook of accessing water from outside the urban built environment, failing to acknowledge the pool of water below the town that emerges through these myriad springs and provide water to those excluded by the distribution system. This centralised system of water extraction also fails to acknowledge equity issues of water as urban needs are prioritised over rural communities. Thus, Darjeeling demands its rights over water from a distance of 15 kms and terms the needs of communities like Rungbool, located directly below the Senchel lakes as 'illegally tapping'. This scenario of urban rights over water from a distant source being prioritised over those of communities living next to the source is continuously played out by the municipalities in Darjeeling and numerous other urban spaces in India. This centralised system of water management from a distant source does not acknowledge decentralised sources like the 90-odd springs of Darjeeling. Since it ignores these springs it lacks the vision and understanding to conserve and recharge them. In the context of Darjeeling Municipality, there have been no hydrological studies of aquifers and their recharge zones, which results in the lack of plans for their management and conservation.

Hydrological studies should be the key for the development of the town. In the absence of such a study, the development of the built environment does not take into consideration the impacts they have on spring discharge. For instance, the process of concretisation has dramatically reduced recharge resulting in decreased flows. According to anecdotal reports, around 20 back, a 20-litre vessel would fill in five minutes, which now takes 15 minutes and is further compounded by the fact that lines have grown longer around springs (Drew and DLR Prerna community conversations 2016). The rapid and random construction has also led to landslides and destruction of springs, which makes life extremely difficult for communities that are entirely dependent on springs for water. Thus, a hydrological study would indicate critical recharge zones where development is prohibited.

This is not just about developing a conservation plan but also a question of converging a decentralised approach with the existing system to help communities better manage the flow of their springs, whether it be better storage systems or reducing contamination impacts. In Darjeeling, waterways are also carriers of waste, and with increasing waste many of these springs are critically threatened with contamination.

The combination of centralised and decentralised management systems, a convergence of colonial and traditional would be the way to move forward towards water security in Darjeeling Municipality. Recognition of the community-managed springs are critical with growing crisis and marketisation of water, which results in short-term water extraction projects as witnessed in Kalimpong.

DRILLING FOR SOLUTIONS IN KALIMPONG

The article 'Concerns spring from borewells' (The Telegraph, June 3, 2016) highlighted the delicate issue of digging borewells in Kalimpong for groundwater extraction. The first privately commissioned borewell extracted almost 6,000 litres of water each day and seemed to be the ideal solution for this water scarce town that had been battling severe water crises for decades. Ten more borewells were proposed by the Gorkhaland Territorial Administration and supported by a feasibility study conducted by a world renowned hydro-geologist to address the 'water crisis' of the town. This was met with resistance by environmentalists who questioned the sustainability and equity of such a venture and demanded a proper study to understand the issue.

The District Administration swung into action and the State Water Investigation Department (SWID) concluded that the borewells were dug without permission as mandated by the West Bengal Groundwater Resources (Management, Control and Regulation) Act, 2005 further adding that for extraction of water beyond 50 cubic meters, permission had to be sought from the State Level Ground Water Resources Development Agency. SWID also highlighted lapses on its part and mentioned that impacts of digging borewells 'on a young mountain like the Himalayas' need to be considered. Following this, the Kalimpong Municipality suspended the drilling, until a scientific study of the area was conducted.

Kalimpong is an important town in the Darjeeling Himalayas with a population of 49,403 people (Census 2011) and spread over 23 wards in 3.5 sq kms. The town centre is located on a ridge connecting two hills, Delo and Durpin at an elevation of 1,247m and 1,704m. The Teesta river flows in the valley below, separating Kalimpong from the state of Sikkim. The town is a major

hub for agricultural in the sub-division, which has served as a gateway to Tibet. The town is different from Darjeeling in that the town merges seamlessly with agricultural communities.

A report by Kalimpong Sangrachan Samity and Gorkha Dukha Niwarak Samelan, 2012 states that water supply system for Kalimpong was developed under British rule. The inadequacy of water supply necessitated the Neora Khola Water Project. The report suggests that the water crisis is a management issue and not due to the lack of water. 'Kalimpong requires about 10 lakh gallons of water every day and half of the need is met by the Neora Khola Scheme. About 7,500 households receive water for about 30 minutes every second or third day, depending on the availability of water and the rest depend on natural springs and streams to meet their water needs.'(The Telegraph 29 September 2015). This situation means that the town has a water deficit of 300,000 gallons per day.

In this context of a water deficit, boring of wells becomes a tempting and immediate solution, especially when the first one at the top of the hill supplies 6,000 litres of water per day. Yet, one cannot overlook other voices: 'A proper survey needs to be conducted before the mountains are drilled. The impact of drilling the fragile mountains needs to be studied, the type of aquifers beneath the surface needs to be understood, the quality of water needs to be tested and the amount of water that can be extracted needs to be carefully analysed before such an adventure can be allowed.' challenged Wing Commander Praful Rao, Save the Hills and vetted by Dr. R. K. Bhandari, renowned expert on landslide and disasters. This is a very polite response to the drilling and requires one to read between the lines. 'Proper survey needs to be conducted' questions the authenticity of the feasibility report conducted by the world renowned hydro-geologist. With the lead taken by Save the Hills, the feasibility report was requested by a number of organisations including DLR Prerna but the document has not been made public. Requesting a study on the impact of drilling and the aquifers beneath is a tall order, when the region is data insufficient and the Groundwater Scenario of Himalayan Region, 2014 says 'Hydrogeological data has been generated through short-term water supply investigations carried out for defence establishments, railways and tea gardens in the Darjeeling district of West Bengal', which excludes most of Darjeeling. The same report addes that 'The yield of a few such springs ceased while the groundwater was intercepted by a bore well at Namchi area, South Sikkim. To avoid such a situation, it is essential that a thorough survey of the geological structures and human settlements down below along the dip direction of fractures is undertaken before selecting sites for the boreholes.' The Namchi statement is critical, considering the report appears to have been written with a rationale of understanding the amount of groundwater available for extraction. It does point to the fact that downstream needs to be considered and the downstream is not limited to visible water but also to invisible water in aquifers. Groundwater extraction could reduce water supply for others, including future generations.

In case of the Kalimpong borewells, a feasibility study was conducted by a hydro-geologist but this is not available in the public domain despite repeated requests by different organisations. Decisions about a public good such as water cannot be taken based on the basis of a feasibility report that is not transparent. The notions of inter and intra-generational equity, geographical placement equity and carrying capacity have to be taken into account.

Water crisis is not just an urban phenomenon in Darjeeling and the complexity is being experienced increasingly in rural Darjeeling too. The next case elaborates the issue of complexity.

REJUVENATION OF SPRINGS IN UPPER LANKU: BEYOND THE FEASIBILITY REPORT

Upper Lanku is located in the District of Darjeeling under Gram Panchayat Unit Sittong III of Kurseong Block. The village is very close to NH31A and above the Teesta river. Forests around the village are under Kurseong Forest Division and are contiguous with Mahananda Wildlife Sanctuary. Siliguri is the nearest town. Upper Lanku has a population of around 450 people. Agriculture is the main source of livelihood for most of the villages, with a small population engaged as labourers and in government service. The main crops of the village are maize, millet, soya, ginger and broom grass. The main cash crops are Darjeeling Mandarin (Citrus sp) and broomgrass (*Thysanolaena maxima*). Darjeeling Mandarin production over the years has gone down and anecdotal reports reveal that crops have shifted to a higher elevation. Agriculture, as in most hilly areas, is mostly rain-fed, and largely dependent on springs. Livestock is reared by all households as an additional source of income with an average of five to six livestock heads per household.

The community of Upper Lanku depends on three springs for water: Saroj Dhara, Birsing and Gokul Dhara. They are located on the same hill side, almost along a fracture in the hill-side. Saroj Dhara is highest of the springs, followed by Birsing Dhara at 743m above msl and Gokul Dhara at 724m above msl. Around 200 households depend on these springs for drinking, their livestock and irrigation. Community narratives talk about how the discharge of three springs has been declining over the past 10 to 15 years due to deforestation in the catchment areas of the spring. All three springs show greater decline in discharge during the winter months from November to March during which villagers face acute water scarcity.

WWF-India worked with Lanku Valley

Biodiversity Conservation Committee and proposed to increase the discharge of two springs through groundwater recharge by reducing surface runoff. This will result in overall landscape level improvement in water availability in the springs and streams in the lean season. The expertise was provided by the trained resource persons from Rural Management and Development Department, Government of Sikkim. This team is a key part of the spring-shed programme successfully implemented by the state of Sikkim under the Dhara Vikas Programme. Within five years, it has shown encouraging results by increased discharge of most springs under its intervention. This programme was mainly implemented in drought-prone areas of the state in south and west Sikkim, and so far more than hundred springs has been brought under it (www.sikkimsprings.org).

A detailed study was conducted with communities to identify and document springs and their sources using Global Positioning System (GPS). This data was detailed with land tenure, spring discharge, trends of lean period discharge over the last decade, and the number of households dependent on the spring. To understand the springs' basic characteristics, the geology of the area was studied and observed to identify its recharge area. The study found that a large chunk of the recharge area fell within the jurisdiction of the Forest Department under the Kurseong Forest Division. A feasibility report was prepared in 2013 and community capacity enhancement programmes were undertaken as part of the plan, which included physical land use changes and vegetative options in the recharge zones. A letter asking for a permission to work in the forest department area was submitted to the Forest Department in February 2015 along with the feasibility report. Personal meetings with the department were also scheduled, but permission has not been granted even after the assurance that no permanent structures will be built in the area.

The Upper Lanku narrative throws a number of critical issues of governance and convergence when it comes to groundwater management in the Darjeeling Himalayas. Darjeeling has 1,204 sq kmd recorded forest land, which accounts for 38.23% of the total district land area when the state average is 13.38% (State of Forest Report 2010 – 2011). It has four designated protected areas: Senchel Wildlife Sanctuary, Singhalila National Park, Neora Valley National Park and the Mahananda Wildlife Sanctuary. All of these are catchment sources for important rivers, streams and natural springs. Darjeeling town's centralised water system originates in Senchel with large constructions, yet in Upper Lanku recharge interventions could not be taken forward. There is a clear demarcation of mandates between various departments and in this case, the forest department has not been able to expand its mandate to include artificial recharge, even when the identified recharge zone is outside protected areas and degraded. In today's understanding of ecosystem services, there is a need to review mandates of departments with land tenure to include recharge interventions in the Darjeeling Himalayas.

TOWARDS WATER SECURITY IN THE DARJEELING HIMALAYAS AND BEYOND

The three narratives clearly highlight the importance of springs in the Darjeeling Himalayas, an issue that finds resonance in the Central Ground Water Board report, 2014 in the context of the entire Himalayan region. The challenges and issues of the three narratives may appear different in terms of their management regime; ownership of underground water to ownership of recharge zone. Yet, the common thread of groundwater aquifers binds them together.

The National Water Policy, 2012 progressively highlights, 'environmental needs of the Himalayan regions need to be recognised and taken into consideration while planning'. It also narrates the 'need to document groundwater, strengthen institutional mechanism for its management, climate change adaptation and the use of a holistic and integrated approach'. Even though it recognises that the policy is generic for the entire country, it is predominantly focussed on downstream river basins and fails to include mountain-specific issues to the extent that is required.

While there are many references to aquifers and streams in the document, there is no mention specifically of springs, which the Darjeeling case study highlights as being of utmost importance. This lack of specificity means that all the good indicative measures outlined in the policy could well be interpreted to exclude springs and the mountain people who depend on them.

This lack of inclusion is also reflected at the local level within the water scenario of Darjeeling and Kalimpong, where urban springs are ignored. These are still perceived as rural water sources even when a large section of the town's population are dependent on them. In the case of Darjeeling, the centralised water system of the municipality directly collects water from springs and acknowledges it but fails to account for the 90-odd urban springs in the town itself. The water extraction and management system seems to be affected by a tunnel-vision in the context of urban areas in the mountains, with inherent challenges related to equity and resilience.

An integrated management system drawing from centralised and decentralised approaches is critical for water security in the mountains. The *Wetlands Conservation and Management Rules 2010 and the Conservation of Wetlands in India: A Profile 2007* provide good arguments for inclusion of urban springs in policies. The 2010 Rules mention conservation plans that include built environment plans, while the 2007 Profile provides detailed arguments for the need to conserve urban wetlands for water security. Thus

acknowledging urban springs in the lines of the 2010 Rules and 2007 Profile would enable the conservation of urban springs and the delineation of critical zones of recharge and inclusions of built environment rules. This are important elements for urban water security as well as regional water equity of the mountains. Furthermore, there is clearly a need for further refinement of policies of individual water extraction through deep boring within the context of the mountain landscape.

The Lanku case highlights need for an integrated approach within the seen and unseen nature of water. Here is a community committed to undertake water conservation initiative supported by competent resources but are stuck due to issues of land tenure and limited departmental mandates. In the context of reports of decreasing spring discharge and the fact that in Darjeeling, most of the recharge zones are in forest areas, the issue of land tenure is crucial. The National Water Policy 2012 states, 'There is a need to remove the large disparity between stipulations for water supply in urban areas and in rural areas', and if Darjeeling town can have their centralised water from within Senchel Wildlife Sanctuary, why should there be restrictions for the village of Lanku to recharge their dying spring? This narrative also has relevance for a situation where the recharge zone is located outside its jurisdiction, which is the case for most springs. Even for Darjeeling town, many recharge zones are also located in areas designated as cantonment, temple, Governor's House and the zoo; none of which have a water recharge or conservation mandate.

In the Darjeeling Himalayas, the need for rejuvenation of springs for ensuring water security as an effective climate change adaptation measure is irrefutable. This cannot happen till departmental mandates are expanded to a point of convergence to take on holistic and integrated roles. The fluidity of water, and the spaces it occupies above and below ground, while also flowing beyond borders need to be acknowledged with responsibility that reflects governance and management of water beyond traditional departmental silos.

There is a definitive need for a mountain-specific water policy that includes the diversity of springs on which communities depend. This policy needs to actively imbibe equity and social justice at all levels. There is a need to acknowledge the existence of large data gap on aquifers that support these spring discharges with adequate measures to address it. In the context of rapid urbanisation and climate change, long term strategies for recharge and rejuvenation of springs is critical for water security in the Indian Himalayas. For this to happen, a multi-sector and interdisciplinary discourse needs to be further promoted that seeks to address the seen and unseen forces of water.

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Groundwater in the Mountains

HIMANSHU KULKARNI and SIDDHARTH PATIL - Advanced Center for Water Resources Development And Management (ACWADAM)

The mountain regions of India include the Himalayan and sub-Himalayan states, Eastern and Western Ghats and other hilly provinces such as the Aravalli ranges. The mountainous regions of India are primarily dependant on springs for drinking water, domestic use and agricultural needs. Springs can be considered as the lifeline of these regions. Springs also form important cultural symbols while performing the crucial role of providing base flows to rivers and consequently help in maintaining the ecological balance of a region. Climate change, especially erratic precipitation, is affecting spring discharges. However, the cause-effect scenario for spring depletion from climatic factors is obvious. There are other reasons that are not as obvious. On the other hand, until recently, the groundwater assessments for large parts of the mountain regions of India did not consider springs as sources that need to be understood and quantified. The issues of drinking water, sanitation and agricultural productivity are being addressed in the hills without any consideration of the differences between the plains and peninsular India and the mountain regions. This includes the implementation of watershed programmes for augmentation and drilling of bore wells for providing access to groundwater.

Springs are point sources of groundwater discharge and although spring water emerges and flows on to the surface of the earth, springs are fed by aquifers that is a system of rocks capable of storing and transmitting sufficient quantities of water (to the springs). Having established springs as groundwater, it is important to note that groundwater is a common pool resource and the effects of augmentation by a few are enjoyed by many, while on the other hand, the effects of over extraction from the same aquifer by a few—through wells—can also harm a larger population dependent on them. Such disturbances also impact the ecological flows in the form of reduced base flows.

The Himalayan and sub-Himalayan regions are characterised by complex geological systems, with highly deformed rocks. Aquifers in this region often extend from one valley to the next valley depending on the rock structure and thus augmentation programmes need to be modified to include this factor and change the 'ridge-to-valley' approach to a 'valley-to-valley' approach. At the same time, sanitation and drinking water programmes that are designed around spring-water need to be planned in a way so as to incorporate the complexities in geology and typical aquifer settings in order to improve the efficiency of the programmes and to guard against situations where well intentioned programmes end up causing more harm in the long term.

Unlike wells, springs cannot be pumped to extract water. While wells are human-made sources of accessing aquifers, springs are natural discharge points of the aquifer that provide access of water to people. Springs provide water at the specific discharge rates that are an effect of the characteristics of the aquifer providing discharge to the spring. Spring discharge represents a discharging aquifer is some degree of equilibrated state. However, drilling in the same manner as has been followed in the rest of India has begun in large parts of the mountains backed by the need to improve agricultural productivities, access to drinking water and enable industrial growth, thereby affecting such equilibrium. Although the sources of access such as springs and wells are different, the resource from which both abstract remains the same: aquifers. Large scale drilling in the mountains in the absence of regulation and management principles will lead to a competition between uses and users of groundwater and as experienced in large parts of India, in addition to creating a conflict between two types of sources tapping the same aquifer. This, in turn, will lead to iniquitous access, distribution and availability of drinking water in such regions.

Recharge especially in the mountains will enable in mitigating the effects of climate change but the natural limitations associated with springs need to be factored in while trying to improve access to cater to increased demand for different uses of groundwater. The changes in the designs of various national and state driven programmes will have to be at a policy level. This paper demonstrates the need for a separate policy for water in the mountains by examining the factors that differentiate the spring fed landscapes in the mountains from other landscapes in India. Factors such as access, distribution and availability of groundwater from an aquifer perspective, the unique geological conditions in the Himalayas and how the combination of these call for a complete redesign of the current programmes on watersheds, drinking water and sanitation in the mountains can be packaged for a strong policy backing the protection and conservation of springs, spring-sheds and aquifers in the region.

Expedition to Lhonak Glacial Lake in Sikkim

SONAM WANGCHUK. Student's Education and Cultural Movement of Ladakh. The Ice Stupa Artificial Glacier Project.

Glacial lake is a water body formed in/under/beside and in front of a glacier due to glacial dynamics. Such high-altitude glacial lakes are hazardous to human communities and infrastructure as they can drain instantaneously and create devastating floods downstream. The formation of moraine-dammed glacial lakes and glacial lake outburst flood (GLOF) are a major cause for concern in countries such as Bhutan, Tibet (China), India, Nepal, and Pakistan.

Such a lake was reported in the South Lhonak Glacier in Sikkim. Temporal satellite data analysis from CORONA to LISS III shows that the glacier has receded by 1.9 kms between 1962 and 2008 and the formation of a moraine-dammed glacial lake at the snout of the glacier. The probability calculations of a lake outburst returned a very high value of 42% and peak discharge estimate are 586 m3/s (cubic meter per second).

The Ice Stupa Artificial Glacier Project, which was conceived and piloted in Ladakh, is regarded as a possible solution for the problem of fast-melting glaciers, glacial lake-formation and resulting flash floods. It envisages draining and re-freezing the water of these glacial lakes to restore the ice that has been lost.

To implement this vision, a four-member team from the Ice Stupa Artifical Glacier Project participated in a three-week long expedition to the Lhonak Glacial Lake in North-West Sikkim. This lake is located at an altitude of 5,200m above msl along the border with Tibet (China) border. It is only accessible by a day-long jeep ride from Gangtok, followed by a four day trek over high passes. The team camped for two weeks at the lake through different weather conditions to install the first phase of a siphoning system to drain the lake to a safer level, until other measures are developed to mitigate the risk.

The team successfully installed three pipelines of roughly 140m each to siphon 150 litres per second or 13 million litres per day from the lake. At this rate, a 1.5m drop in the level of the two kms-long lake could be achieved by the end of the next winter. Based on the results of the first phase, more pipelines could be installed to lower the lake by 5m, which will drain roughly 25% of the water content of the lake to drastically reduce the risk it posed.

This would probably become the first project of its kind and scale in Asia (possibly in the world).

Here is a visual account of the expedition:.

This was an inter-departmental expedition that included scientists, engineers and officials from departments of the state of Sikkim. This included Department of Science and Technology (DST), Sikkim State Disaster Management Agency (SDMA), Department of Mines and Geology, Water Resource and River Development, Forests and Wildlife, Indo Tibetan Border Police (ITBP) and Indian Army. The team from Ladakh comprised of Stanzin Norbu Shara, Namgyal Tashi Hemis Shukpachan, Surya Narayanan Balasubramanyan from Chennai and me. We were given a warm send off by the top bureaucrats of Sikkim State on 30 August 2016 from Gangtok.

After a day-long jeep drive from Gangtok and an acclimatisation halt in Lachen/Thangu area, the team drove to Thangu top where the vehicle road ends and the yak trails starts.

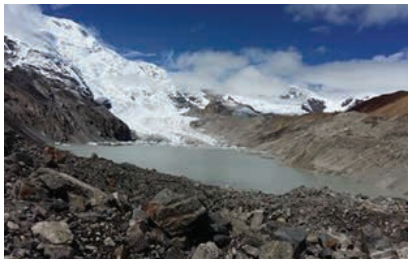
It was a four-day trek from the base camp to Lhonak lake, which included crossing of numerous streams and high mountain passes.

The yaks carried a very unusual load this time: 10-foot long plastic pipes with quick clamp coupling, specially made by Jain Irrigation Systems and

trucked from Maharashtra to Sikkim. Round load on round bodies caused a lot of mental and physical agony to the yaks and their herders.

In this highly sensitive frontier region, the Chinese satellites may have observed scores of 'double barrelled yak-mounted cannons' advancing towards the border. These 'cannons' were meant to deal with a more serious enemy called 'Glacial Lake Outburst Flood' caused by climate change.

After covering the four-day trek in three days, the expedition reached the awe-inspiring lake on 6 September.



The lake from different angles. The chunks of ice floating on the surface and settled in the lake had fallen from the fast-melting glacier. They float around in the lake as icebergs for few days and then disappear.

The next day, we set off to survey and measure different aspects of the lake such as its out flow, gradient etc.

This is what we found:

a) The gradient of the out-flowing stream was roughly 1 in 20 for 200m after which it becomes much steeper.

b) The approximate discharge through the lake stream, measured using an improvised float was roughly 4.5 cubic meter per second (or 160 cusec).

c) The depth of the lake had not been measured before this expedition. In the past, a DST expedition had tried using digital sonar wave machine but it did not function beyond its 80m threshold. This time, the lake's depth was measured using a more sophisticated method by sending a probe to the bottom of the lake at different points. This high-tech probe was developed by filling socks with two kgs of stones, which was submerged using a combination of ordinary string and a long measuring tape. This device gave consistent measurements of 130m at the centre, which decreased gradually towards the shore.

d) This measurement compelled us to revise the estimated volume of the lake. Earlier, the lake was considered to be about 80m deep and the volume was estimated to be around 56 million meter cube. The new finding meant that the lake held an estimated 70 million meter cube (or 70 billion litres).

A rare occasion when security forces were helping prevent a disaster, rather being called in for disaster relief. The ITBP and the Indian Army were partners in the expedition and sent five members each, equipped with wireless communication and other equipment. They have also committed to sending updates on the lake collected by their patrolling parties.

Unforeseen Challenges

The biggest challenge faced by the expedition was not the weather or the altitude, but getting pipes across in time. As the roads between Maharashtra and Sikkim were flooded, followed by the problem of loading round pipes on yaks, the duration of our stay at the lake had to be extended by four days.

Meanwhile, along with the Siphon system, our team also installed DST's lake level sensor-cum-early warning system. This is a remote sensing device that will give real time data of lake's level and the thickness of the ice every half-an-hour to computing centres located in Pune, Thiruvananthapuram and Gangtok. This will provide data on the lake level with the siphoning system and in the eventuality of a breach of the lake wall, also act as an early warning system.

Due to the delay in the arrival of the pipes, we worked on installing the sensor and explored various facets of the lake.

Problems are opportunities in disguise!

Once the pipes started arriving, we focused on installing them. However, we faced other challenges in this task. Before reaching the site, I had calculated that the 10-foot long pipes would be joined to make siphon pipelines on the dry banks of the stream emerging from the lake. However, when we reached the site, there were no dry banks on either side of the stream. It has sheer rock faces and boulders that descended straight into the icy cold and dangerously strong stream. So, there was no place to assemble the 150m long train of pipes and a person could not stand in the icy water for long. But necessity is the mother of invention and we came up with an interesting solution to the problem that made things much easier. In retrospect, I thanked the heavens for ensuring that the stream had no banks.

We closed the ends of the pipeline to make the pipeline behave like a raft and float on the surface of the lake. Nothing could be a flatter ground than this! In conceiving this idea, my high-school science lessons on Archimedes' principle came handy. I was able to precisely predict that if we closed the two ends of the pipeline, the otherwise heavy pipes would float with exactly 3/4th of the pipe body above water and 1/4th submerged in water. Also, the whole pipe train could then be transported downstream by floating it on the rough stream, instead of making porters carry them in cold water. That is how the pipes behaved exactly as if it was part of a script, when we finally lowered the line in water. So, we had trains of 150m long trains of pipes laid on the lake surface.

These trains were made to float down the lake mouth and down the stream using the water's force with half-a-dozen people on either side steering the train precisely how we wanted. By then, the weather started getting bad and we wanted to finish the task before it became impossible with the September snow.

The D-Day!

The remaining pipes finally arrived on 14 September, the next day I had to make a 'do-or-die' decision as the weather was becoming unpredictable and people seemed to be losing interest and energy.

After taking our coordinating leader Mr. Narapati Sharma into confidence, early in the morning that day, I gathered the whole group of some 30 people including civil officers, scientists, engineers, porters, kitchen staff and personnel from military and paramilitary forces. I gave them a pep talk and a challenge. I said, "In view of the inclement weather, we have a choice to either to do our utmost and accomplish everything today and return with flying colours or wait and meet with a possible snow blizzard tomorrow and be forced return as failures."

After the talk, we convinced them to take a weird and risky decision. The whole tent village at base camp was packed and moved to the next camp downstream, which took a day. This was done to leave ourselves with no option but to finish the task that day. We did not have the option of staying back if we failed that day, except for a single tent for emergency.

By late evening, as expected, everybody had put in their best and the pipes were in place. We even expected it to be completed by the afternoon. However, siphon is not just about pipes, but about the tricky part of priming the pipes to start sucking water i.e. start siphoning. And that is where we failed that evening. Just when we could not afford failure, one of the three pipes worked and water gushed at the speed we expected. It was getting dark and we had to let the group march so that they could reach

the new camp site; a five-hour walk from the site. Since the camp and kitchen had moved, we did not have anything to eat that day.

So we had to take another tough decision. I told them to walk ahead to the new camp and that the Ladakhi team would stay back to start siphon in the morning before catching up with the rest of the group later that day.

The day success came to greet us!

My small team stayed back and the emergency tent came in very handy. We later discovered that three soldiers of the Indian Army had also secretly kept their tent back, for just this kind of emergency and they stayed back too.

The next morning, we started working to prime and start the siphoning process. We managed to start two pipes by late afternoon. However, there was one last rebellious pipeline that seemed to be defying gravity and seemed to be doing the impossible: filling water. I was slowly resigning to the idea of going back and telling the world that only two pipelines worked, while the third failed. But my friend Stanzin was sure that we could make the third pipe work and for that he was ready to spend another day at the lake.

By noon, some local porters from Lhachen came to the lake to take back the raft (boat). That was the only support we had left and even that was going. So the mission seemed to be headed for a partial failure. Just when the porters were about to leave, a strange phenomenon happened in the lake. A big wave emerged from deep inside the lake and churned the water around the lake's mouth area. The lake seemed to be going crazy. At one moment, the mouth would overflow with double the quantity, while at another, the big stream coming out of the lake would almost dry up with unseen rocks being exposed. I stood there reasoning that this could have been caused by a huge chunk of the glacier calving below the surface of the lake. Our local porters from Lhachen were all running uphill for safety, fearing that a calamity was starting. Later, we heard that these porters were telling others that our project had angered the spirits of the lake, who were expressing their anger. Even if I was superstitious, I wouldn't agree with them. Soon after this weird incident, with some more efforts the third pipeline started behaving and operating smoothly with a discharge that seemed higher than the other two pipelines. I felt that the lake spirits were happy with us and came to our end of the lake to bless us and help us in our most challenging hours.

As winter sets in and the main stream dries up, these three pipelines will continue sucking water out of the lake. We started our downward march in the dark and reached the camp before midnight to reunite with our eagerly-waiting friends.

And Finally…

We returned to Gangtok on 16 September after covering a four-day walk in two days. Leaders in Gangtok had organised a reception dinner-cum-press conference right after our arrival at 6 pm.

We are particularly grateful to the following people in the Sikkimese bureaucracy for their kind, generous and dedicated support:

From Left to right: Mr. Anil Mainra, the Principal Secretary, Department of Science and Technology, Government of Sikkim; Mr. R.B., Secretary, Water Resources and River Development; Mr. Tsegyal Tashi, State Relief Commissioner (and the fatherly chief of this expedition); Mr. D.P. Sharma, Commissioner Secretary, Mines Minerals and Geology, and Mr. Dhiren Shreshtha, the Additional Director, Department of Science and Technology.

The person who clicked this photograph was the pillar of all the project coordination and even here he was busy coordinating operations i.e. taking this picture. He is Mr. Rinzing Chewang, Special Secretary LR and DMD/Sikkim State Disaster Management Agency (SDMA).

Implementation of Dhara Vikas initiative in Sikkim

PEM NORBU SHERPA. Dhara Vikas Programm, Sikkim

I. OVERVIEW

In 2008, Government of Sikkim conceptualised and pioneered a new program—Dhara Vikas, which is a unique initiative across the Himalayas to tap rainwater for groundwater recharge and revive mountain springs. This initiative was launched in partnership with WWF-India and Peoples Science Institute (PSI), Dehradun bringing about a paradigm shift in the field of water management in the state. The novelty of the idea lies in sustainably developing the spring-shed, to increase the percolation of rainwater and resulting in the recharge of ground water. These measures work to ensure that the surface runoff of rainwater in the spring-shed is reduced, and increased water amounts percolate down to recharge the spring.

Achievements

- Prime Minister's Award for Excellence in Public Administration (2011–2012)

  Recipient: Rural Management and Development Department (RMDD), Government of Sikkim
- National Groundwater Augmentation Award (2010–2011)

  Recipient: WWF-India for technical support to MGNREGS-Dhara Vikas of RMDD;

  Awarded by the Ministry of Water Resources, Government of India
- T.N. Khoshoo Memorial Award by ATREE (2011)

  Recipient : Sandeep Tambe, Special Secretary, RMDD, Government of Sikkim, in recognition of his efforts in sustainability and community-based governance of common property resources in Sikkim
- eNorth East Award (2012): Winner of Village Spring Atlas for conservation of Himalayan springs and adapting to climate change (www. sikkim-springs.org)

II. OBJECTIVES

To promote a unique spring-shed development initiative called Dhara Vikas to revive critical springs, streams and lakes to enhance the groundwater recharge and manage spring discharge.

III. KEY STAKEHOLDERS

Implementing agency

Rural Management & Development Department

Other Government Departments

Department of Forest, Environment and Wildlife Management

Department of Science and Technology and Climate Change

Department of Mines and Geology

Indian Space Research Organisation, Department of Space, Benga Luru

Beneficiaries

People of East and West districts in Sikkim

IV. RATIONALE

Around 80% of the state's rural households depend on springs for drinking water and irrigation throughout the year. According to *Sikkim First*, an economic and political journal, about 65,000 (nearly 80%) of the state's rural households depend on springs for drinking water and irrigation[1]. Over the years, several of these traditional water bodies have either dried up or discharge water only seasonally due to declining natural recharge and ground water table. Some of the key factors that are causing spring to dry up include increasing population, overgrazing and trampling by livestock, erosion of the topsoil, deforestation, forest fires and development activities such as construction of roads and buildings. The water woes in the state are further intensified by the drastic change in rainfall patterns, including increased intensity of rainfall causing topsoil erosion and reduction in temporal spread, and a significant reduction in winter rainfall. A collective impact of these factors gas reduced the 'sponge action' of the land[2]. Consequently, limited rainwater percolates down to create a hydrological imbalance in some of the watersheds. It has been estimated that less than 15% of the rainwater percolates down to recharge springs, while the remaining amount flows down causing floods. The problem of water scarcity was more pronounced in South and West districts, which fall in rain-shadow areas and receive much lesser rainfall than other districts. Recognising the urgent need for ensuring water security, the RMDD, conceptualised the Dhara Vikas initiative to revive the state's dying lakes, springs and streams.

[1] 2.7 Dhara Vikas: Creating water security through spring shed development in Sikkim, *Social Sector Service Delivery: Good Practices Resource Book 2015*, 59 - 63.

[2] Ground water augmentation through rainwater harvesting and artificial recharge to ground water, Deythang GPU National Ground Water Award, 2011, 1-21.

V. IMPLEMENTATION STRATEGY

Area of implementation state wide: East District, South District and West District

1. Developing local human resource as master trainers

To initiate programme implementation at the first stage required specialised knowledge and skills about rainwater harvesting, geo-hydrology, spring discharge measurement, use of Global Positioning System (GPS) and development of contour trenches. There was also a need to ensure technical inputs from Department of Science and Technology, Department of Mines and Geology, Government of Sikkim. In 2009, more than 20 training programmes were organised in collaboration with the State Institute of Rural Development (SIRD) and NGOs such as WWF-India, PSI - Dehradun, Advanced Centre for Water Resources Development and Management - Pune, Central Ground Water Board and G.B. Pant Institute of Himalayan Environment and Sustainable Development. As a result, seven master trainers were identified as para-hydrogeologist resource persons. GIZ (German Technical Cooperation) partnered with the Government of Sikkim to provide technical support in planning and monitoring of this innovative intervention.

2. Village Spring Atlas

Spring-shed development uses geo-hydrology to identify the re-chargeable areas of a spring. This approach also differs significantly from watershed development, which adopts the catchment approach, in terms of scale, costs, duration, treatment methods as well as success indicators. In this framework, the first step was to undertake resource mapping by preparation of a Village Spring Atlas. The mapping exercise was conducted on a Geographic Information System (GIS) platform. The data was made accessible online at www.sikkimsprings.org. The database provided information on the location, GPS coordinates, land tenure, catchment status, dependency, discharge (supply/demand) of nearly 700 springs of Sikkim and is also linked to the Google Earth platform.

3. Spring-shed Development Works

Pilot spring-shed development works were undertaken by harvesting rainwater for groundwater recharge. In the first phase, rainwater harvesting structures were developed in the recharge area above each spring. Groundwater recharge structures, such as staggered contour trenches, percolation pits, check dams etc were dug on sloping land unaffected by landslides. Wherever farmer's fields were used, incentives in the form of horticulture and fodder plantation were provided in the second phase. Activities, such as development of trenches and GI pipes were taken up under MGNREGS. The pilot phase in the year 2010 aimed at reviving the Nagi Lake in South district, by focussing on digging trenches and installing pipes for the recharge of select lakes and springs. The encouraging results of these interventions became evident by 2011, after which the initiative was scaled up in 2012 to cover the South and West districts.

4. Impact assessment of the practice/ innovation implemented for ground water recharge and improvement in ground water quality

Regular measurements of discharge from identified springs along with rainfall were recorded. The data indicated discharge in correlation to rainfall. Information related to water discharge and rainfall was collected on a monthly basis to develop a baseline values for each spring. Post project impact analysis was done by measuring these two parameters and comparing them with the baseline values.

5. Formulation of IEC strategy to protect local water sources

This concept is based on the scientific principles of reducing the speed of running water by developing the catchment of the spring, using soil moisture conservation works along with vegetative and social measures. The IEC strategy used this broad-base principle, "every drop of rain water needs to be conserved where it falls, the 'running' water needs to be trained to 'walk', and the 'walking' water needs to be trained to 'rest' for a while[3]." These measures aimed at educating villagers on points like a) reducing surface runoff of rain water and b) enhancing percolation of rain water to underground aquifers to recharge the spring. This strategy was centred on existing religious and cultural practices of protecting local water sources, locally known as Devithans and keeping them free from biotic interferences.

6. Strengthening delivery systems at the GPU level

To ensure efficient and effective implementation of this development intervention, the first significant step was to strengthen delivery systems at the Gram Panchayat Unit (GPU) level. Initially, RMDD focussed on building basic infrastructure such as buildings at the GPU level. Next, the provision of adequate human resources was emphasised by setting up GPU cluster support offices in the form of Gram Vikas Kendra to provide administrative and technical support. The presence of infrastructure and staff made it possible to devolve implementation of Dhara Vikas activities in GPUs.

7. Sustainability and Replicability

This intervention has been successfully demonstrated the science and practice of reviving drying Himalayan springs in drought-prone rural areas by implementing and monitoring a new scientific groundwater recharge programme using rainwater harvesting techniques. The programme involved local communities at all stages of the project cycle.

[3] Ground water augmentation through Rainwater harvesting and Artificial Recharge to Ground Water, Deythang GPU National Ground Water Award, 2011, 1 - 21.

Upscaling and sustainability of the intervention was achieved by innovatively converging funding from the national flagship programme MGNREGS and developing a cadre of para-geohydrologists and knowledge base in collaboration with government and NGOs. Documentation of programme outcomes has facilitated policy advocacy at the national level and enabled knowledge sharing with other mountain regions.

Based on the experiences of this initiative to revive Sikkim springs, the Planning Commission of India included spring-shed development in the expanded list of permissible works under MGNREGS in 2012. This has paved the way for up scaling this initiative across the Himalayan landscape. Teams representing WWF-Nepal, Bhutan Government, states governments of Arunachal Pradesh, Meghalaya and Nagaland and others agencies have visited Sikkim on exposure tours to understand Dhara Vikas and implement similar initiatives in their respective areas. The intervention will be needed in many parts of the Himalayas, where mountain seasons have become seasonal due to land use and climatic changes.

Sloping land is needed above the spring where artificial groundwater recharge works can be taken up. In India, funds can be tied from various Government of India schemes such as MGNREGS, NRDWP, and IWMP to implement such initiatives.

VII. RESOURCE UTILISATION

The initiative pooled resources from various line departments, NGOs and national-level programmes at each stage of the programme's implementation.

VIII. OUTCOMES

1. Recharging lakes, reviving springs, reforestation

A key outcome of this initiative is an enhanced hydrological mountain ecosystem with the revival of 50 springs and five lakes in 25 drought -prone Gram Panchayats in Kaluk (West District), Rhenock (East District), Ravangla, Sumbuk, Jorethang and Namthang (South District). One good example of the impact of this initiative is the Chukudum spring, which is the only water source for two GPUs: Barfung Zarrong and Kewzing Bakhim. The revival of Chukudum spring ensured water security for 75 rural households. In terms of output, the spring discharge has increased from 40 litres per minute to 60 litres per minute[4].

The five lakes revived through this initiative include Dolling, Deythang, Nagi, Karthok and Datum. This has enabled the reforestation of seven hill-top forests in Simkharka, Sadam, Tendong, Maenam, Gerethang, Chakung and Sudunglakha. Over the last six years, Dhara Vikas has been able to recharge more than 1,000 million litres of ground water each year. These tangible outputs have been verified by independent agencies and have influenced national-level policy. The technical components of this program have been simplified in the form of a handbook and published in the form of an illustrated comic book.

2. Creation of a cadre of technical specialists

Dhara Vikas has also developed seven master trainers as in house cadre of para-hydrogeologists.

3. Creation of a Village Spring Atlas and web portal

Another significant outcome of the initiative is the creation of the Village Spring Atlas web portal, which provides information on 700 springs, and can be accessed online (www. sikkimsprings.org).

4. Benefits to agriculture and farming

Dhara Vikas has made a significant impact on crop patterns and yields. More than 15 hectares of horticulture plantation in the spring-shed catchment have already been taken up, resulting in plantation of over 20,000 saplings of bananas, guavas and oranges in coordination with the Horticulture Department. According to Benga Luru-based Indian Institute of Science's assessment report (2013), increased irrigation has encouraged farmers to cultivate new crops such as beans, radish, cauliflower, cabbage and chilly along with paddy and tomatoes. Many perennial garden fruits, such as guava, banana, orange and litchi, have been cultivated after the programme was implemented. The report also indicates an average of 15% increase in crop yield and 25% increase in the cultivation of irrigated crops, such as paddy, tomato and vegetables[5].

5. Disaster risk reduction: The implementation of Dhara Vikas across the state has reduced landslides and damage to agricultural fields downstream.

IX. KEY CHALLENGES

During the initial phase of the initiative, several mistakes were committed. Identification and analysis of these mistakes provided important lessons for more effective project implementation. Key lessons included:

1. The digging of trenches in terraced fields is not effective, as the surface runoff on terraced lands is checked by mud boundaries and is already low. The investment of labour for digging trenches and ponds through MGNREGS was concentrated in sloping lands in upper catchments and spring-sheds for viable ground water recharge and to maximise outcomes.

[4] Sikkim, Reviving Springs to Mitigate the Impact of Climate Change, Enhancing Sustainable Livelihoods of the poor through convergence of Mahatma Gandhi NREGS with various schemes 2014, 2 - 7

[5] 2.7 Dhara Vikas: Creating water security through spring shed development in Sikkim, *Social Sector Service Delivery: Good Practices Resource Book 2015*, 59 - 63

2. In certain locations, horticulture and forestry plantations were undertaken in areas with limited soil and moisture conservation works. Consequently, the survival rates for these plantations were poor. The earlier practice in the state was to construct a stone masonry boundary wall around water sources and develop plantations at the source itself. These activities would probably have helped protect the source, but would not have assisted in recharging and increasing discharge. This observation on the field indicated that activities in contour trenching and digging of ponds needed to be completed before undertaking plantation works at the source. This paradigm shift in water source development works will entail rejuvenating the spring-shed (*Muhan ko seer*), while not disturbing the water source.

3. The digging of trenches and ponds is assigned to MGNREGS workers on piece-rate basis with wages accrued according to the number of trenches and pits dug by each worker. In certain locations, where daily supervision was lacking, the workers dug trenches and pits too close to each other and in the most convenient locations, instead of following a placement strategy that would have optimised the trapping of surface runoff. After this was realised, all works under Dhara Vikas are supervised by trained and experienced personnel. The first task for this aspect is to identify the location of trenches and ponds to ensure that they are correctly placed.

4. In locations where baseline information on the discharge of springs during lean periods was not collected, the impact of the project activities could not be ascertained conclusively. Now, at the planning stage itself, indicator springs are identified and their lean period discharge are measured to serve as the baseline value.

X. CONCLUSION

In order to address the challenge of water insecurity, Government of Sikkim initiated the Dhara Vikas programme in 2008. Following a convergence approach, MGNREGS was tapped for necessary financial support and activity-specific technical partnerships were developed with various line departments and NGOs. Since 2008, the initiative has successfully revived 50 springs and five lakes in drought-prone areas in 25 GPUs and achieving its annual recharge target of 1,000 million litres of ground water. This has had a significant impact on agricultural livelihoods with the development of more than 15 hectares of horticulture plantations of around 20,000 saplings in the spring-shed catchment areas. The Dhara Vikas has made Sikkim a national leader in watershed management and a pioneer in the protection of hydrological ecosystems in mountain regions.

Successful traditional practices and the need to converge such practices with policy

VENGOTA NAKRO, Sustainable Development Forum of Nagaland. MEDOVIKHO NAKHRO, Assistant Soil Survey Officer; Krutalu Tunyi

WATER RESOURCES OF NAGALAND

The major sources of water in Nagaland are surface water, such as rivers, streams, ponds and natural springs and sub-surface ground water. These sources are mainly sustained by heavy rainfall, which ranges from 2,000mm to 2,500mm—the highest of all states in India.

About 70 to 80% of the total rainfall is received during the monsoon period, while the state experiences water scarcity every year through the lean period from October to April. The steep slopes of the mountainous terrain ensured that huge volumes of water received during the monsoons run off fast and the soil fails to retain enough water to maintain base flow of springs in the lean periods. These springs are the main source of water for 70% of the population residing in rural areas. Therefore, though Nagaland is one of the wettest areas in the country, it is unable to meet its current water demand.

In recent years, erratic rainfall pattern in the state have caused streams and rivers to dry up. Farmers are not receiving rain on time to follow their seasonal cycle, especially in regions where residents practice terraced rice cultivation. In regions that receive very low rainfall, the terraced rice cultivation (TRC) is abandoned for the year and farmers look for alternative areas to practice shifting cultivation for subsistence.

In view of the erratic rainfall pattern in

the state, farmers across Nagaland are facing difficulties in fixing their seasonal calendar of activities to prepare their field for rice cultivation. It is, therefore, important that the rainfall received during summer months is harvested in ponds and used for irrigation. This concept of water harvesting is not new to Naga farmers. The Kikruma villagers have been using this technique since the establishment of their village more than 500 years back. Kikruma village, located at an altitude of 1,270m above msl in Phek district of Nagaland is inhabited by Chakhesang tribe

The Kikruma technology of Rainwater Harvesting Farming System (RHFS) is locally known as *zabo* (impounding water). It is being replicated to other villages where high altitude terraced rice cultivation is practiced, especially in regions located in rain shadow areas, scanty forests and where streams and rivers are absent to provide irrigation water. Zabo rainwater harvesting farming system is a combination of forest, agriculture and animal husbandry with well-founded conservation system that include soil erosion control, water resources recharge and management.

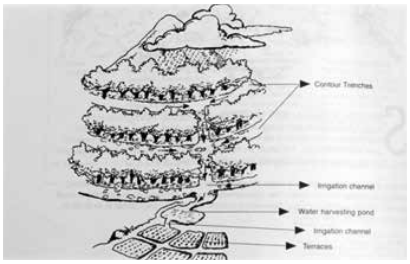
Activities involved for development of rainwater harvesting farming system:

1. Integrated Rainwater Harvesting Farming System (RHFS)

By and large, the Rainwater Harvesting Farming System is an organic farming system. On the whole, RHFS comprises of traditional agricultural and forestry land use, inbuilt water harvesting systems based on well-founded conservation principles. There are five components to RHFS: 1) Afforestation in the upper reaches 2) Feeder channel leading to siltation tank 3) Siltation tank 4) Water Harvesting Pond (WHP) and 5) Open earthen irrigation channel to the terrace fields. All these five components are described below.

1) Afforestation in the upper reaches

If areas in the upper reaches of water harvesting site are barren, these areas are planted with local tree varieties.



Induced artificial regeneration of forest in the degraded upstream areas is carried out. The benefits of such afforestation are well documented.

2) Feeder Channel

A feeder channel is constructed in a rectangular shape along the catchment across the running slope in a serpentine fashion till it reaches the silt-retention tank. This ensures the runoff from the catchment area is trapped in the feeder channel and drains to the siltation tank, which is then stored in the water harvesting pond. The cross section of the feeder channel is 0.35m in breadth and 0.30m deep with a rectangular shape.

3) Silt retention tank

Silt retention tank is constructed at the mouth of the feeder channel just before water enters the WHP. The dimension of the tank is 5.5m long, 1.5m across and 1.2m deep. This collects 9.9 cubic metre of debris consisting of eroded top soil, leaf litter and other materials. The debris is removed periodically when it fills up. This debris has high soil nutrient value and used as manure in the fields.

4) Water Harvesting Pond

WHPs are excavated and an embankment is constructed at feasible depression areas across the slope of the catchment area. The base of the pond consists of boulders that are excavated to check seepages. A mixture of soil, cow dung and fine straw/husk in a ratio of 2:1:1 are mixed thoroughly to make a slurry that is applied to the walls and floor of the WHP to check seepage or percolation of water from the pond. This technique has been used by villagers for several years and decades. It has been effective in checking percolation of water from the pond. With every shower, some rainwater finds its way to the pond and the bottom is always wet and stagnant—this prevents cracking and seepage.

A pond of 3x2x2 cubic metre is able to provide supplementary irrigation to terraces that yield 600kg of paddy (about 0.25 acre TRC area). Depending on the need of a farmer, the size of the pond can be as large as 20x15x2 cubic metre.

During the rice planting season, water is released from the pond by cutting open a small section of the bund of the pond depending on the water requirement. Subsequent cuts are made till the water is drained or the need for water is met. The cut portion is then plugged with soil to trap water during the next rain.

5) Open Irrigation Channel

An earthen dug out irrigation channel is constructed. The pond is connected with spill way leading to irrigation channels that irrigate the terraced field. The cross section of the irrigation channel is 0.45 m in breadth and 0.40 m in depth with a rectangular shape.

Benefits of Rainwater Harvesting Farming System

1) Direct Benefits

The development of WHPs in the villages enables farmers to diversify their agricultural system from mono-cropping of rice production to other crops, especially in the winter after rice is harvested. This has several benefits, which include;

a) The hilly terrain TRC is assured of water even if the rainfall is erratic and farmers are able to transplant their paddy.

b) The terraced fields are used for multiple cropping and farmers are able to cultivate vegetables and other winter crops to generate a cash income.

c) Farmers are able to farm fish, even if it is for a short term when WHP is filled to capacity from May to September. This increases the farmer's cash income and allows the farmers access to fish for their own consumption.

d) System of Rice Intensification (SRI) can be introduced in the TRCs where water harvesting ponds have been developed and increase the rice yield by more than 20%. SRI requires assured irrigation for transplantation of rice seedlings that are 21 to 25-days-old. It has been observed that when regular rainfall fails, transplantation is not possible due to the lack of irrigation water. The WHP assures irrigation water and enables the farmer to practice SRI in the terraced rice fields to increase its yield.

2) Indirect benefits
a) Streams, springs and ground water are recharged.

b) The gently slanting contour trenches function as 'ditch and furrow' effect that help recharge the surface area below the trenches through infiltration of rainwater.

c) WHPs lead to an increase in water yield from wells. Local communities report that the water in these wells are available for longer periods and there is an observed rise in ground water levels.

d) Employment generation through increased access to alternative livelihood strategies.

e) The WHP not only serves as a water reservoir for irrigation, but also becomes a source for drinking water for livestock.

2. Case stories
1) A progressive farmer

Mr. Putha Tunyi, a farmer from Kikruma village, owns one WHP and terraced rice cultivation field. He usually cultivates two crops a year, while his neighbouring farmers who do not have WHP only cultivate rice. After harvesting paddy, Mr Putha Tunyi cultivates winter vegetables like mustard, cabbage, potato, cherry, tomatoes, colocasia, amaranthus, beans, chillies, and local vegetables like Naga onion.

The area around his field is very highly fertile due to the year-long availability of water, which is made possible by the *zabo* system. This has supported the development of a very rich diversity of plants in the field. Fruit-bearing trees such as Prunus sp (peach, plum, cherry), Citrus sp, Pyrus sp, Musa sp, Mangifera indica, Psidium guajava, Emblica officinalis (Indian gooseberry), Rubus indica, Artocarpus heterophyllus, Passiflora edulis are found in and around his field. Trees species like Quercus sp (oak), Pinus sp, Alnus nepalensis (Alder), and Parkia roxburghii (Tree Bean) were also found in and around his field. Some flowering plants like Poinsettia and Bougainvillea were also observed around the field. In addition, medicinal plants like Pennywort (Centella asiatica) grow in abundance in and around his field. All these plant species provide direct and indirect benefits; some add to his income, while others increase soil fertility and help maintain the local ecosystem. Thus, the zabo system plays a vital role in the management and crop production on Mr. Putha Tunyi's farm.

2) Rainwater Harvesting Farming System: An answer to erratic rainfall

Erratic rainfall pattern was observed across Nagaland in 2013. In the month of May, the state received 79% more rain than the average, while the month of June recorded 43% less rain than the average. In order to cultivate rice in a high altitude terrace, adequate rainfall is essential in the month of June. As a result of this erratic rainfall, many irrigated rice fields could not be cultivated. Farmers reported that only 60 to 70% of their field were cultivated due to the lack of water.

While most farmers were suffering from the impacts of water scarcity, the farmers who had developed WHPs were able to complete their rice cultivation without difficulty. Kikruma village is located in a rain-shadow area and receives less rainfall than their neighbouring villages. Despite this, the villagers were able to carry out rice cultivation operations without any hindrance.

3. The need to converge such practices and policy

Studies by several research organisations (ICIMOD, Kathmandu, Indian Institute of Science, Bangu Luru, India Network on Climate Change Assessment) on climate change for the north-east mountain states have conclude that the impacts of climate change are being experienced in the region and will only intensify in the near future.

- Most mountain states have been experiencing increased precipitation of around 15 to 20%. Though rainy days have decreased, extreme rainfall events (100 mm/day) have increased. There are indications of a significant decrease in summer monsoon rainfall at a rate of approximately 11mm per decade. Heavier monsoon precipitation with increase in extreme precipitation events exacerbates soil erosion due to aggravated surface runoff.
- Increase in number of dry days during the monsoons and consecutive decrease in wet days, which causes moisture stress and affects agriculture and biodiversity.

Rainfall in Phek Meteorological Observatory Station, 2013

Month	Actual (mm)	Normal (mm)	Difference (mm)	Departure from normal (%)
May	284.6	159.0	125.0	+79.0
June	140.0	247.0	-107.5	-43.4

• Increase in flood discharge that affects agricultural land and infrastructure.

• A 25% increase in sediment yield has been projected for the Northeast region. The increase in sediment yield may intensify stream bank erosion that may destroy or damage prime agricultural land along riverbanks and cause flood events.

• Increasing water scarcity for domestic use and irrigation are a universal cause for concern.

• In the mountain states, declining condition of forests (often as a result of shortened *jhum* (shifting agriculture) cycles and increased frequency of forest fires) has reduced the ability of forests to conserve and store rainfall to regulate and sustain perennial stream and spring flows.

• The temperature records show a steady warming trend in their minimum and maximum temperatures an average annual increase of between 1.6 to 1.8 degrees Celsius. Increase in average temperatures results in frequent forest fire as bushes dry up and lose their ability to retain soil moisture.

• Around 80% of the rainfall in Nagaland is received during the pre-monsoons and monsoons. The heavy rains during the monsoons and the mountainous topography leads to high surface runoff. Lack of adequate water storage—natural and artificial—and scanty rainfall in the post-monsoon and winter seasons are not favourable for cultivating Rabi crops.

Various Centrally Sponsored Schemes (CSS), including MGNREGS, recognise the need to conserve runoff rainwater as priority areas. However, the issue for in-situ conservation of runoff rainwater has not been made mandatory. With limited resources available in the programme with regard to the need of the community, activities such as diversification of agriculture, enhancing household income generation etc. takes precedence. As a result, activities to conserve runoff water have not emerged as a major component of work for CSS programmes.

It is therefore important guidelines for CSS are re-framed so that 15 to 20% of the allocated budget is compulsorily allocated for in-situ conservation of runoff rainwater.

Like the *zabo* rainwater harvesting farming system, many good practices are being practiced by mountain communities. IMI and other relevant agencies need to promote such good practices among other mountain communities, while extension services by the government, in the agriculture sector need to be strengthened.

Reviving traditional skills in the mountains: The case of Ladakh

BY DR SONAM WANGCHOK. President, International Association for Ladakh Studies. Founding Secretary, Himalayan Cultural and Heritage Foundation.

When we study different influences on art, architecture and handicrafts in Ladakh, we realise that many skills originated in different regions such as Tibet, Kashmir, Baltistan and Central Asian countries. For instance, the technique used to make paper in Ladakh probably originated in China or Tibet. Similarly, woodblock carving is said to have originated in the Kham region of Tibet. In the past, all major monasteries had their own units devoted to thangka painting, paper making, wood-block carving and printing of texts. Major monasteries would print manuscripts which were then provided to branch temples and villages. Traditionally, the skilled people included Buddhist monks and lay people. They had would learn the required skills to engage in these activities and devote themselves to paper-making, calligraphy, printing of sacred manuscripts, wood-block carving, *thangka* painting and moulding clay sculptures. Paper-making was popular in Zangskar in monasteries and

amongst villagers. Stongdey Monastery would produce the largest amount of paper to barter for butter and other necessities. However, the development of cost-effective machine-made papers and books had a direct impact on these those monastic and family industries.

As modern printing allows for mass production of texts, traditional wood block printed manuscripts are no longer being produced in Ladakh. While some block printing of prayer flags and manuscripts is still practiced by lay devotees in some villages, there is no comprehensive programme on support the production of traditional materials such as paper, inks, wood block etc. and the skills required to produce these manuscripts. Today, most people consider these skills as outdated and deficient sources of income.

Traditional craft skills in Ladakhi have declined for several reasons. These include:

- Lack of time and increase people dependence on high-speed technologies
- Introduction of new cost effective technology to print manuscripts
- Paper making involves high cost due to elaborate procedures and raw materials are not easily available.
- Decline in the population of monks and resulting reduction in the number of practitioners of monastic crafts skills

Most people do not realise that they are neglecting the traditional skills they inherited from their ancestors. As a result, they lack knowledge about traditional materials such as hand-made paper. Many elders claim that traditional manuscripts written on hand-made paper are easier to read and lighter to carry. Many elderly monks and lay people still prefer manuscripts written or printed on traditional paper as they do not cause any harm to their eyes while reading. The dry climate of Ladakh and the special materials used to paper ensured that it was mothproof and moisture-proof. Thus, it has very long shelf life as and outlasts machine-printed texts. It is evident from the fact that Ladakhi monasteries still have religious manuscripts and secular texts that are hundreds of years old. Today, many of these texts are the only source of original Buddhist manuscripts in the world. Scholars translated these texts from Sanskrit to Tibetan. In fact, some of these manuscripts date back to the very early period of the Buddhist renaissance in the Tibetan region.

I have been involved in several projects to document and revive monastic art, crafts and rituals in several monasteries across Ladakh. Through these projects I realised that there are very few individual who still have the knowledge and skill about the technique and process of making traditional paper. There are a handful of families in Zangskar who still have the knowledge and skill to make authentic paper, including burnishing segment, making of tools, handling, processes to cut and paste, sizing of paper etc. People no longer maintain these family industries, which are part of Ladakh's cultural traditions. If we want to revive traditional skills, we must first get people interest in these crafts.

Himalayan Cultural Heritage Foundation (HCHF) is a community-based, non-government organisation. It is devoted to preserve and promote indigenous, natural and historic heritage in the Himalayas by working directly with local communities and strengthening and supporting community-based institutions. HCHF has done extensive work to revive dying monastic arts, crafts, rituals and village handicrafts in different parts of the Himalayas. It emphasises trainings and workshops to ensure practical and beneficial outcomes in terms of learning and preservation of the rich cultural heritage of Himalayas. HCHF has successfully revived skills such as willow basket weaving in Nubra valley, Stupa-building, stone-carving etc.

However, in many cases a need was felt to explore changes of indigenous materials and techniques to meet the needs of contemporary society. This can only be done by people who have specialised knowledge and experience of traditional skills and contemporary scientific practices to develop sustainable solutions and train young people in these skills. This can also be enriched through dialogues with other areas with similar cultural practices, such as Sikkim and Kalimpong where traditional paper-making is still popular. Encouraging people through resource exchange and net-economic returns at individual level is an important incentive to help them understand their traditional culture, while also generating an income.

As of now, we need to develop a policy and implement programmes to encourage local craft skills. We need to develop a market for village and monastic craft products. Today, people are keen on hand-made products and traditional designs gaining popularity. An effective and sustainable strategy based on people's capacities and knowledge needs to be developed, so that people can generate income and livelihood by practising their traditional skills.

Strengthening Institutional Capacities in Agriculture for Sustainable Mountain Development

JOHN PAULRAJ. Coordinator, Integrated Mountain Initiative

The Indian Himalayan Region (IHR) and its ecosystems are of critical global significance. Around 76% of India's hill districts fall within the IHR. The entire geographical area of these states is mountainous, and the average forest cover is 65%. This region is inhabited by a significantly large population of more 65.57 million people, who represent 172 of India's 573 Scheduled Tribes.

Most of these communities primarily depend on agriculture and its allied services for their livelihood. For mountain communities, agriculture is not just a means of livelihood but a way of life and a number of their cultural practices revolve around it. These communities integrate management of natural ecosystems as an integral part of their agricultural practice, which enables them to sustain various ecological processes. This ability to strike a balance has enabled these communities to cope with various natural challenges. However, recent trends in global development have significantly reduced the ecological and social resilience of mountain communities to environmental changes. Despite an increased recognition of these issues, significant constraints remain in achieving sustainable development in mountain regions. These constraints are often exacerbated by climate change, vulnerability to disasters and increase in urbanisation and migration. In addition, increasing population, deforestation, market integration and changes in human values are also taking a heavy toll on development in the mountains.

The need for conceptualising sustainable development in mountain regions has gained critical momentum with the adoption of Agenda 21 in 1992, which contained a chapter titled "Managing fragile ecosystems: Sustainable Mountain Development". In this context mountain communities can provide important inputs for managing fragile ecosystems by drawing on their knowledge, experience, and capacity. This body of knowledge is a significant building block for achieving sustainable development in mountain regions.

Agriculture production in mountain region is largely rain-fed and constrained by natural factors which result in increased workload, fewer possibilities for mechanisation, greater need for specialised machinery, bad accessibility and limited possibilities for operational extension and development of production alternatives. These constraints are further compounded by limited capacities, skills and governance, which hamper the development of alternate livelihood options for local communities and increase their dependent on natural resources. In addition, the linkages between food production and the Himalayan Mountains remains poorly understood. These mountain systems are a major source of water for growing rice and wheat—staple food in south Asia—in the plains during the dry season. Studies show that all mountain regions in south Asia are facing a common challenge of increasing food production, especially of wheat and rice, to meet the needs of a growing population. These crops also require a large and predictable supply of water. Moreover, the increase in food production is expected from the same amount of land by bringing additional land under irrigation as the potential of increasing agricultural land has almost been exhausted. Additionally, increasing water stress, climate change and climate variability are also intensifying the challenges (and opportunities, which are poorly explored and understood) faced by mountain agriculture.

The climate and topography of the upper IHR i.e. the Trans-Himalayan Regions, are not very conducive for agriculture and other forms of development such as industry. Thus, these regions are largely dependent on pastoralism. Livestock grazing in these fragile but dynamic ecosystems remains the most pervasive land-use with opportunities for alternative livelihoods being largely absent for local communities. The livestock numbers in these regions are fairly high and the total area of available pastures remains limited. This results in overgrazing once the carrying capacity of these ecosystems is exceeded and causes extensive degradation to the alpine rangelands/meadows. The loss of pastures and increase in the number of livestock has a negative impact on wild herbivore populations, which are in decline in many areas. This has resulted in an increased dependence of wild predators, such as snow leopard and wolf, on livestock and increased conflicts between humans and wildlife.

SCOPE OF THE PROJECT

Mountain agriculture and allied sectors have been an important aspect of sustainable development in IHR. In the context of the harsh and difficult environment in which it is

practised, mountain agriculture has evolved multiple strategies over centuries. It encompasses all other activities such as forestry, fisheries, pastoralism and aquaculture, which are all heavily reliant on family labour. Today, there is a lot of focus on family farming as part of the global emphasis on 'green products'. This presents an opportunity for mountain farmers to garner support and develop specific policy interventions. The second goal of the newly adopted Sustainable Development Goals speaks about a global collective action to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture".

This goal targets doubling of agriculture productivity and income of small-scale food producers through productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment (2.3); ensure sustainable food production systems and help implement resilient agricultural practices that increase productivity and production, help maintain ecosystems, strengthen capacity for adaptation to climate change, extreme weather events, disasters, and progressively improve land and soil quality (2.4); maintain the genetic diversity of seeds, cultivated plants, farmed and wild species and ensure access to, along with fair and equitable sharing, benefits arising from the utilisation of genetic resources and associated traditional knowledge (2.5). It also targets an increase in investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant gene banks (2a). However, achievement of these targets will requires a unique platform to raise public awareness and ensure adequate political, institutional and financial commitment to concrete actions for sustainable mountain development.

Achieving these goals will require work on recommendations submitted by the FAO, which is a part of the United Nations. These recommendations were submitted in accordance with General Assembly resolution 66/205, for the sixty-eight session of the United Nations General Assembly on the status of implementation of sustainable development in mountain regions. The recommendations highlight the need for collaborative efforts to form Mountain partnership and encourage the active involvement of various stakeholders; consolidation of existing and/or establishment of new national committees, bodies and mechanisms to strengthen inter-sectorial collaboration; inclusion of mountain specific policies in national sustainable development strategies; elaborate strategies, programmes and policies for promoting food security in mountains, and undertake studies to better understand the vulnerability of mountain communities. It also mentions the need to support development of communications, capacity building advocacy and outreach activities for Sustainable Mountain Development at all levels.

FAO OBJECTIVES FROM PROJECT

The project will work towards achieving FAO's Strategic Objective 2, which looks at increasing and improving the provision of goods and services from agriculture, forestry and fisheries in a sustainable manner. The organisational outcomes expected from the project are:

- Organisational Outcome 201: Producers and natural resource managers adopt practices that increase and improve the provision of goods and services
- Organisational Outcome 204: Stakeholders make evidence-based decisions in the planning and management of agricultural sectors and natural resources to support the transition to sustainable agricultural sector production systems

The Technical Cooperation Programme Facility (TCPF) also contributes to the formulation and dissemination of FAO's Corporate Output 2.4.2 Methodologies that sets norms, standards, definitions and other tools for the collection, management, aggregation and analysis of data. It also contributes to Output 2.4.3 - Capacity development, through which support is provided to institutions at national and regional levels to plan for and conduct data collection, analyses, application and dissemination.

EXPECTED OUTPUTS FROM THE FAO-IMI TCP PROJECT

In most parts of the world, including India, a sector-based approach is used to understand the relationship between agriculture and development. Socioeconomic growth and environmental trends have largely been neglected while considering the adversities faced by this sector, leading to a number of constraints for development of agro-based communities. Theapproach to dealing with cross-sector challenges related to agriculture requires a paradigm shift. There is a need to incorporate crosscutting issues such as food security, climate change and disaster events while conceptualising, planning and executing ideas as actionable projects. There is a need for institutions working in this sector to incorporate this paradigm shift in their strategies. One of the primary goals of this project is to increase awareness and build capabilities of mountain communities and local institutions dealing with vulnerabilities caused by various issues. It will work towards building new networks and strengthening existing ones to support development of the agriculture sector in the face of changes in climatic patterns, disasters and increasing food insecurity. Platforms and communication channels will be provided to discuss state-specific issues and highlight best practices across the mountain states. Current scenario of the mountain agricultural sector will be shared with all stakeholders and a mechanism to shape policy for mountain agriculture and allied sectors at the state and central level. The expected output and outcomes of this project are:

a. Enhanced institutional base of IMI across Indian Himalayan Region (IHR) through State Sustainable Development Forums (SSDFs) in all states and effective collaboration, networking and sharing amongst legislators; grassroots workers, civil society, and other stakeholders in mountain states.

b. Increased institutional capacity of IMI and its constituent members for sustainable mountain development, with a focus on mountain agriculture and allied sectors including value chains—from planning to producing, processing and marketing to improve access of mountain farmers to resources and enhance their capacities for income generation.

c. Enhanced policy focus on mountain agriculture and allied sectors in IHR state governments through development of regional (IHR) and state-level policy advocacy bodies that include mechanisms to shape policies.

These will contribute to the following outcomes in the IHR states:

(i) Producers and natural resource managers will adopt practices that increase and improve the provision of goods and services in agricultural production systems in a sustainable manner

(ii) Stakeholders make evidence-based decisions in the planning and management of agricultural and natural resources to support the transition to sustainable agricultural production systems through monitoring, statistics, assessment and analysis

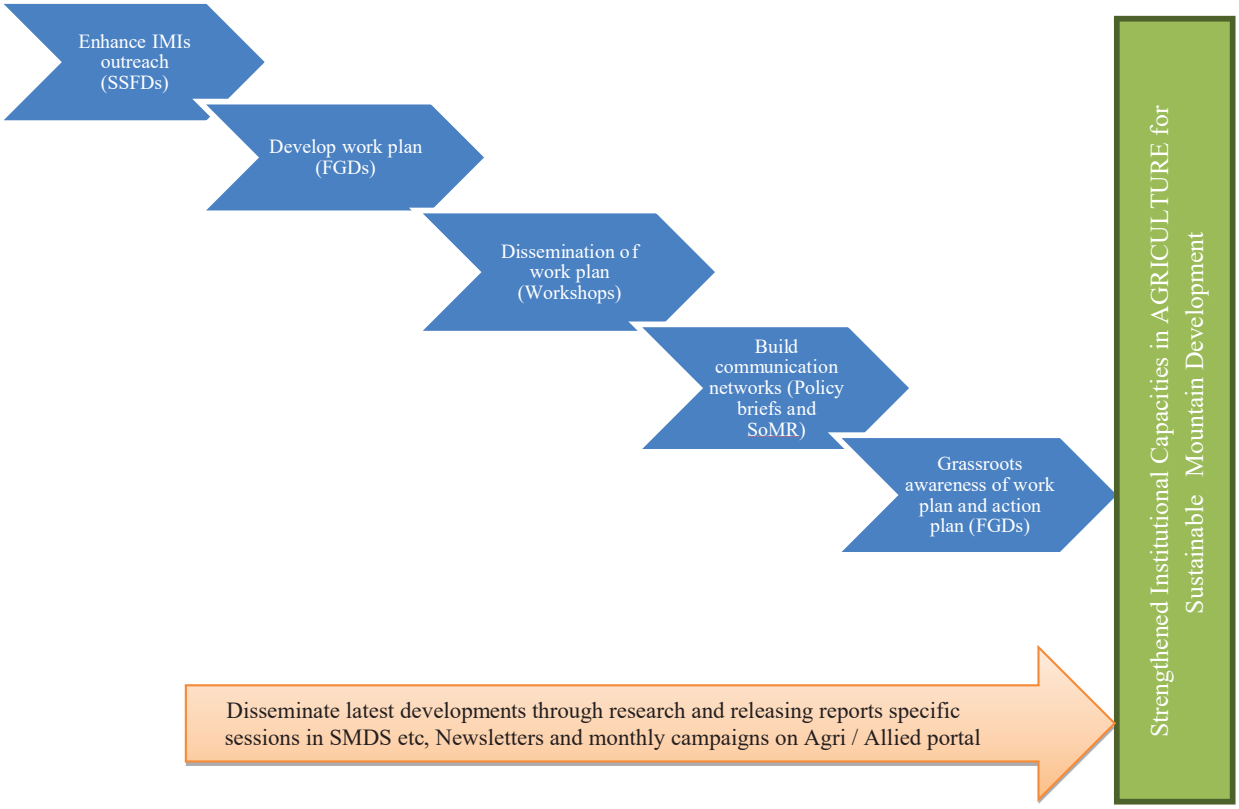
(iii) Integrated and multi-sectorial approaches for ecosystem valuation, management and restoration are identified, assessed, disseminated and adopted by stakeholders

(iv) Relevant data and information is assembled, aggregated, integrated and disseminated, and new data generated through analyses and monitoring conducted jointly with partners

(v) Capacity development support to institutions at national and regional levels for planning and implementation of data collection, analyses, application and dissemination;

(vi) A final report detailing the output and outcomes of the FAO-IMI project in mountain states of the Indian Himalayan Region.

FAO-IMI PROJECT - A SNAPSHOT



Experiences from FAO-TCP

SUNDER SUBRAMANIAN

BACKGROUND

The Mountain Partnership is a United Nations voluntary alliance of partners, dedicated to improving the lives of mountain communities and protecting mountain environments around the world. Founded in 2002, the Mountain Partnership addresses the challenges facing mountain regions by tapping the wealth and diversity of resources, knowledge, information and expertise, from and between its members, in order to stimulate concrete initiatives at all levels that will ensure improved quality of life and environments in the world's mountain regions. Currently, more than 250 governments, intergovernmental organisations, major groups (e.g. civil society, NGOs and the private sector) and sub-national authorities are members. The Mountain Partnership is supported by a secretariat that is hosted by the Food and Agriculture Organisation of the United Nations (FAO) in Rome, Italy.

CURRENT ANALYSIS OF HUNGER IN MOUNTAINOUS AREAS

According to a 2015 FAO/Mountain Partnership Secretariat study, an estimated 39% of the mountain population in developing countries, or 329 million people, are estimated to be vulnerable to food insecurity—that is one of every three mountain dwellers. When only rural areas are considered, this figure increases to one of every two mountain dweller. During the period 2000-2012, food insecurity decreased around the world but increased in mountain areas. These alarming statistics highlight the plight of mountain communities. They underline the need for policy-makers to include mountains in their development agendas, especially to alleviate the harsh living conditions of mountain communities and reducing outmigration from mountain areas. The study revealed a 30% increase in the number of mountain people vulnerable to food insecurity from 2000 to 2012, even as number of people living in the mountains increased by 16%.

The FAO 2015 Mountain Vulnerability Model used to develop the findings of the study estimates the availability of calories in rural mountain regions, considering the production rate of agricultural areas as an average of the yields of six main mountain crops: beans, cassava, maize, potatoes, rice and wheat. It also includes information on food quality by estimating the availability of proteins from beef meat, cow milk, sheep meat, sheep milk, goat meat, goat milk, pig meat, chicken meat and eggs. People having access to less than 1,370 kcal and 14g of animal protein per day are considered to be at risk of food insecurity as those thresholds are taken as survival requirements in case other foods are not available.

FAO also has an active programme on mountain agriculture (and allied sectors). Therefore, the findings of the study highlight the need to focus on mountain agriculture and allied sectors. For many years, FAO India has maintained a low profile but more recently, it has intensified its activities and started developing a range of new programmes. As part of these initiatives, FAO India has also just begun work on the detailed design of a FAO-GoI-GEF Project on landscape-based approach to biodiversity conservation and agriculture and allied sectors in five states, two of which are in the IHR: Mizoram and Uttarakhand.

In this context, I started exploring how FAO could use this GEF Project as a basis to expand its outreach to other IHR states. My long association with IMI helped me find an answer, given its wide outreach across the IHR. This provided the basis for conceptualising and developing the Technical Cooperation Programme—designed to help IMI institutionalise further, while also initiating a collaborative programme with IMI to contribute to advocacy for enhanced policy outcomes for the agriculture and allied sectors across the IHR states through focussed interventions that will be also complementary to the FAO-GoI-GEF interventions. The FAO-IMI TCP also aims to bring in international best practices and experiences from other mountain regions elsewhere in the world.

Living Sustainably in the Himalayas through community-based initiatives

RASHMI BHARTI. Co Founder and Founding Secretary, AVANI. Founder and Chairperson, Kumaon Earthcraft Self Reliant Cooperative

The bond between man and nature in the mountains is very strong. The people, the environment and the ecology are one contiguous whole until we try to mould the mountains to the plains…The reality of mountain living as we all know, is completely different…it is relaxed… it is peaceful and it has creativity that nourishes the soul…Every society needs ritual and practice to engage the mind and the soul…to continue to live peacefully…Our traditions were created to make this a part of our daily lives without making it regimental.

This is what we believe in…to re-establish and strengthen the bond of earth and man. Create a circle of production and consumption that is earth friendly and that supports the local communities as well. Avani is an NGO working in the Kumaon Himalayas since 1997, with the creation of rural livelihood opportunities through preservation of traditional craft, appropriate technology and farm based activities. Avani's work has reached more than 20,000 people in 104 villages. It focuses on the empowerment of rural women through livelihood creation and conservation based activities that focus on appropriate technologies like solar energy and pine needle gasification.

The participation of the community, respect for traditional knowledge, conservation of the environment and fair trade practices are the cornerstones of our work.

Avani has helped establish an artisans' collective, Kumaon Earthcraft, a self reliant cooperative, in 2005, that produces and markets high quality, eco friendly, hand-made textiles with natural fibres of silk and wool in natural dyes. This cooperative comprises of women who are farmers and artisans from 64 villages in the Kumaon region of Uttarakhand.

This enterprise has revived the art of hand spinning and hand weaving in remote Himalayan villages and enabled rural mountain women to earn a living close to their homes for the past 17 years. This is a movement of slow textiles with a very small carbon footprint.

Earthcraft focuses on the use of local skills, local people and local resources. In congruence to this philosophy, Earthcraft produces natural dye powders, extracts and pigments from local plants as well as organic detergents, art supplies made from plant based pigment. Our purchase of dye materials from local trees and invasive species, has led to conservation of local bio diversity and removal of invasive species. We have initiated the cultivation of indigo and madder in the villages to create livelihoods. We aim to work with about 2,000 farmers with cultivation and collection of different dye plants in the Indian Himalayas.

Our entire cycle of production is based in the village. It begins with the planting of trees, sericulture, spinning, weaving and natural dyeing. The processes of production use clean energy (solar and biomass) and recycling of all the wastewater. We have integrated different elements of the rural reality into the creation of this enterprise that remains true to its environmental sensitivity.

It is possible to set up a community-based enterprise that is owned and managed by rural poor that allows for community action and common benefit. However, strengthening and establishing a community-based enterprise that recognises traditional knowledge systems and builds upon them is the key to sustainability. A policy that takes into account the specificity of mountain regions, at the formulation and implementation stage, will set the tone for a long-lasting impact and good governance.

The following basic principles form the basis of our work:

Valuing the local: People, resources and skills

- To give back to the Himalayas.
- To bring value and dignity to local resources and local skills. Avani has trained and empowered a team of rural youth from nearby villages who manage all aspects of the organisation and the enterprise.
- To counter the belief that nothing is possible in the mountains and create a replicable model.
- To create a reliable source of income for socially and economically vulnerable women and girls who have dropped out of school.
- A space has been created where women manage a rural enterprise that has supported them for the past 16 years.

To create an opportunity and choices with local solutions

The Renewable Energy Enterprise

SOLAR PHOTOVOLTAICS AND PINE-NEEDLE GASIFICATION

• This enterprise has taken solar lights to more than 2,800 families and trained local youth to assemble, repair and maintain solar lights. Our solar initiative is managed by rural women and men who are trained in assembling and maintaining solar lighting systems. Self sufficiency of the village is the key.

• A pioneering Pine-needle Gasification plant has been installed that converts pine needles into electricity and also produces cooking charcoal, thereby reducing drudgery of women and conserving the environment.

KUMAON EARTHCRAFT – A PEOPLE'S COOPERATIVE

Revival of traditional crafts – Hand skills

• This enterprise supports over 1,400 families in 64 villages to earn a supplementary income in their homes without migrating anywhere. This has led to the revival and preservation of the local traditional skills of hand-spinning, hand weaving and the Art of natural dyeing. This enterprise has generated around ₹2 crores as wages and salaries for local people in the past 14 years.

• The cooperative has revived a traditional craft and has established a conservation-oriented enterprise that is based in the village and supports the economy of the village. It is now an artisan and farmer-owned cooperative, which restores the ecosystem through cultivation of natural dye plants.

• The women who are part of this programme have managed to meet all their living expenses, educated their children, paid for medical expenses, and constructed their homes. Some have even paid for their own marriages through the income they earn through these activities.

• The age of marriage of young girls has also been extended as they became earning members of the family. The economic empowerment of girls has had a positive impact on decision-making in the family.

• Eupatorium, a highly invasive weed in the Himalayas, has been used for textile dyeing and extraction of pigments. The monetisation of this weed has encouraged farmers to remove it from local areas.

• It is important to bring the entire cycle of production to rural areas. This strengthens the rural economy, builds capacity in the community and establishes a Mountain Brand that originates as a finished product from the hills.

IMPORTANT CHALLENGES

There have been a lot of challenges that Avani has faced in this process and a lot of learning has taken place, which have ensured that it is an operational enterprise:

• Lack of interest amongst rural youth to stay back in the villages.

• Loss of traditional livelihoods due to lack of value to local skills and local resources.

• Lack of access to raw material and capital for farmers and artisans.

• Higher cost of production due to a decentralised production system, keeping the artisan at the core. The work reaches artisans and farmers in village. It is a decentralised model, rather than a centralised factory model, leading to higher production costs.

• Lack of Infrastructure in remote areas.

• Lack of trained human resource.

• Lack of access to information and government schemes in rural areas.

• Ambiguous policies regarding traditional crafts and related raw materials.

• Poor wages for skilled jobs of an artisan, leading to a dilution of skill base. Until recently NREGA wages were more lucrative than weaving.

• Poor linkage to the markets and the lack of investments in developing a supply chain.

RELEVANT SOLUTIONS:

1. Infrastructure and accessibility: Most of the villages where we work are 30 minutes to two hours from the nearest road-head. The nearest train station is 200 kms and the nearest airport is about 250 kms away. Community centres were constructed in five villages where people donated land to Avani to enable the installation of wider looms. These centres are now the hub of all activities coordinated by Avani and Earthcraft in nearby village clusters. These centres have also become the meeting place for the village community institution-building in remote rural areas is very important.

2. Water and energy: Care was taken to ensure that the production processes only uses clean energy sources such as solar and biomass energy, rainwater harvesting and waste water recycling. These minimise waste and reduce the carbon emission of the production cycle

Challenges faced by small producers:

• All communities in the mountains practice some form of weaving and production of goods. Despite this, there has been a steady decline (about 33%) in the number of weavers pursuing their traditional craft between 2001 and 2011.

• Lack of interest amongst the younger generation to pursue the craft due to inadequate returns.

• Disorganised sector, few successful examples of joint initiatives, cooperatives.

• Artisans and farmers need access to capital, raw material, markets, responsible design inputs where the designer is also responsible for the sale of the product.

• Craft wages were not part of MGNREGA and skilled crafts-persons were

carrying stones to earn their living. They have been in the same debt cycle as farmers.

• There is no investment in technologies that would allow artisans to pursue their craft. This includes rainwater harvesting in water deficient areas, waste water recycling (important in the dyeing and printing industry of textiles), and availability and affordability of natural dyes as well as non-toxic dyes. There is also need to support spinning technology that uses indigenous varieties of wool, cotton and other natural fibres. There is no investment in small scale technologies that can serve a village, say like carding machines, spinning mills, etc. Most machines are too large and are usually not functional due to very high input costs in terms of energy and production. There is also the lack of availability of power from clean energy sources.

POTENTIAL

There is immense potential in mountain regions for artisanal, farm produce and eco tourism sectors.

• Skilled artisans do not require skill training to perform their job. They only need linkages to markets and some design and capital inputs.

• Today, the demand for ethically produced, hand-made, eco-friendly and organic products is growing exponentially. Indian and overseas consumers are jaded with cheap, commercially-produced products. They are looking for genuine products.

• Experiential tourism that immerses travellers in the reality of the community. They are visiting and re-establishing the value of the local culture.

• All these activities have a strong potential of generating sufficient income in rural areas to allow communities to continue living in their native surroundings.

• There is a strong movement in favour of hand-spun, hand-woven and naturally-dyed textile products at which Indian artisans excel.

• The demand for natural dyes is going to increase exponentially in the next few years. But who is going to produce? We should be working with small farmers to cultivate wastelands as they are not water and labour intensive crops, especially for small farmers in the mountains.

NATURAL RESOURCES FOR DIFFERENT ENTERPRISES:

• Dye plants

• Medicinal plants

• Organic foods

• Wool and pashmina

• Cultivation and collection of commonly available dye plants and medicinal plants for natural pigments and medicines

• Use of invasive species for productive applications

• Use of traditional skills to produce marketable and high quality textiles

The government can support these objectives in different ways:

• The interaction of policy makers and rural producers is very important before formulation of policy based on skill and resource mapping for every district.

• The emphasis should be on local skills, local materials and local management and small scale.

• Investment in infrastructure: There should be spinning mills close to where the wool is produced. Pashmina from Tibet that comes to Dharchula, goes for carding to a factory in Faridabad and then comes back to Munsiari for spinning. There should be small-scale facilities for artisan communities. The government can invest in such facilities

• The national master-plan should address issues of raw material, processing (weaving, spinning, dyeing) as a contiguous chain.

• Policy for the mountains has to be distinct from those developed for the plains.

• Every administrator and policy maker should take the time to become informed and educated about the subject for which they are responsible.

• Producer collectives should be encouraged and strengthened.

• Training should be dovetailed with entrepreneurship. Access to capital has to be made easier.

• Respect for traditional knowledge and innovation is crucial to ensure that government policy enhances local economy.

• Investment in clean technologies that enable the rural enterprises to become eco-friendly and self-sustaining. Funds should be made available to small enterprises for these objectives.

• It is important to plan for water, energy and industry-related pollution in all programmes that support handlooms and handicrafts.

• There should be stringent implementation of pollution control measures, which will help cottage industries to survive.

• Conservation-based livelihoods around organic produce and eco tourism tp enable small farmers to live sustainably in their native area without migrating to other places.

• A balance between creativity and enterprise.

Ecotourism: A new livelihood alternative and conservation opportunity in Hemis National Park, Western Himalaya, India

JIGMET TAKPA, IFS. Chief Conservator of Forests (Wildlife) Ladakh Region

INTRODUCTION

Ecotourism is one of the new and rapidly growing trends in tourism. The International Ecotourism Society defines ecotourism as the "responsible travel to natural areas that conserves the environment and improves the well-being of local people". Its potential for growth is virtually unlimited. Ecotourism programme mainly consist of nature-based activities that are ecologically sustainable, where education and interpretation are prioritised.

The remarkable biodiversity and spectacular landscapes of the Himalayas make it an ideal destination for Ecotourism. However, there has been a lack of coherence in the Indian Himalayan region over the last few decades with regard to development and sustainable tourism. Ecotourism in the Himalayan region has several advantages and disadvantages (Buckley, 2004). If done correctly, it can provide a vital source of income for local communities, giving them an economic stake in protecting the environment. It can also help foster cultural exchange, employment opportunities and infrastructural growth. However, it can also have potentially negative impacts on local ecology, biodiversity and communities.

Ladakh is a Trans-Himalayan region located in the state of J&K and is characterised by rugged landscapes, limited agricultural landholdings where lack of connectivity hinders various livelihood strategies. The region is rich in cultural and natural resources with spectacular landscapes that make it an ideal candidate for ecotourism initiatives, which have been evolving gradually over the last two decades. At the same time, local communities have had varied experiences with processes related to tourism, even as their own livelihood strategies impact biodiversity and conservation.

A study was conducted for a preliminary assessment of local community perception on engagement with ecotourism ventures, livelihood patterns and their role in conserving biodiversity in Hemis High Altitude National Park and its adjoining areas in Ladakh.

MATERIALS AND METHODS:

Study area

Hemis High Altitude National Park (3409.844° N and 77035.068° E), a representative sample of the larger Ladakh landscape was chosen for intensive study. It is located south of Leh town. The park was established in 1981 with an initial are of 600 sq km, which was subsequently increased by incorporating surrounding areas to cover 4,750 sq km, which makes one of the largest national parks in south Asia. The national park's altitude ranges from 3,200m to 6,400m above mean sea level. Hemis monastery, an ancient and famous pilgrimage site for Buddhists gave the national park its name. The park is located on the western bank of Indus river and encompasses the catchments for Markha, Rumbak, Sumdah and Changchenmo streams.

Besides covering a considerable part of the snow leopard habitat, the park also harbours species of wild sheep and goats that provide it with international importance for biodiversity conservation. These ungulates include Ladakh urial (*Ovis orientalis vignei*), the more common blue sheep or bharal (*Pseudois nayaur*), a small population of Tibetan argali (*Ovis ammon hodgsoni*) and the ibex (*Capra ibex sibirica*). Other carnivores present here include the Tibetan wolf (*Canis lupus chanco*), Dhole or Indian wild dog (*Cuon alpinus*) and red fox (*Vulpus vulpus*). The high altitude pastures harbour Himalayan marmot (*Marmota bobak*) and snow cock (*Tetraogallus himalayensis*), while golden eagles (*Aquila chrysaetos*), Himalayan griffon (*Gyps himalayensis*) and the bearded vulture (*Gypaetus barbatus*) are the main birds of prey. In view the biological resource that it harbours, Hemis High Altitude National park is an important wildlife conservation area in the trans-Himalayas.

Hemis includes most of the catchment of the lower Zangskar river, from the mouth of Markha river to its confluence with Indus river. There are three main valleys in the park: Sumdah in the north, Markha in the south, and Rumbak in the northeast. The valleys are rugged, narrow, and littered with boulders and rocks, and rimmed by peaks that reach 6,000m. Vegetation is predominantly alpine and steppe in nature. Shrublands cover less than 5% of the total land area. Grasses, sedges and herbaceous plants are the main vegetation type, usually covering less than 15% of the total area.

Dominant species include woundwort (*Stachys tibetica*), cinquefoils (*Potentilla* spp.), wormweeds (*Artemesia* spp.), *Bistorta* spp. and *Agrostis* spp. The more moist upper mountain slopes support limited stands of alpine vegetation, characterized by genera such as *Anemone*, *Gentiana*, *Thallctrwn*, *Lloydia*, *Veronica*, *Deiphinum*, *Carex* and *Kobresia*. The remaining mountain slopes and open hillsides, comprising the major portion of the park, support primarily steppe vegetation dominated by *Caragana*, *Artemisia*, *Stachys*, and *Ephedra*. Shrubland (*Hippophae*, *Salix*, and *Myricaria*) with poplar (*Populus*) and a very few birch trees (*Betula*) occur along the lower river courses, and are an important source of wood for the park residents.

Some 1,600 people live in the 15 villages of the three major valleys: Rumbak valley (Rumchung, Zingchen, Rumbak and Yurutse), Markha valley (Skyu, Kaya, Shingo, Markha, and the three Hankar settlements of Umlung, Doltokling and Hankar), and Shang valley (Chogdo, Shang-Dun, Shang-Nakding and Shang-Sumdo). A majority of the residents of these villages rear livestock as their main livelihood strategy. Access to easy prey draws large carnivores, especially snow leopards, to villages and often leads to corral-raiding. Each year, such human-wildlife conflict would leave scores of livestock dead and exert a huge burden on the local economy. This, in turn, affects local support for conservation of wildlife.

Despite being such an important wildlife habitat, Hemis High Altitude National park has never received much attention from researchers due to its remote and inhospitable terrain and harsh climatic conditions. Though there have been some studies, there is need to for more consistent research on biodiversity to generate inputs for conservation.

DATA COLLECTION:

The Data was collected in 2013 from 13 villages in the national park: Hankar, Shingo, Rumbak, Yurutse, Chiling, Sumda Dho, Togte, Markha, Sumda Chun, Sumda, Skyu, Kaya and Ezang. The survey was conducted from 8th October to 30th October with a team of 11 people, which included nine wildlife guards from the Department of Wildlife Protection. The survey team spent about two to three days in each village. Detailed data on wildlife conflict was also collected, which are presented in a separate section. The team trekked to the 13 villages as no other form of transportation is available. A total of 107 people participated in the survey and each respondent was asked for information for three specific time periods: 2003, 2007 and 2013.

During the survey, an attempt was made to ensure equal representation of males and females. However, the participation of the head of family was prioritised. The survey was conducted either in the morning and evening as people are more readily available in their homes at this time of the day.

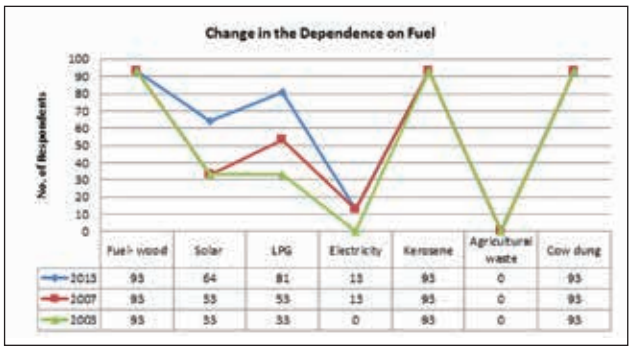
During the survey, most participants were cooperative and participated voluntarily. The duration taken to administer the questionnaire varied for each respondent. Few of the participants did express annoyance when lengthy interviews infringed on their daily schedule.

The survey included information about the respondent's demography, education level, land ownership, income source and change in income, dependence on fuel, ownership and change of livestock numbers and their general perception about the role of the different stakeholders such as NGOs, government and religious authorities towards biodiversity conservation in the region. This information provides a baseline understanding on local socio-economic status.

With regard to human-wildlife conflict, respondents were asked about the number and type of wild species observed in the area, the locations and frequency of sightings, the presence of prey species, types of interactions, the use of wildlife in traditional medicinal systems, general perception on livestock loss and various measures and expectation from the government. They were also asked about various approaches being used to mitigate the impact of such conflicts.

RESULTS

1.1. Change in dependence on fuel:



	Fuel wood	Solar	LPG	Electricity	Kerosene	Agricultural waste	Cow dung
2013	93	64	81	13	93	0	93
2007	93	53	53	13	93	0	93
2003	93	35	33	0	93	0	93

Fig.1. Change in dependence on fuel over the period of 10 years in Hemis NP

As seen in Figure 1, traditional sources of fuel such as kerosene, cow-dung and firewood has not been increased between 2003 and 2013. As a result of government interventions, there is an increased use of environmentally-friendly energy sources, such as electricity, LPG and solar. In 2003, 34.37% people were using solar energy and this increased to 66.6% in 2013. Similarly, 34% people were using LPG and this increased to 84% in 2013.

1.2. Change in source of Income

People in rural areas in Ladakh are still primarily dependent on agricultural activities and the data collected shows no change in the number of people engaged in this activity (Fig 2). An increasing number of people are establishing home-

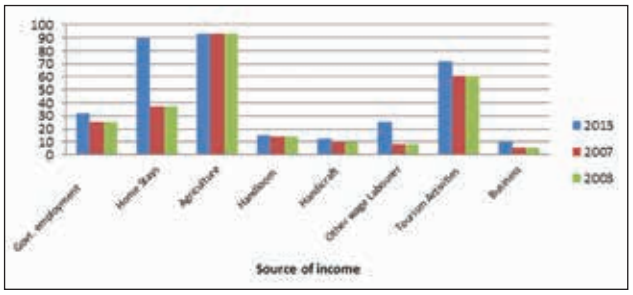


Fig.2. Change in source of income over the period of ten years in Hemis NP

stays as an additional source of income—this is one of the sectors that witnessed a dramatic increase from 38% in 2003 to 96.8% in 2013. In 2003, 63% were dependent on tourism as a source of income, which increased to 75% in 2013. The number of people employed in the government has also increased from 26% in 2003 to 33.3%, in 2013.

1.3. Change in number of educated or school going people

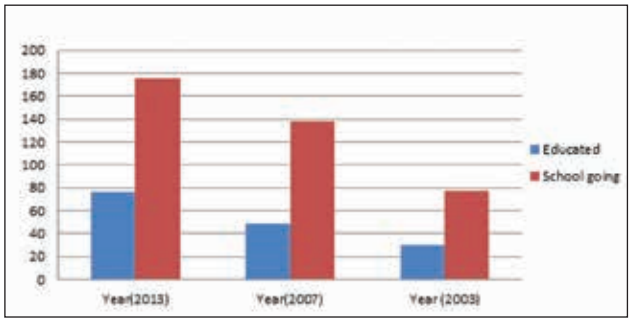


Fig.3 Change in total Number of Educated and school going people study area over the period of ten years in Hemis NP

Figure 3 indicates an increase in the number of educated and school-going individual from 2003 to 2013.

1.4. Change in livestock Number

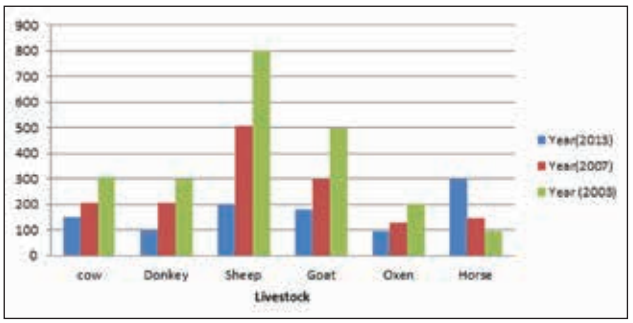


Fig.4. Change in number of livestock number over the period of ten years in Hemis NP

Figure 4 shows a decreasing trend of livestock ownership of sheep and goats, except for horses. This could be explained by the fact that people use horses for various tourist activities.

1.5. Wildlife Conflict issues

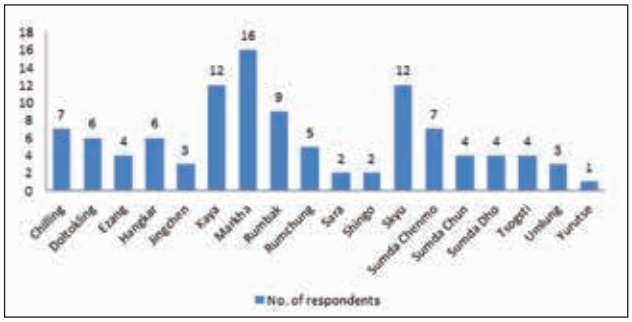


Fig.5. Number of respondents by village in the year 2013

Conflict between humans and wildlife has gained a lot of attention in conservation and policy circles. These conflicts not only cause serious damage to human lives and livelihoods, but also threaten wildlife. Long-term conservation requires understanding and mitigation of conflicts to encourage coexistence of wildlife and humans. Figure 5 provides a village-wise breakdown of the 107 respondents who participated in the survey. The number and type of wild species sighted changed with village location, but the most common were snow leopard, wolf, red fox, Tibetan argali, blue sheep and marmot. Most people reported seeing wildlife away from human settlements and the frequency of sightings ranged from once to 15 times a year. The prey base included domestic animals such as cow, ox, horse, sheep, goat, yak and donkey.

The survey data suggested three main reasons for human-wildlife conflict. These reasons are ranked according to the number of respondents for the specific factor:

1. Increase in numbers of carnivores
2. Ease of access to domestic animals
3. Intrusions by humans in wilderness areas

Though most people identified predators as being responsible for conflicts, most added that predator should not be killed. With regard to measures for conflict mitigation, a majority of the respondents identified the need for some form of security measure to prevent attacks (Fig 6). The most commonly used measure was the use of closed enclosures, followed by open enclosures with use of mesh wire and dogs. Around 10% of the respondents reported that they were not using any security measure to prevent attacks by predators.

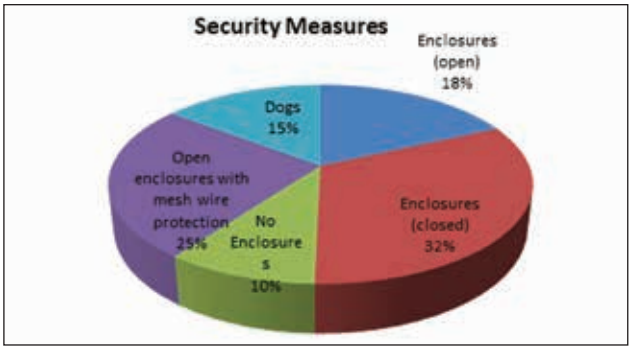


Fig.6. Types of security measures used against predators.

A very small proportion of the population reported killing of predators such as snow leopards and wolves by trapping. When asked about the use of wildlife in traditional medicinal systems, people reported that plant resources were used more commonly than animal parts. The general perception amongst the respondents was that livestock loss due to predation has increased. People expected the Wildlife Department and the Tourism Department to provide compensation for depredation losses, distribute mesh wire protection, help build good quality sheds, and provide man power to guard their livestock.

CONCLUSIONS

Overall, tourism and related activities have had a positive impact on income, livelihood ownership and dependence on fuel. People are more involved in home-stays and are increasingly adopting renewable sources of energy. This is expected to reduce pressure on natural resources and pastures in the area and also discourage people from using energy sources such as cow dung that release harmful emissions.

Respondents identified three reasons for human-wildlife conflict: i) increase in the number of carnivores, ii) ease of access to domestic animals and iii) intrusions by humans in wilderness areas. However, the number of domestic animals has reduced between 2003 and 2013 and the exact number of carnivores is not known. Even though people blamed predators for conflict, they were also tolerant towards them and expected the government to help them mitigate the conflict.

The success of the eco-development project in Hemis National park is based on balancing biodiversity conservation and enhancing livelihood strategies for people living in and around the park. The involvement of local communities in ecotourism activities is a crucial step in this regard. It provides alternative sources of income to local communities that live in and around protected areas, which decreases their dependence on natural resources and increases their commitment to conservation. The lessons from Hemis National park are important for protected areas elsewhere, as it provides a template to benefit communities and achieve conservation simultaneously.

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Sustainable Livelihood Initiative: The experience of Chizami

SENO TSUHAH. Project Team Leader, North East Network Nagaland

INTRODUCTION:

Mountain economy is primarily based on solidarity, territoriality and subsistence. Pastoralist communities in the mountains, shifting cultivators, hill weavers, healers, communities of sustainable practices consider the mountains as their extended families rather than just habitats. Geophysical isolation and rugged terrain excludes the communities from the mainstream developments in plains. As far as entrepreneurship is concerned, it is based on exploration, extraction and depletion of natural resources, rather than regeneration and sustainable management of resources. But in the hills there is a solidarity-based entrepreneurship that prevails across generations. Land on hilly terrains are constantly transforming and evolving through natural forces. Climate variation also increases the vulnerabilities for hill communities with regard to resources. Common resources like water sources, forests, roads, food crop fields in terrace and slopes, mineral resources, unpolluted air and non-timber forest produce defines the hill economy. Such commons are governed through the local self governance institutions, customary codes and a mutual solidarity that exists amongst mountain communities of the world. Under such conditions, livelihoods in the hills become a critical concern for marginalised individuals and communities. Social exchanges, global economic forces and traditional skills open up new avenues for entrepreneurship. In the context of Chizami, such avenues have been created through women's agency. The Chizami experience of practicing sustainable livelihoods is inclusive, innovative and insightful.

THE CHIZAMI EXPERIENCE:

Loin loom textile weaving is a unique craft interwoven with the cultural identity and livelihoods of the people of Nagaland. Weaving in Nagaland is exclusively done by women, cutting across different age-groups and tribes. Traditionally weaving is done solely for self-consumption within the household but there is a thriving market for hand-woven products.

Global market has created diverse livelihood opportunities for hill communities, which demands consistent enhancement of traditional and acquired skills. Today, the younger generation has different aspirations than sustaining traditional livelihoods such as textile weaving and agriculture. Hence, the new skill set has to match the aspirations of the young people, while also retaining their interests in the living heritage of their tribal ethos.

The experience of 'Chizami Weaves' is a story that has transformed the weaving tradition in 11 villages in Phek district of Nagaland. 'Chizami Weaves' is a livelihood project initiated by North East Network (NEN)[1] in 2008. The project aimed at creating livelihood opportunities for women and in enhancing their earning capacities, professional choices and collective space. It is also an attempt to preserve traditional weaving skills and design motifs.

With the penetration of cash economy, our communities are getting trapped in the web of debts, cash crunch and growing needs of modern life. Such changes are gradually affecting the socio-economic conditions of communities, particularly weavers. Our weavers in Chizami belong to the Chakhesang Naga tribe, who are from economically poor families and own very small pieces of cultivable land. Cash income, in general, is low amongst rural communities in Nagaland. Weaving is normally done to meet the needs of the weaver's family, such as children's education, health and daily household expenses. We started with seven weavers and currently work with 300 weavers from Chizami and 10 other villages in Phek district.

Our weavers' primary livelihood is subsistence agriculture and textile weaving is their subsidiary livelihood. Therefore, we adopted a decentralised model of production that provides autonomy to weavers in making decisions about work timings and creating space for innovation in design development. Our Chizami experience taught us that the viability of any entrepreneurial activity needs to be integrated with the socio-cultural ethos of the community.

For sustainability of entrepreneurial activity, one has to understand the market demands. Our loyal clientele includes those who appreciate traditional products as well as those who appreciate contemporary products. More recently, there is a growing interest and demand for products derived from natural fibres and dyes. This opens up new opportunities for mountain communities who have access to a richness of natural resources and biodiversity. If required, location specific infrastructure and related skills can complement the existing resources. NEN is attempting to revive the traditional cotton and stinging nettle plant textiles, starting with the research and design development and an aspiration to develop a product line of natural fibres in the future. The need to adapt and innovate constantly for diverse markets is a priority area and this requires the collaboration between designers, artisans, entrepreneurs, informed consumers and the government.

The Chizami weaves project recognises that unless leadership capacities of local people are built, it's difficult to sustain any venture. A social enhancement component was therefore built in the livelihood project. The outcomes have not only enhanced the income of women weavers but also developed their leadership skills and enabled them to claim their economic, social, cultural and political rights in their homes and community.

STORIES OF POSITIVE CHANGE

- Two weavers from Enhulumi village who have been engaged with the Chizami Weaves project since 2009 – Ms. Konei-u Lohe and Ms. Kedutsolo-u were elected as members of the Village Council in January 2015. Their inclusion in the village council is a landmark achievement for women in the community. This was the first time in the history of the village that women were included in the council. Ms. Koneiu also has been taking a leading role to organise women from her community who work in the informal sector to claim their rights and entitlements.

- Another weaver, Ms. Vezote-u Doulo from Thetsumi village is leading women farmers of her community to sustain agro-bio diverse farming and promote local food.

- Ms. Tshenyilo-u Chirhah, a young weaver from Chizami village is a promising film maker who is making films related to culture and livelihoods, sustainable food and farming, women's rights and community development.

- A weaver from Enhulumi village Ms. Kotele, who is currently the chairperson of her Village Women Society, shared proudly, "My public speaking and leadership skills started from Chizami weaving centre. I became aware of women's rights issues through our weavers' meetings and training programmes."

[1] North East Network (NEN) is a women's organisation working in the Northeast region of India with a focus on women's human rights. Ever since its inception in 1995, NEN's role has been to facilitate an empowering process for women of the region around issues of creative learning, livelihood, environment, health and their representation in governance. This has been and continues to be done through capacity building, awareness raising, networking, research and advocacy. NEN has been working in Assam, Meghalaya, and Nagaland adopting diverse strategies towards good development, corresponding with local situations.

• A weaver from Chizami village Ms. Neikhrolou Thopi, who was with the project since its inception in 2008 said, "Besides agricultural wage work that is seasonal, we have no other regular employment available throughout the year, but NEN has provided me that alternative livelihood through their weaving project. Today, I have a regular income with which I am supporting my siblings' education and taking care of our household needs."

• A weaver from Chizami Town Ms. Aneile Kapfo said, "Earlier, my husband used to tell me not to weave, but I continued to weave and later he started helping me make yarn balls. Now, my husband looks after our livestock while I weave. I can also say that by earning an income, I have started getting more respect from my family members."

These accounts provide evidence of the multidimensional impact of weaving when it transforms into a productive activity from a reproductive activity. It enables rural women to negotiate for greater well-being for themselves and those around them. Women are socially, politically, economically, technologically included as skilled individuals, rather than beneficiaries of various schemes.

CONSTRAINTS AND CHALLENGES

Within the context of hill economy especially in conflict areas like Nagaland, entrepreneurship suffers due to poor infrastructure, including road, power supply, IT, unskilled work force, heavy taxation, and high transportation costs. This is worsened by poor governance that denies basic support services in education, health and other social sectors. Mountain states also constantly suffer due to natural disasters such as landslides, flash floods, hailstorms and earthquakes, which threaten lives and livelihoods of local communities. The lack of appropriate technology inputs such as tools/implements to decrease the drudgery of farmers and artisans is another major constraint. Adequate measures to maintain quality and increase productivity with newer market needs also requires attention. As a non-profit initiative, the social security benefits and emergency health security measures for weavers is very important. However, resources for such measures are almost nonexistent. Sometimes, even basic services are not in place to enhance the quality of life for the weavers. Constant innovation of products and adequate pricing to maintain decent wages, production costs and other benefits provides new challenges for the Chizami Weaves team.

RECOMMENDATIONS

Policy Measures for Futuristic Action:

1. Ecosystem cluster interventions: According to the height of habitats in diverse mountain ranges different interventions can be planned.

2. Sustainable practices for regeneration: Various practices that indigenous communities dependent on mountain ecosystem have been carrying out through generations to enhance the mountain ecosystem and habitats for plants, animals and people should be documented and promoted.

3. Economic and social security measures for promoting ecosystem regeneration:

Communities need to be strengthened with monetary, infrastructural, technological resources, skills, knowledge and information about ecosystem regeneration and sustainable development practices and goals.

4. Local, inter-district, inter-state, regional and international cooperation to network for entrepreneurial initiatives: Communication, transportation, trade linkages, inter-sectoral relationships need to be strengthened for entrepreneurial interventions.

5. Convergence of Skill India, Digital India and Start-Up India to create social, technological and community based innovations that support women and youth in mountain regions.

6. Social entrepreneurial interventions are also needed to address discrimination against women, children, and elderly persons, trafficking of people and development-induced out-migration that affects mountain communities.

7. Create a platform for consumer education to facilitate an interface between craft producers and consumers

8. Cultural rights of hill communities have to be upheld to protect and document community knowledge/ITK.

9. Support community institutional building in the form of artisan collectives/cooperatives, farmers collectives etc. Incentivise producers who grow raw materials (especially natural fibres). Explore convergence of local livelihoods with schemes such as MGNREGS, NRLM.

10. All emergency measures, services, support systems have to be in place during natural and human-induced disasters to support mountain communities.

11. Gender transformation approaches and gender inclusive policy interventions are required to address the needs, gaps and rights of people from mountain communities. This includes recognition of women's skills, knowledge and innovation.

ADDITIONAL LESSONS

1. Informal interaction with women weavers, women farmers, women community leaders, key stakeholders in community institutions, church bodies and community members on concerns of mountain communities helped formulate the recommendations.

2. Weekly and monthly meetings with NEN team members, field workers, community workers, field researchers, critics and resource support groups enabled us to reflect on strategic needs, specific constraints and future possibilities for community initiatives on sustainable livelihoods.

REFERENCES:

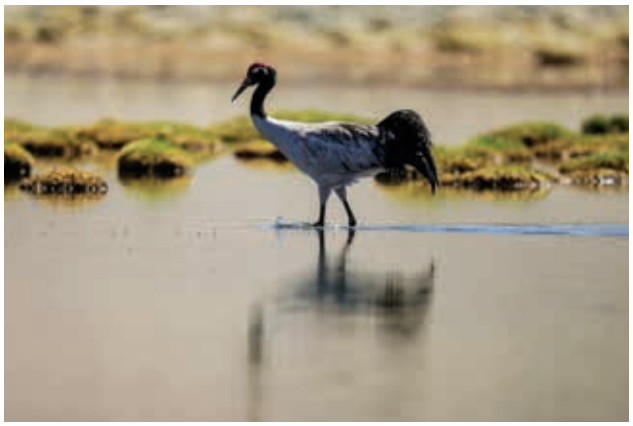
Annual Reports 2014-15, 2015-16, North East Network

Tsuhah Seno, 2014, *Craft Heritage and Transformation* (paper presented).

Photography Competition

First prize
Isaac Tsetan Gergan

Second prize
Tsering Stobdan



Third prize
Mingyur Dechan and Smanla Tsering

Third prize
Thupstan Rinchen

List of participants

Policymakers and elected representatives			
1.	Leh	Dr. Sonam Dawa Lonpo	Chairman/Chief Executive Councillor, LAHDC
2.	Leh	Sh. Tsering Dorjey	Hon. Minister of Cooperative and Ladakh Affairs
3.	Sikkim	Mr. Prem Das Rai	Hon MP (LS) Sikkim
4.	Meghalaya	Mr. Conrad Sangma	Hon MP Meghalaya
5.	Leh	Sh. Nawang Rigzin Jora	Hon MLA, Leh
6.	Leh	Sh. Deldan Namgyal	Hon MLA, Nubra
7.	Sikkim	Dr. Mechung Bhutia	Hon MLA Sikkim
8.	Himachal	Mr. Ravi Thakur	Hon MLA Himachal Pradesh
9.	Leh	Sh. Tsering Sandup	Hon Executive Councillor, LAHDC
10.	Leh	Sh. Dorjay Motup	Hon Executive Councillor, LAHDC
11.	Leh	Sh. Mumtaz Hussain	Hon Executive Councillor, LAHDC
12.	Leh	Sh. Tsering Wangdus	Hon Executive Councillor, LAHDC
13.	Leh	Sh. Ghulam Mehdi	Hon Councillor, LAHDC
14.	Leh	Sh. Gurmet Dorjay	Hon Councillor, LAHDC
15.	Leh	Sh. Gyal P. Wangyal	Hon Councillor, LAHDC
16.	Leh	Sh. Jamyang Tsering Namgyal	Hon Councillor, LAHDC
17.	Leh	Sh. Jigmet Namgyal	Hon Councillor, LAHDC
18.	Leh	Sh. Konchok Stanzin	Hon Councillor, LAHDC
19.	Leh	Sh. Kunzang Lotos	Hon Councillor, LAHDC
20.	Leh	Gey. Lobzang Nyantak	Hon Councillor, LAHDC
21.	Leh	Sh. Lobzang Sherap	Hon Councillor, LAHDC
22.	Leh	Sh. Morup Dorje	Hon Councillor, LAHDC
23.	Leh	Sh. Naseer Hussain	Hon Councillor, LAHDC
24.	Leh	Sh. P. Wangdan	Hon Councillor, LAHDC
25.	Leh	Sh. Phuntsog Dorje	Hon Councillor, LAHDC
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30.	Leh	Sh. Sonam Dorje	Hon Councillor, LAHDC
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32.	Leh	Sh. Tashi Namgail	Hon Councillor, LAHDC
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165.	Leh	Sh. Tsering Angchuk	Wildlife Warden, Leh
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173.	Leh	Sh. Tsewang Rigzin	Ex-Councillor/Media, Leh
174.	Leh	Sh. Tsewang Rigzin	WWF
175.	Leh	Sh. Tsewang Thinles	President, Ladakh Buddhist Association, Leh
176.	Leh	Tsuki Hara	University of Fukui, Japan
177.	Sikkim	Smt. T Uden Bhutia	CEO, Khangchendzonga Conservation Committee
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180.	Leh	Smt. Zahida Bano	CEO, Tourism Dev. Authority/Municipal Corporation Leh
181.	Leh	Sh. Zakir Hussain	General Manager, DIC, Leh
182.	Nagaland	Sh. Zuberno Lotha	Assistant Director, Dept. of Labour & Employment
183.	Leh		Principal, Central Institute of Buddhist Studies

Hon'ble Chief Executive Councillor, LAHDC, Leh, Dr. Sonam Dawa Lonpo (extreme left) and Hon'ble Member of Parliament from Sikkim, Sh. P.D. Rai (second from right) with Hon'ble Union Minister for Tribal Affairs, Sh. Jual Oram.

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189.	Leh	Smt. Chuskit	Eleizer Joldan Memorial College
190.	Leh	Smt. Chuzin	Eleizer Joldan Memorial College
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236.	Leh	Rigzin Palmo	Eleizer Joldan Memorial College
237.	Leh	Smt. Rinchen Dolkar	Eleizer Joldan Memorial College
238.	Leh	Smt. Ruksana Parveen	Eleizer Joldan Memorial College
239.	Leh	Ruqaya Majid	Eleizer Joldan Memorial College
240.	Leh	Smt. S. Angmo	Eleizer Joldan Memorial College
241.	Leh	Smt. S. Chuskit	Eleizer Joldan Memorial College
242.	Leh	Smt. Sabina Bano	Eleizer Joldan Memorial College
243.	Leh	Smt. Sadya Bano	Eleizer Joldan Memorial College
244.	Leh	Smt. Sahara Bano	Eleizer Joldan Memorial College
245.	Leh	Smt. Sakina Bano	Eleizer Joldan Memorial College
246.	Leh	Smt. Shahida Bano	Eleizer Joldan Memorial College
247.	Leh	Smt. Shanti Kumari	Eleizer Joldan Memorial College
248.	Leh	Smt. Skalzang Angmo	Eleizer Joldan Memorial College
249.	Leh	Smt. Skalzang Chondol	Eleizer Joldan Memorial College
250.	Leh	Sonam	Eleizer Joldan Memorial College
251.	Leh	Smt. Sonam Angmo	Eleizer Joldan Memorial College
252.	Leh	Smt. Sonam Angmo	Eleizer Joldan Memorial College
253.	Leh	Smt. Sonam Angmo	Eleizer Joldan Memorial College
254.	Leh	Smt. Sonam Angmo	Eleizer Joldan Memorial College
255.	Leh	Smt. Sonam Chorol	Eleizer Joldan Memorial College
256.	Leh	Smt. Spalzes Dolma	Eleizer Joldan Memorial College
257.	Leh	Smt. Stanzin Chuskit	Eleizer Joldan Memorial College
258.	Leh	Smt. Stanzin Chuskit	Eleizer Joldan Memorial College
259.	Leh	Sh. Stanzin Dadul	Eleizer Joldan Memorial College
260.	Leh	Smt. Stanzin Dolkar	Eleizer Joldan Memorial College
261.	Leh	Smt. Stanzin Dolma	Eleizer Joldan Memorial College
262.	Leh	Smt. Stanzin Pulkit	Eleizer Joldan Memorial College
263.	Leh	Stanzin Spalzang	Eleizer Joldan Memorial College
264.	Leh	Smt. Stanzin Yangdol	Eleizer Joldan Memorial College
265.	Leh	Smt. Stanzin Yangskit	Eleizer Joldan Memorial College
266.	Leh	Sh. Suhail Khan	Eleizer Joldan Memorial College
267.	Leh	Sultan	Eleizer Joldan Memorial College
268.	Leh	Smt. T. Angmo	Eleizer Joldan Memorial College
269.	Leh	Smt. T. Dolma	Eleizer Joldan Memorial College
270.	Leh	Smt. Tahira Bano	Eleizer Joldan Memorial College
271.	Leh	Smt. Tashi Dolkar	Eleizer Joldan Memorial College
272.	Leh	Tashi Palkit	Eleizer Joldan Memorial College
273.	Leh	Tsering	Eleizer Joldan Memorial College
274.	Leh	Smt. Tsering Angmo	Eleizer Joldan Memorial College
275.	Leh	Smt. Tsering Angmo	Eleizer Joldan Memorial College

Students			
276.	Leh	Smt. Tsering Angmo	Eleizer Joldan Memorial College
277.	Leh	Smt. Tsering Chonzom	Eleizer Joldan Memorial College
278.	Leh	Smt. Tsering Chorol	Eleizer Joldan Memorial College
279.	Leh	Smt. Tsering Diskit	Eleizer Joldan Memorial College
280.	Leh	Smt. Tsering Dolkar	Eleizer Joldan Memorial College
281.	Leh	Smt. Tsering Dolkar	Eleizer Joldan Memorial College
282.	Leh	Smt. Tsering Lamo	Eleizer Joldan Memorial College
283.	Leh	Sh. Tsering Mutup	Eleizer Joldan Memorial College
284.	Leh	Smt. Tsering Palmo	Eleizer Joldan Memorial College
285.	Leh	Smt. Tsering Yangskit	Eleizer Joldan Memorial College
286.	Leh	Smt. Tsetan Dolma	Eleizer Joldan Memorial College
287.	Leh	Smt.Tsewang Dolkar	Eleizer Joldan Memorial College
288.	Leh	Smt. Tsewang Lamo	Eleizer Joldan Memorial College
289.	Leh	Tsewang Youton	Eleizer Joldan Memorial College
290.	Leh	Smt. Tundup Dolkar	Eleizer Joldan Memorial College
291.	Leh	Smt. Tundup Dolma	Eleizer Joldan Memorial College
292.	Leh	Youtol	Eleizer Joldan Memorial College
293.	Leh	Smt. Zainab Bano	Eleizer Joldan Memorial College
294.	Leh	Smt. Zubina Bano	Eleizer Joldan Memorial College

Integrated Mountain Initiative team			
295.	IMI	Sh. Amba Jamir	Governing Council Member
296.	IMI	Sh. Alemtemshi Jamir	Governing Council Member
297.	IMI	Smt. Fantry Mein Jaswal	Governing Council Member
298.	IMI	Sh. John Paulraj	Programme Coordinator, IMI
299.	IMI	Dr. Lalbiak Mawia Ngente	Governing Council Member
300.	IMI	Sh. Rajendra P Gurung	Governing Council Member
	IMI	Sh. P.D. Rai	Governing Council Member
301.	IMI	Smt. Shubdha Hirawat	Legislative Assistant to Member of Parliament (Sikkim)
302.	IMI	Sh. Sushil Ramola	Governing Council Member

Delegates during dinner.

Organising team			
303.	Leh	Sh. Arif Kakpori	LREDA
304.	Leh	Sh. Chemet Rigzin	LREDA
305.	Leh	Sh. Delex Namgial, KAS	P.S to Hon'ble CEC, LAHDC, Leh
306.	Leh	Sh. Gonbo Dorjay	LREDA
307.	Leh	Sh. Geleck Phuntsog	Wildlife Department
308.	Ladakh	Sh. Jigmet Takpa, IFS	Wildlife Department
309.	Leh	Smt. Kunzes Dolma	LREDA
310.	Leh	Smt. Kunzes Dolma	*Heritage Himalaya*
311.	Leh	Sh. Mingyur Dechan	LREDA
	Leh	Sh. Moses Kunzang	Additional Deputy Commissioner, Leh
312.	Leh	Sh. Phunchok Wangtak	Wildlife Department
313.	Leh	Smt. Phunstog Angmo	
314.	Leh	Sh. Prasanna Ramaswamy G, IAS	Deputy Commissioner, Leh
315.	Leh	Sh. Reuben Gergan	LREDA
316.	Leh	Smt. Rigzin Chondon	Jawaharlal Nehru University
317.	Leh	Smt. Rigzin Yangdol	
318.	Leh	Smt. Rinchen Dolma	Information Department
319.	Leh	Smt. Salima Bano	LREDA
320.	Leh	Sh. Smanla Tsering	Wildlife Department
321.	Leh	Smt. Stanzin Losang	
322.	Leh	Sh. Stanzin Choster	LREDA
323.	Ladakh	Sh. Sunetro Ghosal	*Stawa*/IALS
324.	Leh	Sh. Tashi Lamchung	LREDA
325.	Ladakh	Sh.Tashi Lundup	Stawa
326.	Leh	Sh. Tashi Namgyal	LREDA
327.	Leh	Smt. Thinlas Chuskit	LREDA
328.	Leh	Smt. Tsering Angmo	LREDA
329.	Leh	Smt. Tsering Chorol	
330.	Leh	Sh. Tsering Motup	LREDA
331.	Leh	Dr. Tsewang Thinlas	LREDA
332.	Leh	Sh. Wangail Rigzin	LREDA
333.	Leh	Smt. Yangskit Angmo	LREDA
334.	Kargil	Smt. Zainab Akhter	Jawaharlal Nehru University

Dignitaries participating in cultural performances during dinner after the valedictory session of SMDS-V.

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Email: smds5@conserveladakh.org
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