Adapting to a world without glaciers
Realities, challenges, and actions

Report on the International Conference-Workshop “Adapting to a world without glaciers: realities, challenges, and actions”

Lima and Huaraz, Peru ● July 7-15, 2009

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PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Prepared by: Jorge Recharte, The Mountain Institute

Florencia Zapata, The Mountain Institute

Julio Postigo, The University of Texas

Laura Avellaneda, Ministry of the Environment

Juan Tarazona, CONCYTEC

Alton Byers, The Mountain Institute

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Acronyms

ANA	Autoridad Nacional de Agua (National Water Authority)
CAN	Comunidad Andina (Andean Community)
CEPLAN	Centro de Planeamiento Estratégico (Strategic Planning Center)
CONAPA	Comisión Nacional de Pueblos Andinos, Amazónicos y Afro-peruanos (National Commission of Andean, Amazonian and Afro-Peruvian Peoples)
CONCYTEC	Consejo Nacional de Ciencia y Tecnología (National Science and Technology Council)
GTH	Grupo de Trabajo Huascaran (Huascaran Working Group)
INIA	Instituto Nacional de Investigación Agraria (National Agrarian Research Institute)
IPROGA	Instituto de Promoción para la Gestión del Agua (Institute for the Promotion of Water Management)
IRG	International Resources Group
MINAG	Ministerio de Agricultural (Ministry of Agriculture)
MINAM	Ministerio de Medio Ambiente (Ministry of the Environment)
MINEDU	Ministerio de Educación (Ministry of Education)
MINEM	Ministerio de Energía y Minas (Ministry of Energy and Mines)
MVCS	Ministerio de Vivienda, Construcción y Saneamiento (Ministry of Housing, Construction and Sanitation)
NSF	National Science Foundation
PUCP	Pontificia Universidad Católica del Perú (Catholic University of Peru)
REMURPE	Red de Municipalidades Rurales del Peru (Network of Rural Municipalities of Peru)
SENASA	Servicio Nacional de Sanidad Agraria (National Plant and Animal Health Service)
TMI	The Mountain Institute
UGA	University of Georgia
USAID	United States Agency for International Development

1. Introduction

An International Conference-Workshop entitled "Adapting to a world without glaciers: realities, challenges, and actions" was held between 7-15 July, 2009 in response to one of the most pressing problems associated with global climate change today, i.e., changes in present and future water supply and availability. The desert Pacific coast of Peru, for example, home to more than 70 per cent of the country's population and producing 60 per cent of its agricultural GDP, rely almost exclusively on water derived from highland watersheds to the east. The rapid recession of glaciers in Peru is certain to cause water shortages that will have severe impacts on the agricultural, power, and tourism sectors, particularly for these downstream and coastal populations. The continued degradation of water-retaining, high altitude ecosystems (cloud forests, grasslands, and alpine *paramo* wetlands), which is often associated with rural poverty, could further diminish both the supply and quality of water while accelerating the occurrence of catastrophic events, such as flooding, landslides, and ultimately droughts.

Glacier retreat has already affected many mountain communities throughout the world, from the Andes to the Himalaya-Hindu Kush. Although many highland populations are drawing on ancestral knowledge to address the impact of climate change on water supply, the scale of the changes occurring today is unprecedented. Nevertheless, organized social response is limited, and knowledge of these processes is partial at best. "Adapting to a world without glaciers: realities, challenges and actions" called on the international scientific, government, non-governmental, and donor communities together to facilitate interdisciplinary discussion about climate change vulnerabilities, risks, and adaptive mechanisms. The workshop also identified priority research, collaboration, and action needs in an effort to promote an integral, coordinated response to the effects of climate change.

The organizing committee for this initiative included representatives of Peru's National Science and Technology Council (CONCYTEC), the U.S. National Science Foundation (NSF), the Ministry of the Environment (MINAM) and the U.S. Agency for International Development (USAID), in cooperation with the Mountain Institute (TMI), the International Resources Group (IRG), the University of Georgia (UGA) and the Catholic University of Peru (PUCP).

The organizers recognize that any successful strategy in response to climate change must draw on the traditional knowledge of local cultures. It must also be firmly rooted in a country's institutions, and reflect the priorities established by local, regional, national, and international societies. The conference brought together specialists from both the physical and social sciences, challenging them to engage in an inter-and intra-disciplinary discussion of appropriate response mechanisms to climate change. The conference also emphasized the need for dialogue and citizen participation in order to link scientific, technical, and policy efforts in ways that develop effective, efficient response models.

Conference presentations on climate change phenomena in both the Andes and the Himalayas made it clear that similar processes are affecting glaciers, water supplies, and societies in both regions. Participants were unanimous in their recommendation that these mountain regions, representing the longest and highest mountains in the world, should take advantage of all opportunities to share scientific learning, experiences, and adaptation models.

Adapting to a World without Glaciers was divided into two parts: (i) a conference that included presentations, panel discussions, and working group formation in Lima, and (ii) a workshop in which working groups developed recommendations and participated in complementary field trips in the Cordillera Blanca region, northwestern Peru. Workshop participants were divided into three interdisciplinary working groups that focused on the themes of (a) Water, (b) Environment (ecosystems and biodiversity), and (c) Agriculture. The

following report provides the priorities in research and pilot action projects for each theme as determined by the working groups over a three-day period

2. Summary of Results

2.1 Capacities & Gaps in Research & Action for Adapting to Climate Change

Current Capacities	Gaps
• Indigenous populations and farmers of the Andes and the Amazon have long history and tradition of adapting to changes in climate and water supply • NGOs are working with local populations to compile and systematize traditional knowledge on climate change and promote proven best practices • Initiatives are being developed to strengthen key institutions at different levels of national and local government, including the creation of the Ministry of the Environment. • The public in general has greater awareness of climate change and its threat to water resources, generating interest and calls for immediate action. • Growing interest among donors, the Government of Peru, local and foreign researchers in climate change impacts in the Andes will help to generate knowledge and resources for Peru. • Globally and regionally there is baseline data and technology available to assist in the analysis of climate change impacts on water, ecosystems, and changes in soil usage.	• Lack of information and research on climate change and water • Institutional weaknesses in Peru in general, especially in agricultural sector • Gap between the wider society and indigenous and native-farming communities. • Peasant-indigenous and Amazonian communities losing control of their natural resources • Gap between the scientific community, decision-makers, and wider society • Lack of financing for climate change strategies, policies, and actions

2.2 Summary Recommendations for Research & Pilot Activities for Adapting to Climate Change

SECTOR	RESEARCH RECOMMENDATIONS	DESCRIPTION	PRIORITY ADAPTIVE ACTIONS	DESCRIPTION
Water & Risk	**Evaluate water availability**	Contribution of different water sources	**Develop & strengthen participation and decision-making of watershed stakeholders**	Convene stakeholders to analyze their interests and interactions
	Identify current & future water uses & users	Agricultural, industrial, urban, & informal water uses	**Capacity building and information exchange**	Training workshops on planning, assessment of vulnerabilities & adaptation, knowledge exchange
	Evaluate past & current water management practices	Policies, institutions, scales, actors, and laws from a historical & social perspective	**Education, communication, and information**	Education & communication to raise public awareness on water resources and good water management practices
Ecosystems & Biodiversity	**Identify vulnerable communities & areas**	Identify communities, ecosystems, & biological zones that are most vulnerable to climate change	**Conservation & management of biodiversity and ecosystems**	Prioritize, protect and manage critical areas for the conservation of biodiversity and agro-biodiversity
	Vulnerability and adaptation	Assess how individuals value & interact with biodiversity & ecosystems from a cultural & economic perspective	**Public awareness**	Raise public awareness of the impact of climate change on biodiversity and ecosystems
	Investigate interactive systems between lowlands and highlands	Explore social, cultural, economic, & environmental ties between lowlands & highlands on eastern & western slopes	**Environmental policy**	Improve existing environmental policies & norms and design new ones on biodiversity conservation & environmental services tailored to each ecosystem
Agriculture	**Evaluation of changes in water use, vegetation coverage & productive systems as a result of climate change**	Using remote sensing & social science methods, with an emphasis on watershed headwaters & diversity of climate zones, especially in economic corridors	**Strengthen government agencies to implement more effective responses to climate change.**	Improve the capacities of different government agencies in resource management, strengthening synergies to address climate change, & creating databases that can be shared across sectors.
	Recovery & reassessment of traditional knowledge with respect to climate change, from a multicultural	Local cultures have adapted to climatic events in the past, accumulating ancestral knowledge that	**Design and implementation of the National Intercultural Education Program on**	Integrate traditional knowledge and cultural diversity with western scientific knowledge on climate change.

SECTOR	RESEARCH RECOMMENDATIONS	DESCRIPTION	PRIORITY ADAPTIVE ACTIONS	DESCRIPTION
	perspective	should be recovered and incorporated into climate change adaptation strategies	**Climate Change**	
	Evaluation of current & potential capacities of sub-watersheds as environmental service providers	Identify capacities of a sub-watershed, with an emphasis on grasslands & forests, as environmental service providers.	**Develop and implement mandatory payment mechanisms for environmental services**	Strengthen existing legal framework on payment for environmental services

3. Results of working groups during the conference-workshop

3.1. Identification of capacities and gaps in research and action for adapting to climate change in Peru

Current responses to increased climate variability are mainly found at **the local level**. They are based on the knowledge and traditions of local cultures and are expressed in their agricultural, water management, and biodiversity conservation practices. Indigenous populations and farmers of the Andes and the Amazon continue to follow practices developed over the centuries in response to changes in climate and water supply. These responses are especially noteworthy in vulnerable zones where populations are broadening their knowledge in an effort to understand the dynamics of natural processes and phenomena (e.g. community-based irrigation systems for agriculture or wetlands for alpaca grazing, *bofedales,* are being expanded or developed by many peasant communities in response to climate change to reduce risk) ,. At the same time, these people are developing the skills necessary to improve their capacity for adaptation while increasing their resilience to climate change.

Non-governmental organizations are working with local populations to compile and systematize traditional knowledge on climate change with a view to promoting the continued use of proven best practices. These efforts have brought to light the potential for these communities to form partnerships and develop inter-institutional initiatives with respect to climate change through community-based pilot activities.

In Peru, several initiatives are being developed to strengthen institutions at different levels of **government**, which in turn will help build their capacities for enhanced climate change research and action. Initiatives of special note include the creation of the Ministry of the Environment; the drafting of regulations for water resource management and risk management; the government effort to strengthen the implementation of climate change plans and programs; the growing interest of local authorities in incorporating environmental policies in their communities; and new environmental strategies being developed in some regions of the country. Moreover, the country has generated a large capacity for *in situ* conservation of biodiversity, and efforts are underway to assess the status of flora and fauna in the national network of protected areas.

In addition, **civil society** has demonstrated greater awareness of climate change and its threat to water resources, generating increasing interest and calls for immediate action. University initiatives to work with communities in water resource management are just one example of this increased interest. Promotional groups and platforms for water management have been established. Projects for modern irrigation systems in different Andean ecological zones are also being developed, and programs have been created to train specialists in integrated water resource management. However, professional capacities in glaciology, geomorphology, and social sciences are still in need of strengthening. Likewise, more facilities are needed to carry out more detailed geomorphological studies and water ion and isotopic analyses.

The growing interest among **donors, the Government of Peru, local and foreign researchers** in climate change and its impact on biodiversity and ecosystems will help to generate knowledge in this area. Because Peru has a large percentage of the world's tropical glaciers (> 70 per cent), the highland zone is of special interest to the scientific community, making it feasible to obtain international resources for research and activities associated with glaciers, water, biodiversity, and ecosystems.

At the global scale, baseline data on global climate change and its impact on water resources and risks is available and can be useful at the national level. Technology is also available to facilitate the analysis and processing of information on water, ecosystems, and changes in soil usage. In Peru, researchers have studied traditional water management practices. Risk management projects have been implemented, such as structural works to protect and contain glacial lakes. Although the country has tested practices for monitoring and evaluating glaciers, there is a need to increase monitoring of glacier mass balance (volume) and to expand the sample of representative glaciers monitored.

Weaknesses identified in climate change research, and those activities required to adapt to this change, were organized into **six core themes** that cut across the three working group sectors**. The first theme** refers to information and research on climate change and water. In this area, workshop participants identified the lack of studies on (1) the interaction between highland and lowland areas of the watershed, environmental services, and the importance of mountains for biodiversity, (2) baseline data and information for monitoring climatic and hydrological parameters with respect to biodiversity, (3) water resources (surface and underground, at the watershed and sub-watershed levels), climate change, and the risks throughout Peru (in real time for adequate water and risk management and the identification of management options), (4) ways to increase the efficiency of current water use systems, and (5) paleoclimatology and climate history. Specialists also need to learn more about temperature and precipitation variations in the medium and long term. Currently, a lack of solid data on these variations has made it impossible to accurately estimate water availability and the magnitude of climate change and its impact. In addition, the lack of tested models and clear scenarios reduces the effectiveness of responses to climate change and hinders planning of strategies for adaptation.

The second core theme refers to the weakness of institutions in Peru in general, and of the agricultural sector in particular. This weakness causes overlapping of responsibilities as well as limited cooperation among government agencies, which is reflected in the absence of a multisectoral government database on climate change. This hinders policy design and implementation. Likewise, there is an evident lack of coordination between agencies that regulate and oversee environmental and natural resources and research organizations, international aid agencies, and national institutions. Consequently, there is limited actual capacity for research, a weak presence of health and research agencies (SENASA and INIA, respectively), discontinuity in agricultural extension activities, and a lack of coordination by the agency responsible for evaluating the state of natural resources (ONERN). Little updated information is available. Moreover, current proposals are largely speculative and lack a planning perspective. In addition, the government does not promote citizen participation or research in climate change, and universities focus their studies on extractive activities, making research a monopoly of the private sector.

The country's weak institutions are also reflected in the lack of compliance with environmental laws and regulations, in the lack of clear water management policies, and in a lack of compliance with policies for adapting to climate change. Additionally, the slow pace of the country's decentralization efforts has hindered many local and regional initiatives.

The third core area refers to the gap between the wider society and indigenous and native-farming communities. Intercultural dialogue has yet to become a government policy, and the few isolated actions in this direction are not being assumed or replicated by public institutions. This gap has caused difficulties in incorporating traditional knowledge in official strategies for adapting to climate change. Even worse, national policies have weakened local capacities to respond to climate variability. Social conflicts arising from inefficient use of water, unequal distribution of benefits of those uses, the growing demand for the resource and the potential reduction in water supply caused by climate change are evidence of intra- and inter-sectoral weaknesses. As a result, the population has little confidence in governmental and non-governmental organizations alike.

The fourth core area refers to weaknesses of peasant-indigenous and Amazonian communities that have been losing control of their natural resources as well as their social capacities to manage their lands. Nationwide, this is expressed in the loss of food security, where the smallholder farmer plays a key role. At the local level, this is reflected in technical-productive limitations, soil erosion, loss of biological diversity and genetic quality, the deterioration of productive infrastructure, and dependence on outside social organizations.

The fifth core theme is the gap between the scientific community, decision-makers, and wider society. Communication and social networks between scientists and decision-makers are lacking, and there is limited interaction between these groups. Research results are not made widely available to the public. Existing information is not organized, and multiple procedures are required to access it. Consequently, public awareness of climate change and its impact is limited.

Finally, the lack of financing limits the implementation of, and compliance with, public policies on climate change as well as the development of strategies and actions for adapting to climate change in the medium and long term (for example, developing renewable energy sources, terracing, and reservoirs). It also threatens continued research into climate change and the participation of local researchers in these studies.

3. 2. Proposals for research and pilot activities for adapting to climate change in Peru

3.2.1 Water and Risk Sector: priority research and activities

Recommendations for <u>research of</u> processes and impacts of climate change in Peru (water sector and risks)

1. Evaluating water availability (natural and artificial)
Description: Contribution of different water sources (for example, precipitation, glaciers, snow, underground water) and their spatial and temporal variability. Study and modeling of physical factors associated with the hydrologic balance in watersheds and the impact of climate change on water availability (quality and quantity)
Support needed: • Monitoring stations (hydrometeorological, climate, discharge, underground water), adequately distributed at the regional and national levels • Capacities to prepare models, including software and human resources • Financial resources • Human resources (evaluation of capacities) • Institutional development (agreements with international groups) • Communication and information mechanisms
Application levels: regional and national network (replication of regional climate change studies)
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, MINAM, ANA, NGOs and the private sector.

2. Identifying current and future water uses
Description: Identification of different water uses (for example, agricultural, industrial, urban, and informal uses)
Support needed: • Human and infrastructural capacities to determine water demand in different sectors • Human and infrastructural capacities to determine water management efficiency in different sectors • Capacities to prepare models, including software and human resources
Application levels: Community, district, regional and national
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, MINAM, ANA, NGOs and the private sector.

3. Evaluating past and current water management practices
Description: Understanding policies, institutions, scales, actors, and laws from a historical and social perspective
Support needed: • Human capacities to identify water management practices in different sectors • Platforms (study center, data archive, etc.) for inter-disciplinary research and institutional cooperation
Application levels: (not identified)
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, MINAM, ANA, NGOs and the private sector.

Other research topics suggested:

- Assessment of freshwater sources in the country
- Study of anthropogenic activity and its effect on water quality
- Study of traditional knowledge and incorporation of this knowledge in water management practices
- Study on community perceptions of risk and climate change and disaster-preparedness training of communities

Proposals for <u>priority actions</u> for adapting to climate change in Peru (water and risks sector)

1. Development and strengthening of mechanisms for participation and decision-making of watershed stakeholders
Description: Bring together different stakeholders and analyze their interests and interactions
Support needed: • Interest and inclusion of stakeholders • Credibility of the institution convening stakeholders • Appropriate location (accessible, size) • Specialists in different fields such as mediation, water resources, economics, geography, etc.
Application levels: communities, user groups, Ministry of the Environment, Ministry of Housing.
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, MINAM, ANA, NGOs and the private sector.

2. Capacity building and information exchange (for participation and decision-making)
Description: Human resource training through practical workshops on topics such as planning, technical aspects, assessment of vulnerabilities and adaptation, etc. Exchange of knowledge and information among key groups in Peru and the Andean region.
Support needed: • Identification of topics, trainers and interested beneficiaries • Evaluation of existing capacities • Mechanisms for knowledge exchange, for example, an entity that can facilitate training and exchange • Establishment and implementation of project data banks on rational water use
Application levels: watershed, community, district, regional, national and international
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, MINAM, ANA, NGOs and the private sector.

3. Education, communication, and information (improving communication and education on climate change)
Description: Education and communication to raise public awareness on water resources and to facilitate the implementation of projects to promote good water management practices
Support needed: • Specialists in communication and information dissemination • Sensitized communications media (TV, radio, press)
Application levels: watershed, community, district, regional and national
Key actors: universities, regional governments, REMURPE/municipalities, CONCYTEC, others.

Other suggested activities:

- Develop national policies with respect to industrialized nations
- Make geo-referenced data available to the public
- Draft development plans at all levels to ensure concrete results
- Offer more competitive salaries to government researchers
- Advocate for regional environmental management policies
- Intensify economic-ecological zones and land organization plans at the local and regional government levels
- Establish government and private conservation areas
- Monitor glaciers nationwide (expand monitoring)
- Design hydraulic models to make projections and develop mitigation measures
- Identify zones which are at risk due to glacier retreat and determine stability of lakeshore areas
- Conserve wetlands, highland grasslands, and water recharge zones
- Introduce new storage/distribution/application technologies for hydraulic infrastructure
- Promote rational use of water through ANA
- Encourage coordination among users and other stakeholders in the watersheds for integrated water resource management
- Train actors in water management techniques
- Develop and strengthen mechanisms for participation and decision-making of local stakeholders

3.2.2 Ecosystem and Biodiversity Sector: priority research and actions

Recommendations for <u>research of</u> processes and impacts of climate change in Peru (ecosystem and biodiversity sector)

1. Identification ecosystems and biological zones at risk
Description: Identify the communities, ecosystems, and biological zones that are most vulnerable to climate change through applied research on: • Interactive systems between highland and lowland areas; • Environmental services; and • Knowledge and management of local systems.
Support needed: - Replicable quantitative and qualitative methods to identify areas rich in biodiversity that are vulnerable to climate change; - Network of research and monitoring stations that cover all ecological floors on the western and eastern slopes; -Coordination of research between private and public institutions at the local, regional, national, and international levels; and - Linkage of institutional research and funding strategies in a national agenda.
Application levels: community, district, regional, and national
Key actors: universities and research organizations

2. Vulnerability and adaptation
Description: Explore how individuals value biodiversity and ecosystems from a cultural and economic perspective, and study interactions and feedback between human and biophysical systems
Support needed: - Information on knowledge and management of local systems; - Identification of feedback mechanisms; and - Regional modeling of the impact of climate on resource use and management.
Application levels: community, district, regional, and national
Key actors: universities, research organizations, and NGOs

3. Interactive systems between lowlands and highlands
Description: Explore the social, cultural, economic, and environmental ties between lowlands and highlands on the eastern and western slopes
Support needed: - Identify and strengthen existing links between stakeholders and institutions of highland and lowland areas; - Identify the range of environmental services; - Explore the potential effects of climate change on environmental services; and - Develop strategies and mechanisms for adapting ecosystems to potential changes.
Application levels: community, district, regional and national
Key actors: universities, research organizations, and NGOs

Recommended <u>priority actions</u> for adapting to climate change in Peru (ecosystem and biodiversity sector)

1. Conservation and management of biodiversity and ecosystems
Description: Prioritize, protect and manage critical areas for the conservation of: • biodiversity • agro-biodiversity
Support needed: - Financing of research and training projects; - Pilot projects program; - Inter-disciplinary, integrated research programs on climate change in coordination with the local population; and - Cooperation among specialized national and international institutions.
Application levels: community, district, regional, and national
Key actors: MINAM, universities, research organizations, and NGOs

2. Public awareness
Description: Raise public awareness of the impact of climate change on biodiversity and ecosystems through: • education • dissemination activities • development of technical capacities

2. Public awareness
Support needed: - Materials for the dissemination of best practices and techniques for communities and decision-makers at all levels; and - Use of different communications media and information exchange and education mechanisms.
Application levels: community, district, regional and national
Key actors: MINAM, MINEDU, universities, research organizations and NGOs

3. Environmental policy
Description: Improve existing environmental policies and norms and design new ones on biodiversity conservation and environmental services tailored to each ecosystem.
Support needed: - Long-term political will and citizen participation in local government; - Transparency in information exchange and decision-making; and - Strengthening of citizen participation and conflict management mechanisms.
Application levels: community, district, regional and, national
Key actors: MINAM, regional governments, universities, research organizations, and NGOs

3.2.3 Agricultural Sector: priority research and activities

Recommended <u>priority research</u> for adapting to climate change in Peru (agricultural sector)

1. Evaluation of changes in water use, vegetation coverage and productive systems as a result of climate change
Description: Using remote sensing and social science methods, with an emphasis on watershed headwaters and diversity of climate zones, especially in economic corridors
Support needed: - Inter-institutional information network, linking provincial universities; - Satellite images and software (GIS, statistics); - Participatory research techniques; and - Financing.
Application levels: National, prioritized sub-watersheds.
Key actors: MINAG, MINAM, CONCYTEC, universities, local communities, NGOs.

2. Recovery and reassessment of traditional knowledge with respect to climate change, from a multicultural perspective

2. Recovery and reassessment of traditional knowledge with respect to climate change, from a multicultural perspective
Description: Local cultures have adapted to climatic events in the past, accumulating ancestral knowledge that should be recovered and incorporated into climate change adaptation strategies
Support needed: - Active participation of local communities and their experts; - Government agencies' interest and awareness; - Inter-learning pilot projects; - Recovery and systematization methodology; and - Financing.
Application levels: Nationwide, at community level
Key actors: SENASA, INIA, universities, communities, NGOs, smallholder and medium-scale farmers, CONAPA, congressional committees, peasant organizations.

3. Evaluation of current and potential capacities of sub-watersheds as environmental service providers
Description: Identify real capacities of a sub-watershed, with an emphasis on grasslands and forests, as environmental service providers.
Support needed: - Institutions identified with payment for environmental services; - Availability of professionals with knowledge of environmental services; - Research and recovery models; - Commitment of sub-watershed stakeholders to participate; - Identification of potential markets; and - Financing.
Application levels: Nationwide, at the sub-watershed level.
Key actors: MINAM, ANA, MINAG, the private sector, INADE, universities, environmental service experts, communities, local governments.

Other research topics suggested:

- Local cultural perspectives on land and markets;
- Importance of native seed as a food reserve;
- Studies to improve productivity of micro-watersheds based on farmer production; and
- Migration and its impact on the sub-watershed.

Research recommendations:

- Systematization should take place at both the local and regional levels.
- A historical perspective should be incorporated into the studies on responses of populations to climate events.
- Traditional knowledge should be recovered and peasants familiar with conservation practices should be consulted.

Recommended <u>priority actions</u> for adapting to climate change in Peru (agricultural sector)

1. Strengthen government agencies, such as MINAM, MINAG, SENAHMI, INIA, and SENASA to implement more effective responses to climate change.
Description: Improve the capacities of different government agencies in resource management, strengthening synergies to address climate change, and creating databases that can be shared across sectors.
Support needed: - Norms that promote alliances among government agencies; - Training of human resources; - Peruvian government and international funding; - Autonomous, strengthened government comptroller's office; and - Established dialogue mechanisms.
Application levels: National
Key actors: MINAM, MINAG, MINEM, MVCS, CEPLAN

2. Design and implementation of the National Intercultural Education Program on Climate Change
Description: Integrate traditional knowledge and cultural diversity with western scientific knowledge on climate change.
Support needed: - Iskay Yachay and intercultural, bilingual education program; - Modification of school curriculum; incorporation of the topic of climate change from a multicultural perspective; - Teacher training on climate change using a multicultural, bilingual approach; - Education materials with a multicultural focus; - Multicultural communication and dissemination strategies; and - Non-formal programs and initiatives with the participation of local experts.
Application levels: community, district, regional and national
Key actors: MINEDU, universities, technical institutes, regional government, teachers.

3. Develop and implement mandatory payment mechanisms for environmental services
Description: Strengthen the existing legal framework on payment for environmental services to guarantee compliance with payments and the distribution of funds among the communities responsible for conserving the ecosystems that provide those services in an effort to fortify communities' resilience to the effects of climate change.
Support needed: - Information on previous experiences with payment for environmental services. For example: private hydroelectric companies, mining companies, initiatives in Moyabamba and Salinas-Aguada Blanca, payment of percentages for water usage, etc. - Monitoring of investment of environmental service payments in zones providing those services.
Application levels: National, at the level of sub-watersheds, with an emphasis on watershed headwaters.

3. Develop and implement mandatory payment mechanisms for environmental services
Key actors: communities responsible for conserving ecosystems that provide environmental services, service users, Congress, MINAG, MINAM.

Other priority actions suggested:

- Incorporate variables of climate change and risk management in studies conducted by the different government sectors, where relevant.
- Strengthen networks and platforms associated with climate change activities at the national (National Climate Change Committee), regional, and local levels (roundtables and participatory budgets), as well as working groups (for example, the Huascarán Working Group).
- Promote the National Development Plan currently being drafted (CAN and Peruvian government) to foster cooperation among the different sectors.
- Promote the representation of indigenous groups on the National Climate Change Committee.
- Support agreements between local and foreign universities to enable Peruvian researchers to participate in research projects (cooperation programs and international exchange for research).
- Prepare local and regional risk maps with early warning systems.

4. Annexes

Annex I. Conference-workshop program

July 7
Conference in Lima

Lima Workshop
Conference open to the public
Location: Main Campus of Pontificia Universidad Católica del Perú (PUCP), Law School Auditorium (morning) and Social Science Faculty auditorium (afternoon)

8:30 to 9:00 am Registration of participants

9:00 to 9:20 am **Welcome and Introduction**
- Representative, National Council for Science and Technology of Peru (CONCYTEC)
- Representative, The Mountain Institute (TMI)
- Representative, USAID
- Official inauguration by the Minister of Environment, Antonio Brack

9:20 to 10:45 am **Keynote speakers**
- **Lonnie Thompson**, The Ohio State University: *Climate and glaciers.*
- **Marco Zapata,** National Water Authority: *Glacier loss and impacts on water in Peru.*
- **Eduardo Durand**, Ministry of the Environment: *National activities in response to climate change.*

12:00 to 12:30 pm Press conference

12:30 to 2:30 pm *Lunch*

Afternoon Session: Integrating social, political, and environmental perspectives

Location: Social Science Faculty Auditorium PUCP.

2:30 to 5:00 pm **Panel discussions. Water and Climate Change: social-environmental perspectives**
- **Pablo Lagos,** Geophysics Institute of Peru: *Climate Models*
- **Bryan Mark,** The Ohio State University: *Glaciers*
- **Carlos Amat y León,** Universidad del Pacífico: *Economics*
- **Hilda Araujo,** Center for Research and Technology for the Andean Countries (CITPA): *Anthropology and communities*
- **Jeffrey Bury,** University of California at Santa Cruz: *Social geography*

Commentator: **Ricardo Giesecke**, Andean Community (CAN), Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes Project (PRAA).

5:00 to 5:30 pm *Coffee break*

5:30 to 7:00 pm **Panel discussions. Water and Climate Change: Political Perspectives**
- **Mariano Castro**, Sociedad Peruana de Derecho Ambiental: *A review of national policies in response to climate change.*
- **Wilbert Rozas Beltrán**, Network of Rural Municipalities of Peru (REMURPE): *Overview of local concerns and policies*.

Commentators: **Javier Abugattás**, Pontificia Universidad Católica del Perú (PUCP) and **Teresa Oré**, Institute for Water Management Promotion (IPROGA).

7:00 pm **Closing remarks,** representative of PUCP.

July 8 to 13
Workshop and training sessions, Lima and Huaraz

July 8 - Lima
Presentations: Climate, Glaciers, Water, and Societies. Group work.

Location: Main Campus of Pontificia Universidad Católica del Perú (PUCP), Rooms 101 and 102, Z Pavilion

9:00 to 9:30 am Welcome to participants and workshop introduction

9:30 to 10:30 am Establishment of working groups and definition of tasks

10:30 to 11:00 am Coffee-break

11:00 am to 1:00 pm Simultaneous panels

Panel discussions – Glaciers, Water, and Society I

- *Overview of Peru.* Marco Zapata, National Water Authority (ANA)
- *Overview of Nepal.* Pradeep Mool, International Center for Integrated Mountain Development: *Glaciology* (ICIMOD)
- *Water supply and impacts on livelihoods.* Jeffrey Bury, University of California at Santa Cruz.
- *Water and conflicts in the Andes.* Teresa Ore, Institute for Water Management Promotion (IPROGA)

Commentator: Mark Carey

Panel discussions – Glaciers, Water, and Society II

- *Overview of Ecuador.* Xavier Zapata-Ríos, Florida International University.
- *Water management technologies in ancient Peru: archeological perspectives on adaptation to climate change.* Alexander Herrera, Universidad de los Andes.
- *Andean cultural perspectives on water, glaciers, landscapes, and climate.* Ricardo Claverías, Center for Research, Education and Development (CIED)
- *Water and conflicts in Peru: future scenarios under the new legislation for integrated water management.* Karen Price and Daniela Cárdenas, National Water Authority (ANA)

Commentator: Pablo Lagos

1:00 to 2:30 pm Lunch

2:30 to 4:30 pm Panel discussions – Examples of Changes in Specific Sectors

- *Agriculture: Impacts and perspectives*. Carlos Amat y León, Universidad del Pacífico
- *Ecosystems and biodiversity: impacts and perspectives.* Alexandra Ponette-González. The University of Texas at Austin.
- *Future demands of water in energy and other economic sectors.* Héctor Vera, Servicio Nacional de Meteorología e Hidrología (SENAMHI)
- *Risk management: impacts and perspectives.* John Gierke and Miriam Ríos-Sánchez, Michigan Technological University

Commentator: Karen Price

4:30 to 5:00 pm Coffee break

5:00 to 6:30 pm Working groups

July 9 - Lima
Presentations: Case studies, experiences and best practices. Working groups.

Location: Main campus of Pontificia Universidad Católica del Perú (PUCP), Rooms 101 and 102, Z Pavilion

9:00 to 9:15 am **Summary of previous day and introduction to the program**

9:15 to 11:00 am. **Panel discussions – Case Studies from the field (part one)**

- *Adaptation to the effects of glacier retreat in the Mantaro Valley.* Pablo Lagos, Geophysics Institute of Peru (IGP)
- *Downstream impact on water and hazards from climate change impact on snow and ice in the Hindu Kush – Himalayan region.* Mats Eriksson, International Centre for Integrated Mountain Development (ICIMOD)
- *Climate, culture, and landscape change in the Everest Region of Nepal.* Alton Byers, The Mountain Institute (TMI)
- *Glaciers, sacred mountains, remote sensors, field techniques, and indigenous perspectives on climate change.* Adina Racoviteanu, University of Colorado at Boulder

Commentator: Jorge Recharte

11:00 to 11:30 am *Coffee break*

11:30 am to 1:00 pm **Panel discussions– Case Studies from the Field (part two)**

- *Economic impacts of climate change in the Mantaro Valley, Peru.* Alejandra Martinez, Geophysics Institute of Peru (IGP)
- *Peasant community perspectives on natural resources.* Gerardo Damonte, The Group for the Analysis of Development (GRADE)

Conference: *Peru's research agenda for adaptation to climate change.* Juan Tarazona, National Council for Science and Technology of Peru (CONCYTEC)

Commentator: Jorge Recharte

1:00 to 2:30 pm *Lunch*

2:30 to 4:50 pm **Simultaneous panels**

Panel discussions – Experiences, policies and approaches I

- *Mapping actors and actions in climate change research and action in Peru-* Juan Torres, Practical Action (ITDG)
- *Range management and hydrology: potential adaptation strategies to climate change impacts in Central Peru.* Enrique Flores, National Agrarian University, La Molina (UNALM)
- *Impact of climate change in the Santa River Watershed (Peru's Second Declaration on Climate Change).* Juan Guerrero Barrantes, National Agrarian University, La Molina (UNALM)
- *Local responses to water stress in southern Peru.* Víctor Bustinza, Climate Adaptation Program

Commentator: Ricardo Claverías

Panel discussions – Experiences, policies and approaches II

• *Designing pilot actions to respond to climate change in the Andes.* Ana Iju, Andean Community (CAN), Adaptation to the impact of rapid glacier retreat in the tropical Andes Project (PRAA)
• *Conflicts and water management in the context of climate change in Peru.* Julio Alegría. Institute for Water Management Promotion (IPROGA)
• *Environmental governance and Andean communities.* Jennifer Lipton, Central Washington University

• *National Policies to promote ecosystem and watershed management as climate change adaptation strategies in Peru.* Doris Rueda, Ministry of the Environment

Commentator: Julio Postigo

4:50 to 5:20 pm *Coffee break*

5:20 to 6:30 pm **Working groups**

July 10
Trip to Huaraz

Travel from Lima to Huaraz

July 11 - Huaraz
Vulnerability and Adaptation Training. Working groups

Conference participants only. Location: Conference Room Hotel Andino, Huaraz.

8:30 to 8:40 am Summary of previous day and introduction to the program

8:40 to 10:40 am Vulnerability and Adaptation Training

- *Adapting to Climate Variability and Change. USAID manual.* John Furlow, USAID and Glen Anderson, IRG.

10:40 to 11:10 am Coffee-break

11:10 to 12:30 pm Working Groups: thematic meetings

12:30 to 3:30 pm Lunch (field location)

3:30 to 5:30 pm Working Groups: thematic meetings (continues)

5:30 to 6:00 pm Coffee break

6:00 to 7:30 pm Presentations

• *Landscapes of the Cordillera Blanca: Introduction to a day in the field.* Jan Sevink and Erik Cammeraat, University of Amsterdam.

July 12 - Huaraz
Day in the field: Glacial lakes, glacier retreat, Andean communities

7:00 am to 6:00 pm Day in the field

- Group 1 Llaca Lake. Glacier lake control. Glaciology Unit.
- Group 2. Pastoruri glacier. A glacier that is disappearing rapidly. Observations of climate change impacts.
- Group 3. Yungay and Llanganuco lakes. Visit the site of the 1970 avalanche and discuss the impact of climate change on glaciers and water with community leaders. Subsequent visit to Llanganuco lakes.

July 13 - Huaraz

Working groups and presentation of preliminary findings

Location: Conference Room Hotel Andino, Huaraz.

8:30 to 10:30 am: Working Groups: thematic meetings

Groups complete their presentations, including photos and examples from the field trips, and prepare a summary of group work results.

10:30 to 11:00 am Coffee-break

11:00 to 1:00 pm Working Groups: Presentation of group results in plenary session

1:00 to 2:30 pm. Lunch

2:30 to 6:00 pm Working Groups (continues)

6:00 to 7:30 pm Presentation of preliminary findings of the workshop

- **Presentation of preliminary findings of the workshop:** summary of findings of working groups.

July 14
Trip to Lima

Trip from Huaraz to Lima, with brief stops for observation along the way.

July 15 - Lima
Meeting with representatives of Peruvian government agencies

Location: Virreynal Room, Lima Country Club Hotel

9:00 to 9:30 am Welcome

- USAID Representative Paul Weisenfeld.
- National Science Foundation representative Kenneth Young.
- Foreign affairs officer Sergio Kostritsky.
- Ministry of the Environment representative Eduardo Durand.

9:30 to 11:00 am. Presentation of workshop recommendations

- Background and introduction: Jorge Recharte, TMI
- Conclusions of the scientific conference: Mark Carey, Washington and Lee University.
- Recommended research and actions: Juan Tarazona, CONCYTEC.
- Question and answer session

11:00 am Closing remarks

- Peruvian Minister of the Environment, Antonio Brack.

Annex II. List of participants

Surname	Name	Organization	E-mail
Abugattas	Javier	Pontificia Universidad Católica del Perú	jabugattas@pucp.edu.pe
Alegria	July	IPROGRA	July.f.alegria@gmail.com
Alfaro	Luis	SERNANP	
Altamirano	Frank		altamirano.fm@pucp.edu.pe
Altamirano	Teófilo	Pontificia Universidad Católica del Perú	taltami@pucp.edu.pe
Amat y Leon	Carlos	Universidad del Pacífico	amatyleon_ca@up.edu.pe
Anderson	Glen	International Resources Group (IRG)	ganderson@irgltd.com
Araujo	Hilda	CITPA	centro_citpa@yahoo.es
Arenas Aspilcueta	Marco	SERNANP - Parque Nacional Huascarán	marenas@sernanp.gob.pe
Avellaneda	Laura	Ministry of the Environment	lavellaneda@minam.gob.pe
Bucheli	Brenda		brenda_bucheli@yahoo.es
Bury	Jeffrey	University of California - Santa Cruz	jbury@ucsc.edu
Bustinza	Victor	Programa de Adaptación al Cambio Climático	bustinzavic@yahoo.com
Byers	Alton	The Mountain Institute	abyers@mountain.org
Byrne	Scott	The College of Saint Rose	smithj@strose.edu
Cammeraat	Erik	University of Amsterdam	i.h.cammeraat@uva.nl
Cárdenas	Daniela	ANA	dcardenas@ana.gob.pe
Carey	Mark	Washington and Lee University Lexington	CareyM@wlu.edu
Castro	Eduardo	Urpichallay Association	ecastro@urpichallay.org
Chan	Isabelle	USAID	chani@state.gov
Chang	Mirko	Ancach Association	mchang@antamina.com
Chavez	Mary	NGO CooperAcción	maryluzchavez@cooperaccion.org.pe
Clark	Sarah	The College of Saint Rose	smithj@strose.edu
Clark	Adam	The University of Montana	adam.clark@umontana.edu
Claverias	Ricardo	CIED PERU	ricardo@ciedperu.org
Conner	Sarah	The College of Saint Rose	smithj@strose.edu
Cordova	Carmen	Ministry of Agriculture	laura.maharaj@gmail.com
Cuba	Maria V.	Pontificia Universidad Católica del Peru	clerigos2004@hotmail.com
Cuenca	Richard H.	National Science Foundation	rcuenca@nsf.gov
Damonte	Gerardo	GRADE / Pontificia Universidad Católica	gdamonte@grade.org.pe
Davis	Robert	The Mountain Institute	bdavis@mountain.org
Delman	Erin	The College of Saint Rose	smithj@strose.edu
Drake	Barbara	Miami Herald	bdrake8112@aol.com
Dunbar	Kate	University of Georgia	dunbar@uga.edu
Durand	Eduardo	Ministry of the Environment	edurand@minam.gob.pe
Encalada	Gabriela	Andean Community	gencalada@comunidadandina.org
Fernandez Baca	Edith	CONDESAM	e.fernandez-baca@cgiar.org
Flores	Enrique	Universidad Nacional Agraria La Molina	efm@lamolina.edu.pe
Foronda	Maria Elena	Natura Institute	mforondaf@hotmail.com
French	Adam	University of California at Santa Cruz	akfrench@ucsc.edu
Fry	Matthew	Washington University, St. Louis	mfry@artsci.wustl.edu
Furlow	John	Global Climate Change Team, USAID	jfurlow@usaid.gov
Garrard	Rodney	University of Bern	rodneygarrard@xtra.co.nz
George	Ivana		
Gierke	John	Michigan Technological University	jsgierke@mtu.edu
Giesecke	Ricardo	Andean Community	rgiesecke@comunidadandina.org
Guerrero	Juan	Universidad Agraria La Molina	jguerrerob@lamolina.edu.pe
Guevara	Diego	The Mountain Institute, Andean Program	brenda_bucheli@yahoo.es
Hernandez	Jose	Pontificia Universidad Católica del Peru	jahernandezm@pucp.edu.pe
Herrera	Alexander	Universidad de los Andes	alherrer@uniandes.edu.co
Hug	Kyung In	The Ohio State University	hug.26@osu.edu
Hunt	Lauren	University of California at Santa Cruz	lhunt@ucsc.edu
Iju	Ana	General Secretariat, CAN	aiju@comunidadandina.org
Lagos	Pablo	IGP - Instituto Geofísico del Perú	plagos@geo.igp.gob.pe
Lapidus	Daniel	International Resources Group (IRG)	dlapidus@irgltd.co
Lau	Alvaro	Universidad Nacional Agraria La Molina	chino.lau@gmail.com
Licht	Galen	University of California at Santa Cruz	glicht@ucsc.edu
Lipton	Jennifer	Central Washington University	liptonj@cwu.edu
Lopez	Norma	Vicariate	normajlf@hotmail.com
Madalengoitia	Laura	Ministry of Foreign Affairs	lmadalengoitia@rree.gob.pe
Maharaj	Laura	McGill University	laura.maharaj@gmail.com
Manning	Dale	University of California - Davis	dtmanning@gmail.com
Mark	Bryan	The Ohio State University	mark.9@osu.edu
Martinez	Alejandra	IGP	amartinez@geo.igp.gob.pe
Matts	Eriksson	ICIMOD	meriksson@icimod.org
Mautino	Eric	Ancash Regional Government	ey_mautino@yahoo.es
McConnell	Joseph	Deaert Research Institute	jmcconn@dri.edu
McKenzie	Jeffrey	McGill University	mckenzie@eps.mcgill.edu

Surname	Name	Organization	E-mail
McKinney	Daene	University of Texas at Austin	daene@aol.com
McLaughlin	Martin	USAID	mmclaughlin@usaid.gov
McTurk	Nicholas	The College of Saint Rose	smithj@strose.edu
Merino	Victor	USAID	vmerino@usaid.gob
Merrin	Richard	USAID	merrinrc@state.gov
Mindreau	Marianna	Instituto de Montaña	mmindreau@mountain.org
Mool	Pradeep	(ICIMOD	pmool@icimod.org
Morales	Benjamin	Instituto Andino de Glaciología y Geo-Ambiente	bmorales34@gmail.com
Nuñez	Tristan	University of Washington	tristan.nunez@gmail.com
O'Brien	Elliott	Washington and Lee University	obriene10@mail.wlu.edu
Ordoñez	Miluska	ITDG	mordonez@itdg.org.pe
Oré	Teresa	IPROGRA	teresaore@amauta.rcp.net.pe
Oscanoa	Luis	Universidad Nacional Agraria La Molina	loscanoa@mountain.org
Osorio	Cesar	CONCYTEC	cosorio@concytec.gob.pe
Palmer	Timothy	The College of Saint Rose	smithj@strose.edu
Polo	Osver	CEDEP	opc2015@gmail.com
Ponette-González	Alexandra	University of Texas at Austin	alexandra.ponette@yale.edu
Pool	Doug	International Resources Group (ICAA)	dpool@irgltd.com
Postigo	July	The University of Texas at Austin	jpostigo@mail.utexas.edu
Price	Karen	ANA - Autoridad Nacional de Agua	kprice@ana.gob.pe
Racoviteanu	Adina	University of Colorado at Boulder	racovite@colorado.edu
Rasul	Ghulam	Pakistan Meteorological Department	rasulpmd@gmail.com
Recharte	Jorge	Instituto de Montaña	jrecharte@mountain.org
Reid	Sara	University of California at Santa Cruz	sara.ann.rei@gmail.com
Rios-Sánchez	Miriam	Michigan Technological University	mriossan@mtu.edu
Rozas	Wilbert	REMURPE	wilbertrozas@remurpe.org.pe;
Rua	Herlinda		herlindarua@yahoo.es
Sabogal	Ana	Pontificia Universidad Católica del Perú / IDEA	asabogal@pucp.edu.pe
Salazar	Lorenzo	Gobierno Regional Piura	lorenzoap2000@yahoo.com
Salinas	Patricia	Instituto de Montaña	andesinfo@mountain.org
Salvador	Martín	SERNANP	lsalvadorp@gmail.com
Sandoval	Esteban	USAID	sandovalej@state.gov
Sevink	Jan	University of Amsterdam	jsevink@uva.nl
Shrestha	Milan	Arizona State University	milanshrestha@gmail.com
Singer	Alyssa	Ohio State University	asinger120@gmail.com
Sipprelle	Cara	University of Georgia	carasipp@yahoo.com
Smith	Jacqueline	The College of Saint Rose	smithj@strose.edu
Stone	Shawn	Ohio State University	spstone.352@gmail.com
Stoner	Larissa	U.S. Embassy Brasilia	stonerla@state.gov
Tarazona	Juan	CONCYTEC	jtarazona@concytec.gob.pe
Teplitz	Joseph	The Mountain Institute	joseph.teplitz@gartner.com
Thompson	Lonnie G.	Ohio State University	thompson.3@osu.edu
Tonry	Sarah	The College of Saint Rose	smithj@strose.edu
Torrres	Juan	Soluciones Prácticas ITDG	jtorres@itdg.org.pe
Untiveros	Monica	PUCP	monica.untiveros@pucp.edu.pe
Valdivia	Ramiro		ravh@hvrcd.com
Valverde	Selwyn	SERNANP	sev_selwyn@hotmail.com
Vandermolen	Kristin	University of Georgia	kristinvandermolen@yahoo.com
Velazquez	Justino	Ministerio de Agricultura	laura.maharaj@gmail.com
Vera	Héctor	SENAMHI	hvera@senamhi.gob.pe
Vigo	Luis	Asociación Ancach	lvig@antamina.com
Villanueva	Clérigo	Huayhuash Peru	clerigos2004@hotmail.com
White	Eric Bradley	The College of Saint Rose	smithj@strose.edu
Wold	Joseph	The College of Saint Rose	smithj@strose.edu
Young	Kenneth	National Science Foundation	kryoung@nsf.gov
Zapata	Marco	ANA - Autoridad Nacional de Agua	glaciologia@ana.gob.pe
Zapata	Florencia	Instituto de Montaña	florenciaz@mountain.org
Zapata-Rios	Xavier	Florida International University	XavierZapata@gmx.net
Zevallos	Magali	CooperAcción	magazevallos@gmail.com